NEWSLETTER

INDICE:

ISTITUTO DI RICERCHE FARMACOLOGICHE MARIO NEGRI IRCCS

BIBLIOGRAFIA ADHD FEBBRAIO 2018

Acta Paediatr Int J Paediatr. 2018.

A CASE REPORT AND LITERATURE REVIEW OF AUTISM AND ATTENTION DEFICIT HYPERACTIVITY DISORDER IN PAEDIATRIC CHRONIC PAIN.

Wiwe LC, von HM, et al.

Psychiatric disorders are common in paediatric patients with chronic pain, but the overall prevalence of comorbid neurodevelopmental disorders is unclear. We report on a case of severe chronic pain in a child with undiagnosed comorbid autism spectrum disorder and attention deficit hyperactivity disorder, where significant improvements in pain and function occurred following methylphenidate medication and parental behavioural training. Conclusion: The inclusion of behavioural assessment and screening for neurodevelopmental comorbidity may be essential in addressing complex paediatric chronic pain

……..

……..

Per la ricerca degli articoli pubblicati nella letteratura scientifica nel mese in esame sono state consultate le banche dati Medline, Embase, PsycINFO e PsycArticle utilizzando le seguenti parole chiave (o i loro sinonimi): 'Attention deficit disorder', 'Attention deficit hyperactivity disorder', 'Infant', 'Child', 'Adolescent', 'Human'. Sono qui riportate le referenze considerate rilevanti e pertinenti.

ADHD Atten Deficit Hyperact Disord. 2018;1-14.

RELATION BETWEEN INTERNALIZING BEHAVIORS, EXTERNALIZING BEHAVIORS, AND PEER VICTIMIZATION AMONG CHILDREN WITH AND WITHOUT ADHD.

Fogleman ND, Leaberry KD, Rosen PJ, et al.

The current study explored the concurrent and longitudinal association between internalizing behaviors, externalizing behaviors, and peer victimization among children with and without ADHD. Eighty children (42 ADHD, 38 non-ADHD) ages 8ΓÇô12 participated in the present study conducted over a 6-month period. During the baseline session, parents completed a structured diagnostic interview and the Vanderbilt ADHD Parent Rating Scale to determine whether their child met criteria for ADHD, and the Child Behavior Checklist (CBCL) to assess their childΓÇÖs internalizing and externalizing behaviors; children completed the Perception of Peer Support Scale (PPSS) to assess experiences of peer victimization. At the 6-month follow-up session, parents completed the CBCL and children completed the PPSS. Concurrently, internalizing behaviors were associated with peer victimization among children with and without ADHD; ADHD moderated this relation, such that internalizing behaviors were more strongly related to peer victimization among children with ADHD. Longitudinally, internalizing behaviors at baseline predicted peer victimization at 6-month follow-up; however, further analyses demonstrated there was a covarying change in internalizing behaviors and peer victimization. These findings suggest internalizing behaviors are related to peer victimization concurrently, and over time, and are associated with increased risk for peer victimization in the presence of ADHD. Additionally, internalizing behaviors and peer victimization appear to share a dynamic relationship; that is, decreases in internalizing behaviors predict similar decreases in peer victimization. No significant relations were observed between externalizing behaviors and peer victimization. Implications and limitations are discussed

……..

Am J Psychiatry. 2018;175:140-49.

LATE-ONSET ADHD RECONSIDERED WITH COMPREHENSIVE REPEATED ASSESSMENTS BETWEEN AGES 10 AND 25.

Sibley MH, Rohde LA, Swanson JM, et al.

Objective: Adolescents and young adults without childhood attention deficit hyperactivity disorder (ADHD) often present to clinics seeking stimulant medication for late on set ADHD symptoms. Recent birth-cohort studies support the notion of late-onset ADHD, but these investigations are limited by relying on screening instruments to assess ADHD, not considering alternative causes of symptoms, or failing to obtain complete psychiatric histories. The authors address these limitations by examining psychiatric assessments administered longitudinally to the local normative comparison group of the Multimodal Treatment Study of ADHD.

Method: Individuals without childhood ADHD (N=239) were administered eight assessments from comparison baseline (mean age=9.89 years) to young adulthood (mean age=24.40 years). Diagnostic procedures utilized parent, teacher, and self-reports of ADHD symptoms, impairment, substance use, and other mental disorders, with consideration of symptom context and timing.

Results: Approximately95%of individuals who in itially screened positive on symptom checklists were excluded from late on set ADHD diagnosis. Among individuals with impairing late-onset ADHD symptoms, the most common reason for diagnostic exclusion was symptoms or impairment occurring exclusively in the context of heavy substance use. Most late-onset cases displayed onset in adolescence and an adolescence limited presentation. There was no evidence for adult-onset ADHD independent of a complex psychiatric history.

Conclusions: Individuals seeking treatment for late-onset ADHD may be valid cases; however, more commonly, symptoms represent non impairing cognitive fluctuations, a comorbid disorder, or the cognitive effects of substance use. False positive late-onset ADHD cases are common without careful assessment. Clinicians should carefully assess impairment, psychiatric history, and substance use before treating potential late-onset cases

……..

An Pediatr. 2018.

THE TREATMENT OF ATTENTION DEFICIT HYPERACTIVITY DISORDER IN CHILDREN AND ADOLESCENTS: EPIDEMIOLOGY, MULTIMORBIDITY AND INTEGRATED HEALTH SERVICES.

Catalá-López F, Hutton B.

……..

Anales de Psicología. 2018 Jan;34:16-22.

IMPLICATION OF VISUOSPATIAL AND PHONOLOGICAL WORKING MEMORY IN THE CLINICAL HETEROGENEITY OF ATTENTION-DEFICIT/HYPERACTIVITY DISORDER (ADHD).

Gallego-Martínez A, García-Sevilla J, Fenollar-Cortés J.

Introduction: The interest in studying the neuropsychological deficits that lie behind ADHD, among which the Working Memory (WM) stands out in its visuospatial and phonological dimensions, has been on increase. The aim of the current study was to explore the performance differences concerning the short-term memory and the visuospatial and phonological working memory among control and clinical groups acknowledging the clinical heterogeneity of the disorder.

Method: A group of 76 children with a prior diagnosis of ADHD was divided by the clinical subtype of the disorder: ADHD predominantly inattentive (n = 26, age M = 10,9, SD = 1,8; 66% male), and combined ADHD (n = 50, age M = 10.8, DT = 1.9; 61.5% male). Additionally, a control group of typically developing children was formed (n = 40, age M = 10.2, SD = 1.9; 57.5% male). Both groups completed a task battery to aimed to measure the short-term memory, as well as the visuospatial and phonological working memory.

Results: The ADHD group showed a decreased performance at visuospatial (Corsi Block Task), as well as phonological (WISC Letter-Number Sequencing) working memory tasks. The decreased performance was consistent among the clinical subtypes. The dimensions of ADHD and the performance output in the neuropsychological tasks used in the study were not related.

Discussion: This study offers empirical evidence to the hypothesis that suggests that children with ADHD show a poor performance than controls at Working Memory tasks, including both visuospatial and phonological WM. In addition, the results of the study suggested that there is no correlation between the dimensions of the ADHD and the performance output in the Working Memory tasks

……..

Ann Med -Psychol. 2018.

THE FRENCH VALIDATION OF THE TODDLER ATTENTION QUESTIONNAIRE.

Violon M, Calso C, Travers R, et al.

Objectives: There is a lack of tools for non-parental caregivers and in the French language to assess the quality of the attachment relationship with toddlers. The Toddler Attention Questionnaire (TAQ) is an Italian scale created for caregivers in day care centers. By its focus on the exploration system, the TAQ offers the opportunity to study the relation between attention characteristics and attachment behavior in toddlers. In the attachment theory, a link is often assumed between these two concepts. Mary Main has described the different attachment patterns (secure, insecure avoidant, insecure ambivalent-resistant, disorganized) by using cognitive psychology dimensions relying on attentional processes. However, this relation is hardly proven scientifically and study results in this field are not always congruent. The validation of the TAQ in French, main purpose of this study, is likely to add new contributions to this field.

Materials and methods: The Toddler Attention Questionnaire is composed of 29 self-reported items and four dimensions which describe 4 attentional processes: lability, flexibility, detachment, disorientation. The items present different behaviors and measure, on a five-point Likert scale, the quality of children's attention during exploration. The French translation was made by two native bilingual persons following the back translation procedure and was administered to the primary caregiver, who was in charge of each child in 13 French daycare centers. The questionnaires were completed for 148 children aged from 20 to 36 months who attended to the daycare center at least 20 hours per week.

Results: The analyses show a robust structure into three dimensions: the disorientation subscale was deleted because of its reduced contribution to the total variance. Some items were also shifted (9 items) or

deleted (6 items) compared to their contribution to the different dimensions. Moreover, a qualitative analysis of the remarks from the participants allowed to adapt some items' formulation (4 items). The final French version of the TAQ, composed of 23 items, explained 46.94 % of the variance. The Cronbach's Alphas ranged from 0.64 (Flexibility) to 0.83 (Lability). The TAQ is a dimensional tool: the sum of the scores gives a position of the child behavior in a continuum of attachment security in each dimension.
Conclusions: Two main differences between the present validation and the original study may limit generalization and comparability. First, we adopted large selection criteria, including children who attended to a daycare center at least 20 hours per week, instead of 36 hours per week of the original study. This choice allowed to collect more questionnaires and to be closer to the total rate of hours attended by French children in daycare center. Second, our sample of professional participants was more heterogeneous than the Italian sample regarding the professional experiences and the seniority in the daycare center. With few items, well-defined questions and easy administration, the TAQ seems to be a cost-effective alternative to the traditional methods used to assess attachment behaviors such as the Strange Situation or the Attachment Q-Sort. Hence, the major advantage of our validation is to allow French researchers to carry out studies with large samples in the attachment field, particularly with toddlers and professional caregivers. Studying the secondary attachment relationship is essential to highlight how a child copes with the absence of his primary attachment figure in the daycare center. Moreover, the focus on attention processes is important to prevent attention deficits and learning difficulties and to reduce its potential effect on the child's development. Nevertheless, further research would be needed to extend its psychometric proprieties (convergent, discriminant and test-retest validity) and to examine its clinical usefulness

……..

Arch Pediatr. 2017 Apr;24:384-90.
AUTISM: AN EARLY NEURODEVELOPMENTAL DISORDER.
Bonnet-Brilhault F.
With approximately 67 million individuals affected worldwide, autism spectrum disorder (ASD) is the fastest growing neurodevelopmental disorder (United Nations, 2011), with a prevalence estimated to be 1/100. In France ASD affects approximately 600,000 individuals (from childhood to adulthood, half of whom are also mentally retarded), who thus have a major handicap in communication and in adapting to daily life, which leads autism to be recognized as a national public health priority. ASD is a neurodevelopmental disorder that affects several domains (i.e., socio-emotional, language, sensori-motor, executive functioning). These disorders are expressed early in life with an age of onset around 18 months. Despite evidence suggesting a strong genetic link with ASD, the genetic determinant remains unclear. The clinical picture is characterized by impairments in social interaction and communication and the presence of restrictive and repetitive behaviors (DSM-5, ICD-10). However, in addition to these two main dimensions there is significant comorbidity between ASD and other neurodevelopmental disorders such as attention deficit hyperactivity disorder or with genetic and medical conditions. One of the diagnostic features of ASD is its early emergence: symptoms must begin in early childhood for a diagnosis to be given. Due to brain plasticity, early interventions are essential to facilitate clinical improvement. Therefore, general practitioners and pediatricians are on the front line to detect early signs of ASD and to guide both medical explorations and early rehabilitation

……..

Atten Defic Hyperact Disord. 2017 Jun;9:89-100.
PRE-SERVICE TEACHERS' PERCEPTIONS OF SLUGGISH COGNITIVE TEMPO.
Meisinger RE, Lefler EK.
Sluggish cognitive tempo (SCT) is characterized by a passive form of inattention that may not overtly disrupt classroom goals. Due to the nature of these symptoms, children with SCT may be "falling through the cracks" in schools. The current study examined pre-service teachers' perceptions of SCT in the classroom. Undergraduate education majors (n = 161) read vignettes describing fictitious fourth-grade boys presenting with symptoms of SCT, attention-deficit/hyperactivity disorder (ADHD), or a non-ADHD-related control: social anxiety disorder (SA), and rated each of the vignettes in terms of their perceptions of the boy described.

Results were analyzed using repeated measures ANOVAs and paired-sample t tests. Pre-service teachers viewed all three sets of symptoms as concerning, but viewed ADHD behaviors as the most problematic. These results are promising, as they suggest that pre-service teachers are concerned about both hyperactive (i.e., ADHD) and non-hyperactive behavioral problems (i.e., SCT and SA). Implications and future directions are discussed

……..

Autism Res. 2018.

SCHOOL DYSFUNCTION IN YOUTH WITH AUTISTIC SPECTRUM DISORDER IN TAIWAN: THE EFFECT OF SUBTYPE AND ADHD.

Chiang H-L, Kao W-C, Chou M-C, et al.

School dysfunction is observed in youths with autism spectrum disorder (ASD), but the factors moderating their school dysfunction have not been well explored. This study investigated school functions in youths with ASD in Taiwan, stratified by personal characteristics including demographics, ASD subtypes, intelligence profiles, and the presence of attention-deficit hyperactivity disorder (ADHD). We recruited 160 youths (aged 6-18 years, 87.5% boys) with a clinical diagnosis of ASD and 160 age and gender-matched typically developing (TD) youths. Their parents received a semi-structured psychiatric interview for their ASD and ADHD diagnoses and reported their school functions. Youths with ASD were further grouped into low-functioning autism (LFA, ASD with intellectual disability and developmental language delay, n=44), high-functioning autism (HFA, ASD with no intellectual disability, n=55) and Asperger's syndrome (AS, ASD with neither language delay nor intellectual disability, n=61). Compared to TD, ASD had worse school functions in the domains of academic performance, attitude toward schoolwork, social interaction, and behavioral problems except for no academic differences from TD in HFA and ASD without ADHD. Subgroup analysis revealed that HFA and AS had better academic performance but showed worse attitude toward school than LFA. Comorbidity of ADHD negatively impacted all domains of school functions. Besides autistic and ADHD symptoms, oppositional symptoms, lower intelligence, older age, and female gender in youths also predicted school dysfunction. Although youths with ASD have school dysfunction in several domains, this study specifically addresses the role of intelligence and comorbid ADHD on their school dysfunction

……..

Behav Genet. 2018 Jan;48:22-33.

CROSS-LAGGED ANALYSIS OF INTERPLAY BETWEEN DIFFERENTIAL TRAITS IN SIBLING PAIRS: VALIDATION AND APPLICATION TO PARENTING BEHAVIOR AND ADHD SYMPTOMATOLOGY.

Moscati A, Verhulst B, McKee K, et al.

Understanding the factors that contribute to behavioral traits is a complex task, and partitioning variance into latent genetic and environmental components is a useful beginning, but it should not also be the end. Many constructs are influenced by their contextual milieu, and accounting for background effects (such as gene–environment correlation) is necessary to avoid bias. This study introduces a method for examining the interplay between traits, in a longitudinal design using differential items in sibling pairs. The model is validated via simulation and power analysis, and we conclude with an application to paternal praise and ADHD symptoms in a twin sample. The model can help identify what type of genetic and environmental interplay may contribute to the dynamic relationship between traits using a cross-lagged panel framework. Overall, it presents a way to estimate and explicate the developmental interplay between a set of traits, free from many common sources of bias

……..

Behav Ther. 2018.

COMPARING ALLIANCE IN TWO COGNITIVE-BEHAVIOURAL THERAPIES FOR ADOLESCENTS WITH ADHD USING A RANDOMIZED CONTROLLED TRIAL.

Boyer B, MacKay KJ, McLeod BD, et al.

Alliance is defined as the client-therapist bond and their ability to collaborate on therapeutic activities. Treatment for adolescents with ADHD is rarely studied in terms of alliance. In this study, two cognitive-behavioral treatments (CBT; one structured treatment aimed at planning skills and one less-structured solution-focused treatment, both delivered in the style of Motivational Interviewing) were compared with regard to alliance and alliance-outcome association. The influence of therapist competence on this alliance-outcome association was also evaluated. The alliance between 69 adolescents diagnosed with ADHD and their therapists was measured early in treatment, using the Therapy Process Observational Coding System for Child Psychotherapy-Alliance scale. Observer-rated therapist competence was measured using the Motivational Interviewing Treatment Integrity scale (version 3.1.1.). Outcome variables were the adolescents' reduction in planning problems and ADHD symptoms. The alliance, and, more specifically, collaboration on therapeutic activities, was significantly higher for the more structured CBT ($p = .04$; moderate effect size). Alliance was not related to outcome in the more structured CBT, while the alliance was positively related to the reduction in planning problems in the less structured CBT. Finally, alliance was a significant mediator between therapist competence and treatment outcome for the less-structured CBT. The clarity and structure of CBT may help facilitate alliance formation for adolescents with ADHD who often have difficulty implementing structure themselves. Therapists may need to invest more in alliance formation in less structured CBT as the alliance affects outcome. Moreover, enhancing therapist competence in less structured CBT may help improve outcomes in less structured CBT, as therapist competence may impact outcome through alliance

……..

Bipolar Disord. 2017 May;19:168-75.

SIMILAR FAMILIAL UNDERPINNINGS FOR FULL AND SUBSYNDROMAL PEDIATRIC BIPOLAR DISORDER: A FAMILIAL RISK ANALYSIS.

Wozniak J, Uchida M, Faraone SV, et al.

OBJECTIVES: To examine the validity of subthreshold pediatric bipolar I disorder (BP-I), we compared the familial risk for BP-I in the child probands who had either full BP-I, subthreshold BP-I, ADHD, or were controls that neither had ADHD nor bipolar disorder.

METHODS: BP-I probands were youth aged 6-17 years meeting criteria for BP-I, full (N=239) or subthreshold (N=43), and also included were their first-degree relatives (N=687 and N=120, respectively). Comparators were youth with ADHD (N=162), controls without ADHD or bipolar disorder (N=136), and their first-degree relatives (N=511 and N=411, respectively). We randomly selected 162 non-bipolar ADHD probands and 136 non-bipolar, non-ADHD control probands of similar age and sex distribution to the BP-I probands from our case-control ADHD family studies. Psychiatric assessments were made by trained psychometricians using the Kiddie Schedule for Affective Disorders and Schizophrenia for School-Age Children Epidemiological Version (KSADS-E) and Structured Clinical Interview for DSM-IV (SCID) structured diagnostic interviews. We analyzed rates of bipolar disorder using multinomial logistic regression.

RESULTS: Rates of full BP-I significantly differed between the four groups ($chi(2)3 =32.72$, $P<.001$): relatives of full BP-I probands and relatives of subthreshold BP-I probands had significantly higher rates of full BP-I than relatives of ADHD probands and relatives of control probands. Relatives of full BP-I, subthreshold BP-I, and ADHD probands also had significantly higher rates of major depressive disorder compared to relatives of control probands.

CONCLUSIONS: Our results showed that youth with subthreshold BP-I had similarly elevated risk for BP-I and major depressive disorder in first-degree relatives as youth with full BP-I. These findings support the diagnostic continuity between subsyndromal and fully syndromatic states of pediatric BP-I disorder

……..

BJOG Int J Obstet Gynaecol. 2018.
ANTIDEPRESSANT USE DURING PREGNANCY AND ADHD RISK IN CHILDREN: CURRENT KNOWLEDGE.
Boukhris T.

……..

BMC Psychiatry. 2017 Jan;17:19.
SYMPTOMS OF ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD) AMONG ADULT EATING DISORDER PATIENTS.
Svedlund NE, Norring C, Ginsberg Y, et al.
BACKGROUND: Very little is known about the prevalence of ADHD symptoms in Bulimia Nervosa and Binge Eating Disorder and even less in other eating disorders. This knowledge gap is of clinical importance since stimulant treatment is proven effective in Binge Eating Disorder and discussed as a treatment possibility for Bulimia Nervosa. The objective of this study was to explore the prevalence and types of self-reported ADHD symptoms in an unselected group of eating disorder patients assessed in a specialized eating disorder clinic.
METHODS: In total 1165 adults with an eating disorder were assessed with a battery of standardized instruments, for measuring inter alia ADHD screening, demographic variables, eating disorder symptoms and psychiatric comorbidity. Chi-square tests were used for categorical variables and Kruskal-Wallis tests for continuous variables.
RESULTS: Almost one third (31.3 %) of the patients scored above the screening cut off indicating a possible ADHD. The highest prevalence rates (35-37 %) were found in Bulimia Nervosa and Anorexia Nervosa bingeing/purging subtype, while Eating Disorder Not Otherwise Specified type 1-4 and Binge Eating Disorder patients reported slightly below average (26-31 %), and Anorexia Nervosa restricting subtype patients even lower (18 %). Presence of binge eating, purging, loss of control over eating and non-anorectic BMI were related to results indicating a possible ADHD. Psychiatric comorbidity correlated to ADHD symptoms without explaining the differences between eating disorder diagnoses.
CONCLUSIONS: There is a high frequency of ADHD symptoms in patients with binge eating/purging eating disorders that motivates further studies, particularly concerning the effects of ADHD medication. The finding that the frequency of ADHD symptoms in anorexia nervosa with binge eating/purging is as high as in bulimia nervosa highlights the need also for this group

……..

BMC Psychiatry. 2018 Feb;18.
HEALTH CARE AND SOCIETAL COSTS OF THE MANAGEMENT OF CHILDREN AND ADOLESCENTS WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER IN SPAIN: A DESCRIPTIVE ANALYSIS.
Quintero J, Ramos-Quiroga JA, Sebastián JS, et al.
Background: Attention-deficit/hyperactivity disorder (ADHD) is a common neurodevelopmental condition in childhood (5.3% to 7.1% worldwide prevalence), with substantial overall financial burden to children/adolescents, their families, and society. The aims of this study were to describe the clinical characteristics of children and adolescents with ADHD in Spain, estimate the associated direct/indirect costs of the disorder, and assess whether the characteristics and financial costs differed between children/adolescents adequately responding to currently available pharmacotherapies compared with children/adolescents for whom pharmacotherapies failed.
Methods: This was a multicenter, cross-sectional, descriptive analysis conducted in 15 health units representative of the overall Spanish population. Data on demographic characteristics, socio-occupational status, social relationships, clinical variables of the disease, and pharmacological and non-pharmacological treatments received were collected in 321 children and adolescents with ADHD. Direct and indirect costs were estimated over one year from both a health care system and a societal perspective.
Results: The estimated average cost of ADHD per year per child/adolescent was €5733 in 2012 prices; direct costs accounted for 60.2% of the total costs (€3450). Support from a psychologist/educational psychologist represented 45.2% of direct costs and 27.2% of total costs. Pharmacotherapy accounted for 25.8% of direct costs and 15.5% of total costs. Among indirect costs (€2283), 65.2% was due to caregiver expenses. The total annual costs were significantly higher for children/adolescents who responded poorly to

pharmacological treatment (€7654 versus €5517; P = 0.024), the difference being mainly due to significantly higher direct costs, particularly with larger expenses for non-pharmacological treatment (P = 0.012).
Conclusions: ADHD has a significant personal, familial, and financial impact on the Spanish health system and society. Successful pharmacological intervention was associated with lower overall expenses in the management of the disorder

……

Brain Res. 2018;1685:1-8.
HIPPOCAMPAL SUBFIELD VOLUME CHANGES IN SUBTYPES OF ATTENTION DEFICIT HYPERACTIVITY DISORDER.
Al-Amin M, Zinchenko A, Geyer T.
Objective: Attention-deficit hyperactivity disorder (ADHD) is accompanied by reduction of total hippocampal volume. However, disorder-related fine-grained structural alterations of hippocampal subfields remain unclear.
Method: Here we compared hippocampal subfield volumes in a large sample of patients with ADHD and healthy controls. We used T1-weighted structural 3-Tesla MRI images of 880 individuals (7-21 years old) from the ADHD-200 database. The images were acquired from 553 healthy individuals and 327 children and adolescents with combined (N = 196) and inattentive (N = 131) ADHD subtypes. Hippocampal subfields were segmented into the cornu amonis regions (CA1, CA2/3, CA4), fimbria, hippocampal fissure, presubiculum, subiculum, hippocampal tail, parasubiculum, granule cell layers of the dentate gyrus, molecular layer within the subiculum and the CA fields, and the hippocampal-amygdala transition area using an automatic algorithm available in Freesurfer 6.0.
Results: We found a significant reduction of total hippocampal volume in the combined ADHD group compared to healthy controls. This reduction was due to the atrophy of CA1, CA4, molecular layer, granule cell layers of the dentate gyrus, presubiculum, subiculum, and hippocampal tail. These differences were exclusively driven by the corresponding brain volume reduction in the combined ADHD-subtype, while hippocampal volumes in inattentive ADHD showed no reliable differences relative to controls. Finally, there were negative correlations between the reduced hippocampal subfields and behavioral ADHD indices.
Conclusion: The present results point to a clear dissociation between inattentive and combined subtypes of ADHD. Therefore, hippocampal subfields may contribute towards understanding the pathophysiology of ADHD

……

Child Adolesc Psychiatr Clin North Am. 2018.
INATTENTION TO PROBLEMATIC MEDIA USE HABITS. INTERACTION BETWEEN DIGITAL MEDIA USE AND ATTENTION-DEFICIT/HYPERACTIVITY DISORDER.
Ceranoglu TA.
As digital media (DM) access among youths continues to surge, caregivers and clinicians are concerned about problems associated with its excessive use. Children with attention-deficit/hyperactivity disorder (ADHD) have an increased risk of experiencing negative effects on sleep, academic achievement, attention, and cognitive skills. ADHD symptom severity and circumstances of DM access are among the factors that mediate these negative effects. Key interventions for parents and clinicians to assist youths with problematic DM habits and opportunities for advocacy groups and the DM industry for public health interventions are discussed

……

Child Neuropsychol. 2017 Nov;23:980-93.
SOCIAL PERCEPTION IN CHILDREN WITH FETAL ALCOHOL SPECTRUM DISORDER.
Stevens SA, Clairman H, Nash K, et al.
Although the profile of social cognitive difficulties is well recognized in children with certain neurodevelopmental disorders such as autism spectrum disorder (ASD) and attention deficit hyperactivity

disorder (ADHD), this profile is not as well established in other clinical pediatric populations. The objective of the present study is to examine patterns of social perception in children with fetal alcohol spectrum disorder (FASD) compared to typically-developing (TD) control children. A total of 56 children between 8 and 12 years of age-35 with FASD and 21 TD-completed the Reading the Mind in the Eyes Task - Children's Version (RMET-C). The RMET-C accuracy scores were compared between groups and also by item difficulty and emotional valence. The relation between cognitive functioning, age, FASD severity, and RMET-C performance was also investigated. The children in the FASD group did not perform as well as the children in the TD group on the RMET-C Total score and Easy items, as well as the Positive, Negative, and Neutral emotional valence items. When age and IQ were investigated, there was a significant effect of age on the Positive items in the TD group, with scores increasing with age. With regard to FASD severity, children with alcohol-related neurodevelopmental disorder were outperformed by children with full/partial fetal alcohol syndrome on the Positive and Negative items. Overall, these results further the understanding of the social cognitive profile in children with FASD and how this profile relates to other childhood-onset neurodevelopmental disorders

……..

Child Neuropsychol. 2018;1-19.

WRITING ABILITIES AND THE ROLE OF WORKING MEMORY IN CHILDREN WITH SYMPTOMS OF ATTENTION DEFICIT AND HYPERACTIVITY DISORDER.

Capodieci A, Serafini A, Dessuki A, et al.

The writing abilities of children with ADHD symptoms were examined in a simple dictation task, and then in two conditions with concurrent verbal or visuospatial working memory (WM) loads. The children with ADHD symptoms generally made more spelling mistakes than controls, and the concurrent loads impaired their performance, but with partly different effects. The concurrent verbal WM task prompted an increase in the phonological errors, while the concurrent visuospatial WM task prompted more non-phonological errors, matching the Italian phonology, but not the Italian orthography. In the ADHD group, the children proving better able to cope with a concurrent verbal WM load had a better spelling performance too. The ADHD and control groups had a similar handwriting speed, but the former groupΓÇÖs writing quality was poorer. Our results suggest that WM supports writing skills, and that children with ADHD symptoms have general writing difficulties, but strength in coping with concurrent verbal information may support their spelling performance

……..

Child Neuropsychol. 2018 Feb;24:247-60.

WISCONSIN CARD SORTING TEST EMBEDDED VALIDITY INDICATORS DEVELOPED FOR ADULTS CAN BE EXTENDED TO CHILDREN.

Lichtenstein JD, Erdodi LA, Rai JK, et al.

Past studies have examined the ability of the Wisconsin Card Sorting Test (WCST) to discriminate valid from invalid performance in adults using both individual embedded validity indicators (EVIs) and multivariate approaches. This study is designed to investigate whether the two most stable of these indicators—failures to maintain set (FMS) and the logistical regression equation S-BLRE—can be extended to pediatric populations.The classification accuracy for FMS and S-BLRE was examined in a mixed clinical sample of 226 children aged 7 to 17 years (64.6% male, MAge = 13.6 years) against a combination of established performance validity tests (PVTs).The results show that at adult cutoffs, FMS and S-BLRE produce an unacceptably high failure rate (33.2% and 45.6%) and low specificity (.55–.72), but an upward adjustment in cutoffs significantly improves classification accuracy. Defining Pass as < 2 and Fail as = 4 on FMS results in consistently good specificity (.89–.92) but low and variable sensitivity (.00–.33). Similarly, cutting the S-BLRE distribution at 3.68 produces good specificity (.90–.92) but variable sensitivity (.06–.38). Passing or failing FMS or S-BLRE is unrelated to age, gender and IQ.The data from this study suggest that in a pediatric sample, adjusted cutoffs on the FMS and S-BLRE ensure good specificity, but with low or variable sensitivity. Thus, they should not be used in isolation to determine the credibility of a response set. At the same time,

they can make valuable contributions to pediatric neuropsychology by providing empirically-supported, expedient and cost-effective indicators to enhance performance validity assessment

……..

Clinical Case Reports. 2018.

ATTENTION DEFICIT/HYPERACTIVITY DISORDER AS AN ASSOCIATED FEATURE IN OCTN2 DEFICIENCY WITH NOVEL DELETION (P.T440-Y449).

Lamhonwah A-M, Bari-ç I, Lamhonwah J, et al.

Key Clinical Message: This boy presented with ADHD at 3 years and at 8 years was hyperactive with no documented hypoglycemia and had myopathy, cardiomyopathy, and very low serum carnitine. L-carnitine improved his exercise intolerance, cardiomyopathy, and behavior. Analysis of SLC22A5 revealed a premature stop codon (p.R282*) and a novel in-frame deletion (p.T440-Y449)

……..

Clin EEG Neurosci. 2017.

THE SIGNIFICANCE OF IMPULSIVE ERROR IN CHILDREN WITH ADHD.

Liao Y-C, Guo N-W, Chen S-J, et al.

A deficit of inhibition ability is a neuropsychological problem in children with attention deficit hyperactivity disorder (ADHD). We investigated whether in children who made impulsive error (IE), less error-related negativity (ERN) would correlate with poorer executive attention functions (EAFs). Ninety children (49 with ADHD and 41 without ADHD) were investigated by a 4-minute simple reaction time task and simultaneous electroencephalogram. When they made IE, the ERN in response-locked event-related potential (ERP) was defined as error awareness. The average area under curve of ERN in the control group with IEs was used as the proper criterion for regrouping the children with ADHD into 2 groups: ADHD children with enough ERN (ADHD-enough ERN) and those with less ERN (ADHD-less ERN). EAFs from Comprehensive Nonverbal Attention Test were used as objective indices, and behavioral questionnaires were used as subjective indices and statistically analyzed within ADHD groups. Forty-eight percent of the children made IEs. ADHD(n = 31, 63%) was significantly more than in the control group (n = 12, 29%; P <.001). The ADHD group had significantly less ERN than did the control group while making IE, especially at frontal and central electrodes (P <.01). Both ADHD-less ERN and ADHD-enough ERN groups had poorer subjective EAFs on questionnaires. Only the ADHD-less ERN group had significant poorer objective EAFs on the Comprehensive Nonverbal Attention Test than did the ADHD without IE. We conclude that investigating the IE and ERN of IE in children with ADHD might help to differentiate subtypes of ADHD with different neuropsychological abilities, and the possibility that ADHD-less ERN children might be confirmed a meaningful subgroup that needs close follow-up, treatments different from standard, or both

……..

Clin Neuropharmacol. 2018;41:28-30.

NEWLY DEVELOPED SKIN PICKING AFTER METHYLPHENIDATE TREATMENT IN ATTENTION DEFICIT HYPERACTIVITY DISORDER: POSSIBLE MECHANISMS.

Kara T, Akaltun I.

Dermatillomania is characterized by excessive and repeated skin picking sufficient to damage cutaneous tissue, but with no underlying dermatological disease. The condition appears as an independent diagnosis in the Obsessive-Compulsive and Related Disorders category in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition. A psychiatric pathology is generally reported to accompany this symptom. Attention deficit hyperactivity disorder (ADHD) is a potentially lifelong condition involving inattentiveness, hyperactivity, and impulsiveness. Attention deficit hyperactivity disorder is one of the most common childhood psychiatric disorders. Treatment includes medication, psychotherapy, and psychosocial therapies. Psychostimulants constitute the basis of treatment of children with ADHD worldwide. We describe a case of

skin picking developing after methylphenidate therapy for ADHD. Possible explanations of methylphenidate and skin picking are reviewed in the light of the current literature

……..

CNS Drugs. 2018;1-11.

COGNITIVE FUNCTION OF CHILDREN AND ADOLESCENTS WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER IN A 2-YEAR OPEN-LABEL STUDY OF LISDEXAMFETAMINE DIMESYLATE.

Coghill DR, Banaschewski T, Bliss C, et al.

Background: SPD489-404 was the first 2-year safety study of lisdexamfetamine dimesylate in the treatment of attention-deficit/hyperactivity disorder in children and adolescents. In accordance with advice from the European Medicines Agency, assessment of cognitive function was a predefined safety outcome in SPD489-404.

Objective: The objective of this study was to assess cognitive function over 2 years in study SPD489-404, using the Cambridge Neuropsychological Test Automated Battery (CANTAB).

Methods: Participants aged 6-17 years received dose-optimised open-label lisdexamfetamine dimesylate (30, 50 or 70 mg/day) for 104 weeks. Cognition was assessed using four CANTAB tasks; Delayed Matching to Sample (DMS), Spatial Working Memory (SWM), Stop Signal Task (SST) and Reaction Time (RTI). Key and additional variables were pre-specified for each CANTAB task; groupwise mean percentage changes in key variables from baseline of > 5% were considered potentially clinically significant.

Results: All 314 enrolled participants received lisdexamfetamine dimesylate and were included in the safety population, and 191 (60.8%) completed the study. No potentially clinically significant deteriorations from baseline were observed in any key CANTAB variable over the 2 years of the study. Based on predefined thresholds, potentially clinically significant improvements from baseline were observed at 6 months (DMS median reaction time, mean per cent change, 6.6%; SWM total between-search errors, 22.8%; SST stop signal reaction time, 18.9%), and at the last on-treatment assessment (DMS median reaction time, 6.5%; SWM total between-search errors, 32.6%; SST stop signal reaction time, 25.7%).

Conclusions: Lisdexamfetamine dimesylate treatment for 2 years was not associated with deterioration of cognitive function in children and adolescents with attention-deficit/hyperactivity disorder. Although improvements in some cognitive measures were observed, lack of a control group makes interpretation of the findings difficult. Further studies of the impact of stimulants on cognition are required. ClinicalTrials.gov identifier: NCT01328756

……..

Computer Methods and Programs in Biomedicine. 2018;157:137-43.

VISUOSPATIAL WORKING MEMORY ASSESSMENT USING A DIGITAL TABLET IN ADOLESCENTS WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER.

Hyun GJ, Park JW, Kim JH, et al.

Background and objective: Attention-deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder hypothesized to involve impaired visuospatial working memory (VSWM). However, there are few studies utilizing neuropsychological tests to measure VSWM in ADHD adolescents. The Rey Osterrieth complex figure test (ROCF) is commonly used as a neuropsychological test to assess visuospatial working memory for individuals with ADHD. We assessed working memory using the ROCF test on a digital Galaxy tablet with the technically new Gaussian filter method.

Methods: Thirty adolescents with ADHD and 30 healthy control adolescents were recruited for participation in the current study. All adolescents were assessed with K-WISC-IV, Children's depression inventory, and the Korean ADHD rating scale. All adolescents were asked to copy the ROCF from paper onto a Galaxy tablet screen using a wireless pen.

Results: There was a significant difference in representative value of the deviation of the original images from template images (R-value) in copy and delayed recall between ADHD adolescents and healthy adolescents. There was no significant difference in R-value of immediate recall between ADHD adolescents and healthy adolescents. In all adolescents (ADHD and healthy) and ADHD adolescents, the R-value of copy

was negatively correlated with visuospatial index and working memory index, and the R-value of delayed recall was negatively correlated with WMI. The R-value of copy and delayed recall was positively correlated with K-ARS in all adolescents and ADHD adolescents.
Conclusions: ADHD adolescents showed differences in the R-values of copy and delayed recall in the digital ROCF version compared to healthy adolescents. The digital ROCF assessment tool can represent different patterns of visuospatial working memory abilities in ADHD adolescents compared to healthy adolescents

……..

Curr Pediatr Rev. 2017;13:111-19.
INSIGHTS IN DEVELOPMENTAL COORDINATION DISORDER.
Farmer M, Echenne B, Drouin R, et al.
BACKGROUND: Developmental Coordination Disorder (DCD) is a neurological impairment occurring in nearly 6% of general population, and sometimes mimics other developmental disorders like Attention Deficit Hyperactivity Disorder (ADHD) or, in the most severe cases, intellectual deficiency.
OBJECTIVES: To review the general portrait of DCD, the physiology, the clinical assessments, and to provide an overview of functional studies on the subject. We finally report some proposed DCD managements which vary depending on the manifestation of the disorder and on the goals of the therapy.
RESULTS: DCD can be stated as a sum of fine motor, perceptual visual and executive difficulties, emerging during childhood brain development and lasting throughout adulthood. Even if DCD can be isolated from other co-morbidities in certain individuals, it is still difficult to categorize it in delimited subclasses of characteristics, e.g. problems of vision or language. The findings in functional imaging also diverge in locating the cerebral deficit for a given motor task.
CONCLUSION: Finding a single explanation seems difficult as many cerebral regions are associated with DCD and many clinical aspects are involved, but, further studies could explore genetic (or epigenetic) explanation for the prevalence of DCD in population

……..

Curr Med Res Opin. 2018;1-14.
HEALTHCARE UTILIZATION AND COSTS OF CHILDREN WITH ATTENTION DEFICIT/HYPERACTIVITY DISORDER INITIATING ATOMOXETINE VERSUS EXTENDED-RELEASE GUANFACINE.
Molife C, Haynes VS, Nyhuis A, et al.
OBJECTIVES: To compare 1-year direct healthcare costs and utilization among children and adolescents initiating non-stimulant medications atomoxetine (ATX) or extended-release guanfacine (GXR).
METHODS: In this retrospective, observational cohort study, children and adolescents aged 6-17 years with attention deficit/hyperactivity disorder (ADHD) who had ≥1 prescription claim for ATX or GXR between December 31, 2009 and January 1, 2011 were identified in the MarketScan Commercial or Multi-State Medicaid claims databases. The first claim was set as the index. Patients with no claims for other ADHD medications that overlapped with the days' supply for the index therapy during the post-period were classified as initiating monotherapy. All-cause and ADHD-related utilization and costs (2011 US$) and treatment patterns (adherence and persistence) were evaluated during the 12 months following index. Propensity score adjustment accounted for differences in patient characteristics, and bootstrapping was used for comparisons.
RESULTS: A total of 13,239 children and adolescents with ADHD met the study criteria (4,411 ATX initiators and 8,828 GXR initiators). There were 2,699 ATX monotherapy patients. In propensity-score-adjusted analyses, mean all-cause total costs were significantly less for monotherapy ATX initiators than for GXR initiators ($7,553 vs $10,639; difference = -$3,086, $p < .0001$), as were mean ADHD-related total costs ($3,213 vs $4,544; difference = -$1,330, $p < .0001$). Monotherapy ATX initiators had significantly fewer all-cause and ADHD-related total medical visits and ∼22 days shorter persistence to index therapy ($p < .0001$). Results were similar for secondary analyses comparing all ATX with all GXR initiators, regardless of monotherapy or combination regimen, and comparing only monotherapy initiators.
CONCLUSIONS: Children and adolescents with ADHD who initiated ATX monotherapy incurred lower all-cause and ADHD-related total healthcare costs than patients who initiated GXR. This was due in part to less

healthcare resource utilization and slightly shorter persistence for ATX patients. These findings may aid decision-making and inform future studies, but must be tempered due to inherent observational research limitations

……..

Current Psychiatry. 2018;17:42-46.
NONPHARMACOLOGIC STRATEGIES FOR HELPING CHILDREN WITH ADHD.
Mason EJ, Joshi KG.

……..

Cytokine Growth Factor Rev. 2017 Apr;34:35-41.
ROLE OF NEUROTROPHIC FACTORS IN ATTENTION DEFICIT HYPERACTIVITY DISORDER.
Tsai SJ.
Neurotrophins (NTs), a family of proteins including nerve growth factor, brain-derived neurotrophic factor (BDNF), neurotrophin-3, and neurotrophin-4, are essential for neural growth, survival, and differentiation, and are therefore crucial for brain development. Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterized by problems of inattention and/or hyperactivity-impulsivity. ADHD is one of the most common childhood onset psychiatric disorders. Studies have suggested that both genetic and environmental factors influence the development of the disorder, although the precise causes of ADHD have not yet been identified. In this review, we assess the role of NTs in the pathophysiology of ADHD. Preclinical evidence indicates that BDNF knockout mice are hyperactive, and an ADHD rodent model exhibited decreased cerebral BDNF levels. Several lines of evidence from clinical studies, including blood level and genetic studies, have suggested that NTs are involved in the pathogenesis of ADHD and in the mechanism of biological treatments for ADHD. Future directions for research are proposed, such as using blood NTs as ADHD biomarkers, optimizing NT genetic studies in ADHD, considering NTs as a link between ADHD and other comorbid mental disorders, and investigating methods for optimally modulating NT signaling to discover novel therapeutics for treating ADHD

……..

Dent Traumatol. 2017 Apr;33:71-76.
THE ATTENTION-DEFICIT/HYPERACTIVITY DISORDER MODEL FOR TRAUMATIC DENTAL INJURIES: A CRITICAL REVIEW AND UPDATE OF THE LAST 10 YEARS.
Sabuncuoglu O, Irmak MY.
It has been more than 10 years since the proposal of attention-deficit/hyperactivity disorder (ADHD) model as an explanatory construct for traumatic dental injuries (TDIs) in children. The aim of this review was to address developments in the study of the issue after 2005-2016. A systematic literature search covering the period from 2005 to 2016 was conducted on PubMed, the Cochrane library and Google Scholar using relevant keywords. Fourteen studies exploring the relationship between ADHD and TDIs from 2005 and onward (including the proposal paper) were identified. Of the 12 controlled studies, nine reported confirming findings for a link with ADHD in the occurrence of TDIs. More than one-third of all children with ADHD may suffer from TDIs. In ADHD children, the most common types of injury were uncomplicated/complicated crown fractures and subluxation of maxillary central incisors resulting from falls and collisions. There is also evidence that ADHD represents an independent risk factor other than the well-established risk factor of incisor overjet. Over the last 10 years, convincing evidence has accumulated that ADHD is an important and common risk factor for TDIs. Increased awareness and side-by-side work of medical, dental and mental professionals at both clinical and research settings are necessary

……..

Dev Neuropsychol. 2017;42:309-22.

PREVALENCE AND PREDICTORS OF LEARNING AND PSYCHOLOGICAL DIAGNOSES FOLLOWING PEDIATRIC ARTERIAL ISCHEMIC STROKE.

Williams TS, McDonald KP, Roberts SD, et al.

This study examined the prevalence of learning and psychological diagnoses and associated neurological and personal-environmental risk factors following perinatal and childhood arterial ischemic stroke. In our sample of 126 children and youth, 52.4% received a diagnosis following their assessment. Specifically, 32% had a single diagnosis and 21% had two or more diagnoses. Learning disability, attention deficit-hyperactivity disorder, and intellectual disability were the most prevalent diagnoses. Associated risk factors varied by diagnosis with lower intellectual functioning being the common risk factor across categories. Seizure status was associated with intellectual disability whereas family history was related to ADHD and comorbid diagnoses

……..

Dev Neurorehabil. 2017 Jul;20:317-22.

THE PRAGMATIC LANGUAGE, COMMUNICATION SKILLS, PARENT-CHILD RELATIONSHIPS, AND SYMPTOMS OF CHILDREN WITH ADHD AND THEIR PLAYMATES 18-MONTHS AFTER A PARENT-DELIVERED PLAY-BASED INTERVENTION.

Wilkes-Gillan S, Cantrill A, Parsons L, et al.

OBJECTIVE: This study examined the communication skills, pragmatic language, parent-child relationships, and attention deficit hyperactivity disorder (ADHD) symptoms of children with ADHD and their playmates 18-months after a pilot parent-delivered intervention for improving social play skills and pragmatic language.

METHODS: Participants were five children with ADHD, their parents, and five typically-developing playmates. Outcomes were measured immediately post and 18-months following the intervention. Parent-rated norm-based assessments and an observational measure were used. Differences within and between the ADHD and playmate groups were examined.

RESULTS: Children maintained all skills gained 18-months following the intervention. Compared to a normative sample, children with ADHD remained below the average range on aspects of communication skills, parent-child relationships, and ADHD symptom levels 18-months following intervention.

CONCLUSIONS: After intervention, children with ADHD still experienced pragmatic language skills below those of their peers on norm-based assessments that measure their skills across contexts. School-based interventions are needed to facilitate ongoing skill development and generalization

……..

Environ Int. 2017 Sep;106:170-77.

PRENATAL AND POSTNATAL EXPOSURE TO NO2 AND CHILD ATTENTIONAL FUNCTION AT 4-5YEARS OF AGE.

Sentis A, Sunyer J, Dalmau-Bueno A, et al .

BACKGROUND: Prenatal and postnatal exposure to air pollution has been linked to cognitive impairment in children, but very few studies have assessed its association with attentional function. OBJECTIVES: To evaluate the association between prenatal and postnatal exposure to nitrogen dioxide (NO2) and attentional function in children at 4-5years of age.

METHODS: We used data from four regions of the Spanish INMA-Environment and Childhood-Project, a population-based birth cohort. Using land-use regression models (LUR), we estimated prenatal and postnatal NO2 levels in all of these regions at the participants' residential addresses. We assessed attentional function using the Kiddie-Conners Continuous Performance Test (K-CPT). We combined the region-specific adjusted effect estimates using random-effects meta-analysis.

RESULTS: We included 1298 children with complete data. Prenatal exposure to NO2 was associated with an impaired standard error of the hit reaction time (HRT(SE)) (increase of 1.12ms [95% CI; 0.22 a 2.02] per 10mug/m(3) increase in prenatal NO2) and increased omission errors (6% [95% CI; 1.01 to 1.11] per 10mug/m(3) increase in prenatal NO2). Postnatal exposure to NO2 resulted in a similar but borderline significant increase of omission errors (5% [95% CI; =0.99 to 1.11] per 10mug/m(3) increase in postnatal

NO2). These associations did not vary markedly between regions, and were mainly observed in girls. Commission errors and lower detectability were associated with prenatal and postnatal exposure to NO2 only in some regions.
CONCLUSIONS: This study indicates that higher exposure to ambient NO2, mainly during pregnancy and to a lesser extent postnatally, is associated with impaired attentional function in children at 4-5years of age

……..

Eur Child Adolesc Psychiatry. 2018;1-21.
STANDARDISED ASSESSMENT OF FUNCTIONING IN ADHD: CONSENSUS ON THE ICF CORE SETS FOR ADHD.
Bölte S, Mahdi S, Coghill D, et al.
Attention-deficit/hyperactivity disorder (ADHD) is associated with significant impairments in social, educational, and occupational functioning, as well as specific strengths. Currently, there is no internationally accepted standard to assess the functioning of individuals with ADHD. WHO's International Classification of Functioning, Disability and Health child and youth version (ICF) can serve as a conceptual basis for such a standard. The objective of this study is to develop a comprehensive, a common brief, and three age-appropriate brief ICF Core Sets for ADHD. Using a standardised methodology, four international preparatory studies generated 132 second-level ICF candidate categories that served as the basis for developing ADHD Core Sets. Using these categories and following an iterative consensus process, 20 ADHD experts from nine professional disciplines and representing all six WHO regions selected the most relevant categories to constitute the ADHD Core Sets. The consensus process resulted in 72 second-level ICF categories forming the comprehensive ICF Core Set these represented 8 body functions, 35 activities and participation, and 29 environmental categories. A Common Brief Core Set that included 38 categories was also defined. Age-specific brief Core Sets included a 47 category preschool version for 0-5 years old, a 55 category school-age version for 6-16 years old, and a 52 category version for older adolescents and adults 17 years old and above. The ICF Core Sets for ADHD mark a milestone toward an internationally standardised functional assessment of ADHD across the lifespan, and across educational, administrative, clinical, and research settings

……..

Eur Child Adolesc Psychiatry. 2018;1-13.
SUSTAINED EFFECTS OF NEUROFEEDBACK IN ADHD: A SYSTEMATIC REVIEW AND META-ANALYSIS.
Van DJ, Arns M, Heinrich H, et al.
Neurofeedback (NF) has gained increasing interest in the treatment of attention-deficit/hyperactivity disorder (ADHD). Given learning principles underlie NF, lasting clinical treatment effects may be expected. This systematic review and meta-analysis addresses the sustainability of neurofeedback and control treatment effects by considering randomized controlled studies that conducted follow-up (FU; 2ΓÇô12 months) assessments among children with ADHD. PubMed and Scopus databases were searched through November 2017. Within-group and between-group standardized mean differences (SMD) of parent behavior ratings were calculated and analyzed. Ten studies met inclusion criteria (NF: ten studies, N = 256; control: nine studies, N = 250). Within-group NF effects on inattention were of medium effect size (ES) (SMD = 0.64) at post-treatment and increased to a large ES (SMD = 0.80) at FU. Regarding hyperactivity/impulsivity, NF ES were medium at post-treatment (SMD = 0.50) and FU (SMD = 0.61). Non-active control conditions yielded a small significant ES on inattention at post-treatment (SMD = 0.28) but no significant ES at FU. Active treatments (mainly methylphenidate), had large ES for inattention (post: SMD = 1.08; FU: SMD = 1.06) and medium ES for hyperactivity/impulsivity (post: SMD = 0.74; FU: SMD = 0.67). Between-group analyses also revealed an advantage of NF over non-active controls [inattention (post: SMD = 0.38; FU: SMD = 0.57); hyperactivity impulsivity (post: SMD = 0.25; FU: SMD = 0.39)], and favored active controls for inattention only at pre-post (SMD = 0.44). Compared to non-active control treatments, NF appears to have more durable

treatment effects, for at least 6 months following treatment. More studies are needed for a properly powered comparison of follow-up effects between NF and active treatments and to further control for non-specific effects

……..

Eur Child Adolesc Psychiatry. 2018;1-11.

EFFICACY AND SAFETY OF DRUGS FOR ATTENTION DEFICIT HYPERACTIVITY DISORDER IN CHILDREN AND ADOLESCENTS: A NETWORK META-ANALYSIS.

Padilha SCOS, Virtuoso S, Tonin FS, et al.

The aim of this study is to gather evidence of head-to-head double-blind randomized-controlled trials on the efficacy and safety of available treatments for attention deficit hyperactivity disorder (ADHD) in children and adolescents. A systematic review was conducted by two independent reviewers in ten electronic databases (PROSPERO register CRD42016043239). Methodological quality of included studies was evaluated according to the Jadad scale. Network meta-analyses were performed including double-blinded head-to-head trials comparing active allopathic drugs in patients (0ΓÇô18 years old) diagnosed with ADHD. The results of efficacy and safety of atomoxetine (ATX), bupropion, buspirone (BSP), dexamphetamine, edivoxetine (EDX), guanfacine (GXR), lisdexamfetamine (LDX), methylphenidate (MPH), mixed amphetamine salts, modafinil, pindolol (PDL), reboxetine (RBX), selegiline, and venlafaxine were analyzed using ADDIS software v.1.16.5. Forty-eight trials were identified (n = 4169 participants), of which 12 were used for efficacy analysis and 33 for safety analysis. On the CGI-I scale, the analysis revealed that MPH was more effective than ATX and GXR. For the safety outcomes, according to drug ranks, LDX was more likely to cause sleep disorders (39%) as well as loss of appetite (65%) and behavior problems such as irritability (60%). BSP (71%) and EDX (44%) caused less appetite decrease. For behavioral effects, PDL was considered safest (50%). For any adverse events, RBX (89%) was the safest alternative. The lack of head-to-head trials properly reporting outcomes of interest limited some comparisons. Network meta-analysis offered a broader overview on the available treatments for ADHD, especially for safety issues, and contributes towards evidence gathering and clinical practice decisions. A core outcome set for ADHD should be designed to guide the conduction and report of clinical trials

……..

Frontiers in Cellular Neuroscience. 2017;11.

XKR4 GENE EFFECTS ON CEREBELLAR DEVELOPMENT ARE NOT SPECIFIC TO ADHD.

Shook D, Brouwer R, de ZP, et al.

A single-nucleotide polymorphism (SNP) of the XKR4 gene has been linked to Attention-Deficit/Hyperactivity Disorder (ADHD). This gene is preferentially expressed in cerebellum, a brain structure implicated in this disorder. This study investigated the effects of this SNP on cerebellar development in children with and without ADHD. We collected 279 longitudinal T1-weighted structural images and DNA from 58 children with ADHD and 64 typically developing (TD) children matched for age, IQ, and gender. Groups were divided by the XKR4 rs2939678 SNP into A-allele carriers versus subjects homozygous for the G-allele. Cerebellar lobular volumes were segmented into 35 regions of interest using MAGeTBrain, an automated multi-atlas segmentation pipeline for anatomical MRI, and statistically analyzed using linear mixed models. We found decreased gray matter (GM) volumes in ADHD compared to TD children in bilateral lobules VIIIA, left VIIIB, right VIIB, and vermis VI. Furthermore, we found a linear age by gene interaction in left lobule VIIB where subjects homozygous for the G-allele showed a decrease in volume over time compared to A-allele carriers. We further found quadratic age × gene and age × diagnosis interactions in left lobule IV. Subjects homozygous for the G-allele (the genotype overtransmitted in ADHD) showed more suppressed, almost flat quadratic growth curves compared to A-allele carriers, similar to individuals with ADHD compared to controls. However, there was no interaction between genotype and diagnosis, suggesting that any effects of this SNP on cerebellar development are not specific to the disorder

……..

Front Human Neurosci. 2018;12.

ON THE EFFICIENCY OF INDIVIDUALIZED THETA/BETA RATIO NEUROFEEDBACK COMBINED WITH FOREHEAD EMG TRAINING IN ADHD CHILDREN.

Bazanova OM, Auer T, Sapina EA.

Background: Neurofeedback training (NFT) to decrease the theta/beta ratio (TBR) has been used for treating hyperactivity and impulsivity in attention deficit hyperactivity disorder (ADHD); however, often with low efficiency. Individual variance in EEG profile can confound NFT, because it may lead to influencing non-relevant activity, if ignored. More importantly, it may lead to influencing ADHD-related activities adversely, which may even result in worsening ADHD symptoms. Electromyogenic (EMG) signal resulted from forehead muscles can also explain the low efficiency of the NFT in ADHD from both practical and psychological point-of-view. The first aim of this study was to determine EEG and EMG biomarkers most related to the main ADHD characteristics, such as impulsivity and hyperactivity. The second aim was to confirm our hypothesis that the efficiency of the TBR NFT can be increased by individual adjustment of the frequency bands and simultaneous training on forehead muscle tension.

Methods: We recruited 94 children diagnosed with ADHD (ADHD) and 23 healthy controls (HC). All participants were male and aged between six and nine. Impulsivity and attention were assessed with Go/no-Go task and delayed gratification task, respectively; and 19-channel EEG and forehead EMG were recorded. Then, the ADHD group was randomly subdivided into (1) standard, (2) individualized, (3) individualized+EMG, and (4) sham NFT (control) groups. The groups were compared based on TBR and EEG alpha activity, as well as hyperactivity and impulsivity three times: pre-NFT, post-NFT and 6 months after the NFT (follow-up).

Results: ADHD children were characterized with decreased individual alpha peak frequency, alpha bandwidth and alpha amplitude suppression magnitude, as well as with increased alpha1/alpha2 (a1/a2) ratio and scalp muscle tension when c (+À2 ΓëÑ 0.212). All contingent TBR NFT groups exhibited significant NFT-related decrease in TBR not evident in the control group. Moreover, we detected a higher overall alpha activity in the individualized but not in the standard NFT group. Mixed MANOVA considering between-subject factor GROUP and within-subject factor TIME showed that the individualized+EMGgroup exhibited the highest level of clinical improvement, which was associated with increase in the individual alpha activity at the 6 months follow-up when comparing with the other approaches (post hoc $t = 3.456$, $p = 0.011$).

Conclusions: This study identified various (adjusted) alpha activity metrics as biomarkers with close relationship with ADHD symptoms, and demonstrated that TBR NFT individually adjusted for variances in alpha activity is more successful and clinically more efficient than standard, non-individualized NFT. Moreover, these training effects of the individualized TBR NFT lasted longer when combined with EMG

……..

Gesundheitswesen. 2017 Mar;79:164-73.

UTILIZATION OF PHYSIOTHERAPY SERVICES BY CHILDREN AND ADOLESCENTS - RESULTS OF THE KIGGS- BASELINE SURVEY.

Weber A, Karch D, Thyen U, et al.

Aim of the study: The use of physical therapy in German children and adolescents has so far solely been analyzed on the basis of health insurance data, which can neither consider case history nor social factors. Using the KiGGS-baseline survey it is possible to examine the use of physical therapy on the basis of parental reported health problems and social factors.

Methodology: Identifiable determinants for the use of physical therapy in the last 12 months in the KiGGS-baseline survey were examined bivariate and multivariate in logistic regression models with mutual adjustment. The following determinants were considered: social factors, somatic disorders and psychological abnormalities. The proportion of the use of physical therapy, which can be explained by these determinants, was estimated using population-attributable risk fraction.

Results: The frequency of the use of physical therapy in the last 12 months in the 0 to 17-year-olds in the KiGGS-baseline survey was 6,4% with higher use during infancy and adolescence. The socio-economic status of parents was not associated with the use of physical therapy. A migration background decreased the probability of the use of physical therapy, for example, among children aged 0 to 2 years (ORadjusted: 0,5 [95% CI: 0,2-1,0]). In those with scoliosis, the use of physical therapy was almost twice as frequent in

infancy as in adolescence (58,4 vs. 34,4%). A maximum of 15% of all children and adolescents with back pain reported the use of physical therapy. When ADHD was diagnosed at preschool age, the probability of using physical therapy was increased (ORadjusted: 5,1 [95% CI: 1,4-18,6]). The health problems, which were assessed in the KiGGS-baseline survey and considered for this analysis could explain 37% of the use of physical therapy in the 0 to 2-year-olds. In the other age groups, 59 to 62% could be explained.
Conclusion: Comparison of the KiGGS-baseline survey with health insurance data shows similar frequencies and patterns of the use of physical therapy and can therefore be used for the analysis of healthcare questions on the use of physical therapy. The data point to potential deficits in treatment in population segments and for some conditions. An examination of these hypotheses based on analyses of health insurance data seems to be reasonable

……..

Hong Kong J Paediatr. 2018;23:41.

PREDICTION OF ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD) RISK USING AN INFANT MEASURE: EXTERNALISING SYMPTOMS AT 12 MONTHS AND RISK OF ADHD AT 54 MONTHS.

Wahab MT, Chong DYY, Wen SCJ, et al.

Background and Aims: Attention Deficit Hyperactivity Disorder (ADHD) is generally diagnosed at the start of school age. By finding a reliable measure of externalising symptoms during infancy to predict risk of ADHD, early intervention may be started before school age.
Methods: Using the Growing Up in Singapore Towards Healthy Outcomes (GUSTO) cohort, we obtained externalising symptoms using the Infant Toddler Social Emotional Assessment (ITSEA) tool at 12 months and ascertained risk for ADHD using the Computerized Diagnostic Interview Schedule for Children (C-DISC) at 54 months (N=163). Nonparametric descriptive statistics compared low and intermediate risk of ADHD based on early ITSEA externalising scores. Binary logistic regression models examined the relationships between the ITSEA externalising score and risk of ADHD, after controlling for child and family factors.
Results: At 12 months, the mean externalising score was 0.580-¦0.278. At 54 months, 41.2% were intermediate risk and 58.8% were low risk. Mann-Whitney U test showed that the mean externalising score of children with intermediate risk of ADHD was higher than those with low risk of ADHD (Ustandardised 3.984, p<0.001). After controlling for gender, birth weight, 3-month postnatal State-Trait Anxiety Inventory (STAI) score, 12-month child media use, and ITSEA 12- month internalising raw score, the model showed that high externalising scores at 12 months increased the prediction of ADHD risk at 54 months by the odds of 13.70 times (OR 13.70, 95%CI 2.62-71.50, p=0.002). for final model and included covariates.
Conclusions: An infant measure at 12 months has predictive validity of risk of ADHD in preschool years. Thus, clinicians should consider administering this infant measure when concerns are raised about externalising symptoms and high risk infants should be followed up regularly for behavioural assessments. Future studies should look at how this infant measure correlates with actual ADHD diagnosis in later childhood

……..

Hong Kong J Paediatr. 2018;23:48.

EARLY FOOD ALLERGY AND SYMPTOMS OF AIRWAY ALLERGY MARCH ON THE RISK OF ATTENTION DEFICIT HYPERACTIVITY DISORDER IN CHINESE CHILDREN: A CROSS-SECTIONAL STUDY.

Shen C, Jiang X, Li F.

Background and Aims: Few studies investigated the effects of food allergy and the symptoms of allergy march on ADHD in children. We aim to investigate the effects of early food allergy and symptoms of allergy march on the prevalence of attention-deficit/hyperactivity disorder (ADHD) in school-age children.
Methods: This cross-sectional study was conducted in school-age children in grade 1-6 in elementary schools in China using cluster-stratified methods from nine cities across China between November and December 2005. A family and social environmental questionnaire including the diagnosis history of ADHD and allergic diseases (food allergy, allergic rhinitis and bronchial asthma), as well as general information of the children were completed by the parents of school-age children. The children were grouped as: no food

allergy group, single food allergy group (FA group), food allergy complicated with one airway allergy march symptom group (FA+AR/BA group), and food allergy complicated with two airway allergy march symptoms group (FA+AR+BA group) according to the diagnosis history of airway allergic diseases.
Results: The prevalence of allergic rhinitis (20.4%) and asthma (11.6%) in the food allergy group were both significantly higher than in the non-food allergy group (9.0% and 2.8%, respectively) (both p<0.001). The multivariable analysis showed that single food allergy (OR=1.53, 95%CI: 1.13-2.05, p=0.005), food allergy complicated with allergic rhinitis or asthma (OR=3.36, 95%CI: 2.19-5.14, p<0.001), and food allergy complicated with allergic rhinitis and asthma simultaneously (OR=4.08, 95%CI: 2.05-8.11, p<0.001) were independently associated with the increased risk of ADHD.
Conclusions: Early exposure to food allergen is a risk factor of ADHD in school-age children. The symptoms of airway allergy march resulted in a synergism with a higher risk of ADHD in children with food allergy. Monitoring food allergy in early life could provide information for the early prediction and intervention for the consequent allergy march and ADHD in children

……..

Hormones and Behavior. 2018.

PRENATAL PARACETAMOL EXPOSURE AND CHILD NEURODEVELOPMENT: A REVIEW.

Bauer AZ, Kriebel D, Herbert MR, et al.

Background: The non-prescription medication paracetamol (acetaminophen, APAP) is currently recommended as a safe pain and fever treatment during pregnancy. However, recent studies suggest a possible association between APAP use in pregnancy and offspring neurodevelopment.
Objectives: To conduct a review of publications reporting associations between prenatal APAP use and offspring neurodevelopmental outcomes. Methods: Relevant sources were identified through a key word search of multiple databases (Medline, CINAHL, OVID and TOXNET) in September 2016. All English language observational studies of pregnancy APAP and three classes of neurodevelopmental outcomes (autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), and intelligence quotient (IQ)) were included. One reviewer (AZB) independently screened all titles and abstracts, extracted and analyzed the data.
Results: 64 studies were retrieved and 55 were ineligible. Nine prospective cohort studies fulfilled all inclusion criteria. Data pooling was not appropriate due to heterogeneity in outcomes. All included studies suggested an association between prenatal APAP exposure and the neurodevelopmental outcomes; ADHD, ASD, or lower IQ. Longer duration of APAP use was associated with increased risk. Associations were strongest for hyperactivity and attention-related outcomes. Little modification of associations by indication for use was reported.
Conclusions: Together, these nine studies suggest an increased risk of adverse neurodevelopmental outcomes following prenatal APAP exposure. Further studies are urgently needed with; precise indication of use and exposure assessment of use both in utero and in early life. Given the current findings, pregnant women should be cautioned against indiscriminate use of APAP. These results have substantial public health implications

……..

Int J Methods Psychiatr Res. 2017 Mar;26.

THE STRUCTURE OF ADULT ADHD.

Adler LA, Faraone SV, Spencer TJ, et al.

Although DSM-5 stipulates that symptoms of attention-deficit hyperactivity disorder (ADHD) are the same for adults as children, clinical observations suggest that adults have more diverse deficits than children in higher-level executive functioning and emotional control. Previous psychometric analyses to evaluate these observations have been limited in ways addressed in the current study, which analyzes the structure of an expanded set of adult ADHD symptoms in three pooled US samples: a national household sample, a sample of health plan members, and a sample of adults referred for evaluation at an adult ADHD clinic. Exploratory factor analysis found four factors representing executive dysfunction/inattention (including, but not limited to,

all the DSM-5 inattentive symptoms, with non-DSM symptoms having factor loadings comparable to those of DSM symptoms), hyperactivity, impulsivity, and emotional dyscontrol. Empirically-derived multivariate symptom profiles were broadly consistent with the DSM-5 inattentive-only, hyperactive/impulsive-only, and combined presentations, but with inattention including executive dysfunction/inattention and hyperactivity-only limited to hyperactivity without high symptoms of impulsivity. These results show that executive dysfunction is as central as DSM-5 symptoms to adult ADHD, while emotional dyscontrol is more distinct but nonetheless part of the combined presentation of adult ADHD

……..

Ir J Psychol Med. 2018;1-3.

ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD): PERSPECTIVE OF THE GENERAL ADULT PSYCHIATRIST.

Murray D, Devitt P.

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder with onset in childhood. In Ireland adult ADHD treatment is drifting in an ad hoc manner into general adult psychiatric services. We propose this process should be halted in favour of a delivering a carefully planned adult ADHD service

……..

J Affect Disord. 2017 Nov;222:7-13.

ANOMALOUS PREFRONTAL-LIMBIC ACTIVATION AND CONNECTIVITY IN YOUTH AT HIGH-RISK FOR BIPOLAR DISORDER.

Chang K, Garrett A, Kelley R, et al.

OBJECTIVE: Abnormal prefrontal-limbic brain activation in response to facial expressions has been reported in pediatric bipolar disorder (BD). However, it is less clear whether these abnormalities exist prior to onset of mania, thus representing a biomarker predicting development of BD.

METHODS: We examined brain activation in 50 youth at high risk for BD (HR-BD), compared with 29 age- and gender-matched healthy control (HC) subjects. HR-BD was defined as having a parent with BD, as well as current mood or attentiondeficit/ hyperactivity disorder (ADHD) symptoms, or a history of at least one depressive episode. FMRI data were collected during an implicit emotion perception task using facial expression stimuli. Activation to fearful faces versus calm faces was compared between HR-BD and HC groups, including analyses of functional connectivity, and comparison of allele subgroups of the serotonin transporter (5-HTTLPR) gene.

RESULTS: While viewing fearful versus calm faces, HR-BD youth had significantly greater activation than HC youth in the right amygdala, ventrolateral prefrontal cortex (VLPFC), superior frontal cortex, cerebellum, and lingual gyrus. HR-BD youth, relative to HC youth, had greater functional connectivity between the right amygdala and the VLPFC as well as visual cortical regions Within the HR-BD group, youth with the s-allele had a trend for greater activation in the right amygdala and subgenual cingulate cortex.

CONCLUSIONS: Similar to youth with BD, youth at high risk for BD have greater activation than healthy controls in the amygdala and ventrolateral prefrontal cortex in response to fearful faces, as well greater functional connectivity between these regions. HR-BD youth with the s-allele of the 5-HTTLPR gene may be at greatest risk for developing BD

……..

J Alzheimers Dis. 2017;55:1339-49.

VISUAL SELECTIVE ATTENTION TOWARD NOVEL STIMULI PREDICTS COGNITIVE DECLINE IN ALZHEIMER'S DISEASE PATIENTS.

Chau SA, Herrmann N, Sherman C, et al.

BACKGROUND: Alzheimer's disease (AD) is associated with selective attention impairments, which could contribute to cognitive and functional deficits. Using visual scanning parameters, selective attention toward novel stimuli, or novelty preference, can be measured by a non-verbal, non-invasive method that may be of value in predicting disease progression.

OBJECTIVE: In this longitudinal study, we explored whether novelty preference can predict cognitive decline in AD patients.
METHODS: Mild to moderate AD patients viewed slides containing both novel and repeat images. The number of fixations, the average fixation time, and the relative fixation time on the two types of images were measured by an eye-tracking system. Novelty preference was estimated by the differences between the visual scanning parameters on novel and repeat images. Cognition and attention were assessed using the Standardized Mini-Mental Status Examination (sMMSE) and the Conners' Continuous Performance Test (CPT), respectively. Cognition was re-assessed every 6 months for up to 2 years.
RESULTS: Multivariate linear regressions of 32 AD patients (14 females, age = 77.9+/-7.8, baseline sMMSE = 22.2+/-4.4) indicated that reduced time spent on novel images (t = 2.78, p = 0.010) was also associated with greater decline in sMMSE scores (R2 = 0.41, Adjusted R2 = 0.35, F3,28 = 6.51, p = 0.002), adjusting for attention and baseline sMMSE.
CONCLUSION: These results suggest that novelty preference, measured by visual attention scanning technology, may reflect pathophysiological processes that could predict disease progression in the cognitively-impaired

……..

J Am Acad Child Adolesc Psychiatry. 2017 Jan;56:40-50.
ASSOCIATION OF PRETERM BIRTH WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER-LIKE AND WIDER-RANGING NEUROPHYSIOLOGICAL IMPAIRMENTS OF ATTENTION AND INHIBITION.
Rommel AS, James SN, McLoughlin G, et al.
OBJECTIVE: Preterm birth has been associated with an increased risk of attention-deficit/hyperactivity disorder (ADHD)-like symptoms and cognitive impairments similar to those seen in ADHD, including attention and inhibitory control difficulties. Yet data on direct comparisons across ADHD and preterm birth on cognitive-neurophysiological measures are limited.
METHOD: We directly compared 186 preterm-born adolescents to 69 term-born adolescents with ADHD and 135 term-born controls on cognitive-performance and event-related potential measures associated with attentional and inhibitory processing from a cued continuous performance test (CPT-OX), which we have previously shown to discriminate between the adolescents with ADHD and controls. We aimed to elucidate whether the ADHD-like symptoms and cognitive impairments in preterm-born individuals reflect identical cognitive-neurophysiological impairments in term-born individuals with ADHD.
RESULTS: Go-P3 amplitude was reduced, reflecting impaired executive response control, in preterm-born adolescents compared to both controls and adolescents with ADHD. Moreover, in preterm-born adolescents, as in term-born adolescents with ADHD, contingent negative variation amplitude was attenuated, reflecting impairments in response preparation compared to controls. Although the ADHD group showed significantly increased NoGo-P3 amplitude at FCz compared to preterm group, at Cz preterm-born adolescents demonstrated significantly decreased NoGo-P3 amplitude compared to the control group, similar to term-born adolescents with ADHD.
CONCLUSION: These findings indicate impairments in response preparation, executive response control, and response inhibition in preterm-born adolescents. Although the response preparation and response inhibition impairments found in preterm-born adolescents overlap with those found in term-born adolescents with ADHD, the preterm group also shows unique impairments, suggesting more wide-ranging impairments in the preterm group compared to the ADHD group

……..

J Atten Disord. 2017 Aug;21:872-81.
THE EFFECTS OF MINDFULNESS-BASED INTERVENTION ON CHILDREN'S ATTENTION REGULATION .
Felver JC, Tipsord JM, Morris MJ, et al.
OBJECTIVE: This article describes results from a randomized clinical trial of a mindfulness-based intervention for parents and children, Mindful Family Stress Reduction, on a behavioral measure of attention in youths, the Attention Network Task (ANT).

METHOD: Forty-one parent-child dyads were randomly assigned to either the mindfulness-based intervention condition or a wait-list control. School-age youths completed the ANT before and after the intervention.
RESULTS: Results demonstrate significant, medium-size (f(2) = -.16) intervention effects to the conflict monitoring subsystem of the ANT such that those in the intervention condition decreased in conflict monitoring more than those in the wait-list control. Youths in the intervention condition also showed improvements in their orienting subsystem scores, compared with controls.
CONCLUSION: Mindfulness-based interventions for youths have potential utility to improve attentional self-regulation, and future research should consider incorporating measures of attention into interventions that use mindfulness training

……..

J Atten Disord. 2017 Aug;21:846-55.
SYMPTOM PROFILE OF ADHD IN YOUTH WITH HIGH-FUNCTIONING AUTISM SPECTRUM DISORDER: A COMPARATIVE STUDY IN PSYCHIATRICALLY REFERRED POPULATIONS.
Joshi G, Faraone SV, Wozniak J, et al.
OBJECTIVE: To compare the clinical presentation of ADHD between youth with autism spectrum disorder (ASD) and ADHD and a sample of youth with ADHD only.
METHOD: A psychiatrically referred sample of autism spectrum disorder (ASD) youth with ADHD attending a specialized ambulatory program for ASD (n = 107) and a sample of youth with ADHD attending a general child psychiatry ambulatory clinic (n = 74) were compared.
RESULTS: Seventy-six percent of youth with ASD met Diagnostic and Statistical Manual of Mental Disorders (4th ed.; DSM-IV) criteria for ADHD. The clinical presentation of ADHD in youth with ASD was predominantly similar to its typical presentation including age at onset (3.5 +/- 1.7 vs. 4.0 +/- 1.9; p = .12), distribution of diagnostic subtypes, the qualitative and quantitative symptom profile, and symptom severity. Combined subtype was the most frequent presentation of ADHD in ASD youth.
CONCLUSION: Despite the robust presentation of ADHD, a significant majority of ASD youth with ADHD failed to receive appropriate ADHD treatment (41% vs. 24%; p = .02). A high rate of comorbidity with ADHD was observed in psychiatrically referred youth with ASD, with a clinical presentation typical of the disorder

……..

J Clin Exp Neuropsychol. 2017 Aug;39:563-73.
ATTENTION LAPSES IN CHILDREN WITH SPINA BIFIDA AND HYDROCEPHALUS AND CHILDREN WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER.
De la Torre GG, Martin A, Cervantes E, et al.
Attentional lapses are usually defined as temporary and often brief shifts of attention away from some primary task to unrelated internal information processing. This study addressed the incidence of attention lapses and differences in attentional functioning in 30 children with attention-deficit/hyperactivity disorder (ADHD), 26 healthy children, and 29 children with spina bifida myelomeningocele and hydrocephalus (SBH). Assessments were conducted using computerized tonic and phasic attention tests, the Symbol Digit Modalities Test (SDMT), and the Trail Making Test Form B (TMT-B). The group with SBH differed from normal controls on cognitive measures of attention and executive functions. The ADHD group obtained lower scores than the SBH group and healthy children. ANOVA results showed that there was an effect of shunt revisions and shunt-related infections on neuropsychological performance. Lapses of attention together with reaction time may thus represent important factors for the understanding of cognitive deficits in SBH

……..

J Consult Clin Psychol. 2017 Jul;85:723-36.

GIRLS WITH CHILDHOOD ADHD AS ADULTS: CROSS-DOMAIN OUTCOMES BY DIAGNOSTIC PERSISTENCE.

Owens EB, Zalecki C, Gillette P, et al.

OBJECTIVE: To ascertain adult outcomes in 10 domains reflecting symptomatology (internalizing, externalizing, self-injury, substance use), attainment (education, employment), and impairment (health, social, driving, overall) as a function of both childhood diagnosis of attention-deficit/hyperactivity disorder (ADHD) and persistence of ADHD symptoms across time.

METHOD: We prospectively followed 140 grade-school-aged girls with rigorously diagnosed childhood ADHD and 88 age- and ethnicity-matched comparison girls for 16 years. Outcome measures were obtained via self- and parent-report questionnaires, interviews, and objective tests.

RESULTS: Childhood ADHD, whether it remitted or persisted, was a pernicious risk factor for a limited number of poor outcomes, including low educational attainment, unplanned pregnancy, body mass index (BMI), and clinician-rated impairment. Childhood ADHD that persisted over time, whether completely or partially, was associated with a number of additional detrimental outcomes in the externalizing, internalizing, self-injury, occupational, social, and overall impairment domains. Finally, in this all-female sample, ADHD was not associated with objective measures of employment, substance use, or driving outcomes.

CONCLUSIONS: We discuss the considerable impairments accruing from both childhood-limited and adult-persisting ADHD, with major implications for the health and well-being of females with this neurodevelopmental disorder

……..

J Int Neuropsychol Soc. 2017 May;23:446-50.

ATYPICAL LOCAL INTERFERENCE AFFECTS GLOBAL PROCESSING IN CHILDREN WITH NEUROFIBROMATOSIS TYPE 1.

Payne JM, Porter MA, Bzishvili S, et al.

OBJECTIVES: To examine hierarchical visuospatial processing in children with neurofibromatosis type 1 (NF1), a single gene disorder associated with visuospatial impairments, attention deficits, and executive dysfunction.

METHODS: We used a modified Navon paradigm consisting of a large "global" shape composed of smaller "local" shapes that were either congruent (same) or incongruent (different) to the global shape. Participants were instructed to name either the global or local shape within a block. Reaction times, interference ratios, and error rates of children with NF1 (n=30) and typically developing controls (n=24) were compared.

RESULTS: Typically developing participants demonstrated the expected global processing bias evidenced by a vulnerability to global interference when naming local stimuli without a cost of congruence when naming global stimuli. NF1 participants, however, experienced significant interference from the unattended level when naming both local and global levels of the stimuli.

CONCLUSIONS: Findings suggest that children with NF1 do not demonstrate the typical human bias of processing visual information from a global perspective

……..

J Intellect Disabil Res. 2017 Jun;61:594-603.

AGE AND GENDER-RELATED DIFFERENCES IN EMOTIONAL AND BEHAVIOURAL PROBLEMS AND AUTISTIC FEATURES IN CHILDREN AND ADOLESCENTS WITH DOWN SYNDROME: A SURVEY-BASED STUDY OF 674 INDIVIDUALS.

Naerland T, Bakke KA, Storvik S, et al.

BACKGROUND: Recent studies have indicated an increased risk of autism, behavioural and emotional problems and attention-deficit/hyperactivity disorder in individuals with Down syndrome.

METHOD: In a large-scale survey-based study, we examined the rates of these problems and their relationship to age and gender, in a sample of 674 individuals (4-18 years) with Down syndrome. The relationship with IQ level was also explored in a subsample (n = 175). The Strengths and Difficulties Questionnaire and the Social Communication Questionnaire were used to assess behavioural and emotional problems and autism traits.

RESULTS: On the Strengths and Difficulties Questionnaire, peer problems were the most frequently reported difficulty (48% > cut-off), followed by hyperactivity/inattention (34% > cut-off). On the Social Communication Questionnaire, 37% scored at or above cut-off (>/=15) for autism spectrum disorder; 17% were at or above the suggested cut-off (>/=22) for autism. Little association between age and behavioural or emotional problems or with severity of autistic symptomatology was found. However, peer problems were more common in adolescents than in junior school children (P < 0.001); Hyperactivity/inattention was less prevalent among adolescents (P < 0.001).
CONCLUSIONS: High rates of autistic features, emotional and behavioural problems are documented. These problems are related to age, gender and degree of intellectual disability

……..

J Perinatol. 2017 May;37:606-14.

EARLY POSTNATAL ILLNESS SEVERITY SCORES PREDICT NEURODEVELOPMENTAL IMPAIRMENTS AT 10 YEARS OF AGE IN CHILDREN BORN EXTREMELY PRETERM.

Logan JW, Dammann O, Allred EN, et al.

OBJECTIVE: A neonatal illness severity score, The Score for Neonatal Acute Physiology-II (SNAP-II), predicts neurodevelopmental impairments at two years of age among children born extremely preterm. We sought to evaluate to what extent SNAP-II is predictive of cognitive and other neurodevelopmental impairments at 10 years of age.
STUDY DESIGN: In a cohort of 874 children born before 28 weeks of gestation, we prospectively collected clinical, physiologic and laboratory data to calculate SNAP-II for each infant. When the children were 10 years old, examiners who were unaware of the child's medical history assessed neurodevelopmental outcomes, including neurocognitive, gross motor, social and communication functions, diagnosis and treatment of seizures or attention deficit hyperactivity disorder (ADHD), academic achievement, and quality of life. We used logistic regression to adjust for potential confounders.
RESULTS: An undesirably high SNAP-II (30), present in 23% of participants, was associated with an increased risk of cognitive impairment (IQ, executive function, language ability), adverse neurological outcomes (epilepsy, impaired gross motor function), behavioral abnormalities (attention deficit disorder and hyperactivity), social dysfunction (autistic spectrum disorder) and education-related adversities (school achievement and need for educational supports. In analyses that adjusted for potential confounders, Z-scores -1 on 11 of 18 cognitive outcomes were associated with SNAP-II in the highest category, and 6 of 18 were associated with SNAP-II in the intermediate category. Odds ratios and 95% confidence intervals ranged from 1.4 (1.01, 2.1) to 2.1 (1.4, 3.1). Similarly, 2 of the 8 social dysfunctions were associated with SNAP-II in the highest category, and 3 of 8 were associated with SNAP-II in the intermediate category. Odds ratios and 95% confidence intervals were slightly higher for these assessments, ranging from 1.6 (1.1, 2.4) to 2.3 (1.2, 4.6).
CONCLUSION: Among very preterm newborns, physiologic derangements present in the first 12 postnatal hours are associated with dysfunctions in several neurodevelopmental domains at 10 years of age. We are unable to make inferences about causality

……..

J Youth Adolesc. 2017 Feb;46:417-28.

HOW MENTAL HEALTH INTERVIEWS CONDUCTED ALONE, IN THE PRESENCE OF AN ADULT, A CHILD OR BOTH AFFECTS ADOLESCENTS' REPORTING OF PSYCHOLOGICAL SYMPTOMS AND RISKY BEHAVIORS.

Herrera AV, Benjet C, Mendez E, et al.

The normative process of autonomy development in adolescence involves changes in adolescents' information management typically characterized by decreasing disclosure and increasing concealment. These changes may have an important impact on the early detection and timely treatment of mental health conditions and risky behavior. Therefore, the objective was to extend our understanding of how these developmental changes in adolescent disclosure might impact adolescent mental health interviews. Specifically, we estimated the effects of third party presence and type of third party presence (adult, child, or

both) on adolescents' reports of psychiatric symptoms, substance use, suicidal behavior, and childhood adversity. In this representative sample of 3005 adolescents from Mexico City (52.1 % female), administered the World Mental Health Composite International Diagnostic Interview (WMH-CIDI-A), adult presence influenced reporting the most; in their presence, adolescents reported more ADHD, parental mental illness and economic adversity, but less panic disorder, PTSD, drug use and disorder, and suicidal behavior. The presence of children was associated with increased odds of reporting conduct disorder, opportunity for drug use, parental criminal behavior, neglect, and the death of a parent. While adolescent information management strategies are normative and even desirable as a means of gaining emotional autonomy, they may also interfere with timely detection and treatment or intervention for mental health conditions and risky behaviors. Research and practical implications of these findings are discussed

……..

JAMA Pediatr. 2018;172:109-10.

MULTIMODAL TREATMENT OF THE SCHOOL-AGED CHILD WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER.

Froehlich TE, Brinkman WB.

……..

J Abnorm Child Psychol. 2018 Jan;46:113-25.

THE INFLUENCE OF CHILD GENDER ON THE PROSPECTIVE RELATIONSHIPS BETWEEN PARENTING AND CHILD ADHD.

Demmer DH, Puccio F, Stokes MA, et al.

The aims of the current study were to (i) explore the potential bidirectional, prospective relationships between parenting and child ADHD, and (ii) explore whether these relationships differed on the basis of child gender. Data were obtained from waves 1 (children aged 4- to 5-years) to 5 (children aged 12- to 13-years) of the Longitudinal Study of Australian Child (LSAC) dataset (child cohort). In order to examine dimensions of both mothers' and fathers' parenting, a subsample of nuclear families with mothers, fathers and children present at all waves was extracted (final sample = 1932; sons = 981, daughters = 951). Child ADHD measures included the hyperactive-impulsive subscale of the strengths and difficulties questionnaire for symptoms, and parent-report question for diagnosis. Mothers and fathers completed scales on dimensions of Angry, Warm and Consistent Parenting. A cross-lagged panel model demonstrated (i) higher child ADHD symptoms at wave 1 led to a global increase in less-than-optimal parenting at wave 2, and (ii) child ADHD symptoms and Angry Parenting shared a prospective, bi-directional relationship (whereby increases in one predicted increases in the other over time) during earlier years of development. Latent growth curve models demonstrated that increases in Angry Parenting across time were significantly predicted by increases in child ADHD symptoms. A logistic regression demonstrated that both mothers' and fathers' Angry Parenting at wave 1 significantly predicted an ADHD diagnosis in children at wave 3. No predictive relationships differed between child genders; thus, it appears these prospective pathways are similar for both sons and daughters

……..

J Abnorm Child Psychol. 2018 Jan;46:127-35.

SLUGGISH COGNITIVE TEMPO, PROCESSING SPEED, AND INTERNALIZING SYMPTOMS: THE MODERATING EFFECT OF AGE.

Jacobson LA, Geist M, Mahone EM.

Sluggish Cognitive Tempo (SCT) has been defined by a constellation of caregiver-reported symptoms that includes daydreaming, difficulty initiating and sustaining effort, lethargy, and physical underactivity. These symptoms have been observed in both typically developing children and in some children with Attention-Deficit/Hyperactivity Disorder (ADHD)—especially those with the predominantly inattentive presentation. Symptoms of SCT (typically identified via rating scales) appear separable from DSM inattentive ADHD symptoms, but have also been associated with internalizing symptoms. To date, however, few studies have examined associations among ratings of SCT and speeded performance-based measures. The present study examined associations among SCT, processing speed, and internalizing symptoms in a sample of 566

clinically referred children (65% male), while also considering how these associations change with age. Findings revealed small but significant age-related differences in the strength of associations between the 'Daydreamy' element of SCT and processing speed (as measured by the WISC-IV Processing Speed Index—PSI), with stronger associations observed in younger children. Importantly, this difference in strength of association was not accounted for by the change in WISC-IV test forms for PSI subtests between 6–7 year-olds and 8–16 year-olds. Conversely, the association between SCT and internalizing symptoms remained generally consistent across the age range. Findings contribute to further characterization of the 'slowness' of responding seen in SCT and may have implications for behavioral intervention

……..

J Atten Disord. 2018 Jan;22:143-53.

ADHD PREVALENCE IN SPANISH PRESCHOOLERS: COMORBIDITY, SOCIO-DEMOGRAPHIC FACTORS, AND FUNCTIONAL CONSEQUENCES.

Canals J, Morales-Hidalgo P, Jané MC, et al.

Objective: The object was to examine the prevalence of ADHD among preschoolers, analyzing comorbidity, and the association with socio-demographic factors.

Method: We conducted a two-phase epidemiological study of 1,104 preschoolers aged 3 to 6 years in Catalonia, Spain. The Early Childhood Inventory–4 (ECI-4) was administered to parents and teachers. Children at risk of ADHD were assessed using open-ended face-to-face interviews and were observed in a school setting. ADHD diagnoses were based on Diagnostic and Statistical Manual of Mental Disorders (4th ed.; DSM-IV) criteria.

Results: The prevalence of ADHD diagnosis was 5.4%. Male sex and first-born status were risk factors for ADHD. Parents reported more symptoms (12.9%) than teachers (8.7%). Behavioral problems (odds ratio [OR] = 12, p = .001), autism spectrum disorder problems (OR = 9.5, p = .001), and obsessive-compulsive problems and tics (OR = 5.9, p = .001) were specifically related to ADHD diagnosis. Mother's health status and school achievement were lower in ADHD children.

Conclusion: Even at early stages of development, ADHD has high rates of comorbidity and a significant impact on school performance and family health

……..

J Atten Disord. 2018 Jan;22:134-42.

ADHD IN THE UNITED KINGDOM: REGIONAL AND SOCIOECONOMIC VARIATIONS IN INCIDENCE RATES AMONGST CHILDREN AND ADOLESCENTS (2004-2013).

Hire AJ, Ashcroft DM, Springate DA, et al.

Objective: To describe the incidence and distribution of ADHD within the United Kingdom, and to examine whether there was any association between ADHD incidence and socioeconomic deprivation.

Method: The study used data from the Clinical Practice Research Datalink (CPRD). Patients diagnosed with ADHD before the age of 19 between January 1, 2004 and December 31, 2013 were stratified according to the region in which their general practice was based. Practice Index of Multiple Deprivation (IMD) score was used as a surrogate measure of patients' deprivation status.

Results: ADHD incidence was relatively stable between 2004 and 2013, but peaked in the last 2 years studied. Statistically significant (p = .05) differences in incidence were observed between U.K. regions. In almost every year studied, incidence rates were highest among the most deprived patients and lowest among the least deprived patients.

Conclusion: In the United Kingdom, ADHD may be associated with socioeconomic deprivation

……..

J Atten Disord. 2018 Jan;22:154-62.

ADHD IN TUNISIAN ADOLESCENTS: PREVALENCE AND ASSOCIATED FACTORS.

Mhalla A, Guedria A, Brahem T, et al.

Objective: The aims of the study were to determine the prevalence of ADHD in a population of high school students and to explore the factors associated with this disorder.

Method: This was a cross-sectional study that had included 447 high school students. The diagnosis of ADHD was made by the Adult ADHD Self-Report Scale translated in Arabic language. The sociodemographic and clinical characteristics were evaluated by a preestablished questionnaire. The self-esteem was assessed by the Rosenberg Self-Esteem Scale.

Results: The prevalence of ADHD was 18.1%. The logistic regression analysis showed an association between the diagnosis of ADHD and the bad relationships with parents (odds ratio [OR] = 16.43; p < 10-3), the presence of personal psychiatric antecedents (OR = 12.16; p < 10-3), internet misuse (OR = 2.39; p = .014), and maltreatment antecedents (OR = 3.16; p = .009).

Conclusion: The prevalence of ADHD in this study was one of the highest prevalence reported. The factors associated with ADHD may have diagnostic and therapeutic implications.

……..

J Atten Disord. 2018 Feb;22:229-39.

RISK OF ADHD AFTER MULTIPLE EXPOSURES TO GENERAL ANESTHESIA: A NATIONWIDE RETROSPECTIVE COHORT STUDY.

Tsai CJ, Lee CT-C, Liang SH-Y, et al.

Objective: To study the association between general anesthesia exposure before age 3 years and having a later ADHD diagnosis.

Method: In a birth cohort, data were collected from a nationwide population database for children born between 1997 and 1999 who were exposed to general anesthesia before their third birthday. Age- and gender-matched enrollees without general anesthesia exposure were taken as the comparison. Groups were compared to identify the incidence of ADHD after age 4 and anesthesia-related predictive factors.

Results: Among the 1,146 exposed children, 74 ADHD cases were identified, and 158 ADHD cases were identified in 3,438 matched controls. After adjusting for comorbid conditions and possible confounding factors, if exposure on more than one occasion or = 3 hr, an increased likelihood of having a later ADHD diagnosis was found (HR, 1.71 and 2.43, respectively).

Conclusion: Children with multiple or = 3 hr general anesthesia exposures before age 3 years have an increased likelihood of a later ADHD diagnosis

……..

J Atten Disord. 2018 Jan;22:116-26.

PREVALENCE AND CORRELATES OF ADHD AMONG ADOLESCENT STUDENTS IN NIGERIA.

Umar MU, Obindo JT, Omigbodun OO.

Objective: To determine the prevalence and psychosocial correlates of ADHD among adolescents in Jos, Nigeria.

Method: A cross-sectional descriptive two-stage study of 487 randomly selected participants using Kiddie–Schedule for Affective Disorders and Schizophrenia–Present and Lifetime Version (K-SADS-PL), Raven's Standard Progressive Matrix (SPM) and the Children's Global Assessment Score (CGAS).

Results: The prevalence of ADHD was 8.8%. The subtypes found were inattentive (3.08%), hyperactive-impulsive (2.05%), and combined (3.08%); male:female ratio of 1.4:1. ADHD was significantly associated with use of substance by father (odds ratio [OR] = 0.35; 95% confidence interval [CI] = [0.154, 0.781]), use of substance by mother (OR = 0.2; 95% CI = [0.055, 0.711]), and lower education of mother (OR = 0.3 95% CI = [0.116, 0.693]). Poor quality of handwriting ($?^2$ = 8.120; p = .010) and impaired global functioning (t test = 10.756; p < .001) were significantly associated with ADHD in the adolescents.

Conclusion: Given the burden of ADHD, efforts should be made to establish a system for the early identification and management

……..

J Atten Disord. 2018 Jan;22:127-33.

THE PREVALENCE OF ADHD IN FAYOUM CITY (EGYPT) AMONG SCHOOL-AGE CHILDREN: DEPENDING ON A DSM-5-BASED RATING SCALE.

Aboul-ata MA, Amin FA.

Objective: In the present study, we created a new valid rating scale to estimate the prevalence of ADHD among school-age children in Fayoum City.

Method: We conducted two consequential studies (Studies 1 and 2). In Study 1, the sample comprised 106 children. The ages of the sample participants ranged between 6 and 14 years. The purpose of that study was to validate a new Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5)-based ADHD rating scale. In Study 2, the sample consisted of 420 children with ages ranging from 6 to 14 years. We used the new rating scale to estimate the prevalence of ADHD.

Results: The first study showed that the new rating scale for ADHD was valid. The second study revealed that the prevalence of ADHD in Fayoum City was 20.5%, with 33.8% among boys and 6.8% among girls.

Conclusion: We validated a new ADHD rating scale and estimated the prevalence of ADHD in Fayoum City for the first time in Egypt

……..

J Child Adolesc Psychopharmacol. 2017 Dec;27:924-25.

NASAL BLEEDING PROBABLY ASSOCIATED WITH METHYLPHENIDATE.

Avcil S.

Presents a case report of a 9-year-old girl was referred to clinic with complaints of inattentiveness, concentration problems, and learning difficulties, which had resulted in low school grades. According to the psychiatric assessment, she was diagnosed with ADHD—inattentive type with normal intellectual capacity. Treatment of OROSMPH 18mg was initiated. The dose of OROS-MPH was increased to 27 mg/day 3 weeks later. During their second visit to our clinic 5 weeks later, the patient's mother reported that on the 10th day of OROS-MPH 27 mg/day treatment, her daughter had experienced nasal bleeding and this had occurred everyday when the dose of OROS-MPH was increased to 27 mg/day. The patient was referred to the pediatric clinic because of the nasal bleeding. A detailed evaluation was made. There was no history of hypertension, no bleeding disorder; or recent intake of nonsteriod anti-inflammatory drugs (NSAIDs), warfarin, or any antiplatelet agents. The patient was not taking any medication other than MPH. No other physical cause, such as excessive sneezing, coughing, nasal trauma, recent surgery, or infection, which could explain nasal bleeding, could be found. The coagulation profile, hemogram, and renal and liver function test results were within normal range. Otorhinological referral did not reveal any local cause of the bleeding. Therefore, the nasal bleeding was considered by the physician to be a possible adverse effect of OROSMPH, and the medication was discontinued

……..

J Child Adolesc Psychopharmacol. 2018;28:66-73.

METHYLPHENIDATE HAS SUPERIOR EFFICACY OVER PARENT-CHILD INTERACTION THERAPY FOR PRESCHOOL CHILDREN WITH DISRUPTIVE BEHAVIORS.

van d, V, van den Hoofdakker BJ, Nauta MH, et al.

Objective: To compare the effectiveness between parent-child interaction therapy (PCIT) and methylphenidate in preschool children with attention-deficit/hyperactivity disorder (ADHD) symptoms and disruptive behaviors who had remaining significant behavior problems after previous behavioral parent training.

Methods: We included 35 preschool children, ranging in age between 3.4 and 6.0 years. Participants were randomized to PCIT (n = 18) or methylphenidate (n = 17). Outcome measures were maternal ratings of the intensity and number of behavior problems and severity of ADHD symptoms. Changes from pretreatment to directly posttreatment were compared between groups using two-way mixed analysis of variance. We also made comparisons of both treatments to a nonrandomized care as usual (CAU) group (n = 17) regarding intensity and number of behavior problems. All children who started one of the treatments were included in the analyses.
Results: Mothers reported a significantly more decreased intensity of behavior problems after methylphenidate (pre-post effect size d = 1.50) compared with PCIT (d = 0.64). ADHD symptoms reduced significantly over time only after methylphenidate treatment (d = 0.48) and not after PCIT. Changes over time of children in the CAU treatment were nonsignificant.
Conclusions: Although methylphenidate was more effective than PCIT, both interventions may be effective in the treatment of preschool children with disruptive behaviors. Our findings are preliminary as our sample size was small and the use of methylphenidate in preschool children lacks profound safety data as reflected by its off-label status. More empirical support is needed from studies with larger sample sizes

……..

J Child Adolesc Psychopharmacol. 2018;28:19-28.
SHP465 MIXED AMPHETAMINE SALTS IN THE TREATMENT OF ATTENTION-DEFICIT/HYPERACTIVITY DISORDER IN CHILDREN AND ADOLESCENTS: RESULTS OF A RANDOMIZED, DOUBLE-BLIND PLACEBO-CONTROLLED STUDY.
Brams M, Childress AC, Greenbaum M, et al.
Objective: The aim of this study was to evaluate the efficacy, safety, and tolerability of SHP465 mixed amphetamine salts (MAS) in children and adolescents with attention-deficit/hyperactivity disorder (ADHD).
Methods: This randomized, double-blind dose-optimization study enrolled children and adolescents (6-17 years) meeting Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision ADHD criteria and having baseline ADHD Rating Scale IV (ADHD-RS-IV) total scores 28. Participants were randomized 1:1 to placebo or dose-optimized SHP465 MAS (12.5-25 mg) for 4 weeks. Total score change (baseline to week 4) on the ADHD-RS-IV (primary endpoint) and the Clinical Global Impressions-Improvement (CGI-I) scale score at week 4 (key secondary endpoint) were assessed using linear mixed-effects models for repeated measures. Safety and tolerability assessments (secondary endpoints) included treatment-emergent adverse events (TEAEs) and vital sign changes.
Results: Of 264 randomized participants (placebo, n = 132; SHP465 MAS, n = 132), 234 (placebo, n = 118; SHP465 MAS, n = 116) completed the study. The least squares mean (95% confidence interval) treatment difference significantly favored SHP465 MAS over placebo for ADHD-RS-IV total score change from baseline to week 4 (-9.9 [-13.0, -6.8]; p < 0.001; effect size = 0.80) and CGI-I score at week 4 (-0.8 [-1.1, -0.5]; p < 0.001; effect size = 0.65). TEAE frequency was 46.6% (61/131) with placebo and 67.4% (89/132) with SHP465 MAS; no serious TEAEs were reported. TEAEs reported at a frequency of 5% and 2 times the placebo rate were decreased appetite, insomnia, irritability, nausea, and decreased weight. Mean -¦ standard deviation increases (baseline to final on-treatment assessment) were higher with SHP465 MAS than placebo for pulse (5.7 -¦ 11.78 vs. 0.7 -¦ 10.79), systolic blood pressure (3.8 -¦ 9.15 vs. 2.1 -¦ 8.72), and diastolic blood pressure (4.0 -¦ 8.23 vs. 0.5 -¦ 7.45).
Conclusions: SHP465 MAS demonstrated superiority over placebo in improving ADHD symptoms and global functioning in children and adolescents with ADHD. The safety and tolerability profile of SHP465 MAS was consistent with that of SHP465 MAS in adults and other long-acting psychostimulants in children and adolescents

……..

J Child Psychol Psychiatry. 2018 Feb;59:110-18.

EFFECTS OF PRENATAL ALCOHOL CONSUMPTION ON COGNITIVE DEVELOPMENT AND ADHD-RELATED BEHAVIOUR IN PRIMARY-SCHOOL AGE: A MULTILEVEL STUDY BASED ON MECONIUM ETHYL GLUCURONIDE.

Eichler A, Hudler L, Grunitz J, et al.

Background: Alcohol intake during pregnancy is considered to be a risk factor for child development. Child biomarkers of intrauterine alcohol exposure have been rarely studied. We investigated whether a meconium alcohol metabolite (ethyl glucuronide, EtG) was associated with cognitive development, ADHD-related behaviour and neurophysiological markers of attention and executive control of children at primary-school age.

Methods: Mothers provided self-report on prenatal alcohol consumption during their 3rd trimester. Meconium samples were collected at birth. A total of 44 children with a meconium EtG above the detection limit (= 10 ng/g) and 44 nonexposed matched controls were compared. A second threshold (= 154 ng/g) was applied to study the dose effects. When children reached primary-school age, mothers rated ADHD-related behaviour, child cognitive development was measured using an IQ test battery, and event-related potentials were recorded during a cued go/nogo task.

Results: Children in both EtG-positive groups allocated fewer attentional resources than controls to the go/nogo task (reduced P3 component in go-trials). Children with a meconium EtG above 154 ng/g were also found to have an IQ that was six points lower than the other groups. Within the EtG = 154 ng/g group, there was a positive correlation between EtG value and ADHD-related behaviour. These significant effects were not observed in relation to the maternal self-report data.

Conclusions: Associations between EtG and cognitive deficits, attentional resource capacity and ADHD-related behaviour could be documented with effects that were partially dose-dependent. In addition to maternal self-reports, this biomarker of intrauterine alcohol exposure may be considered as a predictor of child development

……..

J Clin Exp Neuropsychol. 2018 Jan;40:17-29.

EFFECTS OF A WORKING MEMORY TRAINING PROGRAM IN PRESCHOOLERS WITH SYMPTOMS OF ATTENTION-DEFICIT/HYPERACTIVITY DISORDER.

Capodieci A, Gola ML, Cornoldi C, et al.

Introduction: Preschoolers with attention-deficit/hyperactivity disorder (ADHD) have been found to exhibit impairments on neuropsychological measures of working memory (WM). As WM is an important predictor of future learning abilities, early intervention could help to prevent severe problems. The purpose of this research was to ascertain the efficacy of an intervention for training WM in 5-year-old children with symptoms of ADHD.

Method: Thirty-four children with symptoms of ADHD were randomly divided into two groups: One was assigned to the WM training condition, and the other continued normal class activities. The training was provided at school in small groups that also included typically developing children.

Results: The trained group showed a significant improvement in tasks measuring their WM and other controlled processes at conclusion of study, whereas no significant improvement was found in the control group.

Conclusions: We concluded that early intervention on WM may be effective in children with symptoms of ADHD

……..

J Clin Child Adolesc Psychol. 2018 Jan;47:61-68.

TOWARD ESTABLISHING THE TRANSCULTURAL VALIDITY OF SLUGGISH COGNITIVE TEMPO: EVIDENCE FROM A SAMPLE OF SOUTH KOREAN CHILDREN.

Lee S, Burns GL, Becker SP.

All sluggish cognitive tempo (SCT) research has been conducted in North America and Western Europe, with the addition of 1 study in Chile. Our objective was to determine the internal and external validity of 9

SCT and 9 Diagnostic and Statistical Manual of Mental Disorders (5th ed.) attention deficit/hyperactivity disorder inattention (ADHD-IN) symptoms in South Korean children. Mothers, fathers, and teachers rated SCT, ADHD-IN, ADHD hyperactivity/impulsivity (HI), oppositional defiant disorder (ODD), anxiety, depression, academic impairment, and social impairment in 1st- to 6th-grade children (6–13 years of age) from South Korea (Sample 1: mothers rated 885 children and fathers rated 646 children; 941 unique children, 54% girls; Sample 2: 99 teachers rated 297 children, 44% girls). The SCT and ADHD-IN symptoms showed convergent validity (substantial loadings on their respective factors) and discriminant validity (loadings near zero on the alternative factor) across all three raters. Although ADHD-IN showed a positive relationship with ADHD-HI and ODD even after controlling for SCT across all three raters, SCT was nonsignificantly (mothers and fathers) or negatively (teachers) related to ADHD-HI and ODD after controlling for ADHD-IN. Higher SCT scores predicted higher anxiety, depression, academic impairment (teachers only), and social impairment (teachers only) even after controlling for ADHD-IN, whereas higher ADHD-IN scores predicted higher anxiety (mothers and fathers only), depression, academic impairment, and social impairment after controlling for SCT. The study provides initial evidence for the internal and external validity of SCT relative to ADHD-IN in South Korean children, thereby providing the first evidence for SCT's validity in Asian children

……..

Journal of International Medical Research. 2018;46:122-34.

PREVALENCE OF ATTENTION-DEFICIT/HYPERACTIVITY AND OTHER DISRUPTIVE BEHAVIOUR DISORDER SYMPTOMS AMONG PRIMARY SCHOOL-AGE CHILDREN IN KAYSERI, TURKEY.

Senol V, Unalan D, Akca RP, et al.

Objectives: This study aimed to determine the prevalence of attention-deficit/hyperactivity disorder (ADHD), oppositional defiant disorder (ODD), and conduct disorder (CD), and their influencing factors on primary school-age children.

Methods: This cross-sectional study was conducted among 2045 students, 7ΓÇô15 years old, who were randomly selected from seven schools in Kayseri, Turkey, in 2012. Participants were stratified by socioeconomic status. Data were collected using the Turgay DSM-IV-Based Child and Adolescent Behavioural Disorders Screening and Rating Scale (T-DSM-IV-S). For statistical analyses, the t-test and analysis of variance were used.

Results: Rates of disruptive behaviour disorders (DBDs) among children were as follows: ADHD, 6.2%; CD, 14.4%; and ODD, 6.7%. The prevalence of ADHD was higher in boys and children whose mothers were homemakers and from poorly-educated and low-income families, compared with their peers. CD was more prevalent among boys and children 13-15 years old, whose parents had low income levels and were separated. ODD was higher in boys and children whose mothers were homemakers.

Conclusions: Our findings suggest that the overall prevalence of DBDs in our study area is 27.4%, which is similar to the pooled worldwide prevalence. Adverse family factors are closely associated with the prevalence of DBDs

……..

J Invest Med. 2018;66:68-69.

CARDIOVASCULAR SAFETY OF METHYLPHENIDATE (RITALIN) IN TREATING PAEDIATRIC PATIENTS WITH ADHD (ATTENTION DEFICIT HYPERACTIVITY DISORDER): A LITERATURE REVIEW.

Bui A, Joseph A, Sam D, et al.

Purpose of study Guidelines for monitoring of ADHD patients treated with methylphenidate are lacking. The purpose of this study was to determine the cardiovascular side effects of methylphenidate in paediatric patients with ADHD. Methods used A search of online databases such as PubMed, Google Scholar, and Web of Science was executed to find studies related to this topic. Only articles published after year 2000 that reported the cardiovascular side effects of methylphenidate (separated from other stimulants) in paediatric ADHD patients were included. Summary of results Six studies were found (see table 1). All of the studies concentrated on monitoring blood pressure (BP) and heart rate (HR). The follow-up period ranged from 6 weeks to 2 years. Statistically significant changes in diastolic and systolic BP ranged from -4.3 to +5.87 and

changes in the HR ranged from 3.9 to 6.87. However, these changes were not clinically significant, and the parameters stayed within normal range. Electrocardiogram (ECG) screening was included in a few studies and it did not lead to changes in management. Patients with higher body mass index (BMI) seemed to have higher BP at baseline. The sample sizes of the studies were too small to detect a correlation between cardiovascular effects and other parameters such as dosage or comorbidities. Conclusions Although the majority of the studies confirmed a risk of increased diastolic and systolic BP as well as HR in paediatric ADHD patients within few monhs to 2 years of initiation of methylphenidate, the differences did not seem clinically significant, and treatment was not altered. Data on longterm treatment is limited and therefore, we recommend regular monitoring of cardiovascular parameters in patients on long-term methylphenidate. (Table Presented)

……..

J Invest Med. 2018;66:184.

DEVELOPMENT AND BEHAVIOUR DIAGNOSES USED BY PAEDIATRIC PRIMARY CARE PROVIDERS: EXPLORING INTER-CLINICIAN VARIATION.

Bannett Y, Feldman HM, Ansel D, et al.

Purpose of study Limited objective data exist on variation across paediatric primary care clinicians when diagnosing developmental and behavioural (DB) conditions. Aims . determine numbers of DB diagnosis codes used by clinicians (n=75) in a network of paediatricspediatrics offices (n=21) . describe inter-clinician variation in coding . examine clinician characteristics and assess their independent contributions to DB diagnosis coding rates. Methods used Retrospective analysis of electronic medical records of all encounters documented by network clinicians in one year (10/1/15-9/30/16). Dependent variables Proportion of unique children, per clinician, with visit diagnoses of autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), or developmental delay/concern (DD). Independent variables clinician gender, years in practice, and full time equivalent (%FTE). Analysis (Aims 1, 2) frequencies, proportions. (Aim 3) Multivariate linear regression models to predict variation in use of DB diagnoses. Summary of results . Among 44,856 children age 4-18 years, 456 (1.0%) had ASD diagnosis; 1597 (3.3%) had ADHD diagnosis. Among 18,130 children under 4 years, 1065 (5.6%) had DD diagnosis. . Across clinicians, code use was highly variable; ASD, ADHD, and DD diagnosis proportions ranged from 0%-4.4%, 0%- 11.8%, and 0%-17.2%. . Regression models including clinician gender,%FTE, and years in practice explained 11%, 23%, and 6% of variation in use of ASD, ADHD, and DD codes (table 1). Conclusions Primary care Identification of common DB conditions is lower than estimated prevalence rates and is highly variable; clinician characteristics contribute to this variation. Further study of other clinician, clinic, and patient characteristics is needed to identify modifiable factors that present barriers to providing DB-related care. (Table Presented)

……..

J Pediatr Gastroenterol Nutr. 2018;66:244-49.

ATTENTION DEFICIT HYPERACTIVITY DISORDER AND FUNCTIONAL DEFECATION DISORDERS IN CHILDREN.

Kuizenga-Wessel S, Koppen IJN, Vriesman MH, et al.

Objectives: The aim of the study was to assess the prevalence of attention deficit hyperactivity disorder (ADHD) in children presenting with functional defecation disorders (FDDs) and to assess the prevalence of FDDs in children with ADHD.

Methods: A cross-sectional cohort study was carried out between September 2014 and May 2016. Group 1: Parents of children with FDDs according to the Rome III criteria completed the Child Behavior Checklist and the VvGK (Dutch questionnaire based on the American Disruptive Behavior Disorder rating scale). Patients with ADHD subarea scores 70 on the Child Behavior Checklist and/or 16 on the VvGK were referred for further psychiatric evaluation. Group 2: Parents of children treated for ADHD at a specialized ADHD outpatient clinic completed a standardized questionnaire regarding their child's defecation pattern.

Results: In group 1 (282 children with FDDs), 10.3% (7.1%-13.5% bias-corrected and accelerate confidence interval) were diagnosed with ADHD. Group 2 consisted of 198 children with ADHD, 22.7% (17.6-28.8 bias-corrected and accelerate confidence interval) fulfilled the Rome III criteria for an FDD. Children with both an

FDD and ADHD reported urinary incontinence significantly more often compared to children with an FDD or ADHD alone: 57.1% in FDD + ADHD versus 22.8% in FDD alone (P < 0.001) and 31.1% in ADHD + FDD versus 7.8% in ADHD alone (P < 0.001).
Conclusions: Approximately 10.3% of children with FDDs had ADHD and 22.7% of children with a known diagnosis of ADHD fulfilled the Rome III criteria for an FDD. This observation suggests that screening for behavioral disorders and FDDs should be incorporated into the diagnostic workup of these groups of children

……..

J Am Acad Child Adolesc Psychiatry. 2018 Feb;57:86-95.
NOVEL LOCI ASSOCIATED WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER ARE REVEALED BY LEVERAGING POLYGENIC OVERLAP WITH EDUCATIONAL ATTAINMENT.
Shadrin AA, Smeland OB, Zayats T, et al.
Objective: Attention-deficit/hyperactivity disorder (ADHD) is a common and highly heritable psychiatric condition. By exploiting the reported relationship between ADHD and educational attainment (EA), we aimed to improve discovery of ADHD-associated genetic variants and to investigate genetic overlap between these phenotypes.
Method: A conditional/conjunctional false discovery rate (condFDR/conjFDR) method was applied to genome-wide association study (GWAS) data on ADHD (2,064 trios, 896 cases, and 2,455 controls) and EA (n = 328,917) to identify ADHD-associated loci and loci overlapping between ADHD and EA. Identified single nucleotide polymorphisms (SNPs) were tested for association in an independent population-based study of ADHD symptoms (n = 17,666). Genetic correlation between ADHD and EA was estimated using LD score regression and Pearson correlation.
Results: At levels of condFDR < 0.01 and conjFDR < 0.05 , we identified 5 ADHD-associated loci, 3 of these being shared between ADHD and EA. None of these loci had been identified in the primary ADHD GWAS, demonstrating the increased power provided by the condFDR/conjFDR analysis. Leading SNPs for 4 of 5 identified regions are in introns of protein coding genes (KDM4A, MEF2C, PINK1, RUNX1T1), whereas the remaining one is an intergenic SNP on chromosome 2 at 2p24. Consistent direction of effects in the independent study of ADHD symptoms was shown for 4 of 5 identified loci. A polygenic overlap between ADHD and EA was supported by significant genetic correlation (rg = - 0.403 , p = 7.90 × 10-8) and > 10-fold mutual enrichment of SNPs associated with both traits.
Conclusion: We identified 5 novel loci associated with ADHD and provided evidence for a shared genetic basis between ADHD and EA. These findings could aid understanding of the genetic risk architecture of ADHD and its relation to EA

……..

Kaohsiung J Med Sci. 2018.
BOREDOM PRONENESS AND ITS CORRELATION WITH INTERNET ADDICTION AND INTERNET ACTIVITIES IN ADOLESCENTS WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER.
Chou W-J, Chang Y-P, Yen C-F.
This study examined the associations of boredom proneness with Internet addiction and activities as well as the moderators for such associations in adolescents with attention-deficit/hyperactivity disorder (ADHD). In total, 300 adolescents with ADHD participated in this study. Their Internet addiction, the scores for lack of external and internal stimulation on the Boredom Proneness Scale-short form (BPS-SF), ADHD, parental characteristics, and the types of Internet activities were examined. The associations of boredom proneness with Internet addiction and Internet activities and the moderators of the associations were examined using logistic regression analyses. Higher scores for lack of external stimulation on the BPS-SF were significantly associated with a higher risk of Internet addiction. Maternal occupational socioeconomic status moderated the association of lack of external stimulation with Internet addiction. Higher scores for lack of external stimulation were significantly associated with a high tendency to engage in online gaming, whereas higher scores for lack of internal stimulation were significantly associated with a low tendency to engage in online

studies. Lack of external stimulation on the BPS-SF should be considered a target in prevention and intervention programs for Internet addiction among adolescents with ADHD

……..

Mol Psychiatry. 2018;23:257-62.

THE FAMILIAL CO-AGGREGATION OF ASD AND ADHD: A REGISTER-BASED COHORT STUDY.

Ghirardi L, Brikell I, Kuja-Halkola R, et al.

Autism spectrum disorders (ASD) and attention-deficit/hyperactivity disorder (ADHD) frequently co-occur. The presence of a genetic link between ASD and ADHD symptoms is supported by twin studies, but the genetic overlap between clinically ascertained ASD and ADHD remains largely unclear. We therefore investigated how ASD and ADHD co-aggregate in individuals and in families to test for the presence of a shared genetic liability and examined potential differences between low-and high-functioning ASD in the link with ADHD. We studied 1 899 654 individuals born in Sweden between 1987 and 2006. Logistic regression was used to estimate the association between clinically ascertained ASD and ADHD in individuals and in families. Stratified estimates were obtained for ASD with (low-functioning) and without (high-functioning) intellectual disability. Individuals with ASD were at higher risk of having ADHD compared with individuals who did not have ASD (odds ratio (OR)=22.33, 95% confidence interval (CI): 21.77-22.92). The association was stronger for high-functioning than for low-functioning ASD. Relatives of individuals with ASD were at higher risk of ADHD compared with relatives of individuals without ASD. The association was stronger in monozygotic twins (OR=17.77, 95% CI: 9.80-32.22) than in dizygotic twins (OR=4.33, 95% CI: 3.21-5.85) and full siblings (OR=4.59, 95% CI: 4.39-4.80). Individuals with ASD and their relatives are at increased risk of ADHD. The pattern of association across different types of relatives supports the existence of genetic overlap between clinically ascertained ASD and ADHD, suggesting that genomic studies might have underestimated this overlap

……..

NeuroImage. 2017 Apr;150:50-59.

CHILDHOOD MALTREATMENT IS ASSOCIATED WITH ALTERATION IN GLOBAL NETWORK FIBER-TRACT ARCHITECTURE INDEPENDENT OF HISTORY OF DEPRESSION AND ANXIETY.

Ohashi K, Anderson CM, Bolger EA, et al.

Childhood maltreatment is a major risk factor for psychopathology. It is also associated with alterations in the network architecture of the brain, which we hypothesized may play a significant role in the development of psychopathology. In this study, we analyzed the global network architecture of physically healthy unmedicated 18-25 year old subjects (n=262) using diffusion tensor imaging (DTI) MRI and tractography. Anatomical networks were constructed from fiber streams interconnecting 90 cortical or subcortical regions for subjects with no-to-low (n=122) versus moderate-to-high (n=140) exposure to maltreatment. Graph theory analysis revealed lower degree, strength, global efficiency, and maximum Laplacian spectra, higher pathlength, small-worldness and Laplacian skewness, and less deviation from artificial networks in subjects with moderate-to-high exposure to maltreatment. On balance, local clustering was similar in both groups, but the different clusters were more strongly interconnected in the no-to-low exposure group. History of major depression, anxiety and attention deficit hyperactivity disorder did not have a significant impact on global network measures over and above the effect of maltreatment. Maltreatment is an important factor that needs to be taken into account in studies examining the relationship between network differences and psychopathology

……..

Neuropsychiatr Enfance Adolesc. 2018 Jan;66:3-12.

L'ENTRAÎNEMENT DE LA MÉMOIRE DE TRAVAIL EST-IL BÉNÉFIQUE POUR LES ENFANTS PRÉSENTANT UN TROUBLE DÉFICIT DE L'ATTENTION/HYPERACTIVITÉ? = DO CHILDREN WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER BENEFIT FROM WORKING MEMORY TRAINING?

Villemonteix T .

Introduction: Childhood attention-deficit/hyperactivity disorder is known to be associated with impairment across multiple domains, including social, familial, emotional and academic functioning. Available therapies, and in particular medical treatment, fail to produce lasting improvement in academic and learning outcomes. In this context, recent years have seen a growing interest of experts and practitioners for computer-based cognitive training programs. Indeed, it has been proposed that repeated training of specific executive functions may result in lasting benefits for children with ADHD, especially in the school setting. Cogmed RoboMemo, a program targeting working memory, is the cognitive training that has been the most extensively studied.

Literature findings: Meta-analyses have established that the vast majority of children with ADHD present with decreased performance levels compared to typically developing children when performing working memory tasks. Working memory deficits, in turn, have been linked with classroom inattention and decreased academic performance. Based on these findings, models describing working memory deficits as a core feature of ADHD, accounting both for inattentive and hyperactive symptoms, have been proposed. In this theoretical context, interventions specifically targeting working memory deficits in ADHD appear as particularly promising. However, despite this solid theoretical background, meta-analyses of randomized controlled trials relying on the Cogmed RoboMemo program have consistently failed to evidence significant therapeutic effects on key targets, including ADHD symptoms or academic performance. These results suggest that early reports of clinical efficacy with non-blinded assessors were confounded by placebo and expectancy effects.

Discussion: Different hypotheses have been proposed to explain this lack of significant therapeutic effect. First, it has been observed that Cogmed RoboMemo primarily targets the storage/rehearsal capacity of the child, whereas children with ADHD appear mostly impaired when performing tasks with a strong central executive load (i. e. requiring manipulation and dynamic updating of information). The Cogmed cognitive training program may therefore simply focus on the wrong element of working memory in the context of ADHD. Second, authors have questioned whether RoboMemo practice truly results in increased working memory capacity, proposing that children may simply learn task-specific strategies that they are unable to use in a broader context. In line with this idea, it has also been suggested that training in a non-ecological situation could be insufficient, if children with ADHD do not also learn strategies to apply the capacity acquired in the class context. Finally, one recent randomized control trial suggests that potential methodological limitations (lack of follow-up and/or limited training intensity) may have prevented previous studies from documenting the beneficial effects of the Cogmed program. Conclusions: Meta-analyses available to date indicate that claims regarding the academic, behavioral, and learning benefits associated with Cogmed RoboMemo are unsupported in ADHD. New studies with a follow-up assessment are needed to ensure that beneficial long-term effects of the program have not been overlooked. The development and evaluation of new cognitive training programs targeting the central executive component of working memory is warranted. More research is also necessary to help understand how working memory capacity of children with ADHD could be in improved in an ecological context

……

Neuropsychiatr Enfance Adolesc. 2018 Jan;66:13-21.

TROUBLE DU DÉFICIT DE L'ATTENTION/HYPERACTIVITÉ AVEC OU SANS TROUBLES ASSOCIÉS: MISE EN ÉVIDENCE DE DIFFÉRENCES ATTENTIONNELLES ET EXÉCUTIVES. = ATTENTION-DEFICIT HYPERACTIVITY DISORDER WITH OR WITHOUT ASSOCIATED DISORDERS: EVIDENCE FOR DIFFERENCES IN ATTENTIONAL AND EXECUTIVE PROCESSES.

Puyjarinet F.

Background: Children with attention-deficit hyperactivity disorder (ADHD) manifest deficits in attentional and executive domains. Yet, although ADHD is often associated with other neurodevelopmental syndromes such as developmental dyslexia (DD) and developmental coordination disorder (DCD), very few studies exploring the impact of these associated disorders on cognitive abilities of children with ADHD are available. Whether

and how these comorbid disorders may influence attentional and executive abilities among ADHD patients remained to be explored.
Aim of the study: The goal of the current study was to compare the attentional and executive profiles of ADHD children with and without one or two often-associated comorbid neurodevelopmental disorders: DD, and DCD.
Participants and method: One hundred and sixty-one children (mean age: 8.9 years) were classified into four groups: children with ADHD in isolation (n = 61), children with ADHD and associated DD (n = 36), children with ADHD and associated DCD (n =27), and children with the three associated disorders (ADHD-DCD-DD, n = 37). For assessing attentional and executive skills, we used the Test of Everyday Attention for Children (TEA-Ch).
Results: We observed differences between the groups among the majority of attentional and executive measures: selective visual attention, auditive attention, divided attention, inhibition, and sustained attention.
Conclusion: These results show that children with ADHD manifest different cognitive performances depending on the presence of associated DD and/or DCD. Most of attentional executive domains are negatively impacted by DD and/or DCD. These findings concur with the current theoretical point of view whereby neurodevelopmental disorders partially share etiological and clinical factors. Our results also matter in the way professionals can understand how neurodevelopmental disorders influence each other, and how specific therapeutic projects could be built taking into consideration often-associated disorders in ADHD

……..

Neuropsychologia. 2017 May;99:172-78.
DEFICITS IN INHIBITORY FORCE CONTROL IN YOUNG ADULTS WITH ADHD.
Neely KA, Wang P, Chennavasin AP, et al.
Poor inhibitory control is a well-established cognitive correlate of adults with ADHD. However, the simple reaction time (RT) task used in a majority of studies records performance errors only via the presence or absence of a single key press. This all-or-nothing response makes it impossible to capture subtle differences in underlying processes that shape performance. Subsequently, all-or-nothing tasks may underestimate the prevalence of executive function deficits in ADHD. The current study measured inhibitory control using a standard Go/No-Go RT task and a more sensitive continuous grip force task among adults with (N=51, 22 female) and without (N=51, 29 female) ADHD. Compared to adults without ADHD, adults with ADHD made more failed inhibits in the classic Go/No-Go paradigm and produced greater and more variable force during motor inhibition. The amount of force produced on failed inhibits was a stronger predictor of ADHD-related symptoms than the number of commissions in the standard RT task. Adults with ADHD did not differ from those without ADHD on the mean force and variability of force produced in Go trials. These findings suggest that the use of a precise and continuous motor task, such as the force task used here, provides additional information about the nature of inhibitory motor control in adults with ADHD

……..

NeuroQuantology. 2017;15:121-26.
THE EFFECTIVENESS OF VERBAL SELF-INSTRUCTION PROGRAM ON THE SYMPTOMS OF ADHD: CONTROLLED BEFORE AND AFTER STUDY.
Sun Z.
The high prevalence of hyperactivity disorder and its related problems is the reason for the importance of seeking new therapies. Although several behavioral-cognitive models have been advocated in the literature, we are looking for research on what constitutes the most effective behavioral-cognitive model. Objectives: To determine the efficacy of verbal self-instruction program and to assess which component of the program was most predictive of decreasing the symptoms of ADHD in three medical and counseling centers in Hefei (China). Design: A randomized controlled clinical trial design was utilized with data before and after the program. Our sample consisted of 33 ADHD children admitted to the centers in March 2016. Results: The symptoms of ADHD were significantly reduced in the experimental group. Furthermore, perceived behavioral

control increased in the experimental group but remained unchanged in the control group. Conclusion: The verbal self-instruction program was effective in decreasing the symptoms of ADHD

……..

NeuroQuantology. 2017;15:168-73.

DEVELOPING A TRAINING INTERVENTION TO IMPROVE PERFORMANCE OF NEUROPSYCHOLOGICAL SKILLS IN ADHD CHILDREN.

Yao Z.

Cognitive neuroscience and attention are closely related to each other. By looking at the neurocognitive problems of hyperactivity and the benefits of cognitive function, the purpose of this study was to evaluate the effectiveness of a training intervention to improve the performance of neuropsychological skills of ADHD children. Twenty nine students 9ΓÇô12 years old who had been exposed to high levels of hyperactivity were selected from prior studies. The outcomes measures before and after the intervention were collected during a 13-week study. Post training performance of participants in the EPCP group was significantly higher. ADHD children in the control group had significantly lower performance. The training program that we set up in this study was effective for improving the performance of neuropsychological skills in ADHD children. The findings of this study conclude that an Educational Package of Cognitive Plays (EPCP) program can protect ADHD students from a reduction in neuropsychological skills at the processing and organizing of the information

……..

Nihon Eiseigaku Zasshi. 2018;73:46-50.

TOPICS ON CHILD DEVELOPMENT IN PEDIATRICS.

Hirasawa K.

Over the past few decades, advances in neonatal medicine have increased survival rates among very-low-birth-weight (VLBW) babies. Despite improvements in short-term outcomes, there is increasing concern about the probability of mild cognitive dysfunction in this population. Our analysis of VLBW babies born in our hospital revealed that the incidence of mild developmental disorders including autism spectrum disorder (ASD) and attention deficit hyperactive disorder (ADHD) at the age of 3 years is 7.2%, which is markedly higher than the 2.8% incidence of ASD in the general population. Because problems related to ASD or ADHD tend to become more prominent as children grow up, the ages at diagnosis of developmental disorders are generally 6 years or above. Thus, in our follow up study of VLBW babies at age 6, the incidence of these developmental disorders had risen to 30%. These patients are apparently obstinate and difficult to train, causing parental problems with child care. It is important to support these children and help them establish good relationships with their parents. Given these problems, it is necessary to follow up VLBW children in the longterm, at least until they are elementary school students

……..

Pediatr Int. 2018;60:70-75.

NEUROLOGICAL COMORBIDITY IN CHILDREN WITH NEUROFIBROMATOSIS TYPE 1.

Hirabaru K, Matsuo M.

Background: The aim of this study was to determine the frequency of central nervous system comorbidities in children with neurofibromatosis type 1 (NF1).

Methods: We performed a nationwide survey to investigate neurological comorbidities in 3ΓÇô15-year-old children with NF1 in Japan by sending questionnaires to pediatricians and pediatric neurologists. A secondary questionnaire was sent to the parents of identified NF1 patients to assess neurological comorbidities including headache, attention deficit hyperactivity disorder (ADHD) Rating Scale (RS), and the Social Responsiveness Scale 2.

Results: The primary survey identified 760 NF1 patients, and the parents of 565 patients were sent the secondary questionnaire. The parental response rate was 25.7% (145; 63 girls, 81 boys, one unspecified). Among the patients, 42.9% (55/128; 35 girls, 20 boys) were reported to exhibit intellectual problems. On the

ADHD-RS, 40.2% (47/117) of NF1 patients aged 6ΓÇô15 had ADHD (RS score >93rd percentile), with a rate of 47.7% in boys and 30.8% in girls. Furthermore, 20.2% of patients had suspected autism spectrum disorder (29/143; 10 girls, 19 boys), with Social Responsiveness Scale score ΓëÑ76. Headache was reported by 49.6% (61/123) of children over 5 years old, and 25.2% (31/123; 10 girls, 21 boys) reported migraine. Other neurological comorbidities included 20 cases of epilepsy (13.8%), 11 cases of optic nerve glioma (7.6%), five cases of brain tumor (3.4%), six cases of cerebrovascular disease (4.1%), and two cases of hydrocephalus (1.4%).
Conclusion: Intellectual problems, ADHD, autism spectrum disorder, and migraine are major neurological comorbidities in NF1

……..

Prog Neurobiol. 2017 May;152:38-57.
CHALLENGES IN DEVELOPING DRUGS FOR PEDIATRIC CNS DISORDERS: A FOCUS ON PSYCHOPHARMACOLOGY.
Grabb MC, Gobburu JVS.
Many psychiatric and behavioral disorders manifest in childhood (attention deficit hyperactivity disorder, obsessive compulsive disorder, anxiety, depression, schizophrenia, autism spectrum disorder, etc.) and the opportunity for intervening early may attenuate full development of the disorder and lessen long term disability. Yet, pediatric drug approvals for CNS indications are limited, and pediatric testing generally occurs only after establishing adult efficacy, more as an afterthought rather than with the initial goal of developing the medication for a pediatric CNS indication. With pharmaceutical companies decreasing funding of their neuroscience research divisions overall, the prospects for moving promising investigational drugs forward into pediatrics will only decline. The goal of this review is to highlight important challenges around pediatric drug development for psychiatric disorders, specifically during clinical development, and to present opportunities for filling these gaps, using new strategies for de-risking investigational drugs in new clinical trial designs/models. We will first present the current trends in pediatric drug efficacy testing in academic research and in industry trials, we will then discuss the regulatory landscape of pediatric drug testing, including policies intended to support and encourage more testing. Obstacles that remain will then be presented, followed by new designs, funding opportunities and considerations for testing investigational drugs safely

……..

Prog Neuro-Psychopharmacol Biol Psychiatry. 2018;84:1-10.
GENETIC VARIANTS OF THE FOLATE METABOLIC SYSTEM AND MILD HYPERHOMOCYSTEINEMIA MAY AFFECT ADHD ASSOCIATED BEHAVIORAL PROBLEMS.
Saha T, Chatterjee M, Verma D, et al.
An etiologically complex disorder, Attention Deficit Hyperactivity Disorder (ADHD), is often associated with various levels of cognitive deficit. Folate/vitamin B9 is crucial for numerous biochemical pathways including neural stem cell proliferation and differentiation, regulation of gene expression, neurotransmitter synthesis, myelin synthesis and repair, etc. and a scarcity has often been linked to cognitive deficit. Our pilot study in the field revealed significant association of few genetic variants with ADHD. Mild hyperhomocysteinemia and vitamin B12 deficiency was also noticed in the probands. In the present study additional genetic variants, folate and vitamin B6, which may affect folate-homocysteine metabolic pathway, were investigated in 866 individuals including nuclear families with ADHD probands (N = 221) and ethnically matched controls (N = 286) to find out whether ADHD associated traits are affected by these factors. Population based analysis revealed significant over representation of MTRR rs1801394 G allele and GG genotype in all as well as male probands. Stratified analysis showed significantly higher frequency of RFC1 rs1051266 and BHMT rs3733890 AG genotypes in full term and prematurely delivered ADHD probands respectively. Probands with rs1801394 GG genotype and BHMT rs3733890 G allele showed association with hyperhomocysteinemia. MTHFR rs1801131, MTR rs1805087 and BHMT rs3733890 also showed association with ADHD index. While rs1051266, rs1801131, and rs1805087 showed association with behavioral problems, rs3733890 was associated with ODD score. Conduct problem exhibited association with RFC1 rs1051266, MTHFR

rs1801133 and MTRR rs1801394. Gene-gene interaction analysis revealed positive synergistic interactions between rs1051266, rs1801131 and rs1801394 in the probands as compared to the controls. It can be inferred from the data obtained that folate system genetic variants and mild hyperhomocysteimenia may affect ADHD associated traits by attenuating folate metabolism

……..

Prog Neuro-Psychopharmacol Biol Psychiatry. 2018;82:169-76.

INTERACTION BETWEEN DRD2 AND LEAD EXPOSURE ON THE CORTICAL THICKNESS OF THE FRONTAL LOBE IN YOUTH WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER.

Kim JI, Kim J-W, Lee J-M, et al.

Background The dopamine receptor D2 receptor (DRD2) gene and lead exposure are both thought to contribute to the pathophysiology of attention-deficit/hyperactivity disorder (ADHD). ADHD is characterized by delay in brain maturation, most prominent in the prefrontal cortex (PFC). The D2 receptor is also mainly located in the PFC, and animal studies show that lead exposure affects the dopaminergic system of the frontal lobe, indicating an overlap in neural correlates of ADHD, DRD2, and lead exposure. We examined the interaction effects of DRD2 rs1800497 and lead exposure on the cortical thickness of the frontal lobe in patients with ADHD.

Methods A 1:1 age- and gender-matched sample of 75 participants with ADHD and 75 healthy participants was included in the analysis. The interaction effects of DRD2 and lead exposure on the cortical thickness of 12 regions of interest in the frontal lobe were examined by multivariable linear regression analyses.

Results When we investigated the DRD2 +ù lead effects in the ADHD and HC groups separately, significant DRD2 lead effects were found in the ADHD group, but not in the healthy control group in multiple ROIs of the frontal lobe. There was a significant negative correlation between the cortical thickness of the right superior frontal gyrus and inattention scores.

Conclusions The present findings demonstrated significant interaction effects of DRD2 and lead exposure on the cortical thickness of the frontal lobe in ADHD. Replication studies with larger sample sizes, using a prospective design, are warranted to confirm these findings

……..

Psicologia: Reflexão e Crítica. 2018 Feb;31.

METACOGNITIVE INTERVENTIONS IN TEXT PRODUCTION AND WORKING MEMORY IN STUDENTS WITH ADHD.

Pisacco NMT, Sperafico YLS, Enricone JRB, et al.

This study compared the effects of two metacognitive interventions on writing, working memory (WM), and behavioral symptoms of students with attention-deficit/hyperactivity disorder (ADHD). The disorder was clinically diagnosed by a multidisciplinary team according to DSM-IV criteria. The first approach consisted of a combined intervention in text production and WM while the second focused only on WM. Participants were 47 students from the fifth to ninth grades of two public elementary schools in Porto Alegre (Brazil), randomized to one of the two interventions groups. Writing and WM were assessed before, immediately after, and 3 months after the interventions. The results suggest that both interventions contributed to improving behavior and school performance, whereas only the combined intervention increased the overall quality of narrative text, organization of paragraphs, and denouement

……..

Psychiatr Serv. 2017 Feb;68:173-78.

ASSESSING TELEMEDICINE UTILIZATION BY USING MEDICAID CLAIMS DATA.

Douglas MD, Xu J, Heggs A, et al.

OBJECTIVE: This study characterized telemedicine utilization among Medicaid enrollees by patients' demographic characteristics, geographic location, enrollment type, eligibility category, and clinical conditions.

METHODS: This study used 2008-2009 Medicaid claims data from 28 states and the District of Columbia to characterize telemedicine claims (indicated by GT for professional fee claims or Q3014 for facility fees) on

the basis of patients' demographic characteristics, geographic location, enrollment type, eligibility category, and clinical condition as indicated by ICD-9 codes. States lacking Medicaid telemedicine reimbursement policies were excluded. Chi-square tests were used to compare telemedicine utilization rates and one-way analysis of variance was used to estimate mean differences in number of telemedicine encounters among subgroups.
RESULTS: A total of 45,233,602 Medicaid enrollees from the 22 states with telemedicine reimbursement policies were included in the study, and .1% were telemedicine users. Individuals ages 45 to 64 (16.4%), whites (11.3%), males (8.5%), rural residents (26.0%), those with managed care plans (7.9%), and those categorized as aged, blind, and disabled (28.1%) were more likely to receive telemedicine (p<.001). Nearly 95% of telemedicine claims were associated with a behavioral health diagnosis, of which over 50% were for bipolar disorder and attention-deficit disorder or attention-deficit hyperactivity disorder (29.3% and 23.4%, respectively). State-level variation was high, ranging from .0 to 59.91 claims per 10,000 enrollees (Arkansas and Arizona, respectively).
CONCLUSIONS: Despite the touted potential for telemedicine to improve health care access, actual utilization of telemedicine in Medicaid programs was low. It was predominantly used to treat behavioral health diagnoses. Reimbursement alone is insufficient to support broad utilization for Medicaid enrollees

……..

Psychiatry Res. 2017 Aug;254:158-63.

THE RELATIONSHIP OF SOCIAL ANXIETY DISORDER SYMPTOMS WITH PROBABLE ATTENTION DEFICIT HYPERACTIVITY DISORDER IN TURKISH UNIVERSITY STUDENTS; IMPACT OF NEGATIVE AFFECT AND PERSONALITY TRAITS OF NEUROTICISM AND EXTRAVERSION.

Evren C, Dalbudak E, Ozen S, et al.

The aim of the present study was to evaluate relationship of social anxiety disorder symptoms with probable attention deficit hyperactivity disorder (ADHD) while controlling the personality traits of neuroticism and extraversion, anxiety and depression symptoms in a sample of Turkish university students (n=455). Participants were evaluated with the Beck Depression Inventory (BDI), the Beck Anxiety Inventory (BAI), the Eysenck Personality Questionnaire Revised-Abbreviated Form (EPQR-A), the Adult ADHD Self-Report Scale (ASRS-v1.1) and the Liebowitz Social Anxiety Scale (LSAS). Severity of social anxiety, depression, anxiety and neuroticism were higher among those with probable ADHD, whereas extraversion score did not differ between the groups. The severity of ADHD score, particularly hyperactivity/impulsivity score, was related with the "fear or anxiety" together with low extraversion (introversion) and high neuroticism dimensions of personality, whereas the severity of ADHD score, both inatentiveness and hyperactivity/impulsivity scores, was related with "avoidence" together with low extraversion (introversion) dimension of personality. These findings suggest that probable ADHD and severity of ADHD symptoms are related with both "fear or anxiety" and "avoidance" of social anxiety, while personality dimensions of low extraversion (introversion) and high neuroticism may have an effect on this relationships among young adults

……..

Res Dev Disabil. 2018;74:103-12.

ATTENTION DEFICIT HYPERACTIVITY DISORDER AND AUTISM SPECTRUM DISORDER SYMPTOMS IN SCHOOL-AGE CHILDREN BORN VERY PRETERM.

Brring T, Oostrom KJ, van Dijk-Lokkart EM, et al.

Background: Very preterm (VP) children face a broad range of neurodevelopmental sequelae, including behavioral problems.
Aim: To investigate prevalence, pervasiveness and co-occurrence of symptoms of attention deficit hyperactivity disorder (ADHD) and autism spectrum disorder (ASD) in school-age children born very preterm.
Methods: Using questionnaire and diagnostic interview data, parent and teacher reported symptoms of ADHD and ASD of 57 VP-children (mean age = 9.2 years) were compared with 57 gender and age matched full-term children using t-tests. Intra-class correlation coefficients quantified parent-teacher agreement. Correlation analysis investigated co-occurrence of ADHD/ASD symptoms. ADHD/ASD measures were

aggregated using principal component analysis. Regression analyses investigated the contribution of perinatal risk factors, sex and SES to ADHD/ASD symptoms.
Results: VP-children showed higher levels of parent and teacher reported attention problems, social impairment and compromised communication skills. Fair to strong agreement was found between parent and teacher reported ADHD and ASD symptoms, indicating pervasiveness of observed difficulties. Co-occurrence of ADHD and ASD symptoms in VP-children was found. Lower gestational age was associated with higher ADHD and ASD symptom levels, male sex with higher ADHD symptom levels and lower SES with higher ASD symptom levels.
Conclusion: School-age VP-children show higher levels of ADHD and ASD symptoms, and attention, socialization and communication difficulties in particular. Routinely screening for these problems is recommended in follow-up care

……..

Res Dev Disabil. 2018;74:31-40.

KNOWLEDGE OF PERFORMANCE FEEDBACK AMONG BOYS WITH ADHD.

Bishop JC, Kelly LE, Hull M.

Background: Children with attention deficit-hyperactivity disorder (ADHD) often experience delays in acquiring competence completing fundamental motor skills. The effects of augmented prescriptive knowledge of performance feedback (PKP) have not been explored as a possible component solution. Aims: The purpose of this study was to test the motor learning effects of KP among boys with ADHD.
Methods and procedures: Thirty-one boys with ADHD, randomly selected into either a treatment or a control group, completed a series of cornhole games. It was hypothesized that PKP feedback administered to treatment group participants would increase motor learning. Dependent variables included cornhole scores and quality of performance measures.
Outcomes and results: Both groups improved in cornhole scores and improvement was not dependent upon KP. Treatment group participants performed significantly better in quality of performance of the underhand toss compared to the control group.
Conclusions and implications: PKP feedback improves motor skill performance learning among children with ADHD above knowledge of results feedback only. Recreational program directors should consider using KP feedback when teaching motor skills to boys with ADHD

……..

Res Dev Disabil. 2018;74:41-49.

HANDWRITING DIFFICULTIES IN CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD).

Capodieci A, Lachina S, Cornoldi C.

Handwriting is fundamental in school and everyday life situations. Legibility guarantees that writing productions communicate information, and speed is often crucial, especially in children with attention deficit and hyperactivity disorder (ADHD), in order to increase the likelihood of their being able to work efficiently and stay on-task during school activities. Preliminary reports have shown an impairment in handwriting of children with ADHD, but evidence is still unclear, especially in the case of speed where research has offered contradictory results. Children's performance, furthermore, has yet to be investigated under the cognitive loading conditions typical of academic tasks in classroom. To shed light on this matter, we examined the handwriting performance in a simple condition but also under (verbal or spatial) working memory (WM) load in 16 fourth- and fifth-grade children with symptoms of ADHD and 16 matched control children. Our results showed that the groups speed differed significantly only in the verbal WM loading condition, where children with symptoms of ADHD wrote more slowly and showed a greater intra-individual variability than controls. Handwriting legibility was affected by verbal WM loading too. These findings are discussed in relation to their educational and clinical implications

……..

Rev Chil Pediatr. 2017 Apr;88:294-99.

[IGN]COMPLEMENTARY/ALTERNATIVE MEDICINE IN ADOLESCENTS WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER AND MOOD DISORDERS].

Perez Carmona MP.

The Complementary/Alternative Medicine (CAM) have been increasingly used by patients such as children and adolescents. The Ministry of Health in Chile (MINSAL) has recognized and regulated some CAM, although there is still unknown their effectiveness and safety of these. OBJECTIVE: Review the available evidence regarding the use of CAM in adolescents with the attention deficit hyperactivity syndrome (ADHD) and mood disorders. METHODOLOGY: A review of the related literature about this topic on PubMed, focus on the last 10 years and using as a keywords Complementary/Alternative Medicine/Therapies, Attention deficit disorder with hyperactivity, Mood disorders, and Children/Adolescents. The revision was also complemented with other sources of information. RESULTS: Globally there has been a progressive increase in publications in relation to the CAM. However, not all studies follow a good methodology and the majority of the studies in adolescents show inconclusive results. The ADHD studies have shown benefits when using omega 3 fatty acids. Regarding other CAM and ADHD, the evidence does not show any favorable results beyond placebo. Though some of these studies have methodological mistakes or lack of enough studies, making it impossible to have conclusive. In mood disorders, there are several promising therapies, such as: physical exercise, light therapy, St. Johns Wort and some kinds of meditation like Mindfulness. In Chile, there are still no studies in this age group, which makes important the development of a line of research in this area

……..

Sleep Med. 2017;40:e37.

IS IT ATTENTION DEFICIT HYPERACTIVITY DISORDER, SLEEP DISORDER BREATHING,Gï» OR BOTH?

Bioulac S, Lode-Kolz K, Micoulaud-Franchi J-A, et al.

Introduction: Attention Deficit Hyperactivity Disorder (ADHD) is one of the most common childhood neuropsychiatric disorder affecting over 5% of school age children. ADHD is a developmental disorder characterized by difficulties with attention, hyperactivity and impulsivity which often lead to various behavioral problems and learning disabilities. Obstructive Sleep Apnea Syndrome (OSA) is the most common type of sleep disordered breathing (SDB) and its prevalence has been estimated at 2-4%. Sleep disorders are a frequent comorbid condition associated with ADHD according to a categorical approach. However, sleep disorders can also induce ADHD-like symptoms according to a dimensional approach and are thought to be the consequence of excessive daytime sleepiness.

Material and methods: It may be difficult for clinicians to differentiate the diagnosis of ADHD comorbid with a sleep disorder from sleep disorders with ADHD-like symptoms. Patients with primary sleep disorders presented often hyperactivity and/or attention deficit symptoms. Indeed, obstructive sleep disorders breathing with bad sleep quality can imitate, mimic ADHD in children. In this case, inattention and hyperactivity behavior are induced by sleep disorders but did not constitute a clinical diagnostic of ADHD.

Results: The clinician should gather a developmental and family history (of ADHD and sleep problems) to differentiate ADHD and ADHD symptoms induced by sleep disorder breathing. Clinicians should therefore routinely assess, monitor and manage sleep problems in the presence of both comorbidities in children with ADHD and vice-versa.

Conclusion: ADHD and ADHD-related sleep disorders pose a difficult clinical problem. From these observations, a decision tree to help diagnosis can be proposed for ADHD and ADHD-like symptoms, induced by sleep disorder breathing. Management of sleep problems in ADHD is crucial as they may aggravate ADHD symptoms. Future work and longitudinal research should clarify the direction of the relationship between ADHD, ADHD symptoms and sleep disorders

……..

Sleep Med. 2017;40:e58.

LONG TERM EFFECTS OF METHYLPHENIDATE ON THE SLEEP PROBLEMS OF CHILDREN WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER.

Chen Y-W, Huang Y-S, Chin W-C, et al.

Introduction: We investigate the sleep problems of attention-Deficit/hyperactivity disorder(ADHD) children using objective and subjective measurement with yearly testing for five years, and investigated the effect on sleep and sleep complaints, of methylphenidate -MPH- prescribed to these children for 5 years.

Materials and methods: From July 2009 to December 20015, we recruited ADHD children age between 6 and 12 years old. 266 children were enrolled in our study. We use objective measurements: Polysomnography (PSG) and, Continuous Performance Test (CPT) and subjective measurements: OSA-18 Questionnaire, Disruptive Behavior Rating Scale (DBRS) and Child Behavior Checklist (CBCL) to analyze sleep complaints and problems and ADHD symptoms at each yearly testing. All ADHD children received MPH treatment, and all children with OSA and enlarged adenotonsils-T&A- were treated the 1st year with T&A surgery. Descriptive statistics and repeat measure tests were used to analyze the datas.

Results: 266 ADHD children (mean age 8.8-¦2.3 years old) were included. 173 (65%) children had associated obstructive sleep apnea (AHI = 9.0-¦0.8/ hour) and 93 (35%) children were without OSA (AHI = 0.9-¦0.2/hour). In sleep study finding, PSG data show AHI (Apnea-hypopnea index), HI, ,ODI(Oxygen desaturation index), and sleep efficiency showed significant improvement (P< 0.001, 0.001,< 0.001,0.001) at first year follow-up. Similarly CPT data (p=0.047), DBRS (p< 0.001) and some domains of CBCL questionnaires were significantly improved. But at 5 years follow-up ODI, sleep efficiency and mean SaO2 show slight worsening (p=0.002, < 0.001, < 0.001) as did the OSA 18 Questionnaire, and performance and ADHD tests- CBCL and DBRS - showed worsening despite continuous MPH intake at five years follow-up.

Conclusions: After initial treatment of ADHD with and without OSA, sleep problems and ADHD symptoms have significant improvement. But long term follow-up indicate worsening of the tests at 5 years, raising the question of why, and indicating needs for regular re-testing

……..

Sleep Med. 2017;40:e132.

INFANTS WITH SLEEP PROBLEMS HAVE INCREASED RISK OF ADHD.

Hold I, Bramness JG, Handal M, et al.

Introduction: Children with ADHD often suffer from sleep related problems. Sleep and ADHD have a complex and multidirectional relationship. Previous studies have indicated that mother reported sleeping problems in infancy or toddler age are associated with later behavioral or externalizing problems.

Objective: To assess the association between sleep problems in infancy, as measured by dispensed hypnotics, and a diagnosis for ADHD in school age in a large population based cohort. To explore to which extent parental ADHD and parental education level affect the association. Materials and methods: In this cohort study all children born in Norway in the years 2004-2010 were included, 410 555 individuals. Information on dispensed hypnotic drugs from 0-3 years of age was collected from the Norwegian Prescription Database, and diagnoses of ADHD (ICD-10 F90) from 5 years of age and until the end of 2015 was collected from the Norwegian Patient Registry. The data was analysed using Cox regression.

Results: The hazard ratio (HR) of ADHD for children who were dispensed hypnotic drugs at least twice was 2.4 for girls and 1.8 for boys. For the sedative antihistamine trimeprazine users the corresponding HR was 3.6 for girls and 2.5 for boys. After adjusting for parental ADHD and parental education the HR for trimeprazine users was 2.8 (95% CI 2.1-3.6) for girls and 2.0 (95% CI 1.7-1.4) for boys.

Conclusions: Children who were dispensed hypnotics in infancy had an increased risk of ADHD in school age. Girls dispensed the trimeprazine at least twice had a 3-fold increased risk of ADHD later. After adjusting for parental ADHD the HR for trimeprazine use was still high

……..

Sleep Med. 2017;40:e140.

IMPACT OF ADENOTONSILLECTOMY ON PHARMACOTHERAPY IN CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER AND ADENOTONSILLAR HYPERTROPHY.

Huon L-K, Liu SY.

Introduction: Attention deficit hyperactivity disorder (ADHD) is a common behavior disorder that affects school age children. Approximately 5- 7% of school-age children worldwide are diagnosed with ADHD. The pathophysiology of ADHD is complex, with some sleep disorders frequently reported as co-morbid conditions. These include obstructive sleep apnea (OSA), periodic limb movement disorder, and enuresis. OSA is a leading co-morbid condition to ADHD, and may even be a main contributor as repetitive hypoxemia and hypercapnia at night is associated with cognitive dysfunction during the day. Concurrently, adenotonsillar hypertrophy is a leading cause of OSA in children. Treatment of OSA via adenotonsillectomy (AT) has shown to improve ADHD symptoms. A limitation of current literature on the effect of AT on children with adenotonsillar hypertrophy and ADHD is the reliance on questionnaires such as Conners' Rating scales and test of variables of attention (TOVAs) to assess ADHD symptomatic improvement. As ADHD pharmacotherapy is implemented for behavioral treatment failure, changes in medication use allows for the assessment of an hard outcome. We use a population-based database to characterize the change in ADHD pharmacotherapy after AT in children with co-morbid ADHD and adenotonsillar hypertrophy.

Material and methods: Subjects with adenotonsillar hypertrophy with attention-deficit/hyperactivity disorder who underwent adenotonsillectomy were identified between January 2012 and December 2013 using Taiwan's National Health Insurance Database. Changes in prescription of methylphenidate (MPH) for treatment of ADHD was followed for one year after adenotonsillectomy. We defined the date of intervention as the date when AT was performed. Follow up data for the next 12 months was obtained. The change of ADHD medication use was compared to average daily doses of ADHD medication in the 3 months prior to surgery. Discontinuation of ADHD medication was defined as total cessation of MPH (IR-MPH or OROS-MPH). Decrease in ADHD pharmacotherapy was defined as decrease in dosage of 50% or more MPH. Increase of ADHD pharmacotherapy was defined as increase in dosage of 50% or more MPH. No change of ADHD pharmacotherapy was defined as positive or negative changes under 50% of baseline medication dosage.

Results: 3301 pediatric patients underwent adenotonsillectomy during the study period. 7.6% of them had co-morbid ADHD and was on mehylphenidate (MPH). In this cohort, adenotonsillectomy decreasedMPH usage starting at 4-6 months post-operatively ($p< 0.001$). 1-year after adenotonsillectomy, MPH was discontinued in 61% of the subjects, and its dosage was reduced by more than half in 16% of the subjects.

Conclusion: For children with ADHD and adenotonsillar hypertrophy, adenotonsillectomy effectively decreases need of ADHD pharmacotherapy, where 61% of the patients are weaned off methylphenidate (MPH). Base on this study, presence of adenotonsillar hypertrophy needs to be evaluated in children with ADHD. If adenotonsillar hypertrophy associated with OSA contribute to ADHD symptoms, adenotonsillectomy can significantly decrease the need of ADHD pharmacotherapy. Prospectively, pediatric patients with ADHD and adenotonsillar hypertrophy would benefit from a pre-operative sleep study for the diagnosis of OSA, followed by a correlation of the impact of treating pediatric OSA in patients with ADHD

……..

Sleep Med. 2017;40:e181-e182.

USING MOBILE TECHNOLOGY INTERVENTIONS TO FACILITATE HEALTHY SLEEP HABITS FOR CHILDREN WITH ADHD.

Sonne T, Marshall P, Le Cornu KF.

Introduction: We present a technology-based approach to support families of children with ADHD. Sleep problems including sleep onset delay, bedtime resistance, and consequent daytime sleepiness are commonly reported in children with ADHD. Establishing an effective bedtime routine is important, as sleep deprivation in this population manifests in increased hyperactivity and inattention, increased disruptive behaviors, and poorer concentration and overall school performance. However, morning and bedtime routines can be particularly stressful and frustrating for parents of children with ADHD. Our aim was to develop a mobile technology to assist families in establishing effective bedtime and morning routines. Through a design process involving parents of children with ADHD and ADHD domain professionals comprising two child psychiatrists, three psychologists, and three medical researchers, we developed the

Morning and Bedtime Routines smartphone system (MOBERO) [1]. We hypothesised that mobile technologies may: lower parental frustration level during their child's morning and bedtime routines; assist the child in becoming more independent during morning and bedtime routines; and improve the child's sleep habits.
Materials and methods: MOBERO, a novel mobile phone intervention was developed through a participatory design process as part of this study to assist families in establishing healthy sleep habits for children with ADHD. Thirteen children (four female) clinically diagnosed with ADHD aged between 6-12 years (average age: 9.3) and their families participated in a four-week within-subject study. The study was divided into a two weeks baseline period followed by two weeks intervention period. At baseline and again post-intervention, the families completed the ADHD Rating Scale IV (ADHD-RS IV) and the Child Sleep Habit Questionnaire (CSHQ). In both baseline and intervention periods parents were reminded daily via a smartphone application to assess: the child's wake-up time; bedtime; sleep time; in addition to their rating of the child's independence level during bedtime routines; and their own frustration level during the child's bedtime routines.
Results: Our experiment showed a significant 8.3% improvement in the CSHQ scores between baseline and intervention; a significant 16.5% reduction in the ADHD-RS IV score; significant improvements in parental assessment of their child's independence level around bedtime; and significant reductions in parental assessment of their own frustration level around their child's bedtime. Our study revealed a non-significant trend towards more consistent bedtimes between baseline and intervention phases. However there was no significant difference in actual sleep times between baseline and intervention phase.
Conclusions: Our study suggests that technological interventions, such as MOBERO, are effective in assisting families of children with ADHD to improve their sleep and reduce ADHD symptoms. In addition, our intervention showed the potential for reducing parent frustration and increasing child independence around the child's bedtime

……..

Subst Use Misuse. 2017 Feb;52:392-400.
PSYCHIATRIC SYMPTOMS, PARENTAL ATTACHMENT, AND REASONS FOR USE AS CORRELATES OF HEAVY SUBSTANCE USE AMONG TREATMENT-SEEKING HISPANIC ADOLESCENTS.
Gattamorta KA, Varela A, McCabe BE, et al.
In early adolescence, Hispanics self-report higher drug use rates compared to White and African American peers. Among adolescent users, heavy users have more negative behavioral and health consequences. The purpose of this cross-sectional study is to examine whether psychiatric symptoms, parental attachment, and reasons for use predict heavy alcohol and illicit drug use (more than 10 times in the past three months) among Hispanic adolescents. METHODS: This study examines baseline data from a study evaluating a family based substance abuse treatment program for Hispanic adolescents. Participants were 14-17 years old (N = 156, 44% female). Adolescent reports on the Diagnostic Interview Schedule for Children Predictive Scales measured psychiatric symptoms of major depressive disorder, attention deficit hyperactivity disorder, conduct disorder, and anxiety. The Personal Experiences Inventory measured type and amount of drug use, as well as perceived social and psychological benefits of drug use. The Inventory of Parent and Peer Attachment measured trust, communication, and alienation between adolescents and their mothers. Logistic regression identified correlates of heavy alcohol use and heavy illicit drug use among Hispanic adolescents. RESULTS: Higher social benefits were associated with increased likelihood of heavy alcohol use. Conduct disorder, higher levels of maternal attachment, lower levels of acculturation, and higher levels of psychological benefits of use were associated with an increased likelihood of heavy illicit drug use. CONCLUSION: These findings support the assumption that substance use treatment among Hispanic adolescents must be capable of addressing co-occurring psychiatric disorders, familial relationships, and the individual reasons/motivators to use

……..

Terapia Psicologica. 2017;35:283-91.

USING THE CONNERS CONTINOUS PERFORMANCE TEST FOR DIFFERENTIATION OF NORMAL AND ADHD CHILEAN CHILDREN.

Salas-Bravo S, Gonzalez-Arias M, Araya-Pi+¦ones A, et al.

Attention-deficit hyperactivity disorder (ADHD) is one of the most prevalent disorder during childhood. The present study aimed to evaluate if the Conners Continous Performance Test was able to discriminate among ADHD and normal children completed the Conners computarized test. Significant differences between normal and clinical sample were found. All children selected as normal did not fit the clinical profile. Only 50% of the children considered as having ADHD fit the clinical profile. Implications for the issue of overdiagnosis of the disorder are discussed

……..

J Genet Psychol. 2018 Jan;179:19-29.

IMPAIRED VISUOSPATIAL SHORT-TERM MEMORY IN CHILDREN WITH ADHD.

Narimoto T, Matsuura N, Hiratani M.

Previous studies provide clear evidence that visuospatial memory performance in children with attention-deficit/hyperactivity disorder (ADHD) is significantly lower than in typically developing children. In the present study, we investigated a major cause of their low performance using a spatial span test. Possibly, inattention resulting from lack of motivation or interest causes their low performance so that they do not correctly encode targets to be remembered. On the other hand, a deficit in temporary maintenance per se may cause their low performance; that is, their inefficient use of rehearsal during a retention interval may lead to memory traces' fast decay. Results in this study indicated that children with ADHD could sustain attention during the encoding phase. Furthermore, their performance at delayed recall was significantly lower than immediate recall, but delayed recall did not affect typically developing children's performance. These results provide evidence for the likelihood that a factor causing children with ADHD difficulty in temporarily maintaining visuospatial information is fast decay of memory traces as a result of inefficient use of rehearsal, not inattention in the encoding phase

……..

Therapie. 2017 Dec;72:635-41.

METHYLPHENIDATE: GENDER TRENDS IN ADULT AND PEDIATRIC POPULATIONS OVER A 7YEAR PERIOD.

Ehrhardt C, Boucherie Q, Pauly V, et al.

OBJECTIVE: Methylphenidate (MPH) is a prescription-stimulant medication which is authorized in France for two indications: attention-deficit hyperactivity disorder in children (aged>/=6years) and narcolepsy in cases where modafinil is ineffective (for children and adults). MPH use has increased worldwide in the past 2 decades in children and adults. Different pharmacoepidemiological Europeans studies have described MPH patterns of use. To our knowledge, few pharmacoepidemiological studies have described MPH patterns of use in France.

METHODS: In this context, we have performed a study on regional reimbursement database (PACA-Corse area, covering approximately 4 millions inhabitants). The first part of the study analyzed the evolution of MPH users characteristic's yearly (grouped by age and gender) over a 7year period (2005-2011). In order to better characterize patterns of MPH use in adults, a specific analyze has been performed in the second part on MPH adult users in 2011 with a gender descriptive approach.

RESULTS: During the 7year period, MPH dispensing grew from 0.28 to 0.68 patient per 1000. The proportion of adult patients rose from 14.8 to 25.7% (P<0.0001), with patients mainly aged 35-49years old. Gender differences in MPH users were noted between adults and children: the proportion of girls was less important in children than in adult (in 2011, 20.7% of girls among children vs 44.9% among adults). Moreover, the proportion of girls among children increased between 2005 to 2011 (15.1% of girls in 2005 versus 20.7% in 2011). Among adults, women were prescribed more antidepressants (41.5% versus 28.2%, P=0.003) and less opiate maintenance treatments (22.4% versus 31.9%, P=0.03) than men. Finally, 11% of men and 16.4% of women were over 50years old.

CONCLUSION: MPH prescription greatly increased over7years, especially in adults. Moreover, in this population, patterns of MPH use differed with gender specificities. Such findings may increase clinical attention on monitoring MPH use in adults

……..

Tijdschr Psychiatr. 2016;58:655-58.

MEGACISTERNA MAGNA AS INCIDENTAL FINDING IN A BOY WITH ADHD.

Schevenels S, Klockaerts C.

In this case report we describe how a 13-year-old boy with a complex development profile was diagnosed with adhd and who was also found to have a megacisterna magna, a posterior fossa anomaly in the Dandy-Walker continuum. We searched the literature for reports of other patients who had this (mild) brain anomaly along with psychiatric problems in general and attention problems in particular. Our search of the literature suggested a possible link between the two diagnostic entities

……..

Tijdschr Psychiatr. 2017;59:181-84.

A GIRL WITH SELF-HARM TREATED WITH N-ACETYLCYSTEINE (NAC).

Rus CP.

Deliberate and recurrent self-harm could be regarded as addictive behaviour that can be treated with medication. In addiction, the dopaminergic mesolimbic reward system is activated. Pain caused by cutting stimulates the reward system through the opioid system. Glutamatergic neurotransmission follows the same pathway and plays a role in addiction as well. In this case-study a 17-year-old girl was successfully treated with N-acetylcysteine (nac) in order to reduce the frequency of self-cutting. In addition, in this case nac reduced the symptoms of attention deficit/hyperactivity disorder and depression. nac modulates the glutamatergic neurotransmission. This article provides possible explanations for the effect of nac in this case

……..

Translational Pediatrics. 2018;7:36-47.

PHARMACOLOGIC MANAGEMENT OF ATTENTION DEFICIT HYPERACTIVITY DISORDER IN CHILDREN AND ADOLESCENTS: A REVIEW FOR PRACTITIONERS.

Brown KA, Samuel S, Patel DR.

Attention-deficit/hyperactivity disorder (ADHD) is a common neurobehavioral disorder in children and adolescents. ADHD affects multiple aspects of an individualΓÇÖs life and functioning in family, social, and academic realms. Effective management of ADHD is necessary for children and adolescents and may include non-pharmacologic treatments, pharmacologic therapy including use of stimulant and non-stimulant medications, or a combination of the different treatment modalities. In general, medications used to treat ADHD are safe and effective. Medical practitioners can follow a step-wise approach in the selection and adjustment of pharmacologic agents to treat ADHD, while working closely with families, caregivers, and other medical and educational professionals to form appropriate treatment plans. This article reviews practical aspects of pharmacological treatment of ADHD in children and adolescents

……..

CHILD NEUROPSYCHOLOGY, 2018
https://doi.org/10.1080/09297049.2018.1441390

Routledge
Taylor & Francis Group

Writing abilities and the role of working memory in children with symptoms of attention deficit and hyperactivity disorder

Agnese Capodieci, Alice Serafini, Alice Dessuki and Cesare Cornoldi

Department of General Psychology, University of Padova, Padova, Italy

ABSTRACT

The writing abilities of children with ADHD symptoms were examined in a simple dictation task, and then in two conditions with concurrent verbal or visuospatial working memory (WM) loads. The children with ADHD symptoms generally made more spelling mistakes than controls, and the concurrent loads impaired their performance, but with partly different effects. The concurrent verbal WM task prompted an increase in the phonological errors, while the concurrent visuospatial WM task prompted more non-phonological errors, matching the Italian phonology, but not the Italian orthography. In the ADHD group, the children proving better able to cope with a concurrent verbal WM load had a better spelling performance too. The ADHD and control groups had a similar handwriting speed, but the former group's writing quality was poorer. Our results suggest that WM supports writing skills, and that children with ADHD symptoms have general writing difficulties, but strength in coping with concurrent verbal information may support their spelling performance.

ARTICLE HISTORY
Received 4 December 2017
Accepted 10 February 2018

KEYWORDS
ADHD; spelling; writing abilities; types of spelling errors; handwriting

Attention deficit/hyperactivity disorder (ADHD) is a diagnosis that identifies children who exhibit inappropriate levels of inattention and/or hyperactivity (American Psychiatric Association, 2013). The disorder is typically associated with poor scholastic outcomes (e.g., Fischer, Barkley, Edelbrock, & Smallish, 1990). Children with ADHD (Mayes, Calhoun, & Crowell, 2000; Re, Pedron, & Lucangeli, 2010) may have learning disabilities as well, and even those without any such comorbidities may have difficulties at school and be relatively poor in reading and arithmetic. These difficulties may be exacerbated when their impaired self-regulation (in terms of attentional control, planning, organization, monitoring, etc.) is in conflict with the demands of the task, as in writing.

In fact, writing is one of the most complex skills to learn for all children, and even more for children with ADHD (Cornoldi, Del Prete, Gallani, & Sella, 2010), because it involves several cognitive functions, such as planning, generativity, organization, monitoring, attention, and long-term memory, among others, that make the difference between good and poor writers (e.g., Hooper, 2002; Stievano, Michetti, McClintock, Levi, & Scalisi, 2016; Stievano & Scalisi, 2016), and that are typically impaired in

CONTACT Agnese Capodieci agnese.capodieci@phd.unipd.it University of Padova, via Martini 10, Casier, Treviso, Italy

children with ADHD (Biederman et al., 2004; Cornoldi et al., 2010). One such cognitive function is working memory (WM) (Berninger & Swanson, 1994; Swanson & Berninger, 1996), which is crucial during the writing process because it allows to retrieve and maintain words, ideas, linguistic strings and grammatical rules from long-term memory; and to monitor and control irrelevant concurrent information, which is essential in typical everyday-life writing situations (Gathercole, Lamont, & Alloway, 2006; Kellogg, 1996; McCutchen, 2000; Swanson & Berninger, 1996). Writing more efficiently is therefore associated with a better management of WM resources (Olive, 2004). Given that children with ADHD are known to have an impaired verbal and visuospatial WM (Martinussen, Hayden, Hogg-Johnson, & Tannock, 2005), they can be reasonably expected to have several difficulties in writing tasks, due partly to the role of WM.

However, the writing skills of children with ADHD have received little attention to date, despite their crucial importance at school (Hooper, Swartz, Wakely, De Kruif, & Montgomery, 2002), although some evidence suggests that these children have particular difficulties in the different aspects of writing, such as written expression, spelling and handwriting (Kroese, Hynd, Knight, Heimenz, & Hall, 2000; Mayes & Colhoun, 2007; Mayes et al., 2000; Re & Cornoldi, 2010; Re, Pedron, & Cornoldi, 2007).

In particular, spelling difficulties of children with ADHD have not been thoroughly investigated and research has sometimes focused on specific situations rather than on the general case of writing under dictation, as in the case of a study of Re and Cornoldi (2013) who found that children with ADHD symptoms made more spelling mistakes than typically developing children in a copying task, particularly when they had to write accents and geminates. In another study, Noda and colleagues (2013) studied writing performance in two clinical groups, ADHD and developmental coordination disorder. They considered several aspects, such as spelling accuracy, tracing and copying accuracy, and handwriting. Their results showed that inattention predicted spelling accuracy and handwriting fluency, while a fine motor impairment predicted tracing and copying accuracy. In a subsequent study, Re, Mirandola, Esposito, and Capodieci (2014) argued that the simple writing in a quiet context does not represent the situation typical of everyday school life when children experience concurrent requests or distracting information while writing and therefore writing difficulties of children with ADHD could be underestimated. They therefore examined the case of children writing under dictation while also having to keep verbal information in mind. They administered a dictation task to children with ADHD symptoms and matched controls, with and without a cognitive load on the verbal component of WM. The cognitive load (for the dual task methods see Baddeley, 2001) consisted in a concurrent request that involved retaining in memory a series of orally presented digits that the children heard just before the dictation, and were asked to recall afterwards. The results showed that children with ADHD symptoms have problems with dictation tasks in general, and particularly under verbal WM loading, which makes them produce more phonological errors (PEs). These findings were interpreted with reference to the specific role of the articulatory component of WM (Baddeley, 2001), because spelling involves retaining the material to be written and its orthographic representation, and dividing words into their phonological components, where necessary: If resources in the verbal component are occupied by a concurrent memory request, then spelling performance will deteriorate in children with

ADHD both because their WM is impaired and they have weaker orthographic representations. The study had several limitations, however, as it did not systematically consider the different types of spelling errors, nor the quality of handwriting or the level of the concurrent memory performance. In particular, it was not clear whether the children with ADHD symptoms had a general spelling difficulty anyway, or whether a concurrent verbal WM task produced a specific further difficulty. It was also difficult to interpret the results of the study because a condition involving a concurrent WM task that did not involve the verbal component of WM was not tested. Hence the present study, which adopted the same manipulation with a verbal WM preloading, but also included a visuospatial WM preloading condition obtained with a manipulation that reflected the one used in the verbal concurrent WM task. The dual-task paradigm of the present study, based on the distinction between the verbal and the visuospatial WM components (Baddeley, 2000; Levy &Marek, 1999; Olive, 2004; Olive, Kellogg, & Piolat, 2008; Passerault & Dinet, 2000; Ransdell, Arecco, & Levy, 2001), was thus used to further elucidate how concurrent (verbal or visuospatial) WM tasks interfere with spelling accuracy in children with ADHD symptoms.

If the primary spelling task and a verbal WM loading secondary task compete for the same resources to a greater extent than when the secondary task loads the visuospatial WM, then the impairment in spelling accuracy should be more severe in the case of a verbal WM load. On the other hand, the involvement of WM in spelling may be more general, and/or a concurrent visuospatial WM task might impair spelling performance too, in which case both verbal and visuospatial concurrent WM loading should make spelling accuracy deteriorate by comparison with a control condition with no concurrent load. Furthermore, some aspects of the spelling impairment might also depend on the type of concurrent task, especially as regard the type of spelling errors being made. In fact, the classical distinction proposed by the dual-route model between phonological and non-phonological errors (NPEs; Coltheart, 1984) may be relevant in this setting. Accordingly to the dual route model, regular words can be correctly read and written using either the lexical or the non-lexical reading routes, but irregular words can be read and written correctly only by the lexical reading route: the non-lexical route will get them wrong (Patterson, Marshall, & Coltheart, 2017). PEs represent a violation of the relationship between grapheme and phoneme, so words are written differently from the way in which they were pronounced. Examples of PEs include the exchange of graphemes (e.g., “pox” for “fox”), the omission or addition of letters or syllables (e.g., “diry” for “diary”; “pencicil” for “pencil”), and inversions (e.g., “manechi” for “machine”). NPEs are cases in which the incorrectly-spelled word would necessarily sound right – in a transparent language like Italian- if read aloud, and they occur especially when sentences must be written, rather than single words, as in many cases two different spelling versions may exist in Italian (e.g., “l’una” vs “luna”) and only the context offers the possibility of deciding the correct spelling. Other examples of NPEs that can be found in both English and Italian are incorrect separations (e.g., “con certs” for “concerts”), incorrect fusions (e.g., “thebread” for “the bread”), omissions or additions of the letter “h” when deciding whether it is a form of the verb “to have” or a proposition (e.g., “he as eaten” for “he has eaten”). Control of PEs seems to be related to the activity of the verbal phonological component of WM for coping with phonemes and parts of words and thus should be disturbed to a great extent by a concurrent

verbal WM load. The case of NPEs is more complicated as the orthographic representation of whole words has to be associated (for the English language, at least) not only with phonological processes, but also with the visual representation of how words are written (Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001). Therefore, in the latter case, also a visuospatial WM load could have a disturbing effect.

So, the present study examined whether children with ADHD symptoms, but no comorbid learning disability, have spelling difficulties, and whether any such difficulties are exacerbated when the children's verbal or visuospatial WM is overloaded. Children from 8 to 12 years of age with ADHD symptoms and typically developing children matched for age, schooling, gender, rated intellectual abilities, and family environment were dictated three sets of sentences, one control without any WM load condition, and two after preloading their WM by asking them to remember a set of digits or a series of locations on a matrix while they wrote. To make the cognitive load comparable for the different tasks and age groups, the concurrent tasks involved 3 digits (in the verbal task) and 3 dots (in the visuospatial task) for children in third and fourth grade, and 4 digits (in the verbal task) and 4 dots (in the visuospatial task) for children of fifth and sixth grade. This was done to take into account the typical improvement in WM during development (Gathercole, Pickering, Ambridge, & Wearing, 2004), and had proved successful in other works (e.g., Cornoldi et al., 2001). The dual task poses, however, the problem of how the performance in a task may affect the performance in the concurrent task. We considered this aspect in the present study by examining not only the writing performance but also the WM performance and correlating the two performances. Opposite predictions could be made on this respect. In fact, on one side, a negative correlation could be predicted as some children could be unable to complete the secondary WM task (even though it is within their capabilities) due to the demands of the primary (spelling) task, or it could be that some children focused excessive resources on the secondary task and their performance in the primary task was consequently impaired. However, also an opposite positive correlation between the performances in the two concurrent tasks could be predicted due to the fact that children who did better in the WM task had a higher WM capacity that also supported them in the spelling task.

The children were involved in writing the dictated material by hand, so the present study also gave us the opportunity to examine the quality and the characteristics of the children's handwriting. Children with ADHD reportedly (e.g., Borella, Chicherio, Re, Sensini, & Cornoldi, 2011) write less well than typically developing children, and have less motor control, but it is not clear whether these weaknesses relate to difficulties in other cognitive functions, such as WM, or uncertainties associated with spelling. It may be that children with ADHD pay less attention to the quality of their handwriting in order to cope with the dictated material temporarily stored in their WM, or with the overload of WM deriving from the request that they avoid making spelling mistakes. By comparing handwriting quality in the two cognitive loading conditions tested, we could also examine whether a visuospatial WM load typically affecting performance in concurrent visuospatial tasks (Logie, 2014; Stievano et al., 2016) would also impair handwriting quality due to its visuomotor characteristics.

Finally, to investigate the implications of handwriting skills more in general, we also administered a simple speed writing task to shed further light on the controversial issue

of whether children with ADHD write more or less slowly than controls (Adi-Japha et al., 2007; Re, 2006; Ross, Poidevant, & Miner, 1995; Shen, Lee, & Chen, 2012), and to analyze whether a relationship exists between writing speed and spelling accuracy.

Method

Participants

A group of 26 children (22 males, 4 females) with ADHD symptoms attending third to sixth grade (9 children in third grade, 2 of them females; 8 children in fourth grade, 1 of them female; 6 children in fifth grade, all males; and 3 children in sixth grade, 1 of them female), and a control group of children matched with the ADHD group in terms of age, gender, and family environment. All children in both groups had an average cognitive level, as measured with the Reasoning subtest of the Primary Mental Abilities battery (Thurstone & Thurstone, 1981), and no other serious neurological or psychological problems, as assessed with the COM scale (Capodieci, in press; Marzocchi, Re, & Cornoldi, 2010), or diagnosed learning disabilities. COM scale allows to check for general aspects and symptomatic problems frequently associated with ADHD and consists of 30 items, 5 about general abilities and family environment and the remaining 25 divided into 6 areas that define the disorders most associated with ADHD. The questionnaire has high interjudge and test-retest reliabilities ($r > .90$ in both cases). Table 1 shows the two groups' mean age, mean scores in the SDAI subscales, and mean sociocultural level, which was assessed with a specific item of the COM scale (Capodieci, in press), and ranged from 0 (*high*) to 3 (*low*).

Children were included in the ADHD group on the basis of parents' reports, teachers' interviews and the cut-offs on an ADHD scale for teachers, the SDAI ([Scala per i Disturbi di Attenzione/Iperattività per Insegnanti]; Marzocchi et al., 2010), based on the Diagnostic Manual of Mental Disorders (DSM, American Psychiatric Association, 2013), which has revealed a high reliability and validity (Marzocchi et al., 2010). Before completing the SDAI, teachers were asked to observe the child's behavior closely for about 2 weeks, and then report the frequency of the symptomatic behaviors described in each item. A score of 14 or higher (the cut-off proposed by the authors; see Marzocchi et al., 2010) on at least one of the two subscales (for inattention and hyperactivity) indicate a child at risk of ADHD. All but 3 of the children in our sample had not been specifically diagnosed with ADHD, which is a condition still rarely diagnosed in Italy at any age (Skounti, Philalithis, & Galanakis, 2007). Between children selected as having symptoms of ADHD, 10 had prevalent inattentive symptoms, 6 had prevalent hyperactive/impulsive symptoms and 10 were of the combined subtype presenting both types of symptoms. Children were not receiving any treatment, including medication. Written consent was obtained from the children's parents before

Table 1. Means and standard deviations (*SD*) for the two groups.

	ADHD group ($N = 26$)	Control group ($N = 26$)	F (1,50)	*p*
Age (months)	116.00 (14.41)	115.31 (12.1)	.04	.853
Family's sociocultural level (COM)	1.95 (1.07)	1.53 (.96)	.98	.542
Inattention (SDAI)	15.42 (5.68)	1.77 (1.42)	162.88	< .001
Hyperactivity (SDAI)	12.65 (6.95)	1.38 (1.10)	79.03	< .001

COM: Comorbidity questionnaire for teachers; SDAI: ADHD scale for teachers;

they took part in the study. The study was conducted in accordance with the recommendations of the Padua University ethics committee and was approved by the university's institutional review board.

Materials and procedure

Dictation tasks

Three sets of sentences were dictated to assess the children's performance in three different conditions: simple dictation, dictation with a concurrent verbal WM task, and dictation with a concurrent visuospatial WM task. Eight sentences were used for each condition. The three sets of sentences were matched for number of words (total 107), proportions of one-, two- and poly-syllable words, difficulty (particularly as concerns accents on the last syllable, apostrophes, the letter "h", geminates, and so on), and linguistic complexity. Each sentence was divided into 5–7 parts that were each dictated as a short unit to avoid excessive WM loading, but they contained more than one word to enable the emergence of word combination errors. The following sentence is an example (where slashes indicate the pauses between units): "The man/with the red coat/who is at the door/of your house/has rung/the bell/several times" ([L'uomo/con il cappotto rosso/che è sulla porta/di casa tua/ha suonato/più volte/il campanello]). A pilot study in which the sets of sentences were administered without any concurrent task had shown that the three sets of sentences were comparable in terms of their difficulty.

At the end of each dictation, the children also performed a writing speed test, which involved writing as many numbers in letters as possible in 20 s, starting with "one". The policy of the schools involved in the study prevented us from conducting the tests individually, so the dictations were administered to whole classrooms during normal school hours. The whole process took approximately 90–100 min. The sentences were dictated aloud, at a constant pace, adapted to the children in the classroom, i.e., we waited for almost all the children to finish writing a sentence unit before moving on to the next. No explanations were given before or during the dictation, and the dictated words or other input to be remembered were not repeated.

The procedure for the three conditions was as follows.

Simple dictation

The children were given a sheet of lined paper and asked to write the sentences dictated by the experimenter; and – in order to make the intersentence interval similar to the intervals in the other two conditions- after each sentence they had to draw a box around the sentence they had written.

Dictation with a concurrent verbal WM task

The procedure was the same as in the simple dictation condition except that, before dictating each sentence, the experimenter pronounced a set of digits (3 digits for children in third and fourth grade, 4 digits for children in fifth and sixth grade) that the pupils had to remember. Then the sentence was dictated and, after writing the sentence, the children had to write the previously heard digits on the sheet, in the same order as they had been pronounced. A trial run was conducted after providing the instructions.

Dictation with a concurrent visuospatial WM task

The procedure was the same as in the previous condition except that the verbal concurrent task was replaced with a visuospatial concurrent task. The children were asked to look for about 4 s at a 3 × 3 grid in which there were 3 or 4 dots (3 dots for children in third and fourth grade, 4 dots for children in fifth and sixth grade), and to remember their position. Then, after writing a sentence under dictation, they had to mark the locations of the previously seen dots in an empty 3 × 3 grid on their answer sheet. Here again, a trial run was conducted after providing the instructions.

Due to the group administration of the tasks, we could balance the order in which the different conditions were administered, but we presented the different materials always in the same condition. The group administration to the whole classes had the advantage, however, of enabling us to measure WM performance in a large number of children (148 in third grade, 126 in fourth grade; 121 in fifth grade, and 91 in sixth grade), and thus calculate standardized scores for the experimental children using the data collected on the whole sample.

Handwriting speed test

To assess their handwriting speed, the children were administered a test after completing each of the 3 sets of dictations, in which they had to write the numbers in letters, starting from "one", until the experimenter said the word "STOP" (after 20 s). This procedure was drawn from a battery of tests for assessing handwriting and spelling competence, the BVSCO-2 ([Batteria per la Valutazione della Scrittura e della Competenza Ortografica]; Tressoldi, Cornoldi, & Re, 2013), with a high reliability and validity.

Results

Scoring

Spelling mistakes were assessed according to the BVSCO-2 criteria (Tressoldi et al., 2013), considering PEs, NPEs, and a third category comprising addition or omission of accents and double letters (AD). For dictations in the simple condition, the only aspect to consider was the number of spelling mistakes. For the dictations with concurrent WM tasks, we also considered the recall of digits (in the verbal WM loading condition) and dot positions (in the visuospatial WM loading condition). For the sets of digits, based on the procedure adopted in previous works (Lanfranchi, Cornoldi, & Vianello, 2004; Re et al., 2014), one point was scored for each digit correctly remembered in the right order within the set, with respect to the digit preceding it at least. For instance, if the set of digits dictated was "613", a child who wrote "628" scored 1 point for remembering one digit out of three and in the right position; a child who wrote "632" scored 2 points because the 6 was in the right position, and because the 3 followed the 6, albeit in the wrong position. As for the recall of dot positions in the grids, one point was scored for each position correctly remembered. The scores for the verbal and visuospatial WM tasks were converted into *z* scores using the mean and standard deviation of the scores obtained by the whole sample of children in the same school grade.

Handwriting quality was assessed adopting the criteria established in the third edition of the "Handwriting Legibility Scale" developed by Woodcock-Johnson (Woodcock, McGrew, & Mather, 2001). A qualitative analysis of the handwriting was done by two independent judges blinded to the children's groups, who separately awarded three different scores, one for each of the three dictation conditions. The "Handwriting Legibility Scale" envisages scores from 0 to 100, in 10-point steps, with some handwriting judged as: 100: "artistic"; 90: "excellent"; 70: "very good"; 50: "satisfactory"; 30: "adequate"; 10: "poor"; 0: "unreadable". Aspects considered include the slope of letters, the space between letters within and between words, the height of letters such as "p" or "l", the size of letters, the distinction between upper and lowercase letters, and the alignment of the words on the lines on the sheet of paper. Finally, for the handwriting speed measure, we considered the total number of letters written in the three 20-second trials.

Statistical analyses

All analyses were conducted using the free R software (R Core Team, 2015). Generalized mixed-effects models were run using the "lme4" package (Bates et al., 2015). Graphical effects were obtained using the "effects" package (Fox, 2003). The distribution of the residuals was assumed to be normal for all measures of interest, except for the spelling mistakes, which were considered as having a "Poisson" distribution because they consisted of a sum of subsequent occurrences, and because the distribution was extremely skewed.

For the dictations, the total number of mistakes in the three different conditions (simple, visuospatial, verbal) for the two groups (ADHD and control) in the different school grades (from third to sixth) were initially considered and analyzed as a measure of spelling performance.

Due to the distribution of the mistakes, the analysis was conducted using generalized mixed-effects models (Baayen, Davidson, & Bates, 2008) with the Poisson distribution, which seems appropriate given the low frequency of the spelling mistakes and the discrete nature of this variable. The number of words written down could also differ across participants because some children had sometimes skipped words, so this number was entered in the models as the offset variable (i.e., the number of spelling mistakes was considered after controlling for the total number of words written down). The fixed effects included in the model were Group (control vs. ADHD; reference category "ADHD"), Condition (simple vs. visuospatial vs. verbal; reference category "simple"), and Grade (third vs. fourth vs. fifth vs. sixth; reference category "third") and their two-way and three-way interactions. Participants were included in the model as the random effect. Fixed effects were entered in the model in two steps: first only the main effects were considered, then the two-way and three-way interactions were entered. The main effects were considered when assessing the interactions. The significance of the effects was assessed using likelihood ratio tests for nested models (and the relevant distribution is the chi-squared instead of the Fisher-Snedecor F-distribution because mixed-effects models were used; Pinheiro & Bates, 2000).

Results

Figure 1 presents the estimated averages of errors by the two groups (divided for grade) in the different conditions. Concerning the total number of spelling mistakes, we found a significant Group effect, $\chi^2(1) = 23.29$, $p < .001$. Parameter analysis revealed that the ADHD group made significantly more mistakes than the control group. The estimated average of the total number of mistakes was 8.11 in the ADHD group, and 3.03 in the control group, B = .99, $p < .001$ (where B represents the estimated variation of the value from one group to the other). We also found a significant main effect of Condition, $\chi^2(2) = 8.08$, $p = .018$, with more spelling mistakes in verbal and visuospatial WM loading conditions than under simple dictation (B = .20, $p = .006$; and B = .16, $p = .034$; respectively). The estimated average of the total number of mistakes was 4.40 in the simple dictation condition, 5.38 under verbal WM loading, and 5.15 under visuospatial WM loading. School Grade had a significant main effect too, $\chi^2(3) = 20.61$, $p < .001$, with fewer spelling mistakes in fifth and sixth grade than in third and fourth grade. The estimated average of the total number of mistakes was 7.73 in third grade, 5.76 in fourth grade, 3.29 in fifth grade, and 1.98 in sixth grade. As shown in Figure 1, both groups generally made fewer mistakes in the simple dictation condition than in the dual-task conditions. Children with ADHD symptoms made more mistakes than controls in all conditions. None of the interactions were significant. Considering the subtypes of ADHD, we compared children with prevalent inattentive, prevalent hyperactive and combined symptoms. Results must be cautiously considered due to the small sample sizes, but they presented substantial similarities between the subtypes (with the only partial exception of the case of the hyperactive group in the spatial condition) with no significant differences. Estimated average in simple condition was 8.84 for children with prevalent inattentive symptoms, 8.60 for children with prevalent hyperactive symptoms and 9.77 for children with combined symptoms. Estimated average in verbal condition was 11.91 for children with prevalent inattentive symptoms, 10.88 for children with

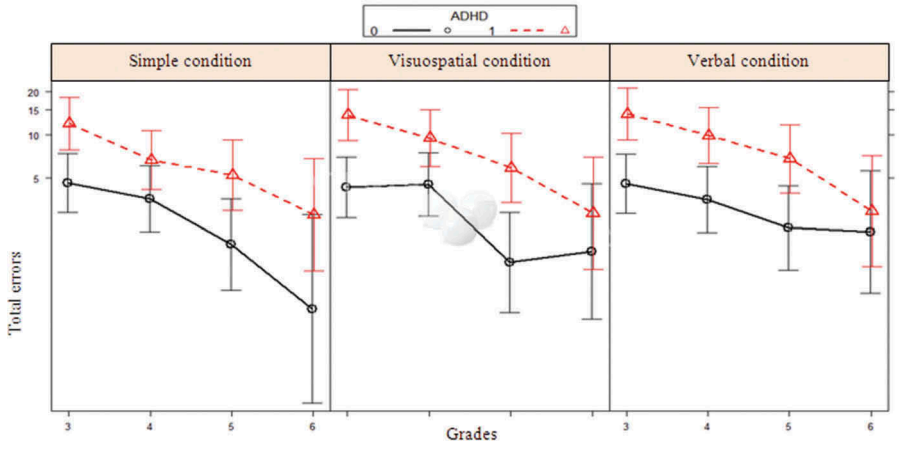

Figure 1. Estimated mean total number of spelling mistakes in the two Groups (ADHD vs. control), the different Grades (third, fourth, fifth, sixth grade), under the different dictation Conditions (simple vs. visuospatial vs. verbal).

prevalent hyperactive symptoms and 11.99 for children with combined symptoms. Estimated average in spatial condition was 11.88 for children with prevalent inattentive symptoms, 8.24 for children with prevalent hyperactive symptoms and 12.16 for children with combined symptoms.

In a second step, we analyzed the children's WM performance. For the whole sample of children, the correlation between their performance in the two WM loading tasks was low, $r(50) = .24$, but the ADHD group performed less well than the control group for both verbal WM (ADHD: M = 68.35 [19.77]; control: M = 77.52 [15.60], with a medium effect size, $d = 0.51$), and visuospatial WM (ADHD: M = 88.02 [12.22]; control: M = 93.39 [9.08] with a medium effect size, $d = 0.50$), and the difference was significant for both verbal WM ($t = -3.24$, $p = .002$), and visuospatial WM ($t = -3.26$, $p = .002$). Maintaining the main effects (of Group, Condition and Grade), performance in terms of the standardized scores (calculated for each Grade with reference to all the children involved in the study) in the verbal, and then in the visuospatial WM loading tasks was added to see how these variables separately influenced spelling performance, and to identify any interactions. Since the ADHD group performed less well in the WM tasks than the control group, considering the effect of Group enabled us to identify the effect of WM on spelling performance after accounting for the effect of ADHD. There was a main effect of verbal WM ($\chi^2(1) = 4.41$, $p = .036$), but not of visuospatial WM ($\chi^2(1) = 2.60$, $p = .107$), and there were no interactions ($\chi^2(1) = 2.38$, $p = .123$). As the effect was only significant for the verbal concurrent task, we disregarded performance in the visuospatial WM task and focused on the verbal WM task, analyzing the two groups separately. It emerged that verbal WM influenced spelling performance differently in the ADHD group ($\chi^2(1) = 6.05$, $p = .014$) and the control group ($\chi^2(1) = .12$, $p = .732$). As shown in Figure 2, although the interaction was not statistically significant, a visual inspection and a separate analysis of the two groups showed that verbal WM influenced spelling performance in the ADHD group, but not in the control group. For instance, in the verbal WM task an estimated average of the total spelling mistakes in the ADHD group was 13.87 at $z = -2$, 10.21 at $z = -1$, 7.52 at $z = 0$, and 5.53 at $z = 1$, whereas for the control group it was 3.18 at $z = -2$, 3.11 at $z = -1$, 3.05 at $z = 0$, and 2.99 at $z = 1$ standard deviation.

The various types of error (PE, NPE, AD) were analyzed together with the fixed effects of Group, Grade and Condition (in the case of the Type of error, the reference category was "AD"). Here again, we found significant main effects of Group, Grade and Condition. The two-way interaction Type of error ^{x} Group was not significant. Parameter analysis revealed that the group with ADHD made significantly more PE, NPE and AD errors than the control group (B = .67, $p < .001$; B = .36, $p = .045$, B = .55, $p < .001$). The two-way interaction Type of error ^{x} Condition was significant, however, $\chi^2(4) = 15.61$, $p = .004$, with more NPEs in the visuospatial WM loading condition (B = .60, $p = .001$; see Figure 3). Although the three-way interaction was not significant, it is clear from a visual inspection of Figure 3 that the ADHD group's pattern of errors was more similar in the three conditions than that of the control group, which made few PEs in the simple dictation condition, and many NPEs in the visuospatial WM loading condition, giving the impression that they used a different approach, depending on the resources needed for the second task.

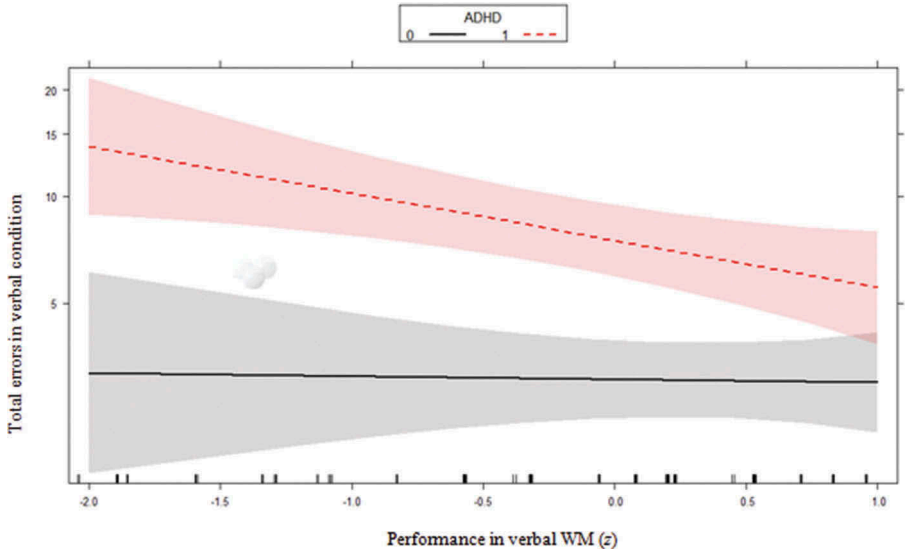

Figure 2. Estimated average of total spelling mistakes under dictation with a concurrent verbal WM task as a function of performance in the concurrent verbal WM task.

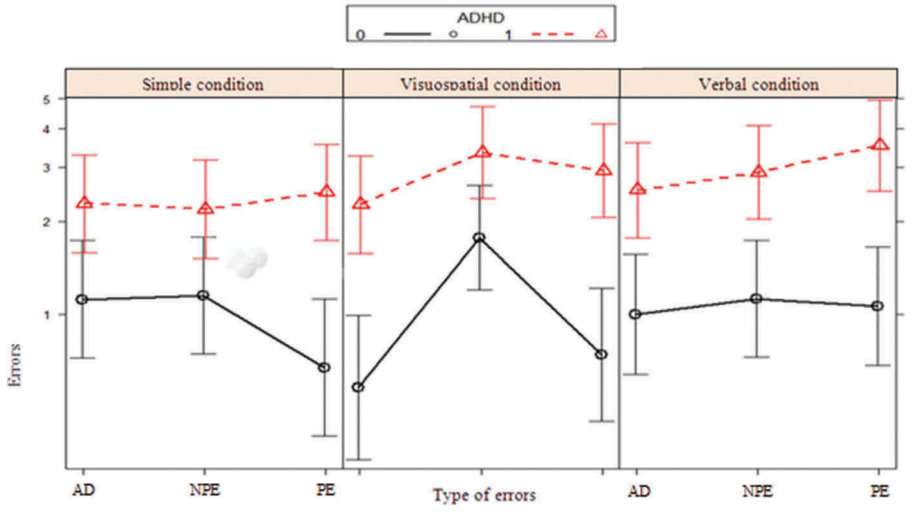

Figure 3. Estimated average number of the different types of error (PE vs. NPE vs. AD) for the two Groups (ADHD vs. control) in the different Conditions (simple vs. verbal vs. visuospatial).

In considering the types of error (with the two-way interactions), we also examined the explanatory power when the interaction between Type of error and performance in the concurrent verbal and visuospatial WM tasks was added to the best model identified. We found that the two-way interaction Type of error ^{x} verbal WM was significant, $\chi^2(4) = 63.81$, $p < .001$, and so was the two-way interaction Type of error ^{x} visuospatial WM, $\chi^2(4) = 68.21$, $p < .001$. In particular, parameter analysis showed that children with a better visuospatial WM generally made fewer NPEs (B = −.18, $p = .022$), whereas

children with a good performance in the verbal WM task made fewer PEs (B = −.06, p = .048). We also found a three-way interaction for Type of error x Group x verbal or visuospatial WM, but only in the case of visuospatial WM ($\chi^2(3)$ = 8.23, p = .042), because the children with ADHD symptoms who fared better in this area made fewer NPEs – an effect not seen in the case of the children in the control group (B = −.54, p = .008).

As a final point, when performance in terms of handwriting quality and speed was compared between the two groups, and then considering the importance of WM, the distribution of the residuals was normal, so an analysis of variance for linear models was conducted.

A preliminary examination had shown a good inter-rater reliability (IRR) between the two judges of handwriting quality. IRR was assessed using a two-way mixed, average measures, intra-class correlation (ICC) (McGraw & Wong, 1996) to assess the degree to which the judges were consistent in their ratings of handwriting quality. The resulting ICC was in the "excellent" range (r = .94; Cicchetti, 1994), indicating that the judges reached a high level of agreement, and suggesting that their handwriting quality ratings were similar (Hallgren, 2012). We consequently considered the mean rating for a given child as a quality measure, except in the few cases where the ratings diverged, which were discussed by the judges to arrive at a consensus, as recommended in the manual (Woodcock et al., 2001). We then compared the two groups, including Group (control vs. ADHD; reference category "ADHD"), Condition (simple vs. spatial vs. verbal; reference category "simple"), and Grade (third vs. fourth vs. fifth vs. sixth; reference category "third"), and their two-way and three-way interactions, as fixed effects in the model, which were entered in two steps (the main effects first, then the two-way and three-way interactions). The main effects were considered when assessing the two-way interaction. The main effect of Group was significant, $F(1,50)$ = 7.34, p = .007, η^2 = .35, with the ADHD group obtaining lower scores for handwriting quality than the control group (ADHD: M = 48.78 [18.84]; control: M = 57.50 [18.39], with a medium effect size, d = 0.47). So was the main effect of Grade, $F(1,50)$ = 11.18, p < .001, η^2 = .41, with children in third and fourth grade (M = 47.89 [18.86]) obtaining lower scores for handwriting quality than children in fifth and sixth grade (M = 64.54 [16.43], with a high effect size, d = 0.94). The main effect of Condition was not significant (F < 1), nor were any interactions. Children with ADHD symptoms had lower scores for handwriting quality than controls in all Conditions and all Grades.

As for handwriting speed, the task did not depend on the WM loading condition because the children had no concurrent task, so we only considered the fixed effect of Group and Grade. The main effect of Group was not significant (F < 1), as the ADHD and control children wrote a similar number of letters in 60 s, i.e., 106.65 (30.10) and 104.92 (19.09), respectively. The effect of Grade was significant (F = 25.30, p < .001, η^2 = .38), with children in third and fourth grade writing more slowly (M = 94.74 [19.95]) than those in fifth and sixth grade (M = 126.67 [19.80]), with a very high effect size (d = 1.61). No interactions emerged. We also considered the correlations between handwriting speed and number of spelling mistakes, which were significant (p = .002, p = .017, p = .008) in all three conditions (simple dictation, with concurrent verbal or visuospatial WM tasks, −.41, −.33, at −.36, respectively).

Discussion

The present study produced new knowledge on the writing abilities of children from third to sixth grade, and specific information on the case of children with ADHD symptoms. The study collected further evidence (Tressoldi et al., 2013) of the important improvements in spelling and handwriting occurring during the latter years of primary school, showing that these improvements affect all types of error. The clear age effect observed in our sample also provides evidence of the discriminatory power of the dictations we used. The study confirmed, moreover, that WM is crucially involved in spelling (Kellog, 1996; McCutchen, 2000), since concurrent WM loading impaired the children's spelling performance, but did not interfere with their handwriting.

The main goal of the study, however, was to examine the writing skills of children with ADHD symptoms, so the overall results are discussed in terms of the similarities and differences identified between the ADHD and control groups.

One of the main difficulties that children with ADHD encounter in life relates to the academic sphere, but the literature has not paid enough attention to the nature of their difficulties at school, especially in cases of ADHD unassociated with any learning disability. The present study examined writing skills, and produced further evidence of the difficulties of such children in this area (Borella et al., 2011; Re & Cornoldi, 2013). It also clarified some of the mechanisms behind writing abilities, highlighting the role of verbal and visuospatial WM in the writing process. We compared children with ADHD symptoms and a group of typically developing peers on three dictation tasks: one under typical conditions and two with WM preloading, which involved having to remember a set of digits or dot positions while writing the sentences dictated by the experimenter. Our results showed that children with ADHD symptoms in all school grades and in all dictation conditions made more spelling mistakes than controls.

The concurrent WM task prompted much the same increase in the number of spelling mistakes whatever the group or concurrent task (when the overall number of errors was considered at least). It is worth noting that the WM preloading manipulation typically does not severely impair performance in the primary task because individuals can focus on it relatively easily (Re et al., 2014). The fact that WM preloading affected spelling performance (but not handwriting quality) nonetheless suggests that spelling and WM have some resources in common. This assumption is consistent with the notions that the phonological loop is responsible for maintaining and processing sets of both digits and words (Baddeley, 1986), and that an impaired phonological loop affects spelling performance (Re, Tressoldi, Cornoldi, & Lucangeli, 2011). A concurrent visuospatial WM load prompted an increase in the number of spelling mistakes too, suggesting that this component is also involved in writing, presumably to maintain whole representations of written words (Coltheart et al., 2001). In fact, we found that children made more NPE than PE or AD errors in the visuospatial WM loading condition – an effect not seen in the case of a verbal WM load.

It is worth emphasizing that, despite their weaker WM, children with ADHD symptoms were not more severely affected by the concurrent tasks than the controls. It does seem, however, that WM may be crucial for these children, supporting their spelling in some way. In fact, it was only in the ADHD group that a good performance in the concurrent verbal WM task was associated with fewer spelling mistakes. This

probably means that children with ADHD and a good verbal WM can spell better, though this hypothesis needs to be tested in future research by obtaining an independent measure of verbal WM. In the typically developing children, and in the case of visuospatial WM loading, we found no such relationship between performance in the primary and secondary tasks, i.e., there was apparently no explicit tendency to subtract resources from one task in order to complete the other.

The present findings confirmed what we know from the principal writing models, i.e., that WM is crucial during the writing process (Cornoldi et al., ; Kellog, 1996; McCutchen, 1996; Swanson & Berninger, 1996) as it enables all the information needed during the writing process to be managed adequately. In the case in point, an efficient WM enabled the children with ADHD symptoms to keep the digits and dot positions in mind while retrieving the correct spelling of the words being dictated. The fact that visuospatial WM loading interfered with spelling accuracy as well suggests that the phonological loop is not enough to avoid other types of error, when the lexicon stored in the long-term memory is needed (Kellog, 1996). Our children with ADHD symptoms performed less well in the WM tasks than the control children, so it was not that they paid more attention than controls to the WM tasks, at the expense of the dictation task. Generally speaking, the poor overall performance of children with ADHD under WM loading may be due to their impaired WM (Barkley, 1997), and associating two tasks as in the present study (dictation and a WM task) probably overburdened these children's abilities.

In short, we found that children with ADHD symptoms had a worse spelling performance than their typically developing peers under all test conditions, in all school grades, and for all types of error, with no clear distinctions between the types of error. This picture is inconsistent with the report from Re and colleagues (2013), of children with ADHD making mistakes especially with accents and geminates. The difference may be due to the difficulties posed by the very particular text used for the purposes of the earlier study. As concerns the role of WM loading, we found no specific effects in the ADHD group, even though verbal WM loading influenced their spelling more than in their typically developing peers. Our having included a concurrent visuospatial WM task gave us the chance to shed light on the contribution of different components of WM from those considered in the study by Re and colleagues (2014). We found more NPEs in the concurrent visuospatial loading condition in both groups, and particularly in the controls – presumably because they are better able to use the direct visual pathway in spelling (Coltheart et al., 2001).

As for handwriting, we found that the children's performance generally improved with aging, and the children with ADHD symptoms had a worse handwriting quality in all test conditions, confirming previous reports (Langmaid, Papadopoulos, Johnson, Phillips, & Rinehart, 2014; Luisotto, Borella, & Cornoldi, 2011; Noda et al., 2013). It is worth noting, however, that concurrent WM loading did not affect handwriting performance, so WM does not seem to be very strongly involved in handwriting (even in its visuospatial component). The same conclusion was reached by several other authors (Brossard-Racine, Majnemer, Shevell, Snider, & Bélanger, 2011; Kaiser, Albaret, & Doudin, 2009; Langmaid et al., 2014), who mainly stressed the role of other neuropsychological functions, such as motor control and visuomotor coordination, rather than WM. No difference emerged between our two groups in terms of writing speed,

confirming previous evidence (Re, 2006; Ross et al., 1995). It seems that a difference can only emerge in certain circumstances, apparently relating to prolonged tasks during which fluctuations in children's performance may be more evident (Borella et al., 2011). Spelling performance correlated with writing speed, however. This may be due to the nature of the writing speed task (which involved writing numbers in letters, and consequently demanded competence in spelling too). On the other hand, it may be that writing more quickly subtracted fewer resources from the writing process as a whole, enabling the writer to cope better with the demands of the task. In fact, it has already been suggested (Berninger & Abbott, 1994) that handwriting skills influence other aspects of writing, and in particular expressive writing.

Our findings offer a new, coherent description of certain facets of the writing skills of typically-developing children and those with symptoms of ADHD, but the study suffers from a number of limitations that need to be considered in future research. In particular, it would be important to replicate this study with larger, clinical samples of children with ADHD and other disorders (e.g., children with learning disabilities and behavioral disorders), though it is not easy to collect a group of children with an explicit diagnosis of ADHD. In Italy, at least, ADHD is generally diagnosed with caution, and typically only in very severe cases, in children who usually have several comorbidities. Another aspect of our study to point out is the small number of females in the sample, which made it impossible to examine any gender-related effects (although the gender distribution reflected the characteristics of the ADHD populations). In addition, if schools had given the permission to test the children on other measures, it might have been possible to examine the role of other aspects potentially involved in spelling accuracy, such as reading decoding ability, or intelligence. It is also important to consider that the context may have influenced our results. At the request of the schools involved, the tasks (dictations and WM loading tasks) were assigned in class, for all students at the same time. This enabled us to examine the children's behavior in a situation reflecting typical everyday school activities, but it may be that the results would have been different if the children had been tested individually in a quiet room. A broader array of written materials should be used in future research too, because the fact that some of our results did not replicate previous findings (i.e., the higher frequency of accents and geminates; Re & Cornoldi, 2013) may be due to the specific material used in this study, which focused on distinguishing between phonological and NPEs and had a relatively small number of words that might elicit other errors. Including another primary task with the same concurrent task effects would also offer a further information for examining the nature of the interference caused by concurrent tasks. Similarly, as concerns the secondary task, it would be worth considering the effects of other WM tasks, e.g., simultaneous tasks, for example, instead of preloading manipulations. Or spatial sequential rather than spatial simultaneous material (Pazzaglia & Cornoldi, 1999) could be used to mirror the sequential presentation of the verbal material.

Albeit with the above limitations, the present study sheds light on the important role of WM in sustaining the spelling process (one of the most important academic abilities), and on the difficulties encountered by children with ADHD symptoms. The findings of this study add an important piece to the puzzle concerning the role of WM in the spelling accuracy and handwriting of children

with ADHD symptoms faced with a typical writing task such as dictation. Schoolchildren typically have to write in conditions that affect their WM capacity, when they are disturbed by concurrent ambient noise, or when they must write while remembering other verbal or visuospatial information, instructions, and so on. Such conditions may foster the occurrence of spelling mistakes – even in the absence of any learning disability in spelling. Limiting such concurrent loads should attenuate the difficulties of children with ADHD symptoms. Various interventions can also help children with ADHD to write better. For instance, Re, Caeran, and Cornoldi (2008) showed that giving children with ADHD guidelines on how to plan a text they have to produce (which involved dividing the text drafting process into separate sentences, and reducing the memory load), not only improved the quality of the text, but also reduced the number of spelling mistakes the children made.

Acknowledgments

We wish to thank Ilaria Cester for her help in preparing the study project and the related materials, and professor Frances Coburn for her valuable suggestions and English revision.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

Adi-Japha, E., Landau, Y. E., Frenkel, L., Teicher, M., Gross-Tsur, V., & Shalev, R. S. (2007). ADHD and dysgraphia: Underlying mechanisms. *Cortex*, *43*(6), 700–709.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders: DSM-V*. Washington, DC: APA.

Baayen, R. H., Davidson, D. J., & Bates, D. M. (2008). Mixed-effects modeling with crossed random effects for subjects and items. *Journal of Memory and Language*, *59*(4), 390–412.

Baddeley, A. D. (1986). *Working memory*. New York: Oxford University Press.

Baddeley, A. D. (2000). The episodic buffer: A new component of working memory? *Trends in Cognitive Sciences*, *4*(11), 417–423.

Baddeley, A. D. (2001). Is working memory still working? *American Psychologist*, *56*(11), 851.

Barkley, R. A. (1997). Behavioral inhibition, sustained attention, and executive functions: Constructing a unifying theory of ADHD. *Psychological Bulletin*, *121*, 65–94.

Bates, D., Maechler, M., Bolker, B., Walker, S., Christensen, R. H. B., & Singmann, H. (2015). lme4: Linear mixed-effects models using Eigen and S4, 2014. *R Package Version*, *1*(4), 1–9.

Berninger, V. W., & Abbott, R. D. (1994). Multiple orthographic and phonological codes in literacy acquisition: An evolving research program. In V. W. Berninger (Ed.), *The varieties of orthographic knowledge* (pp. 277–319). Dordrecht: Springer.

Berninger, V. W., & Swanson, H. L. (1994). Modifying Hayes and Flower's model of skilled writing to explain beginning and developing writing. In E. C. Butterfield (Ed.), *Advances in Cognition and Educational Practice. Vol. 2: Children's writing: Toward a process theory of the development of skilled writing* (pp. 57–81). Greenwich, CT: JAI.

Biederman, J., Monuteaux, M. C., Doyle, A. E., Seidman, L. J., Wilens, T. E., Ferrero, F., … Faraone, S. V. (2004). Impact of executive function deficits and attention-deficit/hyperactivity

disorder (ADHD) on academic outcomes in children. *Journal of Consulting and Clinical Psychology*, *72*(5), 757.
Borella, E., Chicherio, C., Re, A. M., Sensini, V., & Cornoldi, C. (2011). Increased intraindividual variability is a marker of ADHD but also of dyslexia: A study on handwriting. *Brain and Cognition*, *77*, 33–39.
Brossard-Racine, M., Majnemer, A., Shevell, M., Snider, L., & Bélanger, S. A. (2011). Handwriting capacity in children newly diagnosed with attention deficit hyperactivity disorder. *Research in Developmental Disabilities*, *32*(6), 2927–2934.
Capodieci, A. (in press). Le scale COM-R/Insegnanti: un aggiornamento sui profili e una integrazione per la rilevazione di difficoltà sociali nei bambini con e senza ADHD [The COM-R/ Teachers scales: an update on profiles and an integration for the detection of social difficulties in children with and without ADHD]. *Psicologia Clinica dello Sviluppo*.
Cicchetti, D. V. (1994). Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instruments in psychology. *Psychological Assessment*, *6*(4), 284–290.
Coltheart, M. (1984). Theoretical analysis and practical assessment of reading disorders. In C. Cornoldi (Ed.), *Aspects of reading and dyslexia*. Padova: Cleup.
Coltheart, M., Rastle, K., Perry, C., Langdon, R., & Ziegler, J. (2001). DRC: A dual route cascaded model of visual word recognition and reading aloud. *Psychological Review*, *108*(1), 204.
Cornoldi, C., Del Prete, F., Gallani, A., Sella, F., & Re, A. M. (2010). Components affecting expressive writing in typical and disabled writers. *Advances in Learning and Behavioral Disabilities*, *23*, 269–286.
Cornoldi, C., Marzocchi, G. M., Belotti, M., Caroli, M. G., De Meo, T., & Braga, C. (2001). Working memory interference control deficit in children referred by teachers for ADHD symptoms. *Child Neuropsychology*, *7*, 230–240.
Fischer, M., Barkley, R. A., Edelbrock, C. S., & Smallish, L. (1990). The adolescent outcome of hyperactive children diagnosed by research criteria: II. Academic, attentional, and neuropsychological status. *Journal of Consulting and Clinical Psychology*, *58*, 580–588.
Fox, J. (2003). Effect displays in R for generalised linear models. *Journal of Statistical Software*, *8*(15), 1–27.
Gathercole, S. E., Lamont, E., & Alloway, T. P. (2006). Working memory in the classroom. In S. Pickering (Ed.), *Working memory and education*. London: Academic Press.
Gathercole, S. E., Pickering, S. J., Ambridge, B., & Wearing, H. (2004). The structure of working memory from 4 to 15 years of age. *Developmental Psychology*, *40*(2), 177.
Hallgren, K. A. (2012). Computing inter-rater reliability for observational data: An overview and tutorial. *Tutorials in Quantitative Methods for Psychology*, *8*(1), 23.
Hooper, S. R. (2002). The language of written language: An introduction to the special issue. *Journal of Learning Disabilities*, *35*(1), 2–6.
Hooper, S. R., Swartz, C. W., Wakely, M. B., De Kruif, R. E., & Montgomery, J. W. (2002). Executive functions in elementary school children with and without problems in written expression. *Journal of Learning Disabilities*, *35*(1), 57–68.
Kaiser, M. L., Albaret, J. M., & Doudin, P. A. (2009). Relationship between visual-motor integration, eye-hand coordination, and quality of handwriting. *Journal of Occupational Therapy, Schools, & Early Intervention*, *2*(2), 87–95.
Kellog, R. T. (1996). A model of working memory in writing. In C. M. Levy & S. Ransdell (Eds.), *The science of writing: Theories, methods, individual differences and application* (pp. 57–71). Mahwah, NJ: Erlbaum.
Kroese, J. M., Hynd, G. W., Knight, D. F., Hiemenz, J. R., & Hall, J. (2000). Clinical appraisal of spelling ability and its relationship to phonemic awareness (blending, segmenting, elision and reversal), phonological memory and reading in reading-disabled, ADHD and normal children. *Reading and Writing*, *13*, 105–131.
Lanfranchi, S., Cornoldi, C., & Vianello, R. (2004). Verbal and visuospatial working memory deficits in children with down syndrome. *American Journal on Mental Retardation*, *109*(6), 456–466.

Langmaid, R. A., Papadopoulos, N., Johnson, B. P., Phillips, J. G., & Rinehart, N. J. (2014). Handwriting in children with ADHD. *Journal of Attention Disorders*, *18*(6), 504–510.

Levy, C. M., & Marek, P. (1999). Testing components of Kellog's multicomponent model of working memory in writing: The role of the phonological loop. In M. Torrance & G. Jeffery (Eds.), *The cognitive demands of writing. Processing capacity and working memory in text production* (pp. 25–41). Amsterdam: Amsterdam University Press.

Logie, R. H. (2014). *Visuo-spatial working memory*. Hove, UK: Psychology Press.

Luisotto, E., Borella, E., & Cornoldi, C. (2011). Il grafismo nel bambino ADHD: Indici di velocità, qualità grafica e variabilità intraindividuale [Graphism in the ADHD child: Indexes of speed, graphic quality and intra-individual variability]. *Disturbi di attenzione e iperattività*, *6*(2), 5–14.

Martinussen, R., Hayden, J., Hogg-Johnson, S., & Tannock, R. (2005). A meta-analysis of working memory impairments in children with attention-deficit/hyperactivity disorder. *Journal of the American Academy of Child and Adolescent Psychiatry*, *44*, 377–384.

Marzocchi, G. M., Re, A. M., & Cornoldi, C. (2010). *BIA – Batteria Italiana per l'ADHD* [Italian Battery for the assessment of ADHD]. Trento: Erickson.

Mayes, S. D., & Calhoun, S. L. (2007). Learning, attention, writing, and processing speed in typical children and children with ADHD, autism, anxiety, depression, and oppositional-defiant disorder. *Child Neuropsychology*, *13*(6), 469–493.

Mayes, S. D., Calhoun, S. L., & Crowell, E. W. (2000). Learning disabilities and ADHD: Overlapping spectrum disorders. *Journal of Learning Disabilities*, *33*(5), 417–424.

McCutchen, D. (1996). A capacity theory of writing: Working memory in composition. *Educational Psychology Review*, *8*, 299–325.

McCutchen, D. (2000). Knowledge, processing, and working memory: Implications for a theory of writing. *Educational Psychologist*, *35*(1), 13–23.

McGraw, K. O., & Wong, S. P. (1996). Forming inferences about some intraclass correlation coefficients. *Psychological Methods*, *1*(1), 30–46.

Noda, W., Ito, H., Fujita, C., Ohnishi, M., Takayanagi, N., Someki, F., … Tsujii, M. (2013). Examining the relationship between attention deficit/hyperactivity disorder and developmental coordination disorder symptoms, and writing performance in Japanese second-grade students. *Research in Developmental Disabilities*, *34*, 2909–2916.

Olive, T. (2004). Working memory in writing: Empirical evidence from the dual-task technique. *European Psychologist*, *9*(1), 32–42.

Olive, T., Kellogg, R. T., & Piolat, A. (2008). Verbal, visual, and spatial working memory demands during text composition. *Applied Psycholinguistics*, *29*(4), 669–687.

Passerault, J.-M., & Dinet, J. (2000). The role of visuospatial sketchpad in the written production of descriptive and argumentative texts. *Current Psychology Letters: Behavior, Brain & Cognition*, *3*, 31–42.

Patterson, K., Marshall, J. C., & Coltheart, M. (2017). *Surface dyslexia: Neuropsychological and cognitive studies of phonological reading*. London: Routledge.

Pazzaglia, F., & Cornoldi, C. (1999). The role of distinct components of visuo-spatial working memory in the processing of texts. *Memory*, *7*, 19–41.

Pinheiro, J. C., & Bates, D. M. (2000). Linear mixed-effects models: Basic concepts and examples. In *Mixed-Effects Models in S and S-Plus*. New York, NY: Springer.

R Core Team. (2015). *R: A language and environment for statistical computing* [Internet]. Vienna, Austria: R Foundation for Statistical Computing.

Ransdell, S., Arecco, M. R., & Levy, C. M. (2001). Bilingual long-term working memory: The effects of working memory loads on writing quality and fluency. *Applied Psycholinguistics*, *22* (1), 113–128.

Re, A. M. (2006). Disturbo da Deficit di Attenzione con Iperattività e abilità di scrittura [Deficit and Hyperactivity Disorder and writing skills]. *Psicologia clinica dello sviluppo*, *10*(1), 123–140.

Re, A. M., Caeran, M., & Cornoldi, C. (2008). Improving expressive writing skills of children rated for ADHD symptoms. *Journal of Learning Disabilities*, *41,6*, 535–544.

Re, A. M., & Cornoldi, C. (2010). Expressive writing difficulties of ADHD children: When good declarative knowledge is not sufficient. *European Journal of Psychology of Education*, *25*(3), 315–323.

Re, A. M., & Cornoldi, C. (2013). Spelling errors in the copy of a text by children with dyslexia and ADHD symptoms. *Journal of Learning Disabilities*. Published online. doi:10.1177/0022219413491287

Re, A. M., Mirandola, C., Esposito, S. S., & Capodieci, A. (2014). Spelling errors among children with ADHD symptoms: The role of working memory. *Research in Developmental Disabilities*, *35*(9), 22199–22204.

Re, A. M., Pedron, M., & Cornoldi, C. (2007). Expressive writing difficulties in children described by their teacher as exhibiting ADHD symptoms. *Journal of Learning Disabilities*, *40*(3), 244–255.

Re, A. M., Pedron, M., & Lucangeli, D. (2010). *ADHD e Learning Disabilities* [ADHD and Learning Disabilities]. Milano: Franco Angeli.

Re, A. M., Tressoldi, P., Cornoldi, C., & Lucangeli, D. (2011). Which tasks best discriminate between dyslexic adults and controls in a transparent language? *Dyslexia*, *17*(3), 227–241.

Ross, P. A., Poidevant, J. M., & Miner, C. U. (1995). Curriculum-based assessment of writing fluency in children with attention-deficit hyperactivity disorder and normal children. *Reading & Writing Quarterly: Overcoming Learning Difficulties*, *11*(2), 201–208.

Shen, I. H., Lee, T. Y., & Chen, C. L. (2012). Handwriting performance and underlying factors in children with attention deficit hyperactivity disorder. *Research in Developmental Disabilities*, *33*(4), 1301–1309.

Skounti, M., Philalithis, A., & Galanakis, E. (2007). Variations in prevalence of attention deficit hyperactivity disorder worldwide. *European Journal of Pediatrics*, *166*(2), 117–123.

Stievano, P., Michetti, S., McClintock, S. M., Levi, G., & Scalisi, T. G. (2016). Handwriting fluency and visuospatial generativity at primary school. *Reading and Writing*, *29*(7), 1497–1510.

Stievano, P., & Scalisi, T. G. (2016). Unique designs, errors and strategies in the Five-Point Test: The contribution of age, phonemic fluency and visuospatial abilities in Italian children aged 6–11 years. *Child Neuropsychology*, *22*(2), 197–219.

Swanson, H. L., & Berninger, V. W. (1996). Individual differences in children's working memory and writing skill. *Journal of Experimental Child Psychology*, *63*(2), 358–385.

Thurstone, L. L., & Thurstone, T. G. (1981). *PMA, Test of primary mental abilities, age level 11–17. Italian Ed.* Firenze: Organizzazioni Speciali.

Tressoldi, P. E., Cornoldi, C., & Re, A. M. (2013). *Batteria per la valutazione della scrittura e della competenza ortografica nella scuola dell'obbligo III ed* [BVSCO, Battery for the assessment of writing skills of children from 7 to 13 years old, third ed.]. Firenze: Organizzazioni Speciali.

Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock-Johnson tests of achievement*. Itasca, IL: Riverside Publishing.

JOURNAL OF CLINICAL AND EXPERIMENTAL NEUROPSYCHOLOGY, 2018
VOL. 40, NO. 1, 17–29
https://doi.org/10.1080/13803395.2017.1307946

Routledge
Taylor & Francis Group

Effects of a working memory training program in preschoolers with symptoms of attention-deficit/hyperactivity disorder

Agnese Capodieci[a], Maria Laura Gola[a], Cesare Cornoldi[a] and Anna Maria Re[b]

[a]Department of General Psychology, University of Padova, Padova, Italy; [b]Department of Development and Socialization Psychology, University of Padova, Padova, Italy

ABSTRACT

Introduction: Preschoolers with attention-deficit/hyperactivity disorder (ADHD) have been found to exhibit impairments on neuropsychological measures of working memory (WM). As WM is an important predictor of future learning abilities, early intervention could help to prevent severe problems. The purpose of this research was to ascertain the efficacy of an intervention for training WM in 5-year-old children with symptoms of ADHD. *Method*: Thirty-four children with symptoms of ADHD were randomly divided into two groups: One was assigned to the WM training condition, and the other continued normal class activities. The training was provided at school in small groups that also included typically developing children. *Results*: The trained group showed a significant improvement in tasks measuring their WM and other controlled processes at conclusion of study, whereas no significant improvement was found in the control group. *Conclusions*: We concluded that early intervention on WM may be effective in children with symptoms of ADHD.

ARTICLE HISTORY
Received 30 August 2016
Accepted 10 March 2017

KEYWORDS
Attention-deficit/hyperactivity disorder; executive functions; preschoolers; training; working memory

Working memory (WM) has been defined as "a limited-capacity system allowing the temporary storage and manipulation of information necessary for such complex cognitive tasks as comprehension, learning, and reasoning" (Baddeley, 2000, p. 418). Baddeley's (2000) theoretical model of WM distinguishes between a central controlled component (the "central executive") and limited-capacity, short-term memory components. Research with children support the distinction between short-term memory tasks that involve the storage of information and WM tasks that demand attentional control (Alloway, Gathercole, & Pickering, 2006; Martinussen & Major, 2011). This distinction seems to be crucial in the case of children with attention-deficit/hyperactivity disorder (ADHD), who are weak in controlled WM, but not in short-term memory (e.g., Cornoldi, Giofrè, Calgaro, & Stupiggia, 2013). Finally Cornoldi (2007) have shown that the differentiation between passive (low controlled) and active (high controlled) WM processes may vary along a continuum also including intermediate cases.

ADHD is a developmental disorder characterized by inattention, impulsivity, and hyperactivity (American Psychiatric Association, 2013). Among the cognitive deficits identified in this disorder, WM impairment is particularly important (Kuntsi, Oosterlaan, & Stevenson, 2001; Mariani & Barkley, 1997; Rapport, Chung, Shore, Denney, & Isaacs, 2000) because WM is associated with a broad set of academic skills, including mathematical problem solving, reading and language comprehension, and written expression (Alloway, Gathercole, Kirkwood, & Elliott, 2009; Montgomery, Polunenko, & Marinellie, 2009; Swanson, Howard, & Sáez, 2007). WM is also associated with children's ability to cope with requirements commonly encountered at school, such as following instructions (Gathercole, Durling, Evans, Jeffcock, & Stone, 2008). For example, Gathercole et al. (2008) reported a significant association between WM and the accuracy with which children were able to carry out instructions such as "Pick up the yellow ruler and put it in the black box." WM difficulties are also associated with weaknesses in planning, organizing information, and monitoring school work (Alloway et al., 2009; Gathercole et al., 2008). Preschoolers with ADHD characteristics and children with problems in executive functions with poor WM may consequently be at risk of future weaknesses in learning academic skills.

Preschoolers are not frequently diagnosed with ADHD because at this age symptoms or delayed maturation could overlap with symptoms of ADHD and lead to incorrect diagnosis. Therefore, many studies have included children who exhibit symptoms and characteristics of ADHD, as reported by parents and teachers, but

CONTACT Agnese Capodieci agnesecapox@gmail.com University of Padua, via Martini 10, Dosson di Casier, 31030 Treviso, Italy

who do not have a diagnosis. These studies that compare preschool-age children with symptoms to children without symptoms from the same cohort report impairment in WM (Mariani & Barkley, 1997; Re, De Franchis, & Cornoldi, 2010; Schoemaker et al., 2012; Sinzig, Vinzelberg, Evers, & Lehmkuhl, 2014), with particular association with weaknesses in control processes. In particular, Sonuga-Barke and colleagues (2002) examined a large sample of preschoolers with ADHD and found specific weaknesses in capacity for inhibition, planning, and WM. Also, Re and colleagues (2010), using a visuospatial WM task that required the selective recall of information, found that children with ADHD symptoms performed less well than controls, particularly in rates of intrusion errors (i.e., the recall of initially encoded information that needed to be suppressed during the task). In summary, the literature shows that WM is already impaired in preschoolers with ADHD symptoms, and that this ability is crucial to the children's development because it is essential for coping with academic and life demands in later years (Diamond, 2012). This means that WM could be the target of early interventions aiming to reduce the future negative consequences of a poor WM of children with ADHD, as also suggested by previous research showing the impact of early-onset ADHD symptoms (Sonuga-Barke, Thompson, Abikoff, Klein, & Brotman, 2006). Early intervention (Young & Amarasinghe, 2010) has also had positive consequences for the neurodevelopment of children with ADHD symptoms. Despite the potential benefits of early intervention on young children exhibiting ADHD symptoms, few intervention studies have been conducted on such children younger than six years of age. The role of WM has yet to be thoroughly investigated in this age group, whereas more work has been done with older children (Evans, Owens, & Bunford, 2013; Klingberg, Forssberg, & Westerberg, 2002).

In general, it seems important to devise intervention projects to support young children with ADHD symptoms, possibly involving not only the children themselves but also their schools and families (DuPaul & Kern, 2011; Sonuga-Barke, Daley, Thompson, Laver-Bradbury, & Weeks, 2001; Young & Amarasinghe, 2010). In fact, a meta-analysis (Rajwan, Chacko, & Moeller, 2012) found 29 intervention studies on young children, most of which concerned parent training. Only four studies considered a direct psychological intervention for the children, but they aimed mainly at teaching them skills for controlling their behavior, focusing on cognitive–behavioral strategies, or using contingency analyses and reinforcement techniques, without considering the associated neuropsychological problems in depth. Furthermore, only a few studies of preschool children involved intervention on executive functions (EFs; Bergman Nutley et al., 2011; Röthlisberger, Neuenschwander, Cimeli, Michel, & Roebers, 2012). In particular, EF intervention programs for ADHD preschoolers were adopted in two studies, one by Halperin et al. (2012), the other by Re, Capodieci, and Cornoldi (2015). In the first study, children and their parents took part in group sessions where they played games designed to develop inhibitory control, WM, attention, visuospatial abilities, planning, and motor skills. Parents were also prompted to play these games with their children for at least 30–45 min a day. Parents' and teachers' assessments of the severity of the children's ADHD symptoms dropped significantly from pre to post test. In the second study, a group training was provided at school to improve attentional control, WM, and impulsive behavior of 5-year-old children with ADHD symptoms. The children taking part in the intervention showed an improvement in their EFs, confirming the importance of early intervention for preschool-age children with ADHD symptoms.

To sum up, studies on the effects of cognitive intervention on young children's EFs have produced good results, but the effects of WM training on children with ADHD have yet to be studied in depth. The only study on this issue (Dongen-Boomsma, Vollebregt, Buitelaar, & Slaats-Willemse, 2014) was implemented outside school, and has the limitation that requires the availability of a particular computerized program, and cannot be easily embedded in everyday school practices. More evidence is therefore needed on the effects of programs specifically targeting WM for preschoolers with ADHD symptoms and applicable as part of their everyday school activities, possibly in groups, and based on a protocol that makes any results repeatable (Rapport, Orban, Kofler, & Friedman, 2013). The preliminary evidence available on the effects of interventions on EFs with preschoolers with symptoms of ADHD (DuPaul & Kern, 2011; Halperin et al., 2012; Re et al., 2015) seems promising, showing long-term effects in preventing the disruptive behavioral problems (as referred in the follow-up thru a parents' questionnaire) associated with this condition (Kern et al., 2007; Washbrook, Propper, & Sayal, 2013), and it seems important to ascertain whether this is also true for the case of a training specifically focused on WM. The use of parental ratings has the limitation that it is a subjective measure, and parents could have incentive in the success of the program. The inclusion of both subjective rating and objective outcomes could help to have a better measure of the effectiveness of the trainings.

The present study was devoted to more systematically examining the effects of a WM training provided for groups of preschoolers as part of their school activities, and involving both children with ADHD symptoms and

typically developing (TD) children in interaction within each trained group. The inclusion within each group of both children with ADHD and typically developing children was due to the schools' adoption of an inclusion model where children with behavioral difficulties work together with children without problems, but had also the advantages of having activities deeply rooted in the school settings and of using children's classmates as positive models for ADHD children during the trained activities. Schools typically need interventions to be suitable for implementation during everyday activities, and to be of interest to all children in the class. The present study thus aimed to test the efficacy of an intervention embedded in the school setting and replicable by the schools themselves, although this carried the disadvantage of certain limitations and requirements imposed by the schools involved. The training focused on the active component of WM, which seems to be specifically impaired in children with ADHD (Cornoldi et al., 2013), using a published program and proposing group activities for promoting the children's active WM (Caponi, Clama, Re, & Cornoldi, 2009). We expected to see a specific effect of the training on active WM, and we also checked for transfer effects to other EFs, passive WM, short-term memory, and behavioral measures. The issue of transfer effects of WM treatments has been amply discussed in recent years. It has been argued that WM improvements cannot be generalized to other independent intellectual skills (e.g., Melby-Lervåg, Redick, & Hulme, 2016) or innate temperamental characteristics (Rapport et al., 2013). An improvement might be seen in other types of memory or executive function, however, that share with active WM either the same short-term maintenance processes or the control processes. In the present study, this issue was investigated by testing the children before and after the training using not only a measure of active WM, but also passive WM and executive control measures. As the experimental design of our study focused on the children with ADHD symptoms, and TD were only involved at the request of the schools participating in the study, the focus of our analyses is on the former.

Method

Participants

The study involved 34 children attending their last year of kindergarten and exhibiting symptoms of ADHD, who resulted from a selection (see Figure 1) based on the consideration of 183 children belonging to schools including many at-risk children. It should be noted that these children had not been specifically diagnosed with ADHD—a condition still rarely diagnosed in Italy at any age (Skounti, Philalithis, & Galanakis, 2007) and virtually never before six years old.

The authors identified symptoms of ADHD based on interviews and information collected from teachers using a validated rating scale, the IPDDAI [Identificazione Precoce del Disturbo da Deficit di Attenzione/iperattività per Insegnanti—(Early Identification of ADHD for Teachers); Re & Cornoldi, 2009], and from parents using another rating scale, the IPDDAG [Identificazione Precoce del Disturbo da Deficit di Attenzione/iperattività per Genitori (Early Identification of ADHD for Parents); Riello, Re, & Cornoldi, 2005]. The presence of each type of behavior was reported by teachers and parents using a 4-point Likert scale ranging from 0 to 3 (0 = *never*; 1 = *sometimes*; 2 = *often*; 3 = *always*). Ratings for the single items were summed in order to obtain, respectively, overall Inattention and Hyperactivity scores. As shown in Figure 1, at the beginning 183 children were assessed for eligibility, and then 53 were excluded for different reasons. After this first step, 130 children remained, and from this group we selected children with symptoms of ADHD (40 children) and matched peers without these characteristics (40 children); thereafter the children selected were allocated in the training or in the no-training condition.

The children with ADHD symptoms were randomly assigned to two conditions as follows: A total of 18 children (14 boys and 4 girls, M_{age} = 65.88 months, *SD* = 3.81) were involved in the experimental training (the training condition) while 16 (14 boys and 2 girls, M_{age} = 65.88 months, *SD* = 3.77) took part in their normal school activities (the no-training condition). The sizes of the groups were slightly different because, for organizational reasons, if one child in a class was assigned to a condition, eventually other children of the same class were assigned to the same condition. The two groups of children with ADHD symptoms completed their respective activities together with 40 TD children (IPDDAI total score below 3, i.e., >50th percentile) who were selected from the same classrooms as the children with ADHD symptoms and had similar age, schooling, sociocultural level, and general ability, but without any ADHD symptoms. In choosing the TD children to be involved in the study, we had to decide whether or not to maintain the same proportions of males and females as in the groups with ADHD symptoms (i.e., considerably more boys than girls). As the study design did not foresee comparisons between children with ADHD symptoms and TD children (but only between treated and untreated children with ADHD symptoms), after discussing this issue with the schools participating in the study, we opted to randomly select TD children in order to represent the

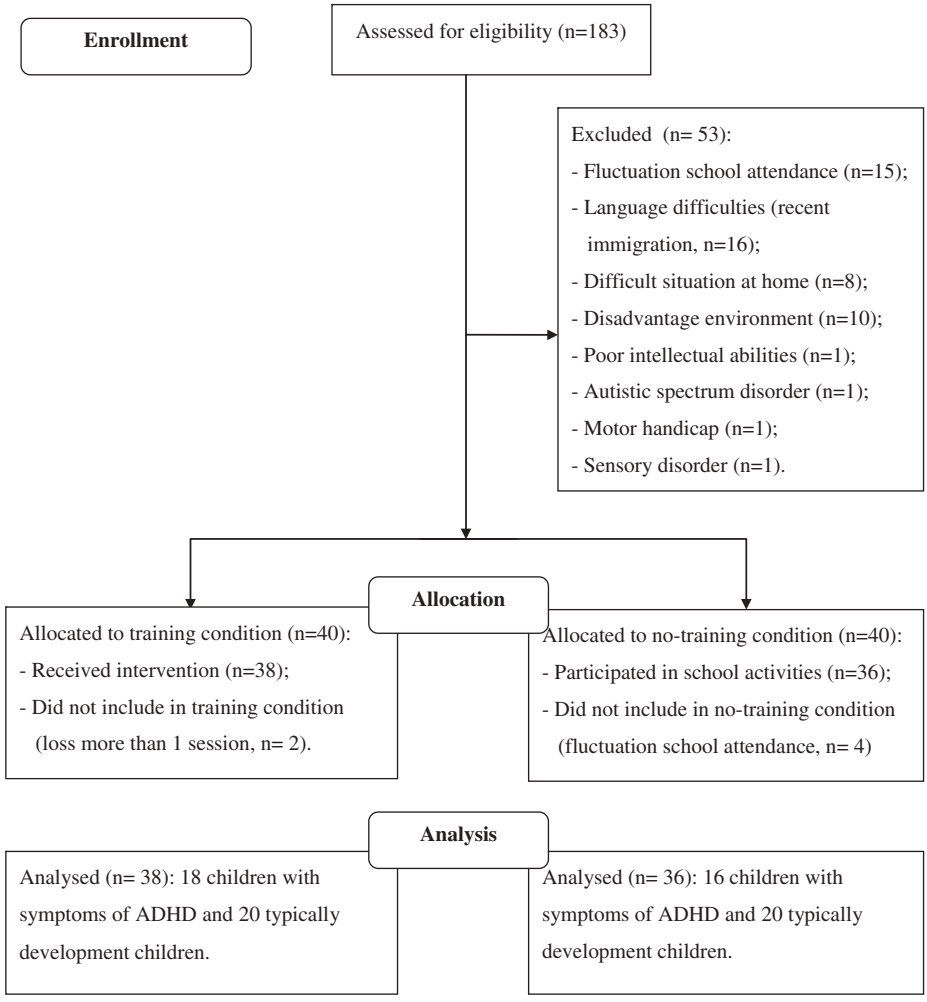

Figure 1. Procedure for selection and analysis of participants. ADHD = attention-deficit/hyperactivity disorder.

gender balance of a typical school class (see Re et al., 2015). Of the TD children selected, 20 (10 boys and 10 girls, M_{age} = 66.55 months, SD = 3.63) were randomly assigned to the training condition, and 20 (12 boys and 8 girls, M_{age} = 66.63 months, SD = 4.72) to the no-training condition. This study was conducted in accordance with the recommendations of the ethics committee of the University of Padua and was approved by the institutional committee.

Procedure

The authors identified symptoms of ADHD based on interviews and information collected from teachers using a validated rating scale, the IPDDAI (Re & Cornoldi, 2009) and from parents using another rating scale, the IPDDAG (Riello et al., 2005). The IPDDAI contains 14 items that refer to symptoms described in the *Diagnostic and Statistical Manual of Mental Disorders–Fifth Edition* (*DSM–5*, American Psychiatric Association, 2013) and that are identified as the most predictive of ADHD in children of preschool age (7 concerning inattention, 7 concerning hyperactivity/impulsivity) in the study by Re and Cornoldi (2009). As the full IPDDAI scale is not available in English, we have added its translation in an Appendix (see Appendix A). This version, used in the present study, includes additional items not referring to ADHD symptoms. Some additional items were included in the original version of the IPDDAI (Items 19, 20, 21, 22), and four items were specifically created for this study (Items 15, 16, 17, 18) in order to investigate the teachers' impression on children's WM functioning in everyday-life activities at school (e.g., "child has difficulty in remembering a short rhyme by heart"). The IPDDAI scale has been validated and standardized for the Italian population and appears to correlate closely with scores for ADHD obtained with the Conners' Teacher Rating Scale Revised (Nobile, Alberti, & Zuddas, 2007) for both Inattention (r = .88) and Hyperactivity (r = .84; Trevisi & Re, 2008). Though test–retest data are only available for the version for older children (r = .80), there is evidence showing the good predictive properties of the version for preschoolers.

In particular, Marcotto and colleagues (2002) found a positive correlation (r = .56) in a study correlating the IPDDAI scores awarded by kindergarten teachers with ADHD symptoms identified a year later by primary school teachers. Information collected with the scales was integrated with data from interviews with the teachers in order to examine whether the ADHD profile that emerged from the IPDDAI corresponded to an ADHD profile that emerged not only in classroom but also in other contexts.

The IPDDAG (an English version of the scale is presented in the Appendix of the paper by Re & Cornoldi, 2009) is parallel to the IPDDAI, and concerns the 14 symptoms found most representative of ADHD in children of preschool age and that showed the strongest discriminatory power in a preliminary study conducted with parents (Riello et al., 2005). It consists of 19 items: seven for inattention, seven for hyperactivity/impulsivity, and five for "risk factors" (poor cognitive abilities, languages difficulties, aggressive behaviors, emotional problems, and relational problems). The scale has a Cronbach's alpha of .88 (Riello et al., 2005) and a medium test–retest reliability, r = .59, $p < .001$, for the total score (Marcotto et al., 2002).

We collected scores from the IPDDAI for all children, but unfortunately not all parents completeded the IPDDAG questionnaire so that it was necessary to collect information on children's behavior at home with informal interviews with teachers and parents. The ADHD group scored more than 9 (a cutoff suggested by Caponi et al., 2009, corresponding to the approximately 15th percentile) either on the Inattention or the Hyperactivity subscale of the IPDDAI or on both, and appeared to have symptoms of ADHD at home, judging from the parents' ratings and parents' and teachers' responses. As a disadvantaged family, especially in the case of recently immigrated children who might have irregular school attendance, could find it difficult to implement the program, the group of children from a disadvantaged environment or difficult home situation were excluded based on interviews with teachers and the information obtained with the IPDDAI (see Appendix A, Items 19 and 21). Also, the few children with either weak intellectual abilities (as measured by the IPDDAI specific control item, see Appendix A, Item 20: We excluded children with the rating of 3) or other neurodevelopmental problems (in particular autistic spectrum disorder, sensory disorders, motor handicap, or other major neurological diseases) were excluded from the sample. Therefore all the children were Italian and had no physical, sensory, or neurological impairments, they spoke Italian fluently, and they had not grown up in a disadvantaged or problematic family. We also ascertained that the children were not receiving any other type of treatment including medication.

Tasks

After administering the teachers' rating scale and before the training, all the children completed a set of tests. Following the Cornoldi (2007) classification, we administered one active WM measure (Span Backward; Bisiacchi, Cendron, Gugliotta, Tressoldi, & Vio, 2005), one high-demand active WM measure (Selective WM; Lanfranchi, Cornoldi, & Vianello, 2004; Re et al., 2010), one passive WM measure (Span Forward, Bisiacchi et al., 2005), and two EF measures in which previous research had found preschoolers with ADHD to be often impaired—that is, a controlled attention measure (the Walk–No Walk Test, Marzocchi, Re, & Cornoldi, 2010) and an impulsivity control measure (Matching Figures, MF-14; Marzocchi et al., 2010). Each test was preceded by instructions and practice trials. Testing was done individually by psychology postgraduate students and took about one hour for each child to complete. The tests were administered in the same order as follows: Span Forward, Span Backward, WM, Selective WM, Walk–No Walk, MF-14. Each test was only administered when the children appeared to have understood the nature of the task and had responded correctly in practice trials.

Forward and Backward Digit Span tests (FDS and BDS)

Similar to the classical digit span tasks (using the adaptation by Bisiacchi et al., 2005), in the Forward Digit Span (FDS) task children listened to a series of digits (e.g., 3, 8, 5) and were asked to repeat them immediately in the same order. If they did so successfully, they were given a longer list (e.g., 6, 8, 1, 2). In the Backward Digit Span (BDS) task, they were required to reverse the order of the numbers (e.g., for 5, 9, 6, they had to say 6, 9, 5). For the purposes of our study, we measured the number of series the children could correctly remember. The test–retest reliability for the FDS observed in a sample of 709 children from 59 to 140 months of age (Alloway et al., 2006) was .84, and for the BDS it was .64.

Selective Working Memory Test

This measure was obtained by combining two tasks that involve selecting and recalling target information, and inhibiting irrelevant information, while performing a concurrent task (hand clapping when a particular target was presented). The test used visuospatial and verbal material. The visuospatial material (Re et al., 2010) was based on a 4 × 4 matrix (17 cm × 17 cm), divided into 16 cells, one of which was red. To make the task more attractive, a small plastic frog was shown moving around in the matrix. For each path taken by

the frog, the children had to remember its first position and clap their hands when the frog was in the red square. There were 10 trials of increasing difficulty, defined by the number of cells occupied by the frog (the length of the path) from a minimum of two to a maximum of six cells. There were two trials for each path length. The child was required to complete all trials of the test. A trial was completed correctly only if the child recalled the frog's first position and clapped their hands at the right time. Cronbach's alpha for this subtest is .84 (Lanfranchi, De Mori, Mammarella, Carretti, & Vianello, 2015). The verbal material (Lanfranchi et al., 2004) consisted of eight very concrete and familiar two-syllable words (i.e., the Italian two-syllable words corresponding to the English words house, mother, dog, cat, apple, grandma, ball, and sun). The experimenter presented the words verbally at a rate of 1 word per second. The task progressed to increasingly long lists, containing from two to five words. The children had to remember the first word on the list and to tap on the table when they heard the word "ball." The maximum scores on the Selective WM test was 18. Cronbach's alpha for this subtest is .85 (Lanfranchi et al., 2004).

Walk–No Walk test

The Walk–No Walk test (Marzocchi et al., 2010) is a paper-and-pencil test that assesses attentional control and inhibition of an ongoing response. It is derived from the "stop signal task" of Logan and Cowan (1984). The children had to follow a series of directions and inhibit an ongoing response when a particular event (an auditory signal) occurred. The test consists of two sheets of A4 paper on which 20 staircases (one for each trial) are drawn with a little frog on the first stair. The children were asked to start crossing out the stairs as if the frog was climbing them one by one each time they heard the GO signal, and to stop doing so every time heard the STOP signal. The STOP and GO signals were very similar but ended differently, so the children needed to wait until they had heard the whole sound before responding to a signal. The score corresponded to the number of trials completed correctly (maximum score = 20). The test–retest reliability is r = .70 (Marzocchi et al., 2010).

Matching Figures Test (MF-14)

The MF-14 test (Marzocchi et al., 2010) is derived from the Matching Familiar Figures Test (MFFT; Kagan, 1966) and assesses several executive functions, particularly impulsivity control. The test consists of 14 images of everyday objects, and comprises a target picture and six other similar pictures, only one of which is a duplicate of the target. The child was told to identify the picture that was exactly the same as the target. The score for this test was the number of errors and could at the pure theoretical level of a child systematically selecting all the wrong responses for each item reach the error score of 70 (the range in a standardization sample of preschoolers was between 0 and 35). Although the test–retest reliability calculated in a series of studies and reported in the manual (Marzocchi et al., 2010) is only moderate (ranging between .49 and .60), the test has been validated and used successfully in a large number of studies (see Marzocchi et al., 2010).

Retest

A week after the children completed the training (see below), the teachers were invited to complete the IPDDAI scale again, the parents were asked to complete the IPDDAG questionnaire, and the children were administered the same measures as before the training, in the same order. Teachers were not naïve with respect to the condition, but the parents had not been explicitly informed about the study design. Furthermore experimenters who carried out the assessment (psychology postgraduate students) were blind to randomization (training vs. no training).

Training

The training was administered in 16 one-hour sessions distributed twice weekly over an 8-week period, in groups of 6–8 children (children were trained in a group, although many activities had to be carried out by each child individually within the group). The training involved activities presented in the manual published by Caponi and collaborators (2009; see also Re & Cornoldi, 2007), and was administered at school by one of the two class teachers supervised by trained psychologists in between routine school activities, whereas the other children remained with the other teacher. The training activities were divided into four main blocks (Appendix B presents the complete series of activities):

Block 1: The first two sessions introduced behavioral strategies for retaining and controlling information in WM. A dummy with his rhyming poem was presented at the start of each session to indicate the beginning of the specific training activity.

Block 2: The next six sessions trained selective WM, where the selection had to be based on a criterion indicated by the trainer. Games requiring pencil and paper or a motor activity were proposed.

Block 3: The next six sessions concerned selective WM in association with an interpolated task. Games

requiring pencil and paper or a motor activity were proposed.

Block 4: The last two sessions focused on the ability to update information in WM.

The training included no materials or procedures directly related to the pre and post measures.

Each session (the detailed description of a session is reported in Appendix C) was always arranged in the same way:

(1) Metacognitive introduction: The trainer captured the children's attention and commented on the aim of the activity of the day.
(2) Presentation of the cognitive demands: The trainer explained the activity for the day.
(3) Instructions and preliminary practice with the activity of the day.
(4) Organization of the activity: The trainer organized the activity and, in some cases, divided the children into smaller groups.
(5) Practice with the activity: The trainer asked the children to complete the activity.
(6) Promotion of strategic reflections: The trainer asked the children to comment on the activity and report strategies they had used or thought they could use. The trainer guided the children's descriptions of any such strategies.
(7) Introspection and feedback: The trainer asked the children how well they thought they had done in the activity, gave them feedback, and discussed the reasons for any failures.

In the control condition, children were provided with an equivalent amount of time working on typical school activities, such as prereading and prewriting exercises. These activities were conducted by the other teacher of each class, who stimulated, as much as possible, the same type of interactions as those that were involved in the trained groups.

Fidelity of implementation

The authors of the present paper met every two weeks with the teachers involved in the study. During the training, the trainers kept a daily journal of the activities conducted at each session, which were examined by the experimenters and rated according to the degree of fidelity: low, medium, or high. In 90% of cases, the activities were rated as highly consistent with the training manual.

Data analysis

First, a comparison was drawn between the performance of the children with ADHD symptoms and the TD children in the pretest measures. Due to minor differences that emerged between the two groups of children with symptoms of ADHD in the initial measures, we decided to separately examined any changes in the performance of the two groups in the trained versus untrained condition (Student's t test with Bonferroni correction).

Audio recordings were also obtained in some cases, and sessions of observation and supervision were conducted for the control condition, considering the topics of each session.

Results

All children who were involved in the final groups, and whose data were analyzed, concluded the training with a maximum loss of one session. The two groups obtained similar scores on the IPDDAI rating scale (trained group: Inattention, M = 9.46, SD = 3.70, Hyperactivity, M = 9.77, SD = 3.57; control group: Inattention, M = 9.56, SD = 4.30, Hyperactivity, M = 10.06, SD = 5.19).

Table 1 shows the characteristics of the children with ADHD symptoms and the TD children on the behavioral and neuropsychological measures collected at pretest. Notice that for one measure (IPDDAG) it was not possible to collect information from all the parents but only for a relevant subgroup (N = 28 for children with symptoms of ADHD, N = 26 for TD children). As shown in Table 1, the differences between the performances of the ADHD and the TD groups in the pretest measures were significant for all measures except the FDS and Walk–No Walk tests. The finding for the FDS confirmed the hypothesis advanced by Cornoldi et al. (2013) that smart children with ADHD have more difficulty with active WM than with passive WM tasks. The Walk–No Walk task result was unexpected, however, and might be due to high variability in performances in this age due to task difficulty.

Due to minor differences that emerged between the trained and untrained groups of children with symptoms of ADHD in the initial measures (Table 2), we decided to separately examined any changes in the performance of the two groups (Student's t-test with Bonferroni correction). Table 2 shows that the trained group significantly improved in all the neuropsychological measures. The effect was greater, with a relevant (Cohen, 1988) effect size for the active WM (BDS), and the high-demand active WM measure (Selective Working Memory). A significant,

Table 1. Characteristics of the ADHD and the TD groups.

	ADHD symptoms (N = 34)	Typical development (N = 40)	t(72)
Ratings			
IPDDAI Inattention	9.51 (3.93)	1.99 (2.31)	9.80***
IPDDAI Hyperactivity	9.91 (4.34)	2.51 (2.43)	8.82***
IPDDAI WM	4.56 (3.50)	0.78 (1.51)	5.86***
IPDDAG Inattention	7.50 (4.25)	4.04 (3.01)	3.43**
IPDDAG Hyperactivity	9.82 (4.39)	5.50 (3.36)	4.04***
Neuropsychological measures			
FDS	3.56 (0.70)	3.60 (0.71)	0.25
BDS	1.15 (1.16)	1.83 (0.98)	2.69**
Selective Working Memory	7.65 (3.67)	10.73 (3.64)	3.61**
Walk–No Walk	9.39 (4.43)	9.75 (5.64)	0.29
MF-14	24.65 (7.22)	17.75 (7.30)	3.88***

Note. Means, with standard deviations in parentheses, and t test results of the comparison between the groups. ADHD = attention-deficit/hyperactivity disorder; TD = typically developing; IPDDAI = Rating Scale "Identificazione Precoce del Disturbo da Deficit di Attenzione/iperattività per Insegnanti" (Early Identification of ADHD for Teachers); IPDDAG = Rating Scale "Identificazione Precoce del Disturbo da Deficit di Attenzione/iperattività per Genitori" (Early Identification of ADHD for Parents); WM = Working Memory; FDS = Forward Digit Span; BDS = Backward Digit Span; MF = Matching Figures.
*p < .05. **p < .01. ***p < .001.

Table 2. Performance at pre and post test of children with symptoms of ADHD in the training and no-training conditions.

	Training (N = 18)				No training (N = 16)			
	Pre test	Post test	t(17)	d	Pre test	Post test	t(15)	d
Teachers' ratings								
IPDDAI Inattention	9.46 (3.70)	6.81 (3.89)	2.75	0.70	9.56 (4.30)	7.00 (4.70)	2.65	0.57
IPDDAI Hyperactivity	9.77 (3.57)	7.37 (3.65)	2.85	0.66	10.06 (5.19)	7.79 (5.18)	2.46	0.44
IPDDAI WM	4.49 (3.53)	1.66 (1.68)	4.43*	1.00	4.13 (3.52)	2.13 (2.03)	3.70*	0.70
IPDDAG Inattention	7.10 (5.69)	6.30 (3.64)	0.86	0.17	7.82 (2.82)	5.91 (2.77)	2.70	0.68
IPDDAG Hyperactivity	11.50 (4.95)	9.60 (4.90)	1.49	0.39	8.82 (3.84)	7.73 (3.61)	1.34	0.29
Neuropsychological measures								
FDS	4.78 (1.59)	6.17 (2.23)	3.13*	0.72	4.44 (1.86)	5.06 (1.69)	1.62	0.35
BDS	1.33 (1.70)	4.22 (1.68)	7.64*	1.70	2.50 (2.28)	3.00 (2.00)	0.82	0.23
Selective Working Memory	7.67 (2.57)	12.78 (3.32)	5.23*	1.70	7.63 (4.70)	10.00 (3.48)	2.46	0.57
Walk–No Walk	7.27 (3.86)	11.93 (3.61)	4.72*	1.25	11.38 (4.08)	13.13 (4.00)	1.68	0.43
MF-14	24.27 (7.18)	16.20 (5.12)	5.96 *	1.29	25.00 (7.62)	20.44 (6.39)	2.30	0.65

Note. Mean scores, with standard deviations in parentheses, and comparisons between the pre and the posttest measures (Student's t test and Cohen's d). ADHD = attention-deficit/hyperactivity disorder; IPDDAI = Rating Scale "Identificazione Precoce del Disturbo da Deficit di Attenzione/iperattività per Insegnanti" (Early Identification of ADHD for Teachers); IPDDAG = Rating Scale "Identificazione Precoce del Disturbo da Deficit di Attenzione/iperattività per Genitori" (Early Identification of ADHD for Parents); WM = Working Memory; FDS = Forward Digit Span; BDS = Backward Digit Span; MF = Matching Figures.
*Significant (alpha = .05) after Bonferroni's correction (p = .006).

albeit smaller, effect was seen for the FDS too, although passive WM was not the object of the treatment. A significant effect of the training emerged even in the tasks for measuring other EFs (attentional control and inhibition, Walk–No Walk, and impulsivity control, MF-14), which were outside the treatment goals. We observed small improvements in all measures in the control group as well, but they had low effect sizes and never reached statistical significance. Concerning the teachers' ratings of the children on attention and hyperactivity using the IPDDAI scale, we found a small but statistically not significant improvement in both groups. On the other hand, the ratings describing WM showed an improvement in both groups that, judging from the descriptive statistics and effect size (Table 2), was larger for the children who took part in the training. Similar results were found for parents' ratings using the IPDDAG scale, although the significance of these results are disminished because not all parents, despite the fact that they in general seemed satisfied with the program, completed the questionnaire (N = 15 for the training condition and N = 13 for the no-training condition).

Based on the clinical significance criteria, the training improved children's performance compared with the non-trained children in all parameters, except for inattention of the IPPDAG rating scale, with large effect sizes, calculated with Cohen's d and interpreted according to Cohen (1988) recommendations, which ranged between 0.70 (for WM items of IPDDAI) and 1.70 (for BDS and Selective WM).

Conclusions

The main goal of this work was to examine the value of training of WM with children with symptoms of ADHD

in the extraordinarily sensitive period represented by their preschool years. For this purpose, we provided WM training for a group of 5-year-old children, adopting a metacognitive approach and aiming to improve the children's WM through playful activities that involved the need to maintain information and control it. The children with ADHD symptoms were randomly assigned to the training or the no-training condition given during normal school activities. At the request of the school, the children were trained together with other TD children to avoid isolating the children with ADHD symptoms.

Our results suggest that a WM training can be effective —although its effect was evident on our neuropsychological measures but not in the inattention and hyperactivity problems rated by teachers and parents (where the trained group improved slightly, but so did the control group). A part of the improvement seen in the children may be due to nonspecific factors, of course, such as practice with the tests, gains deriving from other general activities provided to the children during the same period, and their associated maturation over almost three months period (between pre and post test). The improvement seen in the neuropsychological measures was significant only in the trained group, however, which suggests that the training had a specific effect. In particular, the training that focused on active WM – on the ability to control information stored in WM – had a positive effect on the trained children and also concerned their passive WM, albeit to a lesser extent. This could be due to the effect of practice on the maintenance component of WM (also involved in active WM), but it may also be that the preschoolers benefitted from improved control abilities in short-term-memory tasks as, for 5-year-olds, short-term-memory tasks also require effort and control. In the trained group, a significant transfer effect was also observed for the EF measures, suggesting that training young children to control information stored in their WM may help them to improve their ability to control their cognitive activity in other tasks as well. In fact, the trained children also showed conspicuous improvements in the two tasks (FDS and Walk–No Walk) in which they had no particular difficulty by comparison with the TD children, suggesting that the training may not only attenuate their weaknesses, but reinforced the self-control (or reduced the impulsivity) of children with symptoms of ADHD.

Conversely, the teachers saw little improvement in the presence of ADHD symptoms, which decreased similarly in the two groups. It is worth emphasizing that it was necessary for the goals and method of our study to be shared with the teachers who rated the children, so they knew which children were in which group. This is a strength of the procedure, but also a weakness in terms of how the teachers' ratings should be interpreted. The teacher's bias might have engendered an overly critical view of any symptom improvement in the trained group, however, which was rated on a par with the control group. There may have been a bias in the opposite direction, inducing the teachers to pay more attention to the symptoms of the children in the training group. Teachers reported a similar WM improvement in both groups, despite the fact that only the trained group significantly improved in the WM objective measures.

In our view, this study has important clinical and educational implications. First, it demonstrates the feasibility of administering WM training to preschool children who exhibit ADHD symptoms. Our training had the advantages of being easy to implement as part of the preschoolers' usual school activities, it was well received by children, teachers, and parents, and it produced specific effects on the children's WM. Because active WM is related to a number of school activities (e.g., comprehension, expressive writing, problem solving, mental calculation, etc.), we hypothesize that the benefits of improving WM could extend to various aspects of cognitive functioning and academic performance. In the present study, our trained group showed a significant improvement in EFs that had not been specifically trained—attentional control and impulsive response control. However, we were allowed to collect only a limited number of measures and could not assess far transfer effects, such as changes in school-related behaviors or longitudinal outcomes on primary academic abilities in the present study, so only future research will be able to shed more light on these aspects.

In particular, it has been suggested (Kern et al., 2007) that working with very young children can also have the advantage of helping to prevent any negative consequences for self-esteem and the emotional and motivational difficulties caused by having symptoms of ADHD, and may reduce the onset of oppositional or deviant behavior. Our training may contribute to improving self-esteem, but this aspect was not directly studied in the present research. In fact, the present study has other limitations including the small number of children trained, the modest involvement of their parents, and the absence of follow-up measures. Further research should also examine the issue of the specificity of the observed effects (as we could not exclude that social and motivational aspects of the training could affect the performance). Future studies should collect data on individual clinical profiles of the children, which might inform why some children improved while others did not. Further research examining the implications of the same type of WM training for preschoolers with other types of risk—for example, learning disabilities—may reveal WM weaknesses (Swanson et al., 2007). Even with these limitations, our findings show that great attention should be paid to the opportunities afforded by early cognitive

interventions for children with ADHD or who exhibit symptoms of this disorder. Even if a diagnosis of ADHD is difficult to discern in the preschool age, early identification and intervention could be very beneficial for the future of the children affected.

Acknowledgments

I would thank the INS ILC Research Editing and Consulting Program for their help and in particular Carol Armstrong for her valuable suggestions and English revision.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

Alloway, T. P., Gathercole, S. E., Kirkwood, H., & Elliott, J. (2009). The cognitive and behavioral characteristics of children with low working memory. *Child Development*, *80*(2), 606–621. doi:10.1111/cdev.2009.80.issue-2

Alloway, T. P., Gathercole, S. E., & Pickering, S. J. (2006). Verbal and visuospatial short-term and working memory in children: Are they separable? *Child Development*, *77*(6), 1698–1716. doi:10.1111/cdev.2006.77.issue-6

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (pp. 5). Arlington, VA: Author.

Baddeley, A. (2000). The episodic buffer: A new component of working memory? *Trends in Cognitive Sciences*, *4*(11), 417–423. doi:10.1016/S1364-6613(00)01538-2

Bergman Nutley, S., Söderqvist, S., Bryde, S., Thorell, L. B., Humphreys, K., & Klingberg, T. (2011). Gains in fluid intelligence after training non-verbal reasoning in 4-year-old children: A controlled, randomized study. *Developmental Science*, *14*, 591–601. doi:10.1111/j.1467-7687.2010.01022.x

Bisiacchi, P. S., Cendron, M., Gugliotta, M., Tressoldi, P. E., & Vio, C. (2005). *BVN 5-11: Batteria di Valutazione Neuropsicologica per l'età evolutiva [Battery for neuropsychological assessment in children]*. Trento: Erickson.

Caponi, B., Clama, L., Re, A. M., & Cornoldi, C. (2009). *Sviluppare la concentrazione e l'autoregolazione. Giochi e attività sul controllo della memoria di lavoro*. [Improving concentration and self-regulation. Games and activities on the control of working memory]. Trento: Erickson.

Cohen, J. (1988). *Statistical power analysis for the behavioural sciences*. Hillside, NJ: Lawrence Erlbaum Associates.

Cornoldi, C. (2007). *L'intelligenza* [Intelligence]. Bologna: Il mulino.

Cornoldi, C., Giofrè, D., Calgaro, G., & Stupiggia, C. (2013). Attentional WM is not necessarily specifically related with fluid intelligence: The case of smart children with ADHD symptoms. *Psychological Research*, *77*, 508–515. doi:10.1007/s00426-012-0446-8

Diamond, A. (2012). Activities and programs that improve children's executive functions. *Current Directions in Psychological Science*, *21*(5), 335–341. doi:10.1177/0963721412453722

Dongen-Boomsma, M., Vollebregt, M. A., Buitelaar, J. K., & Slaats-Willemse, D. (2014). Working memory training in young children with ADHD: A randomized placebo-controlled trial. *Journal of Child Psychology and Psychiatry*, *55*(8), 886–896. doi:10.1111/jcpp.12218

DuPaul, G. J., & Kern, L. (2011). *Young children with ADHD: Early identification and intervention*. Washington, DC: American Psychological Association.

Evans, S. W., Owens, J. S., & Bunford, N. (2013). Evidence-based psychosocial treatments for children and adolescents with attention-deficit/hyperactivity disorder. *Journal of Clinical Child & Adolescent Psychology*, *43*(4), 527–551. doi:10.1080/15374416.2013.850700

Gathercole, S. E., Durling, E., Evans, M., Jeffcock, S., & Stone, S. (2008). Working memory abilities and children's performance in laboratory analogues of classroom activities. *Applied Cognitive Psychology*, *22*(8), 1019–1037. doi:10.1002/acp.v22:8

Halperin, J. M., Marks, D. J., Bedard, A. C., Chacko, A., Curchack, J. T., Yoon, C. A., & Healey, D. M. (2012). Training executive, attention, and motor skills: A proof-of-concept study in preschool children with ADHD. *Journal of Attention disorders*, *17*, 711–721. doi:10.1177/1087054711435681

Kagan, J. (1966). Reflection-impulsivity: The generality and dynamics of conceptual tempo. *Journal of Abnormal Psychology*, *71*(1), 17. doi:10.1037/h0022886

Kern, L., DuPaul, G. J., Volpe, R., Sokol, N., Lutz, J. G., Arbolino, L., & …Vanbrakle, J. D. (2007). Multi-setting assessment-based intervention for young children at-risk for ADHD: Initial effects on academic and behavioral functioning. *School Psychology Review*, *36*(2), 237–255.

Klingberg, T., Forssberg, H., & Westerberg, H. (2002). Training of working memory in children with ADHD. *Journal of Clinical and Experimental Neuropsychology*, *24*(6), 781–791. doi:10.1076/jcen.24.6.781.8395

Kuntsi, J., Oosterlaan, J., & Stevenson, J. (2001). Psychological mechanisms in hyperactivity: I response inhibition deficit, working memory impairment, delay aversion, or something else? *Journal of Child Psychology and Psychiatry*, *42*(2), 199–210. doi:10.1111/jcpp.2001.42.issue-2

Lanfranchi, S., Cornoldi, C., & Vianello, R. (2004). Verbal and visuospatial working memory deficits in children with Down syndrome. *American Journal on Mental Retardation*, *109*(6), 456–466. doi:10.1352/0895-8017(2004)109<456:VAVWMD>2.0.CO;2

Lanfranchi, S., De Mori, L., Mammarella, I. C., Carretti, B., & Vianello, R. (2015). Spatial-sequential and spatial-simultaneous working memory in individuals with Williams Syndrome. *American Journal on Intellectual and Developmental Disabilities*, *120*(3), 193–202. doi:10.1352/1944-7558-120.3.193

Logan, G. D., & Cowan, W. B. (1984). On the ability to inhibit thought and action: A theory of an act of control. *Psychological Review*, *91*(3), 295.

Marcotto, E., Paltenghi, B., & Cornoldi, C. (2002). La scala IPDDAI: Contributo per la costruzione di uno strumento per l'identificazione precoce del disturbo da deficit di attenzione e/o iperattività. [The IPDDAI Scale. Contribution for the early identification of ADHD]. *Difficoltà Di Apprendimento*, *8*(2), 153–172.

Mariani, M. A., & Barkley, R. A. (1997). Neuropsychological and academic functioning in preschool boys with attention deficit hyperactivity disorder. *Developmental Neuropsychology*, *13*(1), 111–129. doi:10.1080/87565649709540671

Martinussen, R., & Major, A. (2011). Working memory weaknesses in students with ADHD: Implications for instruction. *Theory into Practice*, *50*(1), 68–75. doi:10.1080/00405841.2011.534943

Marzocchi, G. M., Re, A. M., & Cornoldi, C. (2010). *BIA. Batteria italiana per l'ADHD per la valutazione dei bambini con deficit di attenzione-iperattività* [Italian Battery for the assessment of ADHD]. Trento: Erickson.

Melby-Lervåg, M., Redick, T. S., & Hulme, C. (2016). Working memory training does not Ń improve performance on measures of intelligence or other measures of "far transfer": Evidence from a meta-analytic review. *Perspectives on Psychological Science*, *11*(4), 512–534. doi:10.1177/1745691616635612

Montgomery, J. W., Polunenko, A., & Marinellie, S. A. (2009). Role of working memory in children's understanding spoken narrative: A preliminary investigation. *Applied Psycholinguistics*, *30*(3), 485–509. doi:10.1017/S0142716409090249

Nobile, M., Alberti, B., & Zuddas, A. (2007). *Conners' rating scales-revised (Adattamento italiano). Firenze*: *Giunti Organizzazioni Speciali*.

Rajwan, E., Chacko, A., & Moeller, M. (2012). Nonpharmacological interventions for preschool ADHD: State of the evidence and implications for practice. *Professional Psychology: Research and Practice*, *43*(5), 520. doi:10.1037/a0028812

Rapport, M. D., Chung, K.-M., Shore, G., Denney, C. B., & Isaacs, P. (2000). Upgrading the science and technology of assessment and diagnosis: Laboratory and clinic-based assessment of children with ADHD. *Journal of Clinical Child Psychology*, *29*(4), 555–568. doi:10.1207/S15374424JCCP2904_8

Rapport, M. D., Orban, S. A., Kofler, M. J., & Friedman, L. M. (2013). Do programs designed to train working memory, other executive functions, and attention benefit children with ADHD? A meta-analytic review of cognitive, academic, and behavioral outcomes. *Clinical Psychological Review*, *33*, 1237–1252. doi:10.1016/j.cpr.2013.08.005

Re, A. M., Capodieci, A., & Cornoldi, C. (2015). Effect of training focused on executive functions (attention, inhibition, and working memory) in preschoolers exhibiting ADHD symptoms. *Frontiers in Psychology*, *6*, 1–9. doi:10.3389/fpsyg.2015.01161

Re, A. M., & Cornoldi, C. (2007). ADHD at five: A diagnosis-intervention program. *Advances in Learning and Behavioral Disabilities*, *20*, 223–240. doi:10.1016/S0735-004X(07)200096

Re, A. M., & Cornoldi, C. (2009). Two new rating scales for assessment of ADHD symptoms in Italian preschool children. *Journal of Attention Disorder*, *12*, 532–539. doi:10.1177/1087054708323001

Re, A. M., De Franchis, V., & Cornoldi, C. (2010). Working memory control deficit in kindergarten ADHD children. *Child Neuropsychology*, *16*(2), 134–144. doi:10.1080/09297040903373404

Riello, M., Re, A. M., & Cornoldi, C. (2005). Costruzione di uno strumento rivolto alla famiglia per l'identificazione precoce del DDAI [Construction of a tool devoted to families for the early identification of ADHD]. *Disturbi di Attenzione e Iperattività*, *1*(1), 9–26.

Röthlisberger, M., Neuenschwander, R., Cimeli, P., Michel, E., & Roebers, C. M. (2012). Improving executive functions in 5- and 6-year-olds: Evaluation of a small group intervention in prekindergarten and kindergarten children. *Infant Child Development*, *21*, 411–429. doi:10.1002/icd.752

Schoemaker, K., Bunte, T., Wiebe, S. A., Espy, K. A., Deković, M., & Matthys, W. (2012). Executive function deficits in preschool children with ADHD and DBD. *Journal of Child Psychology and Psychiatry*, *53*(2), 111–119. doi:10.1111/jcpp.2012.53.issue-2

Sinzig, J., Vinzelberg, I., Evers, D., & Lehmkuhl, G. (2014). Executive function and attention profiles in preschool and elementary school children with autism spectrum disorders or ADHD. *International Journal of Developmental Disabilities*, *60*(3), 144–154. doi:10.1179/2047387714Y.0000000040

Skounti, M., Philalithis, A., & Galanakis, E. (2007). Variations in prevalence of attention deficit hyperactivity disorder worldwide. *European Journal of Pediatrics*, *166*(2), 117–123. doi:10.1007/s00431-006-0299-5

Sonuga-Barke, E. J., Dalen, L., Daley, D., & Remington, B. (2002). Are planning, working memory, and inhibition associated with individual differences in preschool ADHD symptoms? *Developmental Neuropsychology*, *21*(3), 255–272. doi:10.1207/S15326942DN2103_3

Sonuga-Barke, E. J., Daley, D., Thompson, M., Laver-Bradbury, C., & Weeks, A. (2001). Parent-based therapies for preschool attention-deficit/hyperactivity disorder: A randomized, controlled trial with a community sample. *Journal of the American Academy of Child & Adolescent Psychiatry*, *40*(4), 402–408. doi:10.1097/00004583-200104000-00008

Sonuga-Barke, E. J., Thompson, M., Abikoff, H., Klein, R., & Brotman, L. M. (2006). Nonpharmacological interventions for preschoolers with ADHD: The case for specialized parent training. *Infants & Young Children*, *19*(2), 142–153. doi:10.1097/00001163-200604000-00007

Swanson, H. L., Howard, C. B., & Sáez, L. (2007). Reading comprehension and working memory in children with learning disabilities in reading. In K. Cain & J. Oakhill (cur.), *Children's comprehension problems in oral and written language: A cognitive perspective* (pp. 157–189). New York, NY: The Guilford Press.

Trevisi, G., & Re, A. M. (2008). Profili associati al disturbo da deficit di attenzione e iperattività nella scuola dell'infanzia [Profiles associated with ADHD in kindergarden]. *Difficoltà Di Attenzione E Iperattività*, *4*, 9–23.

Washbrook, E., Propper, C., & Sayal, K. (2013). Pre-school hyperactivity/attention problems and educational outcomes in adolescence: Prospective longitudinal study. *The British Journal of Psychiatry*, *203*(4), 265–271. doi:10.1192/bjp.bp.112.123562

Young, S., & Amarasinghe, J. M. (2010). Practitioner review: Non-pharmacological treatments for ADHD: A lifespan approach. *Journal of Child Psychology and Psychiatry*, *51*(2), 116–133. doi:10.1111/jcpp.2009.51.issue-2

Appendix A

IPDDAI, Early Identification of ADHD for Teachers

The present rating scale allows you to assess various aspects of your pupils' behavior. Your observations are very important for the identification of children who might have problems in attention and/or self-control. Please follow these instructions in the correct order:

1. Read the rating scale.
2. Observe the child.
3. Attempt to answer all questions independently, even if the child shows contradictory behaviors.

Use a 0 to 3 scale to indicate the intensity and frequency with which each of the following items characterizes the child: 0 = behavior never present, 1 = behavior sometimes present, 2 = behavior often present, 3 = behavior always present.

(1) She or he often has difficulty sustaining attention in tasks or play activities.
(2) If she or he hears a noise immediately, she or he leaves the task to see what happens.
(3) She or he often starts tasks but quickly loses focus and is easily sidetracked.
(4) She or he often blurts out an answers before a question has been completed.
(5) She or he often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort.
(6) She or he often leaves seat in situation when remaining seated is expected or activity requires it.
(7) She or he often fails to give close attention to details when the task requires it or makes careless mistakes during activities (for example, given a figure as a model, cannot find the identical figures between multiple figures that differ in small details).
(8) She or he often taps hands or feet or squirms in seat.
(9) She or he when faced with a difficult task often becomes discouraged and gives up.
(10) She or he often runs about or climbs in a situation where it is inappropriate.
(11) She or he often tends not to think before doing something.
(12) She or he often has difficulty waiting her or his turn and is impatient (e.g., while waiting in line and/or butts into conversations).
(13) She or he often passes from one game to another, or from one activity to another, rather than engage on one task at a time.
(14) She or he encounters difficulties in meeting the rules and to be collaborative playing with peers
(15) She or he has difficulty learning short rhymes by heart.
(16) She or he fails to repeat in her/his own words what has just been said.
(17) He or she has difficulty remembering the information, examples, and orders given verbally earlier.
(18) She or he fails to keep in mind several things at once (e.g., if you ask her/him to go and get three objects does not remember them all).
(19) She or he comes from a disadvantaged family.
(20) She or he has poor cognitive abilities.
(21) She or he has a difficult situation at home.
(22) She or he has emotional and relational problems.

Appendix B

Summary of tasks and sessions proposed to children.

	Tasks	Components investigated
Pre and post test	Teachers and parents: IPDDAI and IPDDAG and interviews. Children individual assessment: – Forward and Backward Digit Span tests; – Selective Working Memory Test; – Walk–No Walk Test; – Matching Figures Test	– high controlled active working memory; – short-term memory; – controlled attention; – impulsivity control
	Sessions	**Main activities**
Training	*First block* Session 1: Majestic Memorina Session 2: The Pizza Margherita	Know and apply working memory control strategies and learn a rhyme about that;
	Second block Session 3: The galipot game Session 4: The chessboard Session 6: Training your memory Session 7–8: Contrary Mary Session 9: The crystal cock Session 11–12: The scatterbrain bear	Remember selectively relevant information and inhibit irrelevant information
	Third block: Session 13–14: What number was? Session 15–16: The memory game Session 17: The puzzle Session 18: The mysterious object	Remember information selectively controlling the interference given by an interfering task
	Fourth block: Session 19: The musicians from Bremen Session 20: The little backpack	Learn to update information in working memory

Appendix C

Example of a session
Number of session: 4
Area: control of visuospatial working memory
Objective: remember the position of only two (targets) of three children, moving in a chessboard (made of plastic rings on the floor)
Materials: 12 plastic rings from the gym, 2 hats, 1 tambourine
Time duration and place: 45 minutes, gym
Metacognitive introduction:
"Now we are going to play a game that will require all your attention, so you have to open your ears for listening and your eyes to see everything that is happening (strategies of Majestic Memorina). Furthermore you will need your memory. Are you ready?"

Choose two children and ask them to lay the rings on the floor to form a board of 3 lines of 4 rings each. Ask the children if they know what a chessboard is and for what it is used.
Presentation of the cognitive demands:
Inform the children about the cognitive demands and the expected results.

"With this game you will improve your ability to follow the displacement of some of your classmates in a special chessboard (the trainer points to the rings on the floor). You need to pay attention, follow like a radar the displacement of a plane, update the changing of the place in memory, and always know the right position."
Instructions and preliminary practice with the activity of the day:
"Now each of three children stay in a different position inside a ring in the special chessboard. I'm putting a hat on two of them. Pay attention to your classmates wearing the hat. Then I'll beat the tambourine. Each time I beat, your mates will move to a different ring, as my sound corresponds to one displacement. When I say STOP, everybody will stay in the position for 3 seconds and then exit the chessboard and come to me. And all the others what do you have to do? You have to look carefully at the position of children with hats and try to remember where they were placed when I said STOP. Then I will give the hats to two of you, and you have to place them in the last position of your mates with hats." (Be sure that all children have understood the instructions asking someone to explain to others. Administer two practice trials and remember the strategies.)
Organization of the activity:
Teacher controls that the materials are available and that children are ready and have understood instructions. The teacher reminds the children that they have to pay attention to hats and their positions, follow the hats without being distracted by others, and finally, remember the position of one child with a hat and remember the position of the other one in relationship with the first one.

Practice with the activity:
The children complete the activity. They play the game until they have assumed all the different roles.
Promotion of strategic reflections:
The teacher asks the children to verbalize how they maintained in mind the correct positions of the children with hats. If some children succeed and others do not, they try to explain why. The teacher controls that all children have achieved the objectives, i.e., they have:

- identified the final position of the two children with hats;
- controlled their memory allowing time to give the final answer;
- described the strategies used and why they eventually did not succeed.

If needed (if one or more children have not succeeded) the teacher lets them try another time.
Introspection and feedback:
Complete the present metacognitive schedule selecting one picture connected with one of the three sentences read by teacher. For example:

"To remember the final positions of children with hats:

(1) I looked to all children and gave the answer I thought could be right;
(2) I followed the two children with hats and I finally remembered the position of only one of them;
(3) I followed the two children with hats and I memorized the positions of both of them."

The session was concluded by giving positive reinforcement to children, such as, "you have done a really good job," asking if someone used the suggestions of Majestic Memorina, and inviting children to reward themselves by telling themselves "I did not give answers in a hurry," "I used my memory in a correct way," "I did my best."

Research in Developmental Disabilities 74 (2018) 41–49

Contents lists available at ScienceDirect

Research in Developmental Disabilities

journal homepage: www.elsevier.com/locate/redevdis

Handwriting difficulties in children with attention deficit hyperactivity disorder (ADHD)

Agnese Capodieci*, Simona Lachina, Cesare Cornoldi

University of Padua, via Venezia 12, 35129 Padova, Italy

ARTICLE INFO

Number of reviews completed is 2

Keywords:
ADHD
Handwriting
Speed
Working memory
Intra-individual variability

ABSTRACT

Handwriting is fundamental in school and everyday life situations. Legibility guarantees that writing productions communicate information, and speed is often crucial, especially in children with attention deficit and hyperactivity disorder (ADHD), in order to increase the likelihood of their being able to work efficiently and stay on-task during school activities. Preliminary reports have shown an impairment in handwriting of children with ADHD, but evidence is still unclear, especially in the case of speed where research has offered contradictory results. Children's performance, furthermore, has yet to be investigated under the cognitive loading conditions typical of academic tasks in classroom. To shed light on this matter, we examined the handwriting performance in a simple condition but also under (verbal or spatial) working memory (WM) load in 16 fourth- and fifth-grade children with symptoms of ADHD and 16 matched control children. Our results showed that the groups speed differed significantly only in the verbal WM loading condition, where children with symptoms of ADHD wrote more slowly and showed a greater intra-individual variability than controls. Handwriting legibility was affected by verbal WM loading too. These findings are discussed in relation to their educational and clinical implications.

What this paper adds?

This paper adds to our theoretical and empirical understanding of the handwriting abilities and the relationship between them and working memory (WM) in children with symptoms of Attention Deficit and Hyperactivity Disorder (ADHD). Literature has shown that children with ADHD may fare worse in spelling. There are still scarce evidence or even conflicting results, instead, regarding their performance in terms of handwriting, especially in the case of speed, but researchers have yet to consider this issue in depth, in situations under time pressure and memory concurrent requests (as in everyday life and at school, where the child's WM may be overloaded). WM is a relevant variable and has a fundamental role in all writing processes. We know from the literature that children with ADHD have difficulties in various executive functions, and verbal and spatial WM in particular, and this may affect their writing speed as well as their writing legibility. In a typical classroom situation, children need to write quickly generating a WM overload that may be accentuated by the presence of numerous distractors that also affect WM. Until now, however, no studies had systematically examined writing speed in a context involving a WM overload. The present study demonstrated the importance of WM in handwriting skills and in intra-individual variability comparing children with symptoms of ADHD with typically developing children, whose performance was substantially similar in a control situation but presented great differences in the presence of a concurrent WM load.

* Corresponding author.
E-mail addresses: agnese.capodieci@phd.unip.it (A. Capodieci), simona.lachina@studenti.unipd.it (S. Lachina), cesare.cornoldi@unipd.it (C. Cornoldi).

https://doi.org/10.1016/j.ridd.2018.01.003
Received 2 May 2017; Received in revised form 12 October 2017; Accepted 15 January 2018
Available online 24 January 2018

1. Introduction

1.1. Handriting skills in school context

Handwriting is an important and complex skill that combines different components, requires the integration of cognitive, psychomotor and biophysical processes acquired over an extended period of time (Adi-Japha et al., 2007) and also interacts with the linguistic processes involved in maintaining and processing the verbal to-be-written material (Berninger & Abbott, 1994). Despite the introduction of computerized writing systems, handwriting is still a prerequisite for most classroom activities.

If we consider handwriting per se, excluding the expressive and orthographic components, there are many aspects to consider when examining children's handwriting, including the legibility of the productions, the speed and rate variability of its production. Legibility is obviously crucial to meet the main functions of writing concerning maintenance and transmission of knowledge. However speed is also very important because it not only affects efficiency in performing classroom activities, but also enables children to keep up with classwork (by copying from the blackboard, for instance, taking notes, or writing under dictation). Thus, the ability to keep abreast with their peers when writing by hand becomes crucial for children who tend to go off-task, such as those with attentional problems.

Writing speed develops in a rather linear manner during primary school, and the overall development of graphic skills continues during secondary school (Feder and Majnemer, 2007). In this respect, it is particularly important for children to acquire automatized processes in writing graphic signs that can be written quickly and accurately without the need for conscious attention. A low level of automaticity when writing by hand generates a poor performance, in qualitative and quantitative terms (Connelly & Hurst, 2001).

1.2. Cognitive difficulties and intra-individual variability in children with Attention Deficit and Hyperactivity Disorder

Children with Attention Deficit and Hyperactivity Disorder (ADHD) have a diagnostic profile mainly featuring inattention, hyperactivity and impulsivity (American Psychiatric Association, 2013). They may also have a number of associated problems with a potential bearing on their writing activity. These include difficulties in executive functions, including working memory (WM; Kuntsi, Oosterlaan, & Stevenson, 2001; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005), and inconsistency in cognitive responses, leading to a high intra-individual variability (IIV) due to marked fluctuations in their performance. In particular, IIV appears to be among the best predictors of ADHD (Castellanos & Tannock, 2002), has been studied in relation to various cognitive tasks and may be relevant also in the case of children's with ADHD handwriting (Borella, Chicherio, Re, Sensini, & Cornoldi, 2011).

1.3. Writing difficulties of children with ADHD

In front of substantial evidence concerning spelling and expressive writing difficulties associated with ADHD (e.g. Cornoldi, Del Prete, Gallani, Sella, & Re, 2010; Luisotto, Borella, & Cornoldi, 2011; Re, Pedron, & Cornoldi, 2007), handwriting has been scarcely studied.

Some studies on handwriting in ADHD (e.g. Brossard-Racine, Majnemer, Shevell, Snider, & Bélanger, 2011; Fliers et al., 2009; Shen, Lee, & Chen, 2012) have suggested that children with ADHD have not only poor spelling skills but also weak handwriting skills. These results were confirmed by a recent meta-analysis (Graham, Fishman, Reid, & Hebert, 2016) that compared the writing performance of grade 1–12 students with ADHD to their normally achieving peers. The average weighted effect sizes showed that students with ADHD obtained lower scores than their normally achieving peers for a number of writing dimensions also interesting handwriting. Also studies specifically considering the effect of stimulant medication on handwriting performance of children with ADHD (Brossard-Racine et al., 2015; Rosenblum, Epsztein, & Josman, 2008) found that handwriting difficulties are common in children with ADHD, and medication alone is not sufficient to resolve these difficulties.

Writing difficulties of children with ADHD may prompt teachers' negative opinions and be a cause of stress and frustration for the children concerned (Whalen, Henker, & Granger, 1990), negatively affecting their self-esteem and self-acceptance (Brossard-Racine, Majnemer, Shevell, & Snider, 2008). The relevance of handwriting for children with ADHD is also confirmed by recent research, which showed that their writing expression skills were an important predictor of their academic results 18 months on (Molitor et al., 2016).

1.4. Unclear results about handwriting in children with ADHD

However the observations concerning the difficulties of children with ADHD in handwriting offer partly unclear results and mainly consider the order and legibility of their written productions (e.g. Langmaid, Papadopoulos, Johnson, Phillips, & Rinehart, 2014) sometimes with reference to qualitative observations of teachers (Cornoldi, Gardinale, Masi, & Pettenò, 1996). However, in the case of ADHD handwriting, also speed appears particular relevant as writing slowly can be a crucial issue for children with ADHD because they find it difficult to comply with the time constraints on school work (Amundson & Weil, 1996), but evidence on differences in handwriting speed between children with ADHD and matched controls is unclear and even contradictory. For example, Ross, Poidevant, and Miner (1995) assessed writing speed in children with ADHD from first to fifth grade, comparing them with a typically developing (TD) control group matched for gender and schooling. The children were asked to write the numbers from zero to nine (in letters) and their own name repeatedly as quickly as possible for 1 min. The results showed no difference between the two groups. Similarly, Re (2006) investigated whether ADHD affected the writing skills of secondary school students, finding that those at

risk of ADHD had more difficulty in spelling (especially with double consonants and accents), but not in writing speed. Other authors did find differences in writing speed between children with ADHD and their TD peers, but with results even pointing in opposite directions. For example, Adi-Japha et al. (2007) found that children with ADHD wrote more slowly, while other authors found they wrote more quickly and hurriedly (Brossard-Racine et al., 2008; Shen et al., 2012). Such inconsistent results concerning the writing speed of children with ADHD may be partly due to the type of task proposed, which varied in the different studies. In particular, it should be noted that writing by hand in a laboratory context may differ from writing during everyday school activities, when children's WM may be loaded with other demands while they are writing (such as holding in mind complex instructions, committing information to memory, organizing the space on the paper, etc.), and there may be several contextual distractions: these aspects were not considered in previous studies. Examining handwriting performance in contexts where the cognitive system is overloaded may be therefore important.

1.5. Importance of working memory and rationale of the study

In a typical classroom situation, children need to write quickly, and the task in hand is likely to be quite complex, generating a WM overload that may be accentuated by the presence of numerous distractors that also affect WM. In such activities, the importance of WM is clear: it is needed to keep in mind all the conceptual and linguistic information required to produce a sentence, while also monitoring what is being written (Molitor et al., 2016). Until now, no studies had systematically examined handwriting in a context involving a WM overload. The present study aimed to examining the influence of cognitive loading on handwriting legibility, speed and its variability. To test the impact of cognitive loading, the same handwriting task was administered to children with and without ADHD symptoms in three conditions, one without and two with WM loading. One WM load consisted in a concurrent request that involved the verbal component of WM (Baddeley, 2001), as this represents a typical school situation and has been shown to interfere directly with the spelling processes involved in writing verbal material (Re, Tressoldi, Cornoldi, & Lucangeli, 2011). The concurrent memory request consisted of a series of orally presented syllables that the children would hear just before the handwriting task and were subsequently asked to recall. This manipulation had already been used successfully (Re, Mirandola, Esposito, & Capodieci, 2014) to show that a verbal WM load disrupted spelling accuracy, especially in children whose writing had yet to become well automatized. Our hypothesis was that children with ADHD would also have handwriting problems under verbal WM loading because writing by hand requires resources associated with verbal WM too, to maintain the material to be written and its orthographic representation, and to divide words into their phonological components, where necessary. However it could be argued that the verbal WM task disruptive effect on handwriting speed could not be specific, and also a visuospatial WM load could have a similar disruptive effect, as handwriting is an activity in which the visuomotor component is strongly involved. Therefore a spatial WM pre-loading condition was also included, using a manipulation that mirrored the one adopted for the verbal WM pre-load condition. Children with ADHD with sufficient handwriting skills in simple conditions, but still lacking in automaticity, were expected to be impaired when their WM is overloaded (Re, Caeran, & Cornoldi, 2008) especially in the case of a verbal WM load, subtracting verbal resources to the writing task. Furthermore, children with ADHD woul be impaired in both load conditions and show significant impairment in WM (Martinussen, Hayden, Hogg-Johnson, & Tannock, 2005; Martinussen & Major, 2011; Martinussen & Tannock, 2006; Olive, 2004).

In short, the main aim of the present study was to examine handwriting in a simple situation (which involved rapid writing a simple series of words for a limited amount of time), and in two cognitive loading conditions, one with a verbal and the other with a spatial WM load. The assumption was that, under WM loading, handwriting would suffer more in children with symptoms of ADHD than in TD children. In particular, with reference to the distinct aspects of speed and quality, the concurrent maintenance of information in verbal WM was expected to reduce the former's writing speed more than the latter's; furthermore, as suggested by previous research (Brossard-Racine et al., 2011; Langmaid et al., 2014; Shen et al., 2012) the handwritten productions of children with ADHD should be of poorer quality than those of TD children and the effect should evident under not only a verbal, but also – due to the visuomotor component involved in producing well shaped letters (Cornoldi, Mammarella, & Fine, 2016) – under a visuospatial WM load. As a quality measure we considered the legibility of the written productions, as often suggested (Tressoldi, Cornoldi, & Re, 2013; Woodcock, McGrew, & Mather, 2001), and we examined whether it differed between the two groups and the three test conditions. Finally, we compared the two groups on IIV in relation to handwriting speed to support the hyphotesis that IIV is particularly high in children with ADHD and is typically associated with the tasks where they fail (Castellanos & Tannock, 2002).

2. Method

2.1. Participants

Two groups of children attending the fourth and fifth grades of two primary schools located in Northern-Eastern Italy, in an urban village near Padova (Padua) took part in the study: one group consisted of 16 children (12 males and 4 females) who had symptoms of ADHD (the ADHD group); the other (control) group included 16 TD children matched for age, class, gender, cognitive ability and rated family environment level, but without symptoms of ADHD. As in Italy cases with an explicit diagnosis of ADHD are very rare (Skounti, Philalithis, & Galanakis, 2007), of the children in the ADHD group only one child had been previously diagnosed and the others were selected by the authors on the basis of a screening process that included interviews and a score of 14 or higher (a cutoff proposed by the authors; see Marzocchi, Re, & Cornoldi, 2010) on one or both subscales of the SDAI (Scala per i Disturbi di Attenzione/Iperattività per Insegnanti [ADHD Scale for Teachers]; see also Capodieci, 2017; Marzocchi & Cornoldi, 2000). Teachers were also asked to complete another questionnaire (COM, Capodieci, in press; Marzocchi et al., 2010) to identify any minor

Table 1
Means and standard deviations (SD) for the characteristics of the two groups.

	ADHD group (N = 16)	Control group (N = 16)	F (1, 30)	*p*
Age (months)	120.50 (6.92)	122.19 (6.46)	0.51	0.48
Disadvantaged family environment (COM)	2.15 (1.03)	1.70 (.98)	1.32	0.22
Inattention (SDAI)	15.81 (2.43)	2.44 (3.79)	141.06	< 0.001
Hyperactivity (SDAI)	7.00 (6.66)	.63 (1.26)	14.14	0.001
Reasoning (PMA)	18.19 (2.81)	19.31 (3.00)	1.19	0.28

Note. COM = comorbidity questionnaire for teachers; SDAI = ADHD scale for teachers; PMA = Primary Mental Abilities.

symptoms of other psychological and psychopathological issues, and to record relevant information on the children, including their socio-cultural characteristics. Socio-cultural level was individuated through an item included in the COM questionnaire. (The SDAI and COM scales are presented in more detail in the Materials section). All the children were of average cognitive level, as measured with the verbal reasoning subtask of the PMA battery (PMA; Thurstone & Thurstone, 1981), which involves identifying in sets of words (e.g. red; blue; heavy; green) which word is the odd one out (heavy, in this example). Teachers and parents were interviewed informally from researchers to verify information collected through the questionnaires and to collect further evidence on the children's ADHD symptoms (not only at school, but also in other settings such as home, sport groups etc.) and in order to rule out children with other relevant difficulties. The children in the control group were comparable with the ADHD group in terms of age, class, cognitive ability and socioeconomic level, but scored below 5 (corresponding to the 70th percentile) on both subscales of the SDAI questionnaire. Table 1 shows the characteristics of the two groups involved in the study. In each group there were 10 fourth grade and 6 fifth grade children, in the ADHD group the age range was between 112 and 130 months and in the control group between 114 and 131 months. None of the children involved had a history of neurological, psychiatric or serious psychological problems. Furthermore no child had a diagnosis of learning disability (in Italy the diagnosis is based on shared criteria including a performance in learning tasks below −2 standard deviations or below 5° percentile). Children were not receiving any treatments of any kind, including medication (in Italy very rare). Written consent was obtained from children's parents before they took part in the experiment. The study was conducted in accordance with the recommendations of the ethics committee of the University of Padua and approved by our institutional committee.

2.2. Material and procedure

The questionnaire used to identified children with ADHD was the SDAI, that is widely used in Italy and has been validated for the Italian population, showing high interjudge and test-retest reliabilities ($r > 0.80$ in both cases), optimal discriminatory power and concurrent validity, obtained by correlating the scale with others ($r > 0.95$; Marzocchi, Re, & Cornoldi, 2010). The scale exactly reflects the 18 symptoms listed in the Diagnostic and Statistical Manual of Mental Disorders (DSM 5; American Psychiatric Association, 2013) for the diagnosis of ADHD and therefore includes two subscales, one for inattention (9 items), and one for hyperactivity/impulsivity (9 items). Teachers were asked to closely monitor a child's behavior for about two weeks and then report the frequency of the types of symptomatic behavior described in each item. Scores for the items on the SDAI scale range from 0 (*problematic behavior never present*) to 3 (*very often present*). The other questionnaire teachers filled was the COM scale (Marzocchi et al., 2010; Capodieci, in press). This scale allows to check for general aspects and symptomatic problems frequently associated with ADHD and consists of 30 items, 5 about general abilities and family environment and the remaining 25 divided into 6 areas that define the disorders most associated with ADHD. The questionnaire has high interjudge and test-retest reliabilities ($r > 0.90$ in both cases). Even in this case teachers were asked to closely monitor a child's behavior for about two weeks and then report the frequency of the types of symptomatic behavior described in each item with a scores range from 0 (*problematic behavior never present*) to 3 (*very often present*).

The experimental task was an individual handwriting task adapted from the BVSCO-2, (Batteria per la valutazione delle competenze ortografiche nella scuola dell'obbligo [Battery for the assessment of writing skills in children between 7 and 13 years]), a standardized complete writing battery available in Italy (Tressoldi et al., 2013). The task consisted in writing the numbers in cursive letters starting from one (in letters: uno-one, due-two, tre-three etc.) as fast as possible on a sheet of paper, in 18 successive trials, each lasting 20 s.

Three conditions were adopted in a counterbalanced order, with a brief interval (one minute) between conditions, and an interval of approximately ten seconds between trials:

− simple condition: the child was asked to write the numbers in letters as fast as possible, in six 20-s trials, starting each time from the number one;

− verbal condition: the task used in the simple condition was associated with a verbal WM load, i.e. immediately before each writing trial, the child was auditorily presented four meaningless two-letter syllables drawn from the PRCR-2 (Prove di Prerequisito per la Diagnosi delle Difficoltà di Lettura e Scrittura [Prerequisite tests for the diagnosis of reading and writing difficulties]; Cornoldi, Miato, Molin, & Poli, 2009) at a rate of 1 syllable per second, that s/he was asked to remember; then s/he did the above-described writing task; and then s/he was asked to write down the previously-heard syllables;

− spatial condition: the procedure was the same as in the previous condition except that the load was spatial rather than verbal; for each trial, the child was shown a 3 × 3 matrix containing 4 dots for 4 s and, after completing the writing task, she was asked to

add the previously-seen dots in an empty matrix.

Children were individually tested in a quiet room of their school.

For each condition, we counted the numbers of graphemes written in each 20-s trial, the total number of graphemes written in the six trials and the between-trials intra-individual variability. For the verbal and spatial conditions, we also considered the number of syllables and dot positions correctly remembered in the concurrent WM task.

Three independent judges blinded to the children's groupings assessed the legibility of the children's handwriting in the three conditions on a scale from 0 (*illegible*) to 100 (*excellent*) in 10-point steps, as on the "Handwriting legibility scale" proposed by Woodcock-Johnson (Woodcock et al., 2001).

2.3. Statistical analyses

A preliminary analysis found that all the examined variables met the assumptions of normality: numbers of written graphemes had skewness of −0.16 (*SE* = 0.41), kurtosis of −1.70 (*SE* = 0.81), Kolmogorov-Smirnov test (K-S) of 0.12, $p > .05$, handwriting legibility had skewness of −0.13 (*SE* = 0.41), kurtosis of −0.43 (*SE* = 0.81), K-S of 0.09, $p > .05$, memory task had skewness of −0.12 (*SE* = 0.41), kurtosis of −0.81 (*SE* = 0.81), K-S of −0.12, $p > .05$, and intra-individual coefficient of variation had skewness of −0.88 (*SE* = 0.41), kurtosis of −0.85 (*SE* = 0.81), K-S of 0.10, $p > .05$.

We then compared children with ADHD and TD students on handwriting measures using a univariate analysis of covariance (ANCOVA) and we calculated Pearson correlations to examine the associations between handwriting speed and variability.

3. Results

All the children perfectly understood the tasks and were able to complete them, even when asked to write while keeping other verbal and spatial information in mind (see the last part of the present section for their performance in the WM tasks).

We will first consider handwriting speed that, due to the previous contradictory results, represented the main study goal. Table 2 shows the mean numbers of graphemes written by the children (and the standard deviations) for each group, and in each condition. Children with ADHD were compared with controls using a Group (ADHD group vs control group) × Condition (simple vs verbal vs spatial) mixed-design ANCOVA controlling (having as covariates) for the percentages of syllables and dot positions correctly recalled. The two groups differed in spatial and verbal WM performance (see below), but there were no effects of the covariates (percentages of correctly recalled syllables or dot positions) on handwriting speed. There was a significant main effect of Group, $F(1,30) = 15.39$, $p < 0.001$, $\eta_p^2 = 0.34$, the ADHD group producing fewer graphemes than the control group, with 25% of children in the ADHD group and no child in the control group that performed under 1.5 SD with respect to the normative sample reported for the BVSCO (Tressoldi et al., 2013). We also found a significant main effect of Condition, $F(1,30) = 122.44$, $p < 0.001$, $\eta_p^2 = 0.80$. With Bonferroni's post-hoc test we found that all three conditions differed: participants produced significantly more graphemes in the simple condition, followed by the spatial condition, and the fewest graphemes in the verbal condition. The Group × Condition interaction was also significant, $F(1,30) = 3.70$, $p = 0.03$, $\eta_p^2 = 0.11$. As shown in Table 2, the fewest graphemes were written by children with symptoms of ADHD in the verbal condition. Using Student's *t* tests to compare the two groups in the different conditions (with Bonferroni's correction for $\alpha = 0.05$ and $p < 0.02$), we found that they only differed significantly in the verbal condition, $t(30) = 5.24$, $p < 0.001$, Cohen's $d = 1.91$ (Cohen, 1988), while the differences for the simple and spatial conditions only approached significance, $t(30) = 2.33$, $p = 0.028$, Cohen's $d = 0.85$, and $t(30) = 2.28$, $p = 0.030$, Cohen's $d = 0.83$, respectively.

To find further support for the observation that the legibility of the handwriting was poor in the ADHD group, and to see whether it related to speed of production, we analyzed handwriting legibility based on the three judges' assessments of handwriting legibility (Woodcock et al., 2001). The ratings given by the three judges, despite their subjective nature, substantially correlated (between 0.60 and 0.80), and we considered the mean score of the three judgments. Table 3 shows the mean scores obtained by the two groups in the three conditions. There were slight differences between conditions, and more evident differences between groups. The children with symptoms of ADHD were compared with the TD children using a Group (ADHD group vs control group) × Condition (simple vs verbal vs spatial) mixed-design ANCOVA controlling for the number of graphemes written in the different conditions. There were no effects of the covariate (number of graphemes written in each condition), and only a significant main effect of Group, $F(1,30) = 8.48$, $p = 0.007$, $\eta_p^2 = 0.24$, as the ADHD group's handwriting was generally less legible than that of the control group. The effect of Condition did not reach significance, with $F(1,30) = 2.97$, $p = 0.060$, $\eta_p^2 = 0.10$. Despite the fact that the Group × Condition interaction did not reach significance, $F(1,30) = 2.38$, $p = 0.102$, $\eta_p^2 = 0.08$, an inspection of Table 3 shows that the group effect was mainly related with the conditions with WM load. Using Student's *t* tests to compare the two groups in the different conditions (with Bonferroni's correction for $\alpha = 0.05$ and $p < 0.02$), we found that they differed significantly in the verbal condition, $t(30) = 3.39$,

Table 2
Mean numbers of graphemes (SD in brackets) written by the two groups in the simple, verbal and spatial conditions.

	ADHD group (N = 16)	Control group (N = 16)	*t* (30)
Simple condition	223.13 (31.22)	247.13 (27.01)	2.33
Verbal condition*	130.31 (24.84)	180.19 (28.82)	5.24
Spatial condition	187.95 (45.78)	227.38 (23.08)	2.28

Table 3
Mean (SD in brackets) scores for judgments of handwriting legibility in the two groups and the three conditions.

	ADHD group (N = 16)	Control group (N = 16)	*t* (30)
Simple condition	34.06 (11.47)	43.75 (12.07)	2.33
Verbal condition*	34.90 (10.72)	47.40 (10.11)	3.39
Spatial condition*	33.54 (9.29)	45.83 (12.55)	3.15

* The groups differ significantly from one another, $p < 0.02$.

$p = 0.002$, Cohen's $d = 1.24$, and in the spatial condition, t(30) = 3.15, $p = 0.004$, Cohen's $d = 1.15$, while the difference in the simple condition only approached significance, t(30) = 2.33, $p = 0.027$, Cohen's $d = 0.85$.

Finally, to examine the IIV in speed between trials in each condition, the intra-individual coefficient of variation (ICV) was computed, which corresponds to the individual standard deviation (ISD) divided by the individual mean performance. We used the ICV index because it takes into account individual differences in the mean scores, and may be more appropriate than ex-Gaussian analyses, in the context of procedures such as the one adopted in the present study (Borella et al., 2011; Hultsch, MacDonald, Hunter, Levy-Bencheton, & Strauss, 2000; MacDonald, Nyberg, & Bäckman, 2006). Table 4 shows the mean ICV scores and standard deviations for each group in each condition. The children with symptoms of ADHD were compared with the TD children using a Group (ADHD group vs control group) × Condition (simple vs verbal vs spatial) mixed-design ANOVA. We found a significant main effect of Group, F(1,30) = 5.79, $p = 0.02$, $\eta_p^2 = 0.14$, the ADHD group showing a greater IIV than the control group, and a significant main effect of Condition, F(1,30) = 35.88, $p < 0.001$, $\eta_p^2 = 0.55$. With Bonferroni's post-hoc tests, we found that both groups had a greater IIV in the verbal condition than in the other two conditions. The Group × Condition interaction was also significant, F(1,30) = 4.91, $p = 0.01$, $\eta_p^2 = 0.16$. As shown in Table 4, the ADHD group had a high IIV in the verbal condition. Using Student's *t* tests to compare the two groups in the different conditions (with Bonferroni's correction for $\alpha = 0.05$ and $p < 0.02$), we found that they only differed significantly in the verbal condition, t(30) = 2.49, $p = 0.019$, Cohen's $d = 0.91$, while they were very similar in the simple and spatial conditions, t(30) = 1.60, $p = 0.120$, Cohen's $d = 0.58$, and t(30) < 1, respectively.

To examine the relationship between handwriting speed and variability, we also calculated their Pearson correlations, and found them significantly inversely correlated only for the verbal condition (simple condition $r(32) = 0.11$; verbal condition $r(32) = 0.60$, $p < 0.001$; spatial condition $r(32) = 0.29$). The fact that a high IIV could have influenced the reduced speed in the case of the verbal condition is also confirmed by the ANCOVA including IIV as a covariate in the group comparison on speed, that showed a significant effect of the covariate in the verbal condition, F(1,30) = 8.60, $p = 0.007$, but not in the simple F(1,30) < 1, and spatial conditions F(1,30) = 3.73, $p = 0.063$.

We then examined the children's performance in the WM tasks and we found a group difference in both the verbal and the spatial condition. In fact, although the tasks were relatively easy for all the children with high rates of correct responses, two *t* tests showed that the control group remembered significantly greater percentages of syllables and dot positions ($p < 0.05$) than the ADHD group: control group M (SD) = 70.57 (20.78) vs ADHD group M (SD) = 48.18 (19.78) in the verbal condition; and control group M (SD) = 92.45 (8.77) vs ADHD group M (SD) = 82.03 (9.83) in the spatial condition.

4. Discussion and conclusions

Research has shown that children with ADHD may fare worse in spelling (Brossard-Racine et al., 2011; Luisotto et al., 2011; Re et al., 2007), and the literature and clinical reports also seem to agree that their handwriting is less legible, although evidence is still scarce. On the contrary, there are conflicting results regarding their performance in terms of writing speed (Adi-Japha et al., 2007; Brossard-Racine et al., 2008; Re, 2006; Ross et al., 1995; Shen et al., 2012), but researchers have yet to consider this issue in depth, in situations under time pressure and with concurrent requests to be maintained in WM (as it typically happens in everyday life and at school, where the child's WM may be overloaded).

The main objective of this research was to examine this particular issue and to compare the handwriting performance of children with ADHD symptoms with TD children in conditions with and without cognitive (verbal or spatial) WM loading. WM is a relevant variable for the writing process in these settings, as demonstrated by its inclusion in the main models of writing (Hayes, 2006; Kellogg, 1996), not only in the maintenance and mental segmentation of the verbal material to be written, but also in the maintenance of contents and instructions and in control of irrelevant information. We know from the literature that children with ADHD have difficulties in various executive functions, and verbal and spatial WM in particular (Martinussen & Major, 2011; Martinussen &

Table 4
Mean IIV scores (SD in brackets) for the two groups in the three conditions.

	ADHD group (N = 16)	Control group (N = 16)	*t (30)*
Simple condition	.07 (.02)	.06 (.03)	1.60
Verbal condition*	.23 (.13)	.14 (.07)	2.49
Spatial condition	.07 (.04)	.08 (.04)	0.87

* The groups differ significantly from one another, $p < 0.02$.

Tannock, 2006), and these may also affect not only their spelling accuracy (Re et al., 2014) but also their writing speed and legibility.

The present study showed that our experimental manipulation to include a WM load proved crucial in shedding light on the handwriting of children with ADHD, in particular with reference to speed, offering some explanation for differences previously reported in literature. In terms of handwriting speed in the simple condition, we found the performance of children with ADHD symptoms not very different from that of TD children, as already reported elsewhere by Re (2006) and Ross et al. (1995) who administered a task similar to the one used in our research, differently from other studies (Adi-Japha et al., 2007; Shen et al., 2012) that found differences in the performance of the two groups probably due to the different procedures adopted, although the different results could be also partly due to the different characteristics of the language of children (Hebrew language, Chinese). For example Adi-Japha and colleagues found that children with ADHD spent more time when writing, mainly due to long words and excessive corrections, two aspects not particularly relevant in our task.

In the condition without WM interference, the children with ADHD symptoms only produced about 10% fewer graphemes than their TD classmates and it must be noticed that also their legibility presented a lower difference with respect to controls than in the cases with WM interference. Then, on switching from the simple to the spatial and verbal load conditions, the children in both groups tended to write more slowly, but with more serious consequences in the case of ADHD. Concerning speed, in the spatial condition, the difference between the two groups was slightly greater than in the simple condition (with 20% fewer graphemes in the ADHD group), but this difference was not significant. In the verbal condition, however, the ADHD group wrote significantly more slowly (producing 38% fewer graphemes) than the control group and, despite the fact that they wrote fewer letters than the other group, their legibility was also particularly poor with respect to controls.

The result that overloading the verbal WM led to a more marked impairment in the speed and legibility of writing numbers in letters is presumably due to the facts that the same domain of WM was involved in both the writing task and the concurrent syllable recall task. The fact that children with ADHD were more susceptible to verbal WM interference than the other group can be attributed to their lower automaticity in writing (Re et al., 2011; Olive & Kellogg, 2002) in a situation in which automaticity was particularly necessary for coping with a concurrent task that relied on the same WM resources, thus subtracting resources to the writing task. In the spatial condition, keeping dot positions in mind interfered less with the demands of the writing task, showing that the impairment in writing performance, especially in the case of speed, under verbal WM loading was due not only to the addition of a concurrent secondary task, but also to the particular characteristics of the verbal WM task.

As for the handwriting legibility, we found further support for the observation (Brossard-Racine et al., 2011; Langmaid et al., 2014; Shen et al., 2012) that it is typically worse in children with ADHD, and the difference with the control group was more evident in the two WM loaded conditions. In fact, in the case of legibility, also the spatial load produced a significant impairment of performance, probably due to the crucial role of visuomotor processes in making handwriting legible (Cornoldi et al., 2016). Our results revealed similar handwriting legibility in all three test conditions, however, and speed did not appear to greatly influence legibility, suggesting that there was no clear trade-off between the two. Based on these findings, we surmise that legibility does not affect handwriting speed in the three different conditions considered here, since the children's performance remained similar with and without any (verbal or spatial) cognitive loading.

A related goal of this study was to test the differences between the two groups in terms of IIV in writing performance, with and without any concomitant WM loading tasks, as inconsistency in responses and variability in test performance are among the best predictors of deficits in ADHD (Castellanos et al., 2005). Our results confirm previous evidence of a high IIV in children with ADHD in a variety of tasks, including handwriting (Borella et al., 2011). They also confirm the importance of a condition in which verbal WM is overloaded: IIV increased for both groups in the verbal condition, but significantly more in children with symptoms of ADHD. In situations perceived by the children as less effortful (because their WM is not overloaded with the information needed to perform two concomitant tasks), the consistency in performing the task of children with ADHD seems to be better and their variability lower. Overloading their verbal WM with a secondary task prompted an increase in IIV in all the children, but significantly more so in the ADHD group. The significant correlation found between IIV and handwriting speed in the verbal condition and the results of the ANCOVAs suggest that children with ADHD may write more slowly partly because of their greater IIV.

To sum up, the present study seems to offer an important clarification on handwriting-related issues in children with ADHD. It confirms that the legibility and speed of their handwriting are weaker than in TD children, but the difference may be more evident when automaticity is required because a verbal cognitive load interferes with the children's writing activity. Despite its innovative aspects and potential applications, the present research has certain limitations that need to be mentioned. The first concerns how the selection of the group of children with ADHD was done, which ensured homogeneity but did not include only cases with an explicit diagnosis of ADHD (a diagnosis that is still rare in Italy). Second, constraints imposed by the schools meant that the study could only collect some measures, disregarding several aspects that might be relevant and related to handwriting (e.g. participants' motor, visuomotor and spelling skills, or their executive functions). Further research is therefore needed on these issues. Research should also examine whether the interference of a WM loading condition changes in the case of a graphic speed task that does not involve verbal processes (e.g. drawing simple shapes instead of writing words) and should match the difficulty of the WM loading tasks to see whether the lower disruptive effect of the spatial task seen in our study was also be due to the task itself being easier. It is worth noting, however, that handwriting speed was not affected directly by a trade-off with the concurrent task, i.e. it did not happen that the group of children who devoted more resources to the pre-loaded material (and therefore remembered it better) were more impaired in handwriting speed. In our sample, all the children in both groups performed well in the WM tasks, and the ADHD group, despite having a poorer handwriting performance, remembered less syllables or dot positions, thus replicating other reports of WM difficulties in children with ADHD (Martinussen et al., 2005). Furthermore the group differences in handwriting remained significant also when WM performance (in the concomitant tasks) was included in our analyses as covariate.

Even with some limitations, this research offers new and meaningful information on an underinvestigated but relevant issue for children with symptoms of ADHD, who have to cope every day with classroom situations in which the speed and legibility of their handwriting are important. Our findings could also be useful for the purpose of intervention in the classroom and in the clinical setting. They confirm the importance of reducing the verbal WM overload when children with ADHD are involved in writing tasks (e.g. by providing them with support materials), and teaching these children strategies to cope with the negative implications of an excessive WM load (e.g. looking for non-demanding contexts, trying to maintain a regular rate, using available writing facilitating structures (Re et al., 2008), or dividing the material to be written into separate parts).

Acknowledgment

We would thank Frances Coburn for her valuable suggestions and English revision.

References

Adi-Japha, E., Landau, Y. E., Frenkel, L., Teicher, M., Gross-Tsur, V., & Shalev, R. S. (2007). ADHD and dysgraphia: Underlying mechanisms. *Cortex, 43*(6), 700–709.
American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders (DSM-5®)*. American Psychiatric Pub.
Amundson, S. J., & Weil, M. (1996). Prewriting and handwriting skills. *Occupational Therapy for Children, 3*, 524–541.
Baddeley, A. D. (2001). Is working memory still working? *American Psychologist, 56*(11), 851.
Berninger, V. W., & Abbott, R. D. (1994). *Multiple orthographic and phonological codes in literacy acquisition: An evolving research program. The varieties of orthographic knowledge.* Netherlands: Springer277–319.
Borella, E., Chicherio, C., Re, A. M., Sensini, V., & Cornoldi, C. (2011). Increased intraindividual variability is a marker of ADHD but also of dyslexia: A study on handwriting. *Brain and Cognition, 77*(1), 33–39.
Brossard-Racine, M., Majnemer, A., Shevell, M., & Snider, L. (2008). Handwriting performance in children with attention deficit hyperactivity disorder (ADHD). *Journal of Child Neurology, 23*(4), 399–406.
Brossard-Racine, M., Majnemer, A., Shevell, M., Snider, L., & Bélanger, S. A. (2011). Handwriting capacity in children newly diagnosed with attention deficit hyperactivity disorder. *Research in Developmental Disabilities, 32*(6), 2927–2934.
Brossard-Racine, M., Shevell, M., Snider, L., Bélanger, S. A., Julien, M., & Majnemer, A. (2015). Persistent handwriting difficulties in children with ADHD after treatment with stimulant medication. *Journal of Attention Disorders, 19*(7), 620–629.
Capodieci, A. (2017). L'uso delle scale di valutazione per l'identificazione dei casi con ADHD: il confronto tra la rilevazione in base a punteggi di gravità, cut-off e numero di sintomi [The use of rating scales for the identification of ADHD: A comparison between criteria of intensity, cut-offs, and number of symptoms]. *Psicologia clinica e dello sviluppo*.
Capodieci, A. (2018). Le scale COM-R/Insegnanti: un aggiornamento sui profili e una integrazione per la rilevazione di difficoltà sociali nei bambini con e senza ADHD [The use of scale COM/R revised for teachers and the individuation of social problems]. *Psicologia clinica e dello sviluppo* [in press].
Castellanos, F. X., & Tannock, R. (2002). Neuroscience of attention-deficit/hyperactivity disorder: The search for endophenotypes. *Nature Reviews Neuroscience, 3*(8), 617–628.
Castellanos, F. X., Sonuga-Barke, E. J., Scheres, A., Di Martino, A., Hyde, C., & Walters, J. R. (2005). Varieties of attention-deficit/hyperactivity disorder-related intra-individual variability. *Biological Psychiatry, 57*(11), 1416–1423.
Cohen, J. (1988). *Statistical power analysis for the behavioral sciences.* Hilsdale, NJ: Lawrence Earlbaum Associates2.
Connelly, V., & Hurst, G. (2001). The influence of handwriting fluency on writing legibility in later primary and early secondary education. *Handwriting Today, 2*, 5–57.
Cornoldi, C., Gardinale, M., Masi, A., & Pettenò, L. (1996). *Impulsività e autocontrollo [Impulsivity and self-control].* Trento: Erickson.
Cornoldi, C., Miato, L., Molin, A., & Poli, S. (2009). *PRCR-2/2009. Prove di prerequisito per le diagnosi delle difficoltà di lettura e scrittura [Measures of Precursors of reading and writing].* Firenze: Organizzazioni Speciali.
Cornoldi, C., Del Prete, F., Gallani, A., Sella, F., & Re, A. M. (2010). Components affecting expressive writing in typical and disabled writers. In T. E. Scruggs, & M. A. Mastropieri (Eds.). *Literacy and learning. advances in learning and behavioral disabilities* (pp. 269–286). Bingley, UK: Emerald.
Cornoldi, C., Mammarella, I., & Fine, J. (2016). *Nonverbal learning disabilities.* New York: Guilford.
Feder, K. P., & Majnemer, A. (2007). Handwriting development, competency, and intervention. *Developmental Medicine & Child Neurology, 49*(4), 312–317.
Fliers, E., Vermeulen, S., Rijsdijk, F., Altink, M., Buschgens, C., Rommelse, N., & Franke, B. (2009). ADHD and poor motor performance from a family genetic perspective. *Journal of the American Academy of Child & Adolescent Psychiatry, 48*(1), 25–34.
Graham, S., Fishman, E. J., Reid, R., & Hebert, M. (2016). Writing characteristics of students with attention deficit hyperactive disorder: A meta-analysis. *Learning Disabilities Research & Practice, 31*(2), 75–89.
Hayes, J. R. (2006). New directions in writing theory. In C. A. MacArthur, S. Graham, & J. Fitzgerald (Eds.). *Handbook of writing research* (pp. 28–40). New York: Guilford Press.
Hultsch, D. F., MacDonald, S. W., Hunter, M. A., Levy-Bencheton, J., & Strauss, E. (2000). Intraindividual variability in cognitive performance in older adults: Comparison of adults with mild dementia, adults with arthritis, and healthy adults. *Neuropsychology, 14*(4), 588.
Kellogg, R. T. (1996). A model of working memory in writing. In C. M. Levy, & S. Ransdell (Eds.). *The science of writing: Theories, methods, individual differences, and applications* (pp. 57–71). Hillsdale, NJ, US: Lawrence Erlbaum Associates.
Kuntsi, J., Oosterlaan, J., & Stevenson, J. (2001). Psychological mechanisms in hyperactivity: I Response inhibition deficit, working memory impairment, delay aversion, or something else? *Journal of Child Psychology and Psychiatry, 42*(02), 199–210.
Langmaid, R. A., Papadopoulos, N., Johnson, B. P., Phillips, J. G., & Rinehart, N. J. (2014). Handwriting in children with ADHD. *Journal of Attention Disorders, 18*(6), 504–510.
Luisotto, E., Borella, E., & Cornoldi, C. (2011). Il grafismo nel bambino ADHD: indici di velocità, qualità grafica e variabilità intraindividuale [Handwriting in children with ADHD: Speed, quality and intraindividual variability]. *Disturbi di attenzione e iperattività, 6*(2), 5–14.
MacDonald, S. W., Nyberg, L., & Bäckman, L. (2006). Intra-individual variability in behavior: Links to brain structure, neurotransmission and neuronal activity. *Trends in Neurosciences, 29*(8), 474–480.
Martinussen, R., & Major, A. (2011). Working memory weaknesses in students with ADHD: Implications for instruction. *Theory into Practice, 50*(1), 68–75.
Martinussen, R., & Tannock, R. (2006). Working memory impairments in children with attention-deficit hyperactivity disorder with and without comorbid language learning disorders. *Journal of Clinical and Experimental Neuropsychology, 28*(7), 1073–1094.
Martinussen, R., Hayden, J., Hogg-Johnson, S., & Tannock, R. (2005). A meta-analysis of working memory impairments in children with attention-deficit/hyper-activity disorder. *Journal of the American Academy of Child & Adolescent Psychiatry, 44*(4), 377–384.
Marzocchi, G. M., & Cornoldi, C. (2000). Una scala di facile uso per la rilevazione dei comportamenti problematici dei bambini con Deficit di Attenzione e Iperattività [An easy-to-use scale for detecting problematic behaviors in children with Attention Deficit and Hyperactivity Disorder]. *Psicologia clinica dello sviluppo, 4*(1), 43–64.
Marzocchi, G. M., Re, A. M., & Cornoldi, C. (2010). *BIA: Batteria Italiana per l'ADHD [Italian Battery for ADHD].* Trento, Italy: Centro Studi Erickson.
Molitor, S. J., Langberg, J. M., Bourchtein, E., Eddy, L. D., Dvorsky, M. R., & Evans, S. W. (2016). Writing abilities longitudinally predict academic outcomes of adolescents with ADHD. *School Psychology Quarterly, 31*(3), 393–404.

Olive, T., & Kellogg, R. T. (2002). Concurrent activation of high-and low-level production processes in written composition. *Memory & Cognition, 30*(4), 594–600.
Olive, T. (2004). Working memory in writing: Empirical evidence from the dual-task technique. *European Psychologist, 9*(1), 32–42.
Re, A. M., Pedron, M., & Cornoldi, C. (2007). Expressive writing difficulties in children described as exhibiting ADHD symptoms. *Journal of Learning Disabilities, 40*, 244–255.
Re, A. M., Caeran, M., & Cornoldi, C. (2008). Improving expressive writing skills of children rated for ADHD symptoms. *Journal of Learning Disabilities, 41*(6), 535–544.
Re, A. M., Tressoldi, P. E., Cornoldi, C., & Lucangeli, D. (2011). Which tasks best discriminate between dyslexic university students and controls in a transparent language? *Dyslexia, 17*, 227–241. http://dx.doi.org/10.1002/dys.431.
Re, A. M., Mirandola, C., Esposito, S. S., & Capodieci, A. (2014). Spelling errors among children with ADHD symptoms: The role of working memory. *Research in Developmental Disabilities, 35*(9), 2199–2204.
Re, A. M. (2006). Disturbo da Deficit di Attenzione con Iperattività e abilità di scrittura [ADHD and writing abilities]. *Psicologia clinica dello sviluppo, 10*(1), 123–140.
Rosenblum, S., Epsztein, L., & Josman, N. (2008). Handwriting performance of children with attention deficit hyperactive disorders: A pilot study. *Physical & Occupational Therapy in Pediatrics, 28*(3), 219–234.
Ross, P. A., Poidevant, J. M., & Miner, C. U. (1995). Curriculum-based assessment of writing fluency in children with attention-deficit hyperactivity disorder and normal children. *Reading & Writing Quarterly: Overcoming Learning Difficulties, 11*(2), 201–208.
Shen, I. H., Lee, T. Y., & Chen, C. L. (2012). Handwriting performance and underlying factors in children with Attention Deficit Hyperactivity Disorder. *Research in Developmental Disabilities, 33*(4), 1301–1309.
Skounti, M., Philalithis, A., & Galanakis, E. (2007). Variations in prevalence of attention deficit hyperactivity disorder worldwide. *European Journal of Pediatrics, 166*(2), 117–123.
Thurstone, L. L., & Thurstone, T. G. (1981). *PMA, test of primary mental abilities, age level 11–17 italian edn.* Firenze: Organizzazioni Speciali.
Tressoldi, P. E., Cornoldi, C., & Re, A. M. (2013). *BVSCO-2. Batteria per la Valutazione della Scrittura e della Competenza Ortografica–2 [Battery for the assessment of writing skills in children between 7 and 13 years].* Firenze: Organizzazioni Speciali.
Whalen, C. K., Henker, B., & Granger, D. A. (1990). Social judgment processes in hyperactive boys: Effects of methylphenidate and comparisons with normal peers. *Journal of Abnormal Child Psychology, 18*(3), 297–316.
Willcutt, E. G., Doyle, A. E., Nigg, J. T., Faraone, S. V., & Pennington, B. F. (2005). Validity of the executive function theory of attention-deficit/hyperactivity disorder: A meta-analytic review. *Biological Psychiatry, 57*(11), 1336–1346.
Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock-Johnson III tests of cognitive abilities.* Itasca, IL: Riverside Pub371–401.

Per ricevere la newsletter iscriversi al seguente indirizzo:
http://www.adhd.marionegri.it/index.php/newsletter/iscrizione-newsletter

Iniziativa nell'ambito del Progetto di Neuropsichiatria dell'Infanzia e dell'Adolescenza
(Delibera n. 406 - 2014 del 04/06/2014 Progetti NPI)
Il Progetto è realizzato con il contributo, parziale, della Regione Lombardia
(in attuazione della D.G. sanità n. 3798 del 08/05/2014, n. 778 del 05/02/2015, n. 5954 del 05/12/2016 e N. 1077 del 02/02/2017) Capofila Progetto: UONPIA Azienda Ospedaliera "Spedali Civili di Brescia" "*Percorsi diagnostico-terapeutici per l'ADHD*".

IRCCS ISTITUTO DI RICERCHE FARMACOLOGICHE MARIO NEGRI
DIPARTIMENTO DI SALUTE PUBBLICA
Laboratorio per la Salute Materno Infantile
Via Giuseppe La Masa, 19 - 20156 Milano MI - Italia - www.marionegri.it tel
+39 02 39014.511 - fax +39 02 3550924 - mother_child@marionegri.i