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7th World Congress on ADHD: From Child to Adult Disorder

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Introduction

Dear Colleagues and Friends,

We are pleased to have received more than 180 poster abstracts as well as more than 100 poster abstracts from young scientists and clinicians (< 35 years) who applied for our Young Scientists' Award.

Of all abstracts submitted by our young colleagues, the Scientific Programme Committee has selected the best eight. The authors have been invited to give a presentation as part of our two Young Scientist Award Sessions and to receive a prize money in the amount of 500 Euros. With this approach, we intend to highlight the importance of original scientific contributions, especially from our young colleagues.

In this volume, the abstracts of our two Young Scientist Award Sessions come first, followed by regular poster abstracts. These have been organized by topics: Aetiology, Autism Spectrum Disorders, Co-morbidity, Diagnosis, Electrophysiology, Epidemiology, Experimental Models, Genetics, Neuroimaging, Non-pharmacological Treatment, Pathophysiology, Pharmacological Treatment, Quality of Life/Caregiver Burden, Substance Use Disorders and Miscellaneous.

Submitted abstracts have not been modified in any way. Please, do not just read the selected poster abstracts, we also encourage you to actively discuss and share your ideas with our young colleagues.

Finally, we would like thank all our speakers, contributors and sponsors of our 7th World Congress on ADHD: from Childhood to Adult Disease, and welcome you to join—what we are sure will be—a very enjoyable and highly informative event.

Thank you very much for your participation!

With kind regards,

Luis Rohde
Congress President
President World
Federation of ADHD

Manfred Gerlach
Chairmen Scientific Programme Committee

Young Scientists Awards

Effects of methylphenidate on sleep in children with ADHD

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Objectives: Sleep disorders are frequent amongst children and adolescents with ADHD and can add to the impairment of the disorder. Stimulant medication like methylphenidate (MPH) can also have an impact on sleep. The goal of our study was to analyse sleep architecture of children with ADHD and the impact of MPH on sleep.

Methods: Retrospective analysis of the clinical records of children with ADHD that performed polysomnography (PSG type I) between January 2016 and December 2018. We divided the sample into two groups: group A, with MPH and group B, without MPH, and compared sleep patterns. To analyse statistical significance, we used StataCorp. 2009. Stata Statistical Software and Wilcoxon Mann Whitney/T-student tests.

Results: Total of 72 patients with ADHD. The most frequent ADHD subtype was inattentive (32%). Comparing sleep architecture between group A (n = 41/55%) and group B (n = 31/41%): mean Sleep efficiency was higher in group B (B 83.8%/A 78.1%) with statistical significance ($p = 0.0498$). Not statistically significant: Mean sleep latency (A 33.5 min/B 31 min $p = 0.8645$). Mean duration of Stage N2 (A 58.6 min/B 60.5 min. $p = 0.2151$), mean duration of Stage N3 (A 27.2 min/B 25.1 min. $p = 0.1777$), mean REM sleep latency (A 159.8 min/B 180.4 min. $p = 0.1812$) and mean REM sleep (A 13.2%/B 13.7%. $p = 0.6516$). Obstructive sleep apnoea (OSA) was frequent in both groups (group A 82%/B 87%), but differences weren't significant ($p = 0.4061$).

Conclusions: Our results suggest that MPH does not affect significantly sleep architecture, except for sleep efficiency. Our revision of the literature also found few consistent findings. We highlight the fact that OSA was a predominant feature and should be evaluated in these patients, since it knowledgeably influences sleep architecture. We acknowledge however that finding a relationship between sleep and medication is complex, because other sample characteristics may impact sleep findings, and thus influence results.

Genes and brain cell types linked with selective neuronal vulnerability in ADHD

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Objectives: A series of large multi-site mega-analyses of structural brain imaging data led by the Enhancing Neuroimaging Genetics through Meta-analysis (ENGIMA) Network found specific cortical and subcortical regions that are significantly smaller in individuals diagnosed with attention-deficit/hyperactivity disorder (ADHD) compare to unaffected controls. Those studies provided important insight into neuroanatomical changes in ADHD, but it is unclear why some brain regions are affected by ADHD while other regions remain spared. We hypothesized that spatial variation in the organization of brain cells and/or gene expression levels across brain regions may contribute to selective neuroanatomical changes seen in ADHD.

Methods: To test this hypothesis, we obtained postmortem brain RNA-sequencing data from unaffected donors from the Allen Brain Atlas for cortical and subcortical regions that were analyzed by the ENIGMA-ADHD Working Group. We extracted expression levels of gene sets that were selected based on hypotheses derived from prior work. We performed deconvolution of the bulk transcriptomic data from the Allen Brain Atlas to determine the typical abundance of neuronal and non-neuronal cells per brain region. We tested the correlation between gene set expression levels, cell abundance, and regional changes in brain sizes observed in ADHD cases.

Results: We found statistically significant correlations between reductions in brain region size in ADHD cases and expression levels of genes involved in apoptosis, autophagy, and neurodevelopment. Furthermore, we identified significant associations between reductions in regional brain size in ADHD and abundance of glial and progenitor cell types.

Conclusions: We conclude that expression levels of gene sets involved in brain development and response to cell stress, coupled with the organization of brain cell types, may contribute to selective brain region vulnerability in ADHD.

Neurocognitive markers of late-onset ADHD: a 6-year longitudinal study

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Objectives: There is increased interest in 'late-onset' ADHD, referring to the onset of clinically significant ADHD symptoms after the age 12, i.e. in adolescence or adulthood. Biological siblings of ADHD probands who are unaffected in childhood may be at increased risk for developing late-onset of ADHD.

Aim: To examine whether unaffected siblings with late-onset ADHD could be differentiated from stable unaffected siblings by their neurocognitive functioning in childhood.

Methods: We report findings from a 6-year prospective, longitudinal study of a subsample of the Dutch part of the International Multi-center ADHD Genetics (IMAGE) study, including individuals with childhood-onset (persistent) ADHD (n = 111), late-onset ADHD (n = 34), stable unaffected siblings (n = 111), and healthy controls (n = 186). At study entry (mean age: 11.3) and follow-up (mean age: 17.01) participants were comprehensively assessed on ADHD by structured psychiatric interviews and multi-informant questionnaires. Several neurocognitive functions including time reproduction, timing variability (reaction time variability and time production variability), reaction time speed, motor control, working memory, and intelligence were assessed at baseline and after 6 years.

Results: Siblings with late-onset ADHD were similar to individuals with childhood-onset ADHD in showing longer reaction times and/or higher error rates on all neurocognitive measures at baseline and follow-up, when compared to healthy controls; they differed from stable unaffected siblings by greater reaction time variability and timing production variability at baseline. No significant group by time interaction was present for all tasks.

Conclusions: Neurocognitive dysfunction, in particular for reaction time variability and timing production variability, may serve among unaffected siblings as risk biomarkers for late-onset ADHD.

Genetic alteration of *CADM1* is associated with ADHD during early life: an exploratory study with genetic, neuroimaging and animal model methods

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Objectives: Genes related to cell adhesion pathway is thought to contribute to the genetic architecture of Attention-Deficit Hyperactivity Disorder (ADHD). Cell adhesion molecule 1 (*CADM1*) is cell adhesion active and highly expressed in prefrontal lobe of human brain, where is the most studied area in ADHD. However, genetic effect of *CADM1* underlying neural activity in ADHD still remains unknown. The present study aims to investigate the association of *CADM1* gene with ADHD in human and zebrafish.

Methods: In human study, a total of 2003 individuals (1040 ADHD vs. 963 controls, 6–16 years) participated in this study, and a part of them were recruited in imaging genetic study (35 ADHD vs. 56 controls, 8–16 years). All subjects were genotyped for 10 tagSNPs of *CADM1*. Executive function were measured by stroop color–word test, rey–Osterrieth complex figure test (RCFT) and trail making test (TMT) for inhibition, working memory and shifting respectively. Functional magnetic resonance images (fMRI) were acquired and amplitude of low frequency fluctuations (ALFF) was calculated. In animal study, the wild-type Tübingen strain and *cadm1a* mutant zebrafishes were used. RNA was extracted at 3 days post fertilization (d.p.f.) and then reverse transcribed into cDNA. Real-time PCR was performed to amplify cDNA and to detect changes in gene expression. The locomotion of larvae was analyzed at 6 d.p.f. Larvae incubated in drug solution with or without 5 μ m of methylphenidate were placed in a 48-well plate and recorded for distance swum during a 15 min period.

Results: In genetic association study, results showed genotype of rs10891819 associated with pure ADHD, TT was the protective factor [OR (95% CI) = 0.48 (0.27–0.85), $P = 0.012$]. No genetic effect was found on executive function. In imaging genetic study, main effect of disease was found in bilateral medial superior frontal gyrus (peak $t = 5.06$, cluster size = 54), main effect of rs10891819 genotype was found in right superior frontal gyrus (peak $t = 4.20$, cluster size = 55), and interaction of genotype \times disease was found in a cluster including left precentral and middle frontal gyrus (peak $F = 16.66$, cluster size = 51). In this cluster, ALFF was significantly higher in GG carriers than T allele carriers in ADHD (peak $t = 3.07$, cluster size = 5), while no significance was found in control. Correlation of ALFF with EF showed negative correlations in right superior frontal gyrus and positive correlations in left precentral and middle frontal gyrus. In animal study, the *cadm1a* mutation results in early termination of translation which makes the protein non-functioning. Gene expression changes were found in dopaminergic pathway for increased expression of *dbh* and *th*. Behavioral tests observed an increase in total swimming distance (mutant vs. wild type: 2373.12 ± 103.25 mm vs. 1836.60 ± 97.52 mm, $P < 0.001$), while after incubated in 5 μ m of methylphenidate, mutant larvae showed significant decrease of swimming distance (blank vs. treated: 2373.12 ± 103.25 mm vs. 2056.61 ± 101.82 mm, $P = 0.016$).

Conclusions: It could be deduced that *CADM1* may be associated with ADHD symptom and executive function and involved in the etiology of ADHD.

Early predictors for late-onset ADHD symptoms

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Objectives: ADHD has been conceptualised as a childhood-onset neurodevelopmental disorder. However, a considerable number of studies have identified the emergence of ADHD symptoms beyond the childhood years. In addition, different childhood characteristics were found between late-onset of ADHD and early-onset ADHD. Despite the increasing knowledge about late-onset ADHD, whether it could be predicted in early developmental stage remains less discussed. The current study aimed to investigate early childhood predictors for late-onset ADHD symptoms.

Methods: This study used longitudinal data from the Twins Early Development Study (TEDS), a UK population-representative sample of twins recruited from population birth records in England and Wales between 1994 and 1996. ADHD symptoms, clinical characteristics and family environment were assessed from early childhood to age 16 years. Multinomial logistic regression was performed to identify independent early childhood predictors for late-onset ADHD.

Results: Among a total of 4485 individuals, 2.7% developed significant ADHD symptoms during adolescence. 8.6% had ADHD symptoms limited in childhood and 6.4% had persistent ADHD symptoms. Multinomial logistic regression showed male sex, higher maternal depression, and lower socioeconomic status independently predicted late-onset of ADHD from non-ADHD controls.

Conclusions: Poor socioeconomic status and maternal depression predicted late emergence of ADHD independently of other childhood characteristics. The findings suggest the importance of early environmental adversity on ADHD symptom development in later stage of life. Future research investigating variables emerging and evolving across time could provide more insight on the developmental course of ADHD symptoms.

Persistence and neural correlates of disruptive mood dysregulation disorder in 10-year-old children with ADHD

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Objectives: This study aimed to determine the proportion of children with ADHD with persistent comorbid disruptive mood dysregulation disorder (DMDD) from age 7 to 10, and the proportion with new onset DMDD at age 10. In addition, this study explored whether there were differences in cortical thickness and gray matter volume (GMV) between children with ADHD + DMDD and ADHD-DMDD at age 10.

Methods: The sample consisted of children ($n = 135$) participating in a cohort study with data available at age 7 and age 10. Children with ADHD were recruited through 43 schools, using a two-stage screening (parent and teacher Conners-3 ADHD index) and case confirmation (Diagnostic Interview Schedule for Children, Version IV; [DISC-IV]) procedure. DMDD status was ascertained using proxy items from the DISC-IV. Magnetic Resonance Imaging data were collected in a subset ($n = 77$) of participants at age 10. Extracted using Freesurfer, cortical thickness and GMV were compared between children with ADHD + DMDD and ADHD-DMDD using t -tests.

Results: At age 7, 29 (21.5%) children had comorbid DMDD; this decreased to 16 (11.9%) at age 10. Of those with DMDD at age 7,

eight (27.6%) had DMDD that persisted at age 10. Eight children had new onset DMDD at age 10. Compared to ADHD-DMDD, those with ADHD + DMDD at either time point had lower thickness in the right anterior ($d = 0.6, p = .03$) and posterior cingulate ($d = 0.7, p = .02$), right medial orbitofrontal ($d = 0.6, p = .02$), and both the left ($d = 0.6, p = .04$) and right insula ($d = 0.6, p = .04$) cortices. Children with ADHD + DMDD also had reduced GMV in the posterior cingulate ($d = 0.6, p = .04$).

Conclusions: In the first study investigating the longitudinal course of DMDD in ADHD, one in four children with ADHD + DMDD at age 7 had persistent DMDD 3 years later. Several neural correlates of DMDD were found indicating that, although DMDD can be transient, it is associated with structural differences on neuroimaging.

Parent–offspring recurrence of ADHD

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Objectives: There is a strong recurrence risk of ADHD from parent to offspring, but patterns of recurrence from mothers and fathers to sons and daughters are not studied. We aimed at evaluating whether gender-specific patterns differed between parents and further examine whether reproduction in men and women influenced the recurrence risk.

Methods: The nationwide Medical Birth Registry of Norway (MBRN) was used to identify individuals born 1967–2011, and those born 1967–1996 were linked to their own children to study reproduction. ADHD-cases in both generations were individuals being dispensed any ADHD-drugs as registered in the Norwegian Prescription Database, 2004–2015, or with an ADHD-diagnosis in the Norwegian Patient Registry, 2008–2015. We used Poisson regression to calculate the relative risk (RR) for ADHD in offspring by ADHD in mother only ($n = 20,032$; 0.8%), father only ($n = 16,952$; 0.7%) or both ($n = 1545$; 0.06%). The remaining adult population served as controls ($n = 2,447,559$). Reproduction, defined as the proportion with own children registered in the MBRN, was calculated for men and women with and without ADHD.

Results: Maternal ADHD showed stronger associations with ADHD in offspring compared to paternal ADHD (RR = 8.4; 95% confidence interval (CI) 8.2–8.6 vs. RR = 6.2; 95% CI 6.0–6.4), and highest when both parents had ADHD (RR = 11.7; 95% CI 11.0–12.5). Both mother–offspring and father–offspring recurrence risk were higher in daughters than sons, although paternal associations were lower than maternal (mother–daughters: RR = 10.4; 95% CI 10.0–10.8; mother–sons RR = 7.4; 95% CI 7.2–7.6; father–daughters: RR = 6.7; 95% CI 6.4–7.1; father–sons: 5.8; 95% CI 5.7–6.1). Men with ADHD had reduced reproduction compared to women with ADHD (75.2% vs. 90.4%, respectively); however, looking only at individuals who reproduced, the differences in maternal- and paternal-offspring recurrence risks remained.

Conclusions: The mother–offspring ADHD recurrence risk was stronger than the father–offspring risk regardless of offspring gender, with the strongest estimates found for mother–daughters. Reduced reproduction rates in men with ADHD did not explain the differences.

Genetic liability to ADHD and substance use disorders in individuals with ADHD

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Objectives: To investigate whether genetic liability to ADHD, as indexed by polygenic risk scores (PRS-ADHD) is associated with substance use disorders (SUD) in individuals with ADHD.

Methods: We included 14 398 ADHD cases from the iPSYCH2012 case-cohort sample, born in Denmark between 1981 and 2003. Register-based information on SUD was available until December 31, 2016. We estimated odds ratios (ORs) with 95% confidence intervals (CIs) for any SUD as well as for different types (abuse of alcohol, cannabis, and other illicit drugs) and severities (use, abuse, and addiction) of SUD, with effect sizes corresponding to a comparison of the highest PRS-ADHD decile to the lowest.

Results: PRS-ADHD was associated with any SUD in females (OR [crude] = 1.70, 95% CI 1.30–2.23), but not in males (OR [crude] = 1.01, 95% CI 0.84–1.21) (interaction, $p = 0.008$). Other risk factors for SUD (comorbid conduct disorder, parental SUD, parental mental disorders, low paternal income and maternal educational level) were independently associated with risk of SUD, in both females and males with ADHD. In females, ORs were slightly attenuated (OR [females, fully adj] = 1.65, 95% CI 1.25–2.18) after adjusting for other risk factors for SUD, but associations with PRS-ADHD remained significant for all specific types of SUD. The strongest association with PRS-ADHD was observed for SUD addiction (OR [females, fully adj] = 1.89, 95% CI 1.30–2.73).

Conclusions: The PRS-ADHD was associated with higher risks of SUD in females with ADHD, but not in males with ADHD. Results were robust against adjustment for other known risk factors and across different types and severity levels of SUD.

Poster

Topic: Aetiology

Hypothalamic–pituitary–adrenal axis' activity in ADHD patients

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Objectives: Evaluate the salivary concentration of cortisol as a physiological index of stress and to verify the circadian rhythm pattern in the salivary cortisol concentration analysis.

Methods: 32 patients selected from the ADHD's Clinics at the Federal University of Minas Gerais (NÍTIDA) and 15 controls from Belo Horizonte's public schools were selected. Participants were submitted to the Trier Social Stress Test, a standardized psychosocial stress protocol (TSSTc). Saliva samples were collected at the start of the test and at 30 min intervals, for 90 min after their completion. Salivary cortisol levels were measured by the electrochemiluminescence immunoassay (ECLIA).

Results: In the psychosocial stress test, the cortisol levels evaluated by the Area Under the Curve were smaller in the patients group compared to the controls.

Conclusions: These results suggest that children with ADHD present less stress reactivity when compared to children without ADHD.

Identifying executive functioning profiles of preschoolers with ADHD: a multimethod approach

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Objectives: There is significant heterogeneity in executive functioning (EF) among individuals with Attention-Deficit/Hyperactivity Disorder (ADHD). The current study sought to identify such EF heterogeneity within the preschool period and determine how various EF profiles relate to ADHD symptomatology, and associated impairments in emotion regulation and academic functioning.

Methods: Participants included 288 children (Mage = 4.93, 74% male, 83% Hispanic) diagnosed or at risk for ADHD. Children's EF was measured via standardized tasks, and parent/teacher report. ADHD symptoms and emotion regulation were reported by both parents/teachers while children's academic performance was measured via a standardized test. A latent profile analysis (LPA) was conducted to identify EF profiles.

Results: The LPA resulted in four profiles: (1) Consistent high EF (22% of the sample), (2) Inconsistent high EF (17%), (3) Consistent low EF (44%), and (4) Inconsistent low EF (17%). Children classified in the consistent and inconsistent high EF groups had significantly lower levels of ADHD symptoms compared to children in both the consistent and inconsistent low EF groups ($p < .001$). Only children in the consistent high EF group had significantly better emotion regulation compared to the inconsistent and consistent low EF groups ($p < .001$). Lastly, children in the consistent high EF group had significantly higher academic achievement scores compared to children in the Inconsistent High EF group as well as those in the consistent and inconsistent low EF groups ($p < .001$).

Conclusions: As early as the preschool period, significant heterogeneity in children with ADHD's EF can be found as only 61% of our sample showed some type of EF impairment. Additionally, only children in the consistently high EF group had better emotion regulation and academic functioning compared to the low EF groups, highlighting the importance of a multimethod approach towards measuring EF.

Traumatic stress during pregnancy caused by a natural disaster and the risk of ADHD in children: the case of Aila Cyclone

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Objectives: ADHD is widely recognized as neurodevelopmental disorder with predominant genetic aetiology. Nevertheless, there are numerous environmental factors that may increase the risk of ADHD in children. One of them is prenatal exposure to stress. There is a need of farther studies aimed to examine the relation between objective stressors acting during pregnancy and ADHD in offspring. It is possible in research focused on consequences of adverse, traumatic events, e.g. natural disasters. The aim of the study was to examine the

level of ADHD symptoms in children of mothers exposed during pregnancy to the Aila Cyclone in West Bengal, India, May 2009.

Methods: The Aila Cyclone was a strong tropical storm which was responsible for at least 339 deaths and left about 1 million people homeless across India and Bangladesh. The level of symptoms of ADHD was compared between the sample of 182 children, age 8 years, with prenatal exposure to the Aila Cyclone (ACEp) and the control group (CG) included 189 of their peers from the area of similar level of urbanization to the ACEp but unaffected by Aila Cyclone. The short version of the Conners' Teacher Rating Scale-Revised (CTRS-R-S) was used to assess the level of ADHD symptoms. The differences in ADHD symptoms between ACEp and CG were tested using ANOVA. GLM analysis was applied to control sex, gestational age and birth weight effects.

Results: The analysis adjusted to possible confounding factors revealed significantly increased ADHD symptoms in ACEp in comparison to CG, indicated by the total CTRS-R-S score, ADHD index and Hyperactivity, Cognitive problems/Inattention and Oppositional subscales.

Conclusions: The level of ADHD symptoms was found higher in children affected by the Aila Cyclone. This result underline the role of prenatal stress as a factor affecting the development of child's nervous system and its importance in the ADHD aetiology.

Predicting ADHD symptoms outcomes at 5 years of age: findings from birth cohort study

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Objectives: ADHD is a very important condition because of its high prevalence, persistence into adult life, and adverse outcomes that extend beyond the affected individuals. However, little has been reported on ADHD early neurodevelopmental pattern. Thus, this study investigated the relationship between early neurodevelopmental pattern, ADHD symptoms at 5 years of age.

Methods: Participants were derived from the Hamamatsu Birth Cohort Study for Mothers and Children (HBC-Study) and the final sample comprised 879 children. We assessed the early neurodevelopment by the Mullen Scales of Early Learning (MSEL: 5 domains; gross motor, visual reception, fine motor, receptive language, and expressive language) at four time points, from 18 to 42 months of age, and ADHD measured using ADHD Rating Scale-IV (ADHD-RS; 3 symptoms: inattention, hyperactivity/impulsivity, and combined) at 5 years of age. MSEL scores were classified low, middle and high by T-score (low; $\leq 1SD$, middle; $> -1SD$ and $< +1SD$, high; $< +1SD$). We analysed the data using each neurodevelopment domain as independent variables and ADHD symptoms as the dependent variable by multinomial logistic regression.

Results: Multinomial logistic regression analysis showed that low visual reception (32 m: OR 3.61, CI 1.86–7.09; 40 m: OR 2.63, CI 1.31–5.29), low fine motor (32 m: OR 2.64, CI 1.35–5.16; 40 m: OR 3.19, CI 1.61–6.32) and low receptive language (32 m: OR 2.41, CI 1.12–5.18; 40 m: OR 2.50, CI 1.18–5.30) at 32 months and 40 months were associated with inattention at 5 years of age. Besides, low visual reception (32 m: OR 2.06, CI 1.02–4.18; 40 m: OR 2.63, CI 1.31–5.29) and low receptive language (40 m: OR 2.89, CI 1.36–6.13) at 32 months and 40 months were associated with combine at 5 years of age. Hyperactivity/Impulsivity and early neurodevelopment showed no significant association.

Conclusions: The present results suggested that several low neurodevelopmental domains of childhood are a sign of ADHD. ADHD and ASD have high comorbidity rate. However, we did not take into

account comorbidity of ADHD and ASD in the present study. Future research should add ASD scales into independent variables.

Circadian gene expression in human dermal fibroblasts is altered by different synchronization methods

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Objectives: Serum and dexamethasone are often used synchronizers to study the circadian rhythm in mice and rat fibroblasts. However, for human dermal fibroblasts (HDF) this remains elusive. The aim of our investigation, being part of an on-going study, was to compare different chemical synchronizers and their influence on expression profiles of circadian genes using HDF.

Methods: HDF were obtained by skin biopsy from three healthy controls (2 men and a woman; 36.00 ± 17.35 years, mean \pm SD) and three volunteers suffering from ADHD (a man and 2 women; 36.67 ± 8.62 years, mean \pm SD) and cultivated under standard conditions (37°C , $5\% \text{CO}_2$). Study volunteers completed the Multiple-Choice Word test (IQ score Healthy controls: 112.33 ± 10.01 , mean \pm SD; ADHD participants: 113.23 ± 12.42 , mean \pm SD, n.s), German Morningness–Eveningness-Questionnaire (D-MEQ Score: Healthy controls: 50.33 ± 4.51 , mean \pm SD; ADHD participants: 50.33 ± 8.74 , mean \pm SD, n.s) and Wender Utah Rating Scale, German short-version (WURSk_Score Healthy controls: 13.67 ± 12.22 , mean \pm SD; ADHD participants: 32.33 ± 8.39 , mean \pm SD, n.s). Synchronization was induced either with 100 nM dexamethasone (D), 124.4 nM horse serum (HS) or 0.0828 nM fetal bovine serum (FBS) for 2 h. Sampling was performed every fourth hour starting after synchronization for a period of 28 h. CLOCK, BMAL1, CRY1, PER2/3 gene expression was measured by qRT-PCR. Statistics were calculated using SPSS.

Results: Gene expression was significantly different using D compared to HS in all samples, particularly, for time point ZT4 for CRY1 ($p = 0.001$) and ZT8 for PER3 ($p = 0.0001$) in healthy controls whereas ZT4 was significantly different for BMAL1 ($p = 0.0004$) in the ADHD group.

Conclusions: Our study suggests that choosing of synchronizers is a purpose selective task influencing the readout of circadian gene expression analyses.

Topic: Autism spectrum disorder

Role of school bullying involvement in depression, anxiety, suicidality, and low self-esteem among adolescents with high-functioning autism spectrum disorder

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Objectives: The aim of this study was to examine the differences in the levels of depression, anxiety, suicidality, and self-esteem among adolescents with high-functioning autism spectrum disorder (ASD) who had various experiences of school bullying involvement in Taiwan.

Methods: A total of 219 adolescents with high-functioning ASD participated in this study. According to their experiences of school

bullying involvement in the previous 1 year, as measured using the Chinese version of the School Bullying Experience Questionnaire, the participants were divided into the following groups: pure perpetrators, pure victims, perpetrator-victims, and neutrals. The levels of depression on the Center for Epidemiological Studies Depression Scale, anxiety on the Multidimensional Anxiety Scale for Children, suicidality on the 5-item questionnaire from the epidemiological version of the Kiddie Schedule for Affective Disorders and Schizophrenia, and self-esteem on the Rosenberg Self-Esteem Scale were compared among the aforementioned groups.

Results: The results indicated that compared with the neutrals, the pure victims, pure perpetrators, and perpetrator-victims had more severe anxiety and suicidality. Moreover, compared with the neutrals, the pure victims and perpetrator-victims had more severe depression, whereas perpetrator-victims had lower self-esteem. No difference was found in depression, anxiety, suicidality, and self-esteem between the pure victims and perpetrator-victims or between the pure perpetrators and perpetrator-victims.

Conclusions: Adolescents with ASD who were self-reported pure bullying victims, pure perpetrators, and perpetrator-victims had more severe mental health problems, especially anxiety and suicidality, than those with ASD without any involvement in bullying.

ADOS-2 scores in adults with ADHD with or without autism spectrum disorder

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Objectives: ADHD and Autism Spectrum Disorder are two of the most commonly diagnosed neurodevelopmental disorders in adults. Recent studies suggest ADHD frequently occurs with ASD and they share some phenotypic similarities. Because they present common symptoms and difficulties such as social impairments, differential and comorbidity diagnosis of the two disorders can be challenging. The ADOS-2 is the most widely used and well-validated measure designed specifically to assess ASD symptoms. In order to investigate the boundaries and overlaps between ADHD and ASD, we evaluated scoring patterns on the ADOS-2 in adults with ADHD with and without ASD.

Methods: The ADOS-2 module 4 was administered to 30 adults with a diagnosis of either pure ADHD or ADHD with ASD according to DSM-5. Subjects were outpatients or inpatients of Showa University Karasuyama Hospital in Japan between September and December 2018. ADHD and ASD symptoms were also assessed with CAARS, ADHD-RS, and AQ. IQs were evaluated with WAIS-III.

Results: Scoring patterns were compared between adults with ADHD and those with a dual diagnosis of ADHD and ASD. Adults with ADHD scored lower than adults with ADHD + ASD across all domains on the ADOS-2. On an individual item level, most ADOS-2 items were endorsed more frequently in the ADHD + ASD groups. Adults with pure ADHD tended to score high on Insight Into Typical Social Situations and Relationships and Asks for Information items.

Conclusions: Overall, the ADOS-2 discriminates well between adults with ADHD and those with a dual diagnosis of ADHD and ASD. Symptoms captured in the ADOS-2 have high specificity to ASD, even in adults with ADHD. High scores on some items in adults with pure ADHD may reflect social difficulties ADHD and ASD appear to share. However, as previous studies have argued, the quality and type of social impairments might delineate ADHD from ASD. Further investigation is needed.

Cognitive switching processes, sustained attention and interference control in children with and without ADHD symptoms

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Objectives: Executive function (EF) deficits have been associated with attention-deficit/hyperactivity disorder (ADHD). However, the results differ depending on the type of EF being tested and applied method. The aim of the study was to explore whether children with ADHD symptoms differ significantly from healthy peers in selected executive functions such as: switching, sustained attention and interference control.

Methods: The sample included 285 boys and 262 girls aged 6–12 years. IOWA Conners Rating Scale was applied to measure children's ADHD symptoms. Children who scored above 2 standard deviations were qualified as increased ADHD risk group and were compared with their peers without symptoms (control group, CG). Stroop Color-Word Interference Test (SCWT), The Continuous Performance Test (CPT) and The Trial Making Test A and B (TMT-AB) were applied to assess children's EF. The test results were standardized on age and sex using mean and 1SD from the sample. The research was funded by National Science Centre, Poland (2016/21/B/NZ5/00492).

Results: Both the number of reactions and impulsive errors in CPT were significantly associated with increased ADHD risk (\bar{x} ADHD = .966SD, \bar{x} CG = -.239SD; \bar{x} ADHD = .934SD, \bar{x} CG = .231SD), however, children did not differ within omission mistakes. There were no differences between children in CPT and TMT response time, although children with ADHD symptoms made more mistakes in TMT-B (\bar{x} ADHD = .224SD, \bar{x} CG = -.004SD). Children with ADHD risk had also lower response time in all parts of SCWT (\bar{x} ADHD = .661SD; 1.049SD; 778SD; \bar{x} CG = -.016SD; -.0234SD; -.0177SD) and higher interference score associated with mistakes (\bar{x} ADHD = 1.311SD, \bar{x} CG = -.0294SD).

Conclusions: Children with ADHD symptoms were characterized by decreased interference control and higher impulsivity, but they did not differ in sustained attention and switching processes from their peers without symptoms. The results suggest children with ADHD risk might make more mistakes due to their impulsive reactions and they might need more time to perform the EF task, associated with control.

Are ADHD and autism spectrum disorder dissociating or overlapping disorders? Oculomotor evidence from multiple tasks

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Objectives: Recent trends in the literature suggest an etiological overlap between ADHD and Autism Spectrum Disorder, which since the DSM-5 can be co-morbidly diagnosed. In order to systematically compare these groups and find clues to shared underpinnings of these disorders, potential markers of each disorder need to be investigated in tandem.

Methods: The present study directly examined groups of participants with ADHD, ASD with (ASD+) or without (ASD-) comorbid

ADHD and a typically developing (TD) group (N = 100). Three ecologically valid tasks, namely visual search, copying down and gaze cueing, were selected. These tasks measure local-global processing and joint attention as well-studied constructs in ASD; and intra-subject variability (ISV), a potential endophenotype of ADHD. Step-by-step process analysis was employed to analyze the oculomotor and behavioural data collected.

Results: Results from the visual search and gaze-cueing tasks, show that only the groups with ADHD symptoms (ADHD and ASD+) have increased intra-subject variability. Superior performance on visual search was observed only in the ASD-, not in the ASD+ group. These significant differences between the ASD- and ASD+ groups were observed in the gaze cueing task as well. In the copying down task, once again, the ADHD and ASD- groups differed in strategies used to copy figures.

Conclusions: Across the three tasks employed here, the ADHD, ASD- and ASD+ groups exhibit different performance profiles. While increased ISV is observed in groups with ADHD symptoms, findings that are typical of ASD participants cannot be found in the comorbid ASD+ group. While these findings point towards a double dissociation between ASD and ADHD, more research is still needed in order to identify if, and in which constructs, ASD overlaps with or dissociates from ADHD.

Neurocognitive variability in children with ADHD and autism spectrum disorder: exploring the motor coordination and planning function

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Objectives: ADHD and Autism Spectrum Disorder are two neurodevelopmental disorders that show overlap in both the symptoms and the etiological pathways such as neurocognitive dysfunctions. However, the two conditions have been studied previously mainly in isolation and rarely have co-morbidities been considered. Our study aimed to exploring the neurocognitive variability in children with ADHD and ASD.

Methods: Thus, the present study set out to explore the ADHD and ASD cognitive deficits in children with ADHD (N = 45), high functioning autism spectrum disorder (HFASD, N = 64) that comorbid with (ASD+, N = 22) or without (ASD-, N = 42) ADHD and typically developed children (TD, N = 32). With regard to neurocognitive variability, we used Berry Visual-Motor Integration Developmental (VMI) Test, Purdue pegboard test (PPT), as well as spatial working memory (SWM) test, Stockings of Cambridge (SOC) test, Rapid Visual Information Processing (RVP) test from CANTAB. Group comparisons among ADHD, ASD and TD were conducted and with post hoc t-tests. Furthermore, A one-way ANCOVA, with group as fixed factor (ADHD, ASD+ and ASD-), was followed by post hoc t-tests to clarify the effects of co-morbidities.

Results: The between-group comparisons showed motor coordination functioning deficit in both ADHD and ASD, with ASD more severe than ADHD and most serious in ASD+ group. It indicated that compared with children with ADHD, motor coordination functioning was more damaged in ASD, while ADHD comorbidity will enhance this dysfunction. The results showed that spatial working memory was nonspecific in either of these diseases. As for planning, we found significant functioning deficit only in ADHD, not in ASD- or ASD+. The results suggested that dysfunction in planning were more representative of cognitive deficits in ADHD.

Conclusions: Our results illustrated the different profile of neurocognitive deficiencies in ADHD and ASD, thus enlightened the exploration of the etiology of these two disorders. Future studies are needed to explore the neurocognitive changes after related treatment or behavioral intervention.

Table1. Group comparisons among ADHD, ASD and TD, and post-hoc t-tests

cognition	ADHD(n=45)	ASD (n=64)	TD(n=32)	P	Post hoc
IQ	109.59	95.26	108.22	0.000***	ASD<ADHD/TD
pegboard test R	12.80	10.77	13.74	0.000***	ASD<ADHD/TD
pegboard test L	12.00	10.39	12.76	0.009**	ASD<TD
pegboard test D	11.84	9.44	10.83	0.053	ASD<ADHD
pegboard test A	22.71	16.70	28.17	0.000***	ASD<ADHD<TD
Visual	110.42	102.05	109.44	0.064	-
Motor	99.81	92.81	106.97	0.007**	ASD<TD
VMI	101.33	95.93	104.88	0.067	-
RVP	0.88	0.88	0.91	0.299	-
SWM	52.52	55.03	23.09	0.000***	ASD/ADHD>TD
IED	41.05	48.28	51.52	0.457	-
SNAP	37.15	33.97	22.44	0.000***	ASD/ADHD>TD
SOC	4.42	5.58	7.00	0.001**	ADHD<TD

Topic: Comorbidity

Emotion regulation difficulties in adolescents with ADHD and/or dyslexia

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Objectives: ADHD is commonly associated with emotion regulation (ER) problems. Although around 10–45% of adolescents with ADHD also present with specific learning disorders such as dyslexia, studies on ER in dyslexia or comorbid cases of ADHD/dyslexia remain limited. The aim was to examine potential differences in ER abilities between 11 and 16-year-old adolescents diagnosed with ADHD, dyslexia as well as comorbid dyslexia/ADHD.

Methods: Preliminary data from an ongoing research project was analyzed for 3 diagnostic groups (AD(H)D: $n = 15$; dyslexia: $n = 12$; dyslexia/AD(H)D: $n = 9$) paired on age ($F < 1$, n.s.), gender ($X^2(2) = 0.68$, $p = .71$) and IQ ($F < 1$, n.s.). ER was investigated experimentally using a frustration inducing task (Behavioral Indicator of Resiliency to Distress; BIRD; Lejuez et al. 2006) while assessing adolescents' subjective positive and negative affect before and after the task (PANAS-C; Laurent et al. 1999). Additionally, adolescents completed questionnaires on alexithymia (AQC, Rieffe, Oosterveld and Terwogt 2006) and difficulties in ER (DERS-SF; Kaufman et al. 2016).

Results: Preliminary findings showed a significant effect of time ($F(1, 33) = 6.46$, $p = .02$, $n^2 = .16$) with higher negative affect reported after the task and a marginal diagnostic group effect ($F(2, 33) = 3.05$, $p = .06$, $n^2 = .16$) showing marginally higher negative affect for the comorbid group compared to the dyslexia group ($p = .06$). Marginally significant group differences ($F(2, 33) = 3.21$, $p = .05$, $n^2 = .16$) also showed higher alexithymia scores for the comorbid group compared to the dyslexia group ($p = .06$) but alexithymia and post-task negative affect were not found to be correlated ($r = .25$, $p = .13$). No differences in self-reported ER difficulties were found ($F(2, 33) = 2.52$, $p = .10$, $n^2 = .13$) between the three diagnostic groups.

Conclusions: These preliminary findings indicate that, compared to a single diagnosis of dyslexia, a dyslexia/ADHD comorbidity might potentially entail less developed ER skills. The ongoing data collection (bigger sample, control group) will help to further elucidate these tentative results in the future.

Do weight, waist circumference and fat tissue content indicate increased risk of obesity in children with ADHD?

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Objectives: One of the most commonly studied indicators of obesity in children with ADHD is BMI which does not give direct information on adiposity. What is more, there are few studies evaluating other obesity related parameters such as waist circumference. The aim of this study was to examine the relationship between ADHD and weight, waist circumference and % of fat tissue.

Methods: The sample included 285 boys and 262 girls aged 6–12 years. IOWA Conners Scale was used to distinguish the groups of children with (inattentive-impulsive-overactive, IO) and without elevated level of ADHD symptoms (control group, CG). The type of ADHD symptoms: inattentive (IN) and hyperactive-impulsive (HY) and oppositional-defiant disorder (OD) symptoms were controlled. The percentage of fat tissue was assessed using the electric bioimpedance method (TANITA MC-980). Body weight was transformed into the z scores based on WHO growth charts. Waist circumference and % of fat tissue were standardized on age and sex using the mean and 1SD from the sample. The z score $> 1SD$ was a criterion indicating an increased weight (IBW), waist circumference (IWC) or fat tissue (IFT). The research was funded by National Science Centre (2016/21/B/NZ5/00492).

Results: IO and IN were not related to IBW and IWC. HY was associated with lower rate of IBW ($- 14\%$) but higher rate of IWC ($+ 12\%$) compared to CG. IWC was also found to be more frequent in OD ($+ 8\%$) compared to CG. IFT was related to HY ($+ 25\%$ in comparison to CG) but not to IO, IN and OD.

Conclusions: Regardless of lower body weight, Hyperactive/Impulsive type of ADHD was found to be associated with increased waist circumference and % of body fat, which suggests an increased risk of central obesity in ADHD children. Oppositional-Defiant symptoms may modulate the link between ADHD and obesity.

ADHD symptomatology and sleep disorders in a Romanian sample of patients with chronic psychoactive substance abuse

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Objectives: The study investigates a group of 100 patients admitted in a psychiatric department with addiction profile in terms of the presence of ADHD symptomatology and comorbidities such as sleep disorders. We examined whether certain symptoms of adult ADHD (ADHD subtype) are associated with current presence of persistence sleep altered pattern.

Methods: There were selected 100 adult patients admitted in „Alexandru Obregia” Psychiatry Hospital” from Bucharest,

Romania. The data was provided after the characterization of the group according to final scores after applying DIVA (instrument for adult ADHD diagnosis) and Morningness–eveningness questionnaire (self-assessment instrument that evaluates circadian rhythm and the peak alertness in certain times of the day). Statistical analyses (e.g. linear/logistical regression) were performed in order to correlate the adult ADHD symptoms and the presence of sleep problems.

Results: The obtained results emphasizes that ADHD symptoms were correlated with low quality of sleep. This altered sleeping pattern is associated with a delayed sleep phase, being connected to a disruption of the biological clock. Furthermore, patients with the ADHD subtype with exacerbated hyperactivity component, report more often difficulties in getting to sleep and a shorter sleep duration. Also, the data showed that a significant number of the adult patients with chronic substance abuse presented ADHD symptoms.

Conclusions: The positive correlations should help raise the awareness regarding the use of ADHD diagnosis in adult psychiatry services. An earlier diagnosis of ADHD and comorbidities in adulthood should better orient the intervention (both pharmacological and psychotherapeutic) in the case of these patients.

A retrospective hospital center study - ADHD in childhood and bipolar affective disorder: is there a relationship?

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Objectives: Comorbidity between Attention-Deficit/Hyperactivity Disorder (ADHD) and Bipolar Affective Disorder (BAD) is relatively common and a diagnostic and therapeutic challenge, being associated with more severe symptoms, course and a worse prognosis. To our knowledge, there are no data regarding the comorbidity or evolution of the diagnosis from ADHD in childhood to a PAB in adulthood in our population. We intend to analyze data on the comorbidity presence of both pathologies and the diagnosis evolution.

Methods: We performed a retrospective survey of patients followed at a Psychiatry hospital center with one or comorbid diagnosis, whose current age varies between 18 and 38 years. We identified those that were followed in childhood and examined clinical processes in order to evaluate the previous complaints and psychoactive drug used.

Results: We obtained a total of 34 patients with PAB. No patient had a comorbid diagnosis of ADHD, although two patients appeared to have characteristics suggestive of ADHD, both of whom had substance use since adolescence. Only 6 were followed in childhood: three with diagnosis of BAD, two with diagnosis of Depressive Disorder and one with undefined diagnosis.

Conclusions: Studies suggest that there is a presence of comorbidity between BAD and ADHD. Also the previous diagnosis of ADHD is a strong predictive indicator of BAD. Symptomatology suggestive of ADHD in adult patients is not usually part of the previously history routine. Our hospital center receives a population of 300,000 inhabitants, justifying the small clinical sample of patients with BAD and even smaller with a concomitant presence of follow-up in Childhood Psychiatry. A cross-sectional study following patients with ADHD in childhood to BAD adulthood should be done to analyze the comorbidity and diagnostic evolution.

The prevalence of psychiatric comorbidity in children and adolescents with ADHD in Turkey

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Objectives: The objective of this study was to examine comorbid disorders associated with Attention Deficit Hyperactivity Disorder (ADHD) and the subtypes of ADHD in children and adolescents with the diagnosis of ADHD. In addition, it was examined the relationship between the comorbidities, the subtypes of ADHD and sociodemographic features.

Methods: The study included 326 children and adolescents aged between 8 and 15 years who were diagnosed with ADHD for the first time as a result of an interview by using the Kiddie Schedule for Affective Disorders and Schizophrenia for School-Age Children Present and Lifetime version (K-SADS-PL) that based on a DSM-IV diagnostic criteria by experienced psychiatry resident, in a child adolescent psychiatry clinic in Izmir.

Results: In the study, it was found that 49.7% of the cases were diagnosed with ADHD and 50.3% of children and adolescents with ADHD had at least one comorbid disorder was obtained. The comorbidities accompanied ADHD were disruptive behavior disorder (28.8%), depressive disorder (13.2%), obsessive–compulsive disorder (9.5%) and anxiety disorder (6.1%), in respectively. When the subtypes of ADHD were assessed according to psychiatric comorbidity, oppositional defiant disorder and conduct disorder were frequently seen with ADHD combined type, whereas anxiety disorder was seen more frequent in children diagnosed with ADHD inattentive type.

Conclusions: The most important predictive factor that determines both the response to treatment and the prognosis in ADHD are comorbid diagnoses. Therefore, to determine the comorbid disorders associated with ADHD will affect the prognosis in positively.

Avoidance-related distress in patients with PTSD and ADHD

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Objectives: There is a strong relationship between ADHD and PTSD, as ADHD is found to be an independent risk factor of a PTSD diagnosis, and the presence of both has been found to lead to a worse prognosis. Avoidance, a shared feature of both disorders, has shown to be a significant barrier to treatment. Within PTSD patients, avoidance symptoms, such as numbing feelings or avoiding reminders of the event, serve to maintain and intensify PTSD symptoms. Relatedly, avoidance amongst ADHD populations, typically escape-avoidance, is shown to perpetuate greater symptom severity. Subjective distress over high risk behaviour mediates the relationship between trauma-related distress and PTSD symptom severity. Given the propensity of ADHD patients to engage in escape avoidance, we hypothesized that comorbid PTSD and ADHD populations would have greater subjective distress over their avoidant behaviours.

Methods: Using a sample of patients referred to our tertiary care clinic in Toronto, Canada, we compared the relationship of avoidant related distress between comorbid and non-comorbid PTSD and ADHD patients using an independent samples t-test.

Results: Results show that the comorbid ADHD and PTSD sample had higher subjective distress in regards to their avoidance behaviours compared to the PTSD without ADHD sample, $t(12) = 2.741$, $p = 0.018$.

Conclusions: Our results suggest that engaging in ADHD-consistent avoidant behaviour increases subjective distress, which may contribute to worse prognosis. Whereas within PTSD patients without ADHD, the avoidant behaviours, while not conducive to treatment, lead to less subjective distress as they allow patients the ability to escape their trauma without the same heightened risk as ADHD-consistent avoidance. This finding has implications for therapeutic care, and as such, there is a need for further screening of comorbidities in PTSD, specifically screening ADHD within complex presentations of PTSD that are less responsive to standard treatment. Limitations and future directions will be discussed.

ADHD symptoms are affecting mathematics achievement and well-being in students with mild intellectual disabilities

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Objectives: Attention is one of the most critical and complex factor affecting learning, and ADHD symptoms are increased in children and adolescents with mild intellectual disabilities (Simonoff et al. 2007). The purpose of the present study was to examine the effect of ADHD symptoms on mathematics achievement, subjective well-being and functioning in students with mild intellectual disabilities.

Methods: The study sample consisted of 76 students (44 boys, 32 girls) in the fourth grade, 10–12 years of age, diagnosed with mild intellectual disability. Hyperactive/inattentive behaviour and other emotional and behavioural problems were measured with the parent and teacher versions of Strengths and Difficulties Questionnaire, SDQ (Goodman, Meltzer and Bailey 1998). Health-related quality of life was assessed by parent version of the KINDL-R questionnaire (Ravens-Sieberer and Bullinger 1998). The students performed mathematics achievement test and their general mental abilities were assessed by using the Raven Coloured Progressive Matrices Test (Raven, Raven and Court 2003).

Results: Parent rated SDQ Hyperactivity/Inattention score was associated with lower mathematical performance and lower score of Raven Coloured Progressive Matrices Test ($r = -0.23$ and -0.25 , respectively; $p < 0.05$), while other emotional/behavioural problems measured by SDQ had no significant impact on mathematical achievement. The general intelligence score and math performance were significantly correlated ($r = 0.6$; $p < 0.0001$). Higher hyperactivity/inattention predicted lower emotional well-being ($p < 0.005$), lower quality family relations ($p < 0.005$), and lower self-esteem ($p < 0.05$).

Conclusions: ADHD symptoms have significant negative impact on learning outcome and well-being of the students with mild intellectual disabilities.

The association between insomnia and alcohol consumption in adults with ADHD

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Objectives: Insomnia and alcohol consumption are both described as co-existing problems in adults with ADHD. Here we investigated the frequency of and the association between the two in a sample of adults with ADHD and a control group recruited from the population.

Methods: The sample included cross-sectional data from 270 adults with an ADHD diagnosis (41.3% males) and 201 controls (38% males). All participants completed a questionnaire to define insomnia (the Bergen Insomnia Scale) and the Alcohol Use Disorder Identification Test (AUDIT), where the sum score of the first eight items was used to define the frequency of alcohol use.

Results: Compared to the control group, the ADHD group showed a higher frequency of insomnia (67.2% and 28.8%, respectively, Chi square = 60.97, $p < .001$) and a higher frequency of alcohol consumption ($t(417)3.227$, $p < .001$). The rate of insomnia was not statistically different between males and females, but males obtained higher AUDIT scores than females, both in the ADHD ($t(233) = -3.10$, $p = .002$), and the control group ($t(182) = -2.76$, $p = .006$). A logistic regression analysis with insomnia as the dependent variable showed that the contribution of AUDIT severity was statistically significant even when age, gender and diagnostic status (ADHD/control) were controlled (Beta = .073, $p = .010$). The four variables, altogether, explained 22.2% of the presence of insomnia (Nagelkerke R-square).

Conclusions: Considering the high impact of insomnia and drug abuse on core symptoms of ADHD, a careful assessment should include information about both sleep problems and alcohol consumption before deciding on an intervention program for an adult with an ADHD diagnosis. Additional analyses of the relationship between current and childhood ADHD symptoms, comorbid disorders, sleep, and alcohol consumption will be presented.

Children with ADHD using methylphenidate: analysis of executive functions, attention and verbal fluency

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Objectives: The present study aimed to analyze the performance profile on executive functions (working memory, inhibitory control and cognitive flexibility), attention (sustained, selective, alternated) and verbal fluency (phonological and semantic) of children with ADHD using methylphenidate.

Methods: A total of 71 children aged 7–11 years old were divided into three groups: control group ($n = 38$), ADHD group with methylphenidate ($n = 13$) and ADHD group without methylphenidate ($n = 20$). The parents or responsible for the children signed a Free and Informed Consent Form and completed a sociodemographic questionnaire, and parents of children with ADHD also completed the SNAP-IV. The children signed the Minor Assent Term. The instruments used in order to reach the proposed objectives were Progressive Matrices of Raven, Digit Span, Corsi Block Test, Trail Making Test, Five Digit Test and Verbal Fluency Test. After tested and confirmed the homogeneity of the variance between groups ($p > 0.05$), it was decided to use ANOVA one-way and correspondence analysis.

Results: The results revealed the performance of 38 (53.5%) children of the control group and of 33 children with ADHD (46.5%), carefully diagnosed. Of these children with the disorder, 27 (81.8%) were boys and 6 (18.2%) were girls. In regarding the presentation of ADHD, 19 (26.8%) children were diagnosed as ADHD with predominantly inattentive presentation, 6 (8.5%) had ADHD with predominantly hyperactive-impulsive presentation and 8 (11.3%) had ADHD with combined presentation. Through ANOVA one-way, it was observed there was a significant difference between the averages of the three groups for the abilities of working memory [$F(2, 68) = 5.28$; $p < 0.05$], cognitive flexibility [$F(2, 68) = 6.71$; $p < 0.05$], inhibitory control [$F(2,68) = 4.66$; $p < 0.05$], sustained attention [$F(2,68) = 4.79$; $p < 0.05$], selective attention [$F(2,68) = 5.81$;

$p < 0.05$] and alternated attention [$F(2.68) = 8.16$; $p < 0.05$]. With the post hoc it was possible to verify that the difference of averages was between the control group (CG) and the ADHD with methylphenidate or between the CG and the two experimental groups, since $p < 0.05$. Observing the means of the scores obtained by the groups, it was seen that these differences were better for the Control Group that obtained the highest scores. Correspondence analysis were also performed and was observed an association between the use of the medication and the achievement of an average performance on cognitive flexibility, inhibitory control and selective attention.

Conclusions: The analysis indicated that children with ADHD using methylphenidate, compared with other children with the disorder who do not use medication and with healthy children, presented a lowered profile of executive and attentional functioning regarding the abilities of inhibitory control, cognitive flexibility, working memory, sustained attention, selective attention, alternated attention, phonological verbal fluency and semantic verbal fluency.

Childhood psychological traumatization is associated with prevalent comorbid psychiatric disorders and current PTSD in adult patients with ADHD

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Objectives: Research literature indicate a bidirectional association between ADHD and PTSD, suggesting childhood exposure to psychological traumatic events is associated with worsening of childhood ADHD and comorbid psychiatric disorders. This study examines whether adult ADHD-patients with a history of childhood trauma (CT) have more prevalent comorbid psychiatric disorders in adulthood than ADHD-patients without CT, and whether CT is associated with current PTSD.

Methods: Medication naïve adults with ADHD ($n = 250$) referred to a specialist outpatient clinic diagnosed by board-certified psychiatrists according to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, using the Diagnostic Interview for ADHD in Adults, second edition (DIVA 2.0). The structured interview MINI International Neuropsychiatric Interview Plus (M.I.N.I.-Plus) for DSM-IV Axis I disorders was applied to assess DSM-IV qualifying trauma in childhood (CT) and other comorbid mental disorders. For analyses the ADHD-patients were divided into those with CT reported before 15 years of age and those with no CT. Categorical variables were analyzed using the Chi-square test.

Results: Prevalence of CT was 44% ($n = 109$), more women ($n = 64$) than men ($n = 45$) ($p = 0.048$). More patients with CT had current PTSD (16% vs. 2%, $p < 0.001$), life time panic disorder (36% vs. 16%, $p < 0.001$) or agoraphobia (28% vs. 17%, $p = 0.031$) than the no-CT patients, and a larger proportion the CT patients had two or more comorbid disorders (57% vs. 39%, $p = 0.030$).

Conclusions: For adult ADHD patients, a history of childhood traumatization was related to more prevalent psychiatric comorbidities and PTSD. Studies on whether severity of symptoms and impairment also correlate with these findings are warranted.

ADHD: shall we sleep on it?

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Objectives: This review attempts to investigate potential impacts on daytime functioning of primary sleep disorders in individuals with ADHD.

Methods: A PubMed search was performed in December 2018 using the search keywords “sleep disorders”, “ADHD”, “outcome” and “treatment”.

Results: Attention deficit/hyperactivity disorder (ADHD) is a persistent neurodevelopmental condition that affects 2.5% of adults worldwide, presenting with symptoms of inattention, hyperactivity, and/or impulsivity with significantly impaired functioning. Primary sleep disorders such as sleep-disordered breathing (SDB), restless leg syndrome (RLS), circadian rhythm sleep disorder (CRSDs), insomnia, and narcolepsy are commonly present in individuals with ADHD but not often assessed or treated. Sleep disturbances in these patients might result in significant functional impairment that affect attention, mood, behavior, and ultimately school/work performance and quality of life. According to some authors, polysomnography (PSG) studies have established some differences in sleep architecture between individuals with sleep disorders with and without ADHD. Shorter stage, shorter REM latency, were the main issues found in those patients. Only a few studies have explored daytime impairments in patients with ADHD and comorbid primary sleep disorders. Higher levels of hyperactivity and inattention, lower perceived quality of life and higher level of depression and anxiety symptoms were reported.

Conclusions: The high prevalence of subjective complaints regarding sleep disturbances in individuals with ADHD and the prevalence of daytime symptoms of inattention and hyperactivity in individuals with primary sleep disorders, suggests that a baseline sleep evaluation as well as regular systematic screening for sleep problems is necessary component of ongoing ADHD management. More studies should also be conducted, aiming for the clarification of the clinical characteristics and daytime impairments in those patients.

Suicide: a primary or secondary road in ADHD - clinical case

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Objectives: This review aims to present a clinical case of a patient with undiagnosed ADHD who developed a depressive episode with suicidal ideation.

Methods: Clinical process consultation and PubMed search were performed in December 2018 using the search keywords “ADHD”, “suicidal behavior” and “suicide risk”.

Results: Attention deficit/hyperactivity disorder (ADHD) is a persistent neurodevelopmental condition characterized by persisting inattention, hyperactivity and/or impulsivity with significantly impaired functioning and development. ADHD symptoms are noted during childhood, but can often persist into adulthood in 10–79% of child patients. Several authors defends that, in adulthood, ADHD increases the risk of antisocial behavior, substance abuse, aggressive behavior, social exclusion and low self-esteem. Research has shown that these psychiatric comorbidities may play an importante role in the development of suicidal behavior. Pedro, a 37-year-old male,

unemployed, presented to the Hospital de São José reporting suicidal ideation. He indicated that he had been depressed for several months with easy fatigability, decreased interest in pleasurable activities, low self-esteem, inability to concentrate, low mood and anxiety. Pedro reports a longstanding history of poor attention. He is creative and intelligent, but he has always had a difficult time concentrating in class. His difficulties with focusing and time management have continued into adulthood, affecting his ability to effectively manage his finances and personal life. The pressure he feels towards finding mechanisms to cope with his symptoms, have ultimately resulted in increased anxiety, feelings of guilt, and loss of self-esteem. Pedro admits to having a daily dependence on marijuana.

Conclusions: Although many studies indicate an association between ADHD and suicidal behavior, it remains controversial whether there is a direct relationship or if the association depends on the increased prevalence of pre-existing comorbid conditions and individual and family dysfunctional factors.

Sluggish cognitive tempo but not ADHD symptoms predict child body mass index: examination in a sample of clinically referred youth

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Objectives: ADHD symptoms, particularly inattention, have overlap with sluggish cognitive tempo symptoms, a cluster of symptoms indexing slowed behavior/thinking, reduced alertness, and getting lost in one's thoughts. Both symptom constellations predict a wide array of outcomes, and to some extent have divergent associations. While some studies show possible associations between childhood ADHD and excessive body mass index, no study to date has examined whether ADHD and/or SCT predict body mass index in children.

Methods: A retrospective chart review study of 89 children aged 6–15 years referred for learning, attention and memory problems to a developmental-behavioral pediatrics clinic were assessed (65% diagnosed with ADHD based on K-SADS and multi-informant ratings). Caregivers completed the Child and Adolescent Behavior Inventory (CABI) to measure SCT symptoms and the Vanderbilt ADHD rating scale as part of the assessment. Body mass index was calculated at the time of assessment. SCT was evaluated both overall and following a principal components analysis given evidence of commonly observed SCT subdimensions.

Results: Children in the sample had excessive BMI for age and gender (one-tailed t test $p < .001$; Mean BMI z -score = 0.73). The factor analysis revealed a 3-factor solution for SCT mirroring previously published SCT dimensions (slowed thinking, hypoarousal, and daydreamy). Results of linear regressions revealed that ADHD symptoms overall, and ADHD inattention and hyperactivity/impulsivity symptoms did not predict children's BMI scores (all $p > .65$). Total SCT symptoms also did not predict child BMI scores ($p = .86$). However, this was qualified by examination of the SCT subdimensions that revealed that greater SCT low arousal/alertness scores predicted greater BMI ($B = 0.23$; $p = .02$). SCT dimensions of slowed thinking and excessive daydreaming, however, did not predict child BMI (both $p > .14$). When ADHD inattention symptoms were added to the model, SCT low arousal/alertness continued to predict child BMI scores.

Conclusions: Results suggest that child sluggish cognitive tempo rather than ADHD symptoms may contribute to child BMI, indicating it as a novel risk factor for a deleterious health condition. Specifically, children who show low arousal and alertness are more at risk in particular, and that this risk is independent from child ADHD

symptoms, despite SCT and ADHD showing strong correlations. Future studies with larger samples followed longitudinally are needed.

ADHD is associated with a pervasive pattern of risky behavior which mediated by benefit perception

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Objectives: ADHD is associated with increased engagement in risky behaviors (ERB) such as reckless driving and substance abuse. By using behavioral economics approach in a study performed on a general population, this association was found to be affected by benefit perception, but not risk perception or attitude. These findings raised some drawbacks. Most of the research has focused on specific activities or domains, often without controlling for comorbid disorders. Additionally, finding regarding the role of benefit perception demands corroboration in clinical sample. This study seeks (1) to establish a link between ADHD and an overall level of ERB and beyond other psychiatric disorders, (2) To further the role of benefit perception to clinical sample relying on two different paradigms.

Methods: A sample of 200 adults with and without ADHD were screened for ADHD and other psychiatric symptoms and disorders. Participants completed a new self-reporting questionnaire regarding the likelihood and frequency of engagement in a broad range of risky behaviors that may lead to a variety of hazards. In addition, they ranked their risk and benefit perceptions of those activities following by additional 25 characteristics.

Results: ADHD-participants reported increased likelihood of hypothetical engagement and increased frequency of real-life ERB. The presence of ADHD predicts higher ERB above and beyond demographics and comorbid psychiatric disorder. Benefit perception was found as a mediator via two different paradigms.

Conclusions: ADHD is linked to an increased overall level of ERB in which benefit perception serves as a mediator. Engagement in risky behaviors should be constantly evaluated and monitored, even in the absence of comorbid psychiatric conditions. Interventions should consider the individuals' preferences.

Examining the role of chronic anhedonia as a transdiagnostic risk factor for ADHD, treatment-resistance, and suicidal behavior in patients with generalized anxiety disorder

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Objectives: Treatment-resistance among individuals with anxiety disorders remains a significant public health concern with up to 60% of individuals experiencing residual symptoms after treatment with standard anxiolytics. Suicide is one of the leading causes of death in people aged 15–44 globally. Research has demonstrated attention deficit hyperactivity disorders (ADHD) and anxiety disorders are highly comorbid and associated with reduced quality of life and increased risk of self-harm. The aim of this study was to examine clinical features and predictive factors associated with the development of treatment-resistance and suicidal behavior in patients with generalized anxiety disorder (GAD).

Methods: Data was collected from consecutive new referrals ($N = 160$) to a tertiary-care mood and anxiety clinic. Diagnosis was established by administration of the Mini International Neuropsychiatric Interview Plus (MINI) 6.0.0, ADHD module, and semi-structured psychiatric assessment. Treatment-resistance was defined as failure of two or more antidepressants/anti-anxiety agents for adequate treatment dose and duration. Chi-square analyses were performed to examine clinical features and predictive factors associated with treatment-resistance and suicidal behavior. Logistic regression analyses were performed to obtain odd ratios (OR).

Results: Comorbid ADHD was present in 43.7% of patients referred for treatment-resistant GAD with 91.9% of these patients presenting with chronic anhedonia. Clinical features predictive of undiagnosed or untreated ADHD in this group included sex (65.4% males, $p < .031$), social phobia ($p < .001$, OR 6.68), OCD ($p = .005$, OR 3.63), alcohol ($p = .010$, OR 5.24) and substance dependence/abuse ($p = .047$, OR 3.64), and number of referral diagnosis ($p < .001$, OR 2.17). Whereas, number of current ($p < .001$, OR 1.63) and past medications at intake ($p < .001$, OR 2.21), SSRI failure ($p < .001$, OR 3.15), number of failed SSRIs ($p < .001$, OR 2.14), and comorbid ADHD ($p = .016$, OR 2.38) were significantly associated with a higher risk of treatment resistance in GAD. The most predictive factors associated with suicidal ideation were alcohol dependence/abuse ($p = .025$, OR 7.85) and chronic anhedonia ($p = .042$, OR 2.38). Substance abuse was associated with a higher risk of suicide attempt ($p = .013$, OR 3.21).

Conclusions: These findings support previous studies that have demonstrated comorbid GAD and ADHD are often associated with poorer treatment outcomes. This study suggested that risky behaviors, multiple referral diagnoses, and increased numbers of failed medications may at least in part be explained by the presence of undetected or untreated ADHD. As well, chronic anhedonia may serve as a prognostic indicator of the presence of ADHD and suicidal behavior in patients with treatment-resistant GAD. This signifies the importance of screening for adult ADHD in anxious patients presenting with anhedonia the need for further studies identifying transdiagnostic markers to guide treatment and harm reduction.

Association between dyslexia/high functioning autism symptoms and sluggish cognitive tempo symptoms in the patients who applied to a child psychiatry outpatient clinic

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Objectives: Sluggish Cognitive Tempo (SCT) is a cognitive arousal and awareness disorder presented with clinical symptoms such as tardiness in responding, blank stares, daydreaming and seeming in a puzzled state. Recent evidence demonstrates that SCT is a distinct disorder from Attention Deficit Hyperactivity Disorder. The objectives of our study are to determine whether there is an association between SCT and High Functioning Autism (HFA) symptomatology and investigate whether or not SCT is more prevalent in the children with Dyslexia.

Methods: 171 children without intellectual disability, aged 6–15 years and applied to Ege University Child Psychiatry outpatient clinic were included in this study. Subjects were diagnosed to SCT using four SCT scanning items of teacher-rated Teacher's Report Form (TRF) and parent-rated Child Behaviour Checklist (CBCL) and also Barkley's Child Attention Survey (BCAS). Furthermore, Autism Spectrum Screening Questionnaires (ASSQ) were completed by

parents to assess participants' autistic symptom severity. Psychiatric diagnoses were assessed by clinical interviews according to Diagnostic and Statistical Manual of Mental Disorders-5 (DSM-5).

Results: 12.9% ($n = 22$) of the children scored above the clinical cut-off on at least two of three SCT scales (BCAS, SCT scanning items in CBCL and TRF). It was ascertained that there is a medium–high level of positive correlation between SCT symptoms and HFA symptoms ($p < 0.001$, $r = 0.61$). Supportively, participants with SCT had significantly higher ASSQ scores ($p = 0.001$). However no statistically significant differences were found between children with and without dyslexia in terms of SCT symptoms ($p = 0.568$).

Conclusions: Findings corroborate the idea of presence of association between SCT and HFA. Because there is no study in the literature concerning such a correlation, this study becomes the first research indicating a possible relationship between SCT and HFA. The correlation between SCT and HFA symptoms may result from the overlap of social deficits in HFA and internalizing symptoms in SCT.

ADHD and borderline personality disorder: comorbidity or common underlying disease process

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Objectives: ADHD and Borderline Personality Disorder BPD have several overlapping symptoms. The nature of the relationship between these disorders remains unclear including the possibility of true comorbidity or variations of a common underlying disease.

Methods: Non-systematic review of literature performed through a literature search using the Pubmed database.

Results: ADHD and BPD have several overlapping symptom dimensions (irritability, impulsivity, emotional dysregulation, executive dysfunction). Despite these common symptoms, there are some features that appear to be fairly specific of BPD including avoidance of abandonment, chronic feelings of emptiness, self-harm, and suicidal behavior, dissociative features. One of the key symptoms in both disorders—impulsivity—is of particular relevance since it is linked to adverse behaviors (self-harm and suicide) and to traumatic childhood events. Indeed, ADHD and BPD, despite treatment, revealed higher levels of impulsivity than healthy controls. There is reported comorbidity of 20% of ADHD in BPD and bipolar disorder. Studies exploring the comorbidity between these disorders reveal that patients present more symptoms of impulsivity, additional psychopathology and cognitive disturbances (lower intellectual and attentional functioning) with psychosocial difficulties. Personality traits studies point to a distinct trait profile between ADHD and BPD patients. Pathophysiological studies propose the possibility that there may be a common etiology and shared risk factors with some studies suggesting the possibility that ADHD in childhood might be a precursor of BPD diagnosis in adulthood. The neurocognitive deficits associated with both disorders, reflecting impaired decision making, in BPD may respond to treatment with stimulant drugs used in ADHD, such as methylphenidate.

Conclusions: A syndromic approach may be more effective in the management of these patients, combining pharmacological and psychotherapeutic techniques classically associated with either disorder individually. The underlying association between these disorders remains unclear and merits further research and understanding.

Clinical validity for home based on-line testing of objective markers associated with ADHD

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Objectives: The objective of this ongoing international multicenter study is to evaluate the clinical utility of, a home-based online test of objective markers of inattention, impulsivity, and hyperactivity—the core symptoms of ADHD.

Methods: In total, tests from 99 healthy controls and 99 patients with a clinical diagnosis of ADHD were included. Five different objective markers (MicroEventsX, Omission Errors, Reaction Time, Reaction Time Variation and Commission Errors) reflecting different aspects of ADHD were retrieved by means of a computerized test performed on laptops with a built-in camera in the home setting. Diagnostic validity of those markers was measured using the Area Under the Curve (AUC) of the Receiver Operating Characteristic (ROC) analysis. Both healthy controls and individuals diagnosed with ADHD were included in the study.

Results: The differences in scores between the ADHD and control group were all statistically significant except for the variable Commission Errors in the adolescent/adult version. The variable with the highest diagnostic validity (ROC-curves) in the child version of the test (6–11) was Reaction Time Variability (AUC: .86). The variables Omission Errors (.77) and Reaction Time (.75) had similar validity. MicroEventsX (.69) and Commission Errors (.68) showed the lowest validity. For the adolescent/adult version of the test (12–60), the variables Reaction Time Variation (.81) and MicroEventsX (.80) showed the highest diagnostic validity. However, Omission Errors (.75), Commission Errors (.74) and Reaction Time (.73) showed only slightly lower diagnostic validity.

Conclusions: Most of the objective markers retrieved through online testing in peoples home had fair to good diagnostic validity for the prediction of clinical ADHD both in children and adolescents/adults. It is therefore suggested that home-based testing of markers for ADHD may add value during screening and treatment follow-up in ADHD.

Co-existing psychiatric disorders associated with ADHD: new findings of comorbidity in a clinically referred sample of children and adolescents with recently diagnosed ADHD

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Objectives: We analyzed co-existing disorders in referred clinical sample of children and adolescents recently diagnosed with attention deficit/hyperactivity disorder.

Methods: We included all patients referred to the outpatient units of our psychiatry from 2014 to 2018 and diagnosed with a hyperkinetic disorder (F90.0, F90.1 or F98.8) according to the ICD-10 classification. The percentage and distribution of these comorbidities were assessed according to the MAS classification.

Results: All patients (n = 232; 71.1% male) aged 6 and 17 (10.0 years, SD 2.91) had an average IQ of 102.2 (range of 75–138). About 56% of all patients were diagnosed with the combined (F90.0 or F90.1) and 44% with the inattentive type (F98.8). The majority of all ADHD patients had at least either a psychiatric or a developmental

disorder (59.9%) and in 48.7% cases at least one psychiatric disorder. The most prevalent psychiatric disorders were conduct (23.9%), elimination (15.5%) and affective disorder (11.3%). Interestingly, known comorbid psychiatric disorders like oppositional defiant and anxiety disorder were only seen in a rather low rate (each 7%). Patients with F90.0 suffered more frequently from any comorbidity (*statistically significant, $p < 0.05$). Younger children (age group 11–17 years) were more often diagnosed with F90.0 (*statistically highly significant, $p < 0.001$) but not with more comorbidities. Developmental disorders were detected in about 23.7% of all patients. **Conclusions:** Although, the prevalence of ADHD is similar to other European countries, this study showed overall lower rates of psychiatric and developmental comorbidities. This can be explained by the fact that we included only patients from an outpatient unit and those recently diagnosed by ADHD without any long course or the disorder.

Symptoms overlap in ADHD and bipolar disorder in pediatric population: an overlooked issue?

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Objectives: Difficulties in differentiation between Bipolar Disorder and ADHD has been matter of much discussion lately, mainly due to the considerable symptoms overlap and high rate of co-occurrence between manic episode and ADHD. Therefore, it was of interest how similar is presentation of manic episode in course of the Bipolar Disorder to clinical picture of ADHD in pediatric population.

Methods: Retrospective review of the medical records of 90 patients with first episode of the Bipolar Disorder admitted to the Department of Psychiatry and Psychotherapy of Developmental Age in 2018 was conducted. Analyzed group consisted of 75 females (83%) and 15 males (17%) and average age equaled 15.05 (95% CI 14.71–15.39) years. 38% (n = 34) patients presented with the depressive episode and therefore were excluded from further analysis. Diagnostic criteria for manic episode and ADHD were collected and divided into two groups: (1) symptoms that may suggest diagnosis of both ADHD and manic episode (n = 5); (2) symptoms distinctive for manic episode (n = 5). Ratio of number of group 1 symptoms to group 2 symptoms was calculated to evaluate similarity of clinical presentation to ADHD in each patient.

Results: The average ratio value was 1.25 (95% CI 0.95–1.54). There was statistically significant correlation between age of included patients and the average ratio value ($r = -0.321$; $p < 0.05$) as well as between age of included patients and amount of group 2 symptoms ($r = 0.27$; $p < 0.05$). Correlation with amount of group 1 symptoms was not significant ($r = -0.08$; $p > 0.05$).

Conclusions: Obtained results point out that clinical presentation of manic episode in juvenile may bear a close resemblance to ADHD and thus may be the cause of misdiagnosis. Furthermore, with increasing age there seem to be a significant rise in group 2 symptoms rather than decrease in group 1 symptoms, what may lead to false comorbidity instead of verification of the first diagnosis.

Characteristics of callous-unemotional traits in Chinese preschool children with ADHD

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Objectives: The aim of study was to examine whether CU traits could be used to discriminate among ADHD, ASD and typically developing controls (TDC). Additional aims of study were to compare different characteristics of CU traits between ADHD and ADHD comorbid ODD and explore reciprocal associations between CU traits, ADHD symptoms, Conduct Problems (CPs) and EF among early childhood. **Methods:** Parents of 206 children (68 with ADHD, 51 with ASD, and 87 TDC) with the age of 3–5 years filled out ICU, SDQ and BRIEF-P. This study measured different characteristics of CU traits in preschool children with ADHD and ASD, who are at high risk for behavioral problems. Further, we compared children with ADHD with and without comorbid ODD on CU traits, ADHD symptoms, CPs and EF. **Results:** (1) ICU has a good discernment among ADHD, ASD and TDC ($F = 12.47\text{--}22.25, p < 0.001$). Compared with ADHD, ASD has higher scores on ICU. While the score in ADHD is higher than that of TDC. (2) It is obvious that the score of callousness in ADHD + ODD is statistically higher than that of ADHD only ($F = 13.15, p < 0.01$). However, there is no discrimination power in unemotional between ADHD only, ADHD + ODD and TDC groups. (3) ICU scales are correlated with BRIEF-P and SDQ ($r = 0.15\text{--}0.71, p < 0.01$). (4) CU traits contributed significantly to predicting ADHD controlling for sex, ODD (predictive accuracy 8%).

Conclusions: ICU was used to discriminate ADHD and ASD; CU traits contributed significantly to predicting diagnose of ADHD controlling for sex and ODD; ICU was related to external and internal behaviors problems, executive function, and ADHD symptoms. The current research has demonstrated that the ICU is a promising scale for identifying early Callous and Uncaring traits in preschool years that may help in the identification of a subset of preschool children who might have ADHD.

Topic: Diagnosis

The possibility of virtual reality as an ADHD screening tool

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Objectives: ADHD is a disease that has a great negative impact on children, families, and schools. Although exact diagnosis and appropriate treatment are most important for ADHD children, it is very difficult to differentiate from other psychiatric conditions because at these ages, normal children can also show some distraction and hyperactivity. Existing screening tests for ADHD has a limitation that the test results are very different depending on the subjectivity of the questioner. In addition, it has been found that specialized tests, such as the Continuous Performance Test is relatively expensive, and it is difficult to apply it widely and quickly because of the need of expert evaluation. Therefore, both problems of non-treatment due to the missed diagnosis period and problems caused by wrong diagnosis of non-specialists have been socially interested. Recently, with the rapid growth of Virtual Reality (VR) technology, the possibility of screening and treatment tool for mental disorders is being studied.

Also, VR is an attractive technology to children with familiarity and accessibility. Therefore, this study was designed to introduce the development process of VR game program and examines the possibility of this program as ADHD screening tool.

Methods: The development of the game began with a weekly meeting of child-adolescent psychiatrists, clinical psychologists, and special education specialists. We compared and analyzed the currently developed screening tests and the close-up tests first, and selected those that can be implemented as VR game. In the following 6 months, the game scenarios were revised considering the suitability to the subject, conformity to applicable inspection area, and difficulty level control. The completed scenario was checked twice by an advisory council composed of the child psychiatrists who are the members of ADHD expert committee in South Korea.

Results: We tried to implement the game as a design to evaluate the three core items of the symptoms of ADHD in various ways, such as hyperactivity, impulsiveness, and attention difficulty required for basic ADHD diagnosis. First, all games were designed for elementary school students which have the highest diagnostic rate among the all ages, and were divided into lower grade and upper grade. Each game has difficulty levels from step 1 to step 3. Each level was divided into 10 sessions, 20 sessions, 40 sessions, and 60 sessions to comparison analyze of the inattention of the subjects from the increase of mistakes as the session increased. Second, we have programmed to analyze the response time of the subjects in the game, so that the deviation between the degree of hyperactivity and the response time can be calculated. In addition, we tried to determine the inattention of concentration by presenting irritation of the irrespective stimulus and the ambient noise as the disturbance stimulation during game.

Conclusions: A new testing tool that overcomes the limitations of the current ADHD screening tool which depends on just questionnaire only, or a thorough examination which is costly and inaccessible, is necessary. This abstract describes the process of developing a game program to help diagnose ADHD by utilizing VR technology. As a result, we have made a VR program that can evaluate all of the content in paper-based ADHD assessment tools. This VR program will be compared with those of children who were and were not diagnosed with ADHD and the data will be analyzed in the next study. Through more studies in the future, we expect that this game program can be considered as one of the efficient and convenient screening tools for ADHD.

Multicenter application of diva-5, Korean version, for adults with ADHD

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Objectives: Diagnostic interview for ADHD in adults-5 (DIVA-5) was developed by the DIVA foundation in 2016, revised from DIVA 2.0. Authors translated DIVA-5 into Korean and applied to prove the utility of the tool for adult with ADHD in Korea. Authors aimed to confirm the concordance of DIVA-5 as a diagnostic tool for ADHD by analyzing the agreement between ADHD diagnosed by two child psychiatrists and results of DIVA-5 interview.

Methods: This study was conducted at eight university hospitals and one private clinic. 284 participants (male; 177, female; 107), mean age 27.5 years (male: 26.3; female: 29.5), enrolled in the study. Two child psychiatrists interviewed participants based on the criteria of Diagnostic and statistical manual of mental disorders-5 (DSM-5) and Adult ADHD Self-Report Scale (ASRS) screener which have proven reliability and validity, and classified them into ADHD group (male:

96, female; 46) and healthy controls (male: 81, female; 61). Adults with ADHD were diagnosed first time in adulthood and drug naïve. The ASRS screener score between groups was analyzed to verify the group classification by two child psychiatrists. We analyzed the concordance of diagnosis by two child psychiatrists and DIVA-5 results.

Results: There was a significant difference in the total score of the ASRS screener items in the ADHD group classified by the DSM-5 and the healthy control group ($t = 12.670, p = .000$). According to the DSM-5, 142 (50%) were classified as ADHD group by two child psychiatrists, and 139 (48.9%) were suggested as ADHD by DIVA-5 result. Of the ADHD group, 130 (91.5%) were suggested as ADHD according to DIVA-5. Among ADHD group, false negative rate applied with DIVA-5 was 8.5%. Among healthy controls, false positive rate with DIVA-5 was 6.3%.

Conclusions: Diagnosis by two child psychiatrists and DIVA-5 results showed high concordance. DIVA-5 would be efficient tool to diagnose ADHD in adults.

Five to fifteen questionnaire used as a retrospective assessment of childhood symptoms in the context of adult assessment

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Objectives: The prevalence of the neurodevelopmental disorders (NDDs) ADHD and Autism Spectrum Disorder is rapidly increasing world-wide. This calls for a corresponding increase in effort and resources from clinical psychiatry to meet the needs for assessment and adequate treatment of these patients. Overdiagnosis as well and underdiagnosis can be a problem particularly in patients who seek assessment as adults. Clinically, the Five to Fifteen (FTF) questionnaire is often used to retrospectively assess childhood symptoms in individuals assessed for a neurodevelopmental disorder (NDD) at adult age. However, this kind of retrospective usage has not been scientifically evaluated. We aimed at analyzing retrospective usage of the FTF in adults with NDD and controls without NDD. **Methods:** Between 2001 and 2013, 830 adult patients were enrolled to a study focusing on different aspects of NDD at a tertiary outpatient clinic. Out of this cohort we analyzed those individuals who (1) had the FTF data completed by significant others, and (2) were diagnosed with autism spectrum disorder ASD ($n = 158$) or ADHD ($n = 133$) without intellectual disability. Moreover, we conducted a web survey to collect FTF data from general population adult control group without NDD ($n = 738$), retrospectively rated regarding childhood symptoms by their parents.

Results: The retrospectively rated adults with NDD (ASD and ADHD without ID) displayed similar test profiles to children groups with corresponding diagnosis in previous studies. The psychometric properties of FTF in adult patients and control subjects were satisfactory/good(?) and similar to previously published results for children. Receiver Operating Characteristic (ROC) curve analysis indicated a good classification ability of the FTF total sum score. A cut-off value of 20.50 correctly classified 90% of the controls and 67% of the clinical cases (ADHD and ASD combined), while a cut-off value of 30.50 classified 84% of the controls and 77% of the clinical cases.

Conclusions: Our study will increase the knowledge of retrospective usage of FTF to estimate childhood symptoms in individuals assessed for NDD as adults.

Nine everyday situations, nine different forms of attention

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Objectives: The aim of the present study was to develop a questionnaire for the assessment of everyday attentional capacities in adults: the Everyday Life Attention Scale (ELAS). Its developmental was inspired by multi-component theories of attention and clinical neuropsychology guidelines for the assessment of attention. The items ask about multiple components of attention in nine common everyday situations, including Reading, Movie, Activity, Lecture, Conversation, Assignment, Cooking, Cleaning up, and Driving.

Methods: Two validation studies were conducted. Study 1 investigated the factor structure, validity, and reliability of the ELAS in 1206 healthy participants by means of an online survey. Study 2 further investigated the sensitivity of the ELAS in 80 adults with ADHD compared to 80 matched healthy controls and a mixed clinical group of 56 patients diagnosed with other psychiatric disorders.

Results: Study 1: Confirmatory factor analysis supported a situation-specific approach which categorizes everyday attention into nine situation scales. Within each of these nine situations, ratings of sustained, selective, focused, and divided attention as well as motivation constituted reliable subscales. Study 2: We found convincing evidence that adult patients with ADHD have clearly reduced attention scores (with large effect sizes) on all nine situation scales of the ELAS compared to matched healthy controls. Instead, a mixed clinical group of psychiatric patients (including depression and schizophrenia) without ADHD deviated from the healthy sample only on three situations with medium to large effect sizes (Assignment, Cooking, and Cleaning up). Patients with ADHD showed particularly strong attentional difficulties in comparison to both the control and the mixed clinical group regarding Reading, Assignment, Activity, and Conversation.

Conclusions: Testing the psychometric properties of the ELAS revealed that attention in everyday life can be reliably measured by situation-specific scales (Study 1) and that these scales are sensitive for attentional difficulties in patients with ADHD (Study 2), particularly for Reading, Assignment, Activity, and Conversation. The ELAS can be used as part of a battery assessment approach or in the context of treatment evaluation.

Discriminating ADHD from healthy controls using functional connectivities: the cross-sectional classification and the longitudinal prediction

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Objectives: ADHD is lack of objective diagnosis biomarkers despite substantial evidences for neurofunctional deficits. Therefore, we aim to classify ADHD from healthy controls (HCs) with functional connectivities (FCs) to provide an objective discriminant method.

Methods: We proposed a novel feature selection method based on relative importance and ensemble learning, aiming to classify ADHD from healthy controls (HCs) with FCs yielded from resting-state fMRI. Specifically, both adult ADHD from HCs (77 HCs and 112 ADHD) and child ADHD dataset (28 HCs and 34 ADHD) were classified independently. Next, longitudinal prediction—the FC

features trained from child dataset were used to classify adult ADHD from HCs, and vice versa.

Results: The mean accuracies of cross-sectionally classifying adult ADHD and child ADHD from HCs were 79.86% (Figure 1A) and 84.42% (Figure 1B), respectively, which were both significantly higher than other popular classification models. The accuracies of longitudinal prediction were 70.4% to classify adult ADHD with features trained from child dataset and 75.6% to classify child ADHD with features trained from adult dataset (Figure 1C). Furthermore, the child–adult ADHD common aberrant FC connect between ventromedial prefrontal cortex (VMPFC) and cerebellum (Figure 1D), while the default network (DN) is the most ADHD-discriminative functional network.

Conclusions: There are both common and diverse impaired FCs in adult and child ADHD, particularly, VMPFC, cerebellum and DN might serve as the promising biomarkers for ADHD diagnosis and development.

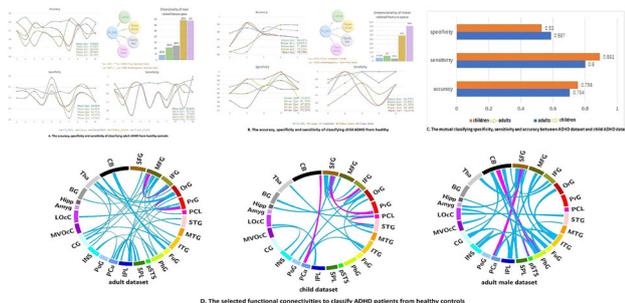


Fig. 1

Attitudes towards adults with ADHD in a Norwegian sample

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Objectives: Misbeliefs and misconceptions about ADHD can add to the challenges experienced by individuals with an ADHD diagnosis. Here we explored attitudes towards adults with ADHD in a Norwegian sample.

Methods: A Norwegian translation of Fuermaier et al.'s (2012) German assessment tool for stigma was distributed via public announcements. Responses on the total score and five of the six subscales in the original assessment tool were analysed, and stigmatizing attitudes from a subsample not reporting an ADHD diagnosis (ADHD –) were compared with stigmatizing attitudes from participants with an official or self-evaluated ADHD diagnosis (ADHD +).

Results: A total of 467 (79.2%) females and 123 males participated (mean age = 32.8, SD = 12.4). The mean total score for the full sample was -1.71 (SD = .50), with the highest stigma score on the subscale called ‘etiology’ ($M = -2.5$ (SD = .64) followed by ‘malingering and misuse of medication’ ($M = -2.4$ (SD = .62), ‘ability to take responsibility’ ($M = -1.92$ (SD = .88) and ‘norm-violating and externalizing behaviour’ ($M = -1.2$ (SD = .99), with the lowest score on the subscale called ‘reliability and social functioning’ ($M = -0.56$ (SD = .40). The ADHD + group reported significant lower scores than the ADHD – group on the “norm-violating and externalizing behaviour” subscale ($p < .001$), but a higher score on the “ability to take responsibility” subscale ($p = .02$).

Conclusions: The Norwegian sample reported stigmatizing attitudes towards adults with ADHD and obtained a higher total score than in the German study, reporting a mean = -1.22 (SD = .59). All participants, independent on diagnostic status, reported negative attitudes towards adults with ADHD. Surprisingly, the ADHD – group reported a lower stigma score than the ADHD + group on the “ability to take responsibility” subscale, but a higher score on the “norm-violating and externalizing behaviour” subscale. The results confirm the importance of actions to substitute myths with facts about ADHD in Norwegian citizens with as well as without an ADHD diagnosis.

The characteristic of attentional networks in sluggish cognitive tempo

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Objectives: Sluggish Cognitive Tempo (SCT) is an attentional disorder characterized by the symptoms of slowness in behavior or thinking, a lack of energy, difficulty initiating and sustaining effort, daydreaming, and drowsiness. In the literature, there is a controversy as to whether SCT could or should be differentiated from attention-deficit/hyperactivity disorder (ADHD). The aim of the present study was to investigate which kind of attentional networks might be unique in individuals with SCT.

Methods: A total of 1098 adults were divided into four groups using Barkley Adult ADHD Rating Scale IV (BAARS-IV): (a) SCT and ADHD (N = 22); (b) SCT only (N = 45); (c) ADHD only (N = 23); and (d) healthy controls (N = 20). In order to investigate each group’s attentional profile, the revised version of Attention Networks Test (ANT-R), a computerized task designed to assess attentional functions of alerting, orienting, and executive control networks, was used.

Results: The results from the ANT-R revealed that the two SCT groups (SCT and ADHD, SCT only) showed a significantly weaker orienting network due to the problems of engaging and disengaging attention than the other two groups index [$F(3, 106) = 3.14$, $p < .05$, $\eta^2 = .08$]. Additionally, the two ADHD groups (SCT and ADHD, ADHD only) showed a significantly weaker executive control network than the other two groups [$F(3, 106) = 3.24$, $p < .05$, $\eta^2 = .08$].

Conclusions: Results of the present study demonstrated an attentional distinction between the SCT and the ADHD groups with a greater dysfunction in the orienting network in the SCT group as compared to the ADHD group. Furthermore, a greater executive control dysfunction was observed in the ADHD group as compared to the SCT group. The findings indicate that SCT may be distinct from ADHD in terms of different attention dysfunctions.

The CPT-3 versus the QB-test: a task-oriented computerized assessment of attention-related problems in out-patient children: will diagnosis predict the atypical attention scores?

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Objectives: Un-biased measures of attention are important in the assessment and diagnosis of attention-related disorders such as ADHD. Two popular assessments of attention-related problems in

Norway are CPT-3 and the QB-test. The aim of the Bup-Orkdal Pilot was to examine whether the atypical t-scores was best explained by diagnosis or by confounding variables for the different test.

Methods: Children (N = 20, females = 6) aged 8–17 with attention-related problems were invited to participate when admitted to the outpatient clinic. In addition to the CPT-3 and the QB test, the patients were assessed with Kiddie-SADS, ADHD-RS, parent and teacher interviews, somatic- and pedagogic examination. Patients were diagnosed by counseling psychologists or psychiatrists. 16 patients got the diagnosis of ADHD. To test for confounding variables hierarchical step-wise block regressions was performed.

Results: Number of atypical scores was successfully predicted by diagnosis of ADHD for the CPT-3 ($p = 0.042$), but not for the QB-test ($p = 0.275$). Regardless of diagnosis the QB-test indicated attention-related problems in all children.

Conclusions: Conclusions: The main finding was that a diagnosis of ADHD successfully explained the variance of atypical scores by the CPT-3 but not the QB-test. Because of the limited sample size type 2 errors cannot be ruled out.

A new instrument to assess executive function in ADHD during school age

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Objectives: The assessment of executive functioning in Spanish language is relatively recent; there are not many international tests adapted into Spanish nor originally developed in this language. Developing a good psychometric test is not a trivial issue. It requires a planned step-by-step procedure over a long period of time that includes test's definition, items' development, a pilot study, item analysis, reliability and validity analysis, standardization and norms.

Methods: First, we defined what we want to evaluate (constructs and facets) and how to do it (number of items and characteristics of the tool). An initial pool of items was developed and refined iteratively until getting a reduced version with 240 items. This version was reviewed by a panel of experts in psychometrics, neuropsychological assessment and ADHD. A readability analysis was also conducted. To refine the scales, a pilot study was carried out in different regions of Spain.

Results: Through a panel of experts, the best items were selected in terms of clarity and representativeness, providing also evidence of the relevance of the areas and facets defined. The pilot study (general sample, $n = 338$; clinical sample, $n = 101$) allowed the analysis of the internal structure and the refinement of the scales. Reliability coefficients were satisfactory in all cases ($r > 0.80$). It showed also a good discrimination in clinical samples, reflecting a characteristic profile in the ADHD group.

Conclusions: To develop a psychometric test is necessary to carry out a planned and rigorous procedure in order to establish its reliability and validity with guarantees. In our case, the instrument has shown satisfactory psychometric properties.

The ATENTO Project or how to assess executive function in ADHD cases during school age

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Objectives: To address ADHD's assessment from a neuropsychological and dimensional perspective, to better describe the deficits and their impact in the person's daily life. The understanding of the disorder from a more global perspective, focusing on affected processes instead of the compliant of diagnostic criteria is especially relevant to: (1) avoid people's stigmatization; (2) help with the identification of their strengths and weaknesses; and (3) allow an adapted and individualized intervention.

Methods: After an extensive literature review and pilot study, the ATENTO questionnaire was administered to a Spanish general population sample of over 1.200 people (average age = 11.2; SD = 4.5) and was administered too to a clinical sample of over 400 cases (average age = 8.8; SD = 4.2). Different studies were carried out to compare the executive profiles in both samples.

Results: The average of the scales' scores of the ADHD group were more than 1.5 standard deviations over the average of general population group, reflecting a lower executive functioning. This profile was found mainly in Attentional control, Working memory, Planning and organization and Temporal orientation scales. Additionally, differences between combine and inattentive types were found in the ADHD group.

Conclusions: ADHD seems to be characterized by an executive profile of lower attentional, working memory, planning and organization and temporal orientation scores in comparison with the profile of general population. This pattern of dysfunctions may be related with the presence of adaptation problems in familiar, scholar and social contexts. So, the comprehension of the individual profile is essential in order to plan the most appropriate intervention and to improve the quality of life of these children and their families.

Distinct classification of adult ADHD: a latent class analysis of ADHD symptom profile

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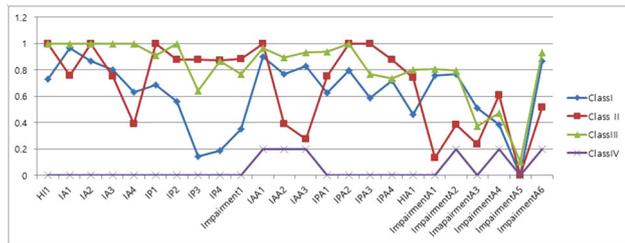
Objectives: The objective of this study was to conduct latent class analysis (LCA) of adult ADHD symptoms to clarify the distinct subtype of adult ADHD.

Methods: The participants of this study were 72 adult patients diagnosed with adult ADHD through Mini International Neuropsychiatric Interview (MINI) among the patients who visited the psychiatric department of Samsung Medical Center, Seoul, Korea. We performed LCA with 10 adolescent childhood ADHD symptoms and 14 adult ADHD symptoms as variables.

Results: A four-class solution was found to be the best model. Of the 4 groups, (1) Class I ($n = 30$), inattentive dominant type in childhood, combined type in adulthood (2) Class II ($n = 8$), hyperactive dominant type in childhood and adulthood (3) Class III ($n = 29$), combined type in childhood and adulthood (4) Class IV ($n = 5$), no problems in childhood, inattentive dominant type in adulthood.

Conclusions: This study revealed adulthood trajectory according to childhood ADHD subtype.

Latent class analysis of ADHD symptom profile:



Note: HI: hyperactivity item in childhood, IA: inattention item in childhood, IP: Impulsivity item in childhood-

IAA: inattentive item in adulthood, IPA: impulsivity item in adulthood, HIA: Hyperactivity item in adulthood-

Persistent ADHD versus adult ADHD, so different from each other? The importance of sex and executive functions in a clinical sample (PROMETEO program)

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Objectives: To determine if there are differences in sex and executive functioning between adults with persistent ADHD versus Adult onset ADHD versus Adults Without ADHD.

Methods: Previous approval by the ethics and clinical research committees, we included patients ($n = 186$) who had recently entered clinical care in the outpatient clinic of National Institute. Patients. They had at least 3 of the 6 positive items of the short version of the Adult ADHD self-report scale (ASRSv1.1), or had a score greater than 11 points as the cut-off point. The diagnostic status of persistent ADHD, adult ADHD or Non ADHD was determined as an independent variable. The main dependent variables were sex, comorbid psychiatric disorders established according to DSM IV and difficulties in executive functions according to BRIEF. We use the SPSS program version 19.

Results: The study sample included 188 subjects, 49.5% ($n = 93$) had ADHD. Nearly sixty-nine percent ($n = 14$) of the persistent ADHD group versus 78% ($n = 52$) of the Adult ADHD Group versus 57.9% ($n = 55$) of Non ADHD group were female ($\chi^2 = 3.517$, $p = 0.061$). Mean age of persistent ADHD group was 29.2 years old ($SD \pm 6.6$) versus 26.6 years old ($SD \pm 5.2$ years) of adult ADHD group versus 30.6 years old ($SD \pm 6.9$) of Non ADHD group ($F = 2.78$, $gl = 2/185$, $p = 0.20$). Mean ASRS score of persistent ADHD group was 48.3 ($SD \pm 9.6$) versus 44.1 ($SD \pm 9.0$) of adult ADHD group versus 34.5 ($SD \pm 9.9$) of non ADHD group. ($F = 35.6$, $gl = 2/185$, $p < 0.001$).

Conclusions: Our results shows that both disorders are two clinical presentations of the same neurodevelopmental disorder. Our finding helps to highlight that regardless of sex, people have the same risk of developing ADHD.

Predictors and outcomes of ADHD in (pre)scholar child

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Objectives: ADHD is a pervasive neurodevelopmental disorder characterized by developmentally inappropriate levels of inattention and hyperactivity/impulsivity that emerge early in childhood and is associated with a range of negative outcomes during childhood and adulthood. The severe negative impact of ADHD underscores the importance of identifying early markers of this disorder. This review aims to identify and clarify the predictors and outcomes of ADHD at pre-school age.

Methods: Literature review of pre-scholar ADHD published at pubmed.

Results: The developmental processes that determine adult mental health have their roots in early childhood and are present in the preschool years. The studies consistently show that more than half of 3–6 year old children who meet criteria for ADHD continue to meet criteria 18 months, 3 years and 7 years later. It has been suggested that a relationship between pragmatic language impairment, activity levels and externalizing behaviors may be a potential early marker of underlying ADHD and/or autism. Delay aversion and/or inhibitory control in preschool have also been significantly related to ADHD symptoms in early school age. Moreover, preschool emotional functioning deficits were strongly related to ADHD symptoms in late adolescence. Preschool hyperactivity in children aged 3 years predicted a diagnosis of oppositional defiant disorder at age 6 years and has also been associated with later emotional problems, poor social skills and academic underachievement. Comorbid conduct disorder and ADHD severity in childhood are the most important predictors of adverse outcomes in adulthood and those from families with lower family incomes had relatively poorer outcomes.

Conclusions: Evidence of a correlation between preschool hyperactivity and adult mental health problems highlights the potential value of targeting early identification and intervention strategies. Early screening for hyperactivity in the preschool period may facilitate the cost-effective targeting of early intervention efforts to reduce long-term burden for mental health problems.

A novel approach to measuring attention in youth with ADHD

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Objectives: We previously developed a novel auditory continuous performance test (CPT) to objectively measure attention in ADHD. We aim to analyze this data, looking at variability in attention, which was not previously calculated due the short interval between stimulus. Variability in attention is key in assessing attention deficits in ADHD. Current measures of attention calculate variability using the standard deviation in reaction times between blocks of time. Alternatively, variability in response accuracy over time could be calculated using Mean Square Successive Differences (MSSD). This technique of calculating variability is commonly used in measurement of heart rate variability, and signal variability on fMRI which was associated with symptom severity in children with ADHD. We aim to improve our CPT by using MSSD to calculate variation in response accuracy over time.

Methods: We reviewed data from 60 subjects ages 12–16 with a clinical diagnosis of ADHD in an outpatient child psychiatry practice in Saskatoon, Canada. These youths completed two baseline CPTs 1 week apart, then another CPT 90 min following a one-time trial dose of a short acting stimulant medication. Variability in attention was measured by looking at errors of omission and commission in response to an auditory stimulus presented every second over 15 min. Variability between response accuracy was measured over time using MSSD.

Results: In youth with ADHD, variability in attention calculated using MSSD was higher on baseline testing than after treatment with a stimulant medication.

Conclusions: We present a novel approach to measuring attention in youth with ADHD on a continuous performance test using MSSD to calculate variability between response accuracy over time. This allowed for detection of response to stimulant medication in youth with ADHD. Our novel CPT with measurement of variability using MSSD could be useful clinically in diagnosis of ADHD and assessment of treatment response.

The influence of sluggish cognitive tempo on child self-report measures in children with ADHD

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Objectives: Clinical behavioral measures are the most common way to analyze the symptoms in children with ADHD compared to other groups. However, most of these measures have focused on parent, teacher or clinicians, being the use of self-reports much less common. The aim of the current study was to analyze the self-perceived differences in a group of children diagnosed with ADHD compared to their peers in a community-based sample and, to observe the influence of a measure of Sluggish Cognitive Tempo (SCT).

Methods: The study involved 1655 children (ages 8–13 years). The 4.6% ($n = 76$) of the sample had an official diagnosis of ADHD. Children completed measures of SCT, anxiety, depression, loneliness, preference for solitude and sleep problems. A multivariate analysis was applied to compare the ADHD group with the control group on all measures.

Results: The most remarkable results to emerge from the data was that the ADHD group showed significant higher scores on SCT, depression, sleep problems and loneliness, while not differing in anxiety and preference for solitude. Then, the same analysis was performed although using the SCT measure as a covariate. In this case, the results showed that the differences between two groups were not significant on all measures, with the exception of loneliness.

Conclusions: The main conclusion is that, in general, children diagnosed with ADHD self-perceive more clinical problems in most measures. Besides, the score on SCT might mediate this self-perception since it clearly affects depression and sleep problems, and to a lesser degree anxiety.

Attentional bias to emotional faces in ADHD and sluggish cognitive tempo

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Objectives: ADHD and Sluggish Cognitive Tempo (SCT) has been known that they have different clinical problems as an attentional disorder. ADHD has mainly externalizing symptoms like impulsive emotionality and SCT has internalizing symptoms like depression. It is necessary to examine different attentional processing of emotional stimuli to explore why they have different emotional problems. The purpose of this study is to investigate different mechanisms of emotional problems by examining attentional bias to emotional faces between ADHD and SCT.

Methods: A total of 1098 adults were divided into four groups using Barkley Adult ADHD Rating Scale IV (BAARS-IV): (a) ADHD and SCT ($N = 15$); (b) ADHD only ($N = 16$); (c) SCT only ($N = 36$); and (d) healthy controls ($N = 23$). In order to investigate each group's attentional bias to emotional faces, participants were instructed to freely view a pair of faces (either happy-neutral, sad-neutral, or angry-neutral) with eye-tracking. Dwell time to each emotional face was measured during the 3,000 ms period, meaning the total time that participants gaze to emotional faces.

Results: The results showed that there was a significant interaction effect between ADHD and emotions [$F(2, 172) = 6.82, p < .05, \eta^2 = .07$]. Individuals with ADHD gazed to angry face significantly more than sad face, while there was no attentional bias between any emotions in those without ADHD. Also, there was a significant main effect of SCT [$F(1, 86) = 8.80, p < .05, \eta^2 = .09$]. Individuals with SCT significantly gazed longer to all emotional faces than those without SCT.

Conclusions: These results suggest that individuals with ADHD showed attentional bias to angry face only, while SCT have slow attentional processing of all emotional stimuli. It would be helpful to deal with their emotional problems separately according to their symptoms, either ADHD or SCT.

Case report: ADHD in adulthood as a differential diagnosis of therapy-refractory major depressive disorder

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Objectives: Given the high percentage of un- or misdiagnosed patients with attention deficit and hyperactivity disorder (ADHD), the aim of this report is to increase awareness of the symptomatology and diagnosis of ADHD.

Methods: A 35-year-old woman suffering from therapy-refractory major depressive disorder (MDD) for more than a decade was transferred from another tertiary psychiatric care unit with the indication for electroconvulsive therapy (ECT). Due to therapy-refractory MDD as well as latent suicidal ideations an ECT series was started. Eight ECT stimulations at dosages of up to 100% bilaterally and adequate seizure activity did not lead to any symptom improvement. Further symptom-guided exploration led to the diagnosis of adult ADHD.

Results: State of the art psychopharmacological treatment with methylphenidate 10 mg once a day already showed an immediate and impressive effect on ADHD symptomatology as well as on depressive

(4) the Chinese version of the Swanson, Nolan, and Pelham, version IV scale-parent report; (5) the Chinese version of the Swanson, Nolan, and Pelham, version IV scale-teacher report. We used deep learning to decide imputation order, and process effectiveness evaluation by support vector machine (SVM) after imputation.

Results: By using SVM to classify the ADHD and TD groups, around 91% accuracy for original sample with complete 5 datasets and 90% accuracy for imputation dataset shown in every different parameter. Most oppositional behavioral items occupied the high priority group to distinguish ADHD from non-ADHD; most inattention issues gathered in the low priority group.

Conclusions: Our results indicate that our architecture turns out a deep learning solution for data imputation without any damage to the group feature, and we can use the reconstructed data for future analysis.

Topic: Electrophysiology

Effects of short-term alpha-rhythm neurofeedback on Go/NoGo performance in adult ADHD: a controlled EEG study

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Objectives: Abnormal patterns of electrical oscillatory activity have been repeatedly described in adult ADHD. In particular, the alpha rhythm (8–12 Hz) is known to be modulated during attentional regulation, and has previously been implicated as an ADHD biomarker. In the present study, we asked adult ADHD patients to down-regulate their own alpha rhythm using neurofeedback (NFB), in order to examine the role of alpha self-regulation on attentional performance and brain plasticity.

Methods: Twenty-five adult ADHD patients and 22 healthy controls underwent a 64-channel EEG-recording at resting-state and during a Go/NoGo task, before and after a 30 min-NFB session designed to reduce (desynchronize) the alpha rhythm. Alpha power was compared across conditions and groups, and specific effects of NFB were statistically assessed by comparing behavioral and EEG measures pre-to-post NFB.

Results: In our ADHD cohort, alpha power was markedly reduced in patients compared to control subjects in all experimental conditions. Both groups significantly reduced their alpha power during NFB, but the degree of alpha desynchronization was relatively smaller in ADHD compared to the control group. In both groups, the alpha rhythm increased (re-synchronized) after NFB, yet this alpha rebound was stronger in the ADHD group, leading to some normalization of alpha power. Importantly, this post-NFB alpha rebound correlated significantly with reduced commission errors (NoGo trials) and slower reaction times only in the ADHD group.

Conclusions: Spectral normalization of alpha rhythm following NFB and its association with improvement of inhibitory control supports potential therapeutic applications of NFB in adult ADHD.

Sleepiness and cognitive performance in adults with ADHD: EEG slowing and observer-rated sleepiness

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Objectives: Adults with ADHD frequently suffer from sleep problems and report higher daytime sleepiness relative to neurotypical controls, which can negatively affect cognitive processing. However, the evidence from objective sleep measures in ADHD is very limited. Here, we investigated daytime sleepiness in adults with ADHD compared to neurotypical controls and aimed to link sleepiness to ADHD-related cognitive performance deficits in order to determine the influence of excessive daytime sleepiness on cognitive processing beyond the symptoms of ADHD.

Methods: 111 adults volunteered to participate in the study, among them 81 diagnosed with ADHD according to the DMS-5 criteria. Daytime sleepiness was evaluated using: (1) Observer-Rated Drowsiness protocol (ORD) administered at three timepoints during the Sustained Attention Response Task (SART); (2) EEG slowing: a quantitative electroencephalographic (qEEG) measure collected before the cognitive testing session during a short period of wakeful rest with eyes open. Sleepiness scores, error rates, reaction times and EEG power density data were collected.

Results: We found that adults with ADHD were significantly sleepier than neurotypical controls during a cognitive task, and that this on-task sleepiness greatly contributed to cognitive performance deficits, such as increased omission errors and reaction time variability, usually attributed to symptoms of ADHD. EEG slowing predicted severity of ADHD symptoms and diagnostic status and was also related to daytime sleepiness. Frontal EEG slowing, as well as increased frontal delta, were especially prominent in adults with ADHD.

Conclusions: Our findings suggest that cognitive performance deficits characteristic of ADHD are largely due to on-task sleepiness and not exclusively due to ADHD symptom severity. The qEEG results suggest that, although associated with sleepiness, EEG slowing is more strongly related to ADHD psychopathology than to sleep-related cognitive impairment. Overall, the EEG results are indicative of frontal slowing in ADHD. Future cognitive studies in ADHD should routinely control for sleepiness.

Beta-phase high gamma-amplitude coupling deficits in children with ADHD

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Objectives: As pointed out by the scientific community, ADHD leads to an intrinsic risk of mis- and over-diagnosis. ADHD research is thus currently focused on the development of biomarkers that support accurate clinical diagnosis and reduce the risk of over-diagnosis. In this work we have explored coupling abnormalities between different brain rhythms in ADHD children.

Methods: In this study 51 children participated, aged between 7 and 11 years old. Participants were assigned to one of two groups: clinical diagnosed ADHD group (N = 21) or healthy controls (N = 30). Experimental recordings followed a 3-min resting state eyes closed protocol where EEG was recorded in the fronto-central region (C3, Cz, C4, F3, Fz and F4) using Enobio. PAC has gained enormous

popularity in the recent years as a means to understand how the amplitude and the phase of distinct oscillations regulate dynamic communication within the brain. We have investigated coupling anomalies in brain rhythms in the 4–200 Hz range using the phase amplitude coupling (PAC) approach proposed in Canolty 2006 in 30-s trials. We have used the non-parametric statistical test based on clustering proposed by Maris et al. 2007 to automatically identify coupled frequency bands of interest.

Results: We successfully demonstrated that ADHD children present overall deficits in phase-amplitude coupling across all frequencies in the frontal cortex. These deficits have proved to be statistically significant in the beta-phase high-gamma-amplitude coupling of the frontal-left hemisphere (channel F3) ($p < 0.05$).

Conclusions: Analyzing 21 ADHD children and 30 age-matched healthy controls, we found a significant deficit in the beta-gamma PAC in the frontal cortex of the ADHD population, that may be related to deficits in the maintenance and encoding of working memory contents (Bastos et al. 2018). This metric successfully discriminated between the ADHD and healthy controls, boosting its potential use as an ADHD diagnosis biomarker.

Quantitative electroencephalography in hypersomnia patients with ADHD and narcolepsy patients without ADHD

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Objectives: Quantitative electroencephalographic (QEEG) traits such as increased theta activity are often reported in attention deficit hyperactivity disorder (ADHD). On the other hand, increased slow wave activity including theta power is also reported in patients with narcolepsy. The aim of this study was to assess the absolute QEEG between adult hypersomnia patients with ADHD and narcolepsy patients without ADHD.

Methods: The evaluated sample comprised of 4 groups; 8 idiopathic hypersomnia patients with ADHD (ADHD), 8 narcolepsy patients without ADHD (NA), 12 idiopathic hypersomnia patients without ADHD (IH), and 6 healthy controls. Nocturnal polysomnography, the multiple sleep latency test (MSLT), a QEEG evaluation, and the Japanese version of Epworth sleepiness score (JESS) were conducted on all patients and controls. An EEG was recorded during an eyes-open condition for 5 min between the MSLT sessions in the morning.

Results: Spectral analysis of absolute power (μV^2) was carried out across four frequency bands: delta (0.5–3.0 Hz), theta (4.0–7.0 Hz), alpha (8.0–12.0 Hz), and beta (13.0–21.0 Hz) on the frontal (F), central (C), and occipital (O) regions. The control group showed a longer mean sleep latency on the MSLT and lower score on JESS than any other group, whereas no differences between the ADHD, NA, and IH groups were found in mean sleep latency on the MSLT and scores of JESS. Delta power at F and C were highest in NA among the 4 groups, and theta power at O was higher in NA compared to ADHD and IH. No differences in the delta and theta powers were found between ADHD, IH, and control groups.

Conclusions: Our data suggest that increased theta activity, which is often reported to be a biomarker of ADHD, is not associated with ADHD. However, narcolepsy is associated with EEG slowing, such as in delta and theta activity, which may reflect the severe sleepiness.

The neural correlations of spatial attention and working memory deficits in adults with ADHD

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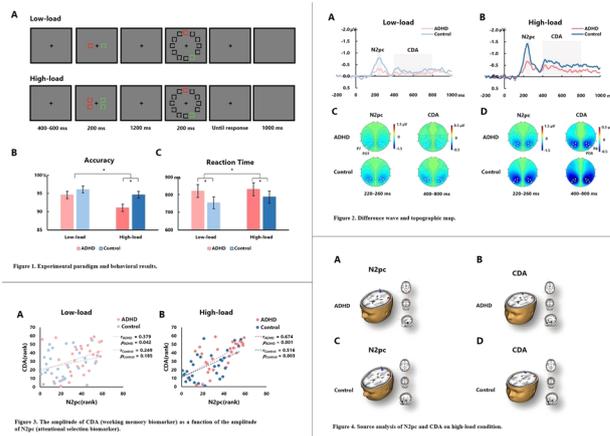
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Objectives: Working memory is one of the typical cognitive abnormalities in patients with ADHD, which is closely related to attention. To explore the interaction between working memory and attention ability in patients with ADHD is of great significance to the study of the pathological mechanism of this disease. In this study, the electrophysiological markers of attention, posterior contralateral N2 (N2pc), and working memory, contralateral delay activity (CDA), were used to explore the relationship between these two cognitive abilities in patients with ADHD.

Methods: EEG data were collected from 32 adults with ADHD and 34 age, sex, IQ matched normal controls, while they performed a classical visuospatial working memory task that consisted of low-load and high-load memory conditions.

Results: Compared with normal controls, the memory array elicited a smaller N2pc (220–260 ms, $p = 0.001$) as well as a smaller CDA (400–800 ms, $p = 0.037$) in adults with ADHD in different memory load conditions. Further analysis revealed that the reduced CDA amplitude could be significantly predicted by the earlier and reduced N2pc amplitude in adults with ADHD, and both of the N2pc and CDA involved from the similar source location of parietal lobule.

Conclusions: Our findings illustrate the relationship between spatial working memory and attention ability in ADHD adults from the neurophysiological aspect that the reduced working memory is closely related to the insufficient attention ability. This provide a potential physiological basis for the working memory deficit of ADHD.



Differences in neurophysiological characteristics according to the ADHD subtypes

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Objectives: ADHD subtypes can be distinguished from each other on various characteristics. Developing a reliable neural marker to distinguish the illness as well as the subtypes will provide further insights underlying the heterogeneous illness and aid in making a precise diagnosis. The goal of this study was to examine the neurophysiological markers among the combined type, predominantly

inattentive type, predominantly hyperactive-impulsivity type of ADHD subjects and control subjects in children and adolescents.

Methods: In 64 (53 male, age 10.09 ± 3.3 years) subjects (32 ADHD-Combined type, 11 ADHD-Inattentive type, 11 ADHD-Hyperactive-impulsive type and 10 healthy controls), resting-state EEG with eyes closed and eyes open were recorded. Relative powers were estimated for delta (1–4 Hz), theta (4–8 Hz), alpha (8–12 Hz), beta (12–25 Hz), gamma (30–40 Hz). Kruskal–Wallis Test was used for statistical analyses.

Results: There were significant differences of qEEG among subtypes of ADHD. In eyes closed state, ADHD-combined type showed significantly higher levels of delta power in frontal regions (Fz, FP2, F3, F4, F7, F8), central regions (CZ, C3, C4), posterior regions (PZ, P4, O2, T6) compared to the ADHD-inattentive type and the controls. In the eyes open state, ADHD-combined type showed significantly higher delta power in the frontal region (FP2) and the central region (CZ) compared to the ADHD inattentive type, as well as higher delta in posterior regions (P4, O2, T6) and lower gamma and high gamma in the central region (CZ) compared to controls.

Conclusions: The findings show combined type to have different neurophysiological characteristics to the inattentive type and controls, while the QEEG of inattentive type appeared similar to controls. These findings indicate differential neurophysiological characteristics among ADHD subtypes. Heterogeneity should be fully considered for exploring neurobiological mechanisms of ADHD.

Electrodermal responses to the unfamiliar situation in children with ADHD and conduct problems symptoms

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Objectives: ADHD and conduct disorder are related to deficits in autonomic nervous system reaction in uncommon and factitious experimental conditions. Little is known about an autonomic reactivity of this group under everyday life conditions. The aim of the study was to examine the association between electrodermal activity (EDA) and symptoms of ADHD and Conduct Problems (CP) in response to an unfamiliar situation.

Methods: Children aged 5–7 years with slightly elevated to a very high level of symptoms measured with hyperactivity/inattention and conduct problems scales of ‘Strength and Difficulties Questionnaire’ (SDQ) were included to the ADHD/CP group ($n = 64$) and compared with healthy controls (CG, $n = 74$). The EDA was measured twice at three-month intervals (M1 and M2), using a Shimmer GSR + unit during a meeting with a previously unknown person who performed basic anthropometric measurements (the unfamiliar situation with potentially uncomfortable stimuli). For both measurements, the differences in skin resistance (SR) between the sample and CG were tested using the U Mann–Whitney test. The Sign test was applied to estimate the differences in SR between M1 and M2 in the sample and CG separately.

Results: ADHD/CP had lower SR in M1 (average value from the time of the first examination) than CG (131.75 vs. 153.78 k Ω). The differences between M1 and M2 were statistically significant in both groups but the direction of change was opposite. SR decreased in ADHD/CP (65.58 k Ω) but increased in CG (164.02 k Ω).

Conclusions: The results suggest an increased autonomic reactivity to the unfamiliar situation in children with ADHD and Conduct Problems in comparison to healthy peers. What is more, comorbidity between ADHD and conduct problems may be a predictor of a

sensitization resulting in increase of arousal in repeated exposition to the same uncomfortable stimuli.

Event-related brain oscillatory and ex-Gaussian markers of ADHD remission and persistence

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Objectives: The processes underlying the different long-term clinical outcomes of ADHD (persistence vs. remission) are poorly understood. We previously found that the cognitive marker of reaction time variability (RTV) and event-related potentials of preparation-vigilance processes are markers of ADHD remission, as ADHD persisters were impaired compared to both remitters and controls, while remitters were indistinguishable from controls (Cheung et al. 2016; Michelini et al. 2016; James et al. 2017). Here, we aimed to test whether finer-grained ex-Gaussian reaction-time distribution and electroencephalographic (EEG) brain oscillatory measures also represent markers of ADHD remission.

Methods: 110 adolescents and young adults with childhood ADHD (87 persisters, 23 remitters) and 169 age-matched controls were compared on ex-Gaussian (μ , σ , τ) indices and EEG measures of brain-oscillatory modulations of power and phase variability from a four-choice reaction-time task with slow-unrewarded baseline and fast-incentive conditions (the ‘Fast task’).

Results: Compared to controls, ADHD persisters showed greater μ , σ , τ , theta phase variability and lower theta power in both task conditions (all $p \leq 0.05$; $d = 0.30$ – 0.86). Remitters showed lower μ , σ , τ , theta phase variability than persisters in the fast-incentive condition, and greater theta power in both conditions (all $p \leq 0.05$; $d = 0.35$ – 0.98), but did not differ from controls on any measure (all $p > 0.05$).

Conclusions: These results extend our previous findings by identifying ex-Gaussian σ and τ , theta phase variability and event-related theta power as novel markers of ADHD remission. These measures of cognitive variability, neural variability, and attentional processes represent promising targets for developing novel non-pharmacological interventions for ADHD.

Topic: Epidemiology

Stagnated prevalence of diagnosis and medication for ADHD in Korean youth

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Objectives: Authors examined the recent changes of the prevalence of diagnosis and anti-ADHD medications for general population under 19 years old.

Methods: 0–18 year old subjects who visited psychiatric department and diagnosed with psychiatric disorders including ADHD, based on National Health Insurance Claims Data for consecutive 6 years, were analyzed. In order to investigate the trends in diagnosis, the year-by-year changes of the diagnoses were analyzed from 2010 as a reference year to 2015, and compared prevalence with other psychiatric disorders. For the prescription trends, anti-ADHD medications were classified into psychostimulants and non-stimulants.

Results: From 2010 to 2015, there was no statistically significant change in diagnosis prevalence (Average Annual Percent Change, AAPC = -0.17, p value = 0.34). In 2010 as a reference year, ADHD was the commonest among psychiatric disorders in both genders (weighted % of population; Total = 7.65). In males, ADHD showed the highest diagnosis prevalence, but ADHD was followed by depressive disorders in female (weighted % of population; Male = 11.46, Female = 3.46). By age distribution, the diagnosis prevalence showed rapid increase in the age range of 7–9 years, and then decreased with aging in both genders. For anti-ADHD medication prevalence, psychostimulants did not change significantly for 6 years, and non-stimulants showed a significant increase over the years (AAPC: 0.15, p value, 0.012). In 2010 as a reference year, psychostimulants were prescribed at 17.50% in male, and 6.78% in female. Non-stimulants were prescribed 3.76% in male and 1.08% in female. **Conclusions:** While the diagnosis prevalence of ADHD and the prescription with psychostimulants were stable over the recent several years, non-stimulants were medicated more year by year. As the prevalence of diagnosis and medication for ADHD in youth were still much lower than the estimated prevalence, it is necessary to analyze the reason the rates were stagnated.

Cessation of cohabitation during pregnancy and offspring ADHD

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Objectives: Research efforts during the past decades have provided intriguing evidence suggesting that stressful experiences during pregnancy exert long-term consequences on the mental wellbeing of the offspring. As cessation of cohabitation constitutes a significant stress factor, the aim of our study was to examine the association between cohabitation status during pregnancy and offspring ADHD diagnosis. Secondly, we examined whether social support during pregnancy and socioeconomic status moderated this association.

Methods: Participants were part of the Danish National Birth Cohort. We included mothers who gave birth between 1996 and 2003 to live born singletons and completed all questions regarding cohabitation status in gestational week 12 and the postpartum interview at child age 6 months ($N = 66,806$). All children were followed in the Danish National Health registries from birth until a diagnosis of ADHD, ADHD medication prescription, death, emigration or 2013, whichever came first. Cohabitation status was categorized into; living with partner, cessation of cohabitation and no partner during pregnancy. Hazard ratios (HRs) were calculated using Cox proportional hazards models and moderation of socioeconomic status and social support during pregnancy was tested by including an interaction term.

Results: In all, 878 (1.3%) mothers experienced cessation of cohabitation, while 1174 (1.8%) did not have a partner during pregnancy. During follow-up, 1992 (2.9%) children received an ADHD diagnosis. Analyses showed no interaction effect of social support or socioeconomic status during pregnancy. After adjusting for maternal history of mental disorders, sex, social support and socioeconomic status, we found more than twice the odds of offspring ADHD after cessation of cohabitation (HRadj: 2.39, 95% CI 1.88; 3.06) and similar results were found when the mother had no partner (HRadj: 2.20, 95% CI 1.74; 2.78).

Conclusions: The consideration of prenatal stress effects on mental health trajectories is critical for improving strategies that support healthy development.

Application of Conners' Rating Scale on children and teenagers assessed in an ambulatory of academic underachievement

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Objectives: Apply the Conners' Rating Scale to screening for Attention-deficit/hyperactivity disorder on teenager and children attended at an ambulatory of academic underachievement.

Methods: Cross-sectional study with patients attended at an ambulatory of underachievement at school, in Cascavel City, Brazil, from January/2016 to July/2018. It was applied the Conners' Rating Scale-Francisco Rosa Neto' Brazilian version, which is a screening tool for Attention-deficit/hyperactivity disorder that assess: hyperactivity, attention-deficit, conduct disorder, hyperactivity with attention-deficit or symptoms of attention-deficit associated to conduct disorder. It's composed by 20 questions, the answers score's varied from 0 to 3 points, in which the parents answered according with the child's conduct over the past 6 months. This study considered, as global ADHD, if the score's sum of all answers (Attention-Deficit, Hyperactivity/Impulsivity and Conduct Disorder) were ≥ 30 .

Results: 60 children and teenagers were evaluated during the study, 39 males and 21 females, the participant's age ranged from 4 to 14 years. From those evaluated, 19 (32%) presented score to global ADHD, being 13 (68%) males.

Conclusions: The global prevalence of ADHD was highest that in medical literature (5%) and confirmed a higher prevalence in males than females, as described in literature, this perhaps could be justified by a selection bias since the ambulatory attends only children and teenagers with school underachievement, which early presented behavioral problems, furthermore having low socioeconomic status.

ADHD and comorbid eating disorders in a Spanish sample of female adolescents

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Objectives: To describe the frequency and characteristics of ED behaviors, ED and obesity or overweight in a Spanish sample of female adolescents with ADHD.

Methods: In this longitudinal observational study all the medical records of women between 12 and 18 years with a main diagnosis of ADHD (DSM-IV), between 2001 and 2017, were reviewed. We searched for suggestive symptoms of ED, and T1: first consultation and T2: last follow-up. Anthropometrical measures (Weight, height, BMI) were expressed as Z-scores. Age at diagnosis, and type of treatment were also analyzed.

Results: Patients are 12.3 (2.8) years at ADHD diagnosis, with 3.48 (3.02) years follow-up period (rank: 0.1–13.2). 98 (49.5%) patients have at least one ED, concern for the figure was the most frequent (17.2%). One (0.5%) patient has Bulimia Nervosa and one (0.5%) Binge Eating Disorder. 29 (14.7%) patients have overweight and 14 (7%) obesity. 92.9% of them are on medication, 85% of them methylphenidate. Overweight and obesity decreased to 4% after 3.48 years.

Conclusions: In this sample, half (49.5%) of the patients present at least one ED symptom, only 2 (1%) patients have a diagnosis of ED.

The most frequent symptom is concern for the figure. 21.7% of patients are overweight or obese, 4% at follow-up. Lack of a control group, sample size, and the absence of standardized tools for the interview are the main limitations.

Attention deficit hyperactivity symptoms and sleep habits among preschoolers: is there a relationship?

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Objectives: To investigate the prevalence of attention-deficit/hyperactivity disorder (ADHD) symptoms and study its association with sleep habits among preschoolers aged 3–6 years-old in Porto, Portugal.

Methods: A cross-sectional study was conducted, through the application of a questionnaire to the caregivers of children attending a random sample of kindergartens at Porto. ADHD symptoms and sleep habits were assessed by the Portuguese versions of the Conners' Parents Rating Scale Revised and the Children's Sleep Habits Questionnaire (CSHQ-PT), respectively. Data on socio-demographic characteristics, TV viewing duration and outdoor activities was also collected. Statistical analysis was performed using SPSS Statistics, version 25 through both Pearson's Chi-square and logistic regression models; a p value < 0.05 was considered significant.

Results: The final sample included 381 preschoolers (50.9% boys). High levels of ADHD symptoms were found in 13.1%, being girls more affected than boys (14.4% vs. 11.85%). Concerning sleep, 45.7% had a mean total score at CSQH-PT > 48, the cut-off point considered for the screening of sleep disturbances in the Portuguese population. There was a significant association between high levels of ADHD symptoms and a lower maternal education level, a lower sleep duration and higher scores at parasomnias and sleep disordered breathing CHQH-PT subscales.

Conclusions: Both ADHD symptoms and sleep problems are prevalent in preschoolers at Porto, Portugal and this study contributes to suggest some clinical correlations between them. Since these interactions are complex and far from being elucidated, further studies will be paramount to provide guidance for earlier prevention and managing strategies in younger children at risk for ADHD.

ADHD in acute care child and adolescent psychiatric inpatients

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Objectives: ADHD is a neurodevelopmental disorder defined by impairing symptoms of inattention, hyperactivity and impulsivity according to the latest version of the Diagnostic and Statistical Manual of Mental Diseases (DSM-V). ADHD has a worldwide combined prevalence of 5.29% in childhood (Polanczyk et al. 2007) with an approximate overall male:female ratio of 2:1 (Bahmanyar et al. 2013). Patients with ADHD have a high incidence of comorbidity with other psychiatric disorders. To the best of our knowledge, there are currently no studies elucidating the prevalence of ADHD in child psychiatric inpatients. The purpose of this study was to understand the prevalence rates of ADHD among psychiatric acute care

inpatients under eighteen years old. Other objectives include exploring ADHD treatment and comorbidities among these patients.

Methods: We conducted a retrospective, descriptive study based on medical records of child and adolescent patients who had been admitted in the acute inpatient psychiatry unit in Sant Joan de Déu Hospital, Barcelona, throughout September 2018 to December 2018. A total of 106 cases were included.

Results: Among the 106 patients admitted to psychiatric acute care over the study period, 14 of them had a diagnosis of ADHD (13%). The most common comorbidities in ADHD patients were oppositional defiant disorder (43%), substance use disorder (29%), autism spectrum disorder (21%) and conduct disorder (21%). Methylphenidate was the ADHD treatment most prescribed among the patients.

Conclusions: In this sample, the prevalence of ADHD is higher among acute care psychiatric inpatients than in the general child population. Other studies in adult population showed similar results (Lines et al. 2018). Further investigation is needed to define the convenience of routine ADHD screening in child and adolescent psychiatric inpatients.

High prevalence of ADHD for Korean adolescent inmates

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Objectives: ADHD is a neurodevelopmental disorder with childhood onset, defined by symptoms of hyperactivity/impulsivity and inattentiveness. According to DSM-5, about 5% of children are suffering from this disorder. (1) A recent study revealed that 3.1% of general adolescent population in Korea were diagnosed with ADHD. (2) In previous studies, the prevalence of ADHD in youth prison population was 30.1%, which is much higher than the general population. (3) In other studies conducted in Korea, the prevalence of ADHD in adolescent probationers was 10.83% and the prevalence of ADHD in male juvenile detainees was 35.3%. (4), (5) Considering previous studies, we hypothesize that in Korea, the prevalence of ADHD in the juvenile prison population will be higher than that of the general population for both males and females. The purpose of our study was to investigate the prevalence of ADHD for Korean adolescent inmates.

Methods: Adolescents at reformative centers in Korea were included. After receiving informed consent from all participants, the interview was conducted using the MINI KID. Interviewers were psychiatric residents, two in 2nd years and two in 3rd years. Participants with IQ 80 or higher only were included.

Results: According to the inclusion criteria, One hundred adolescents were included in the study, 54 boys and 46 girls. The mean age of participants was 17.08 (SD = 1.88) years and the mean FSIQ was 91.27 (SD = 6.38). Twenty eight adolescents meet diagnostic criteria for ADHD (28%). The prevalence of ADHD was 41% (19/46) in girls and 17% (9/54) in boys respectively. ADHD patients were classified according to their type. Combined was 46% (13/28), inattentive predominant 29% (8/28), and hyperactive/impulsive predominant 25% (7/28). In females, Combined was 53% (10/19), inattentive predominant 21% (4/19), and hyperactive/impulsive predominant 26% (5/19). In males, Combined was 33% (3/9), inattentive predominant 44% (4/9), and hyperactive/impulsive predominant 22% (2/9).

Conclusions: Our study found that the prevalence of ADHD in juvenile prison population is 28%, which is about 9 times higher than 3.1% of the general population in Korea. In addition, the prevalence of ADHD of female was 41%, higher than males. Among girls who

were diagnosed with ADHD, combined type was the most common (52.6%).

Suggestive symptoms of ADHD in a sample of adult patients diagnosed with eating disorders

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Objectives: To assess the presence of symptomatology suggestive of Attention deficit-hyperactivity disorder [ADHD] in 86 patients diagnosed with eating disorders [ED] in any of its different subtypes: Restrictive anorexia nervosa [R-AN], purging anorexia nervosa [P-AN], Bulimia nervosa [BN], and Eating Disorder not otherwise specified [EDNOS] To analyse whether a correlation exists between ADHD symptoms and the intensity of eating symptoms.

Methods: We analysed a sample of 86 patients diagnosed with ED (R-AN: 20 patients (23.26%), P-AN: 31 patients (36.05%), BN: 15 patients (17.44%), EDNOS: 20 patients (23.26%). The mean age of the sample was of 30.58 years, and the proportion of males and females was of 9.2 to 1.8. We applied the ASRS v1.1. to quantify symptoms suggestive of ADHD, and the EAT-40, the EDI-3, and the EDE interview for the study of ED.

Results: Statistically meaningful differences were not found in ASRS v1.1 for the different presentations of ED. Mean score of ASRS v1.1 for R-AN is meaningfully lower to the rest of ED subtypes. We found no statistically meaningful difference between the scores obtained in ASRS v1.1 and the scores in EAT-40 and EDI-3 subscales. EDE interview shows statistically meaningful differences only between the subscales of Eating Concern and Shape Concern as compared to ASRS v1.1 scores.

Conclusions:

1. No specific ED presents a correlation with a more intense presentation of symptoms suggestive of ADHD.
2. Pure restrictive EDs present lower symptomatology suggestive of ADHD than those presentations with impulsive and/or purging behaviors.
3. A higher presence of symptomatology suggestive of ADHD is not correlated with eating the seriousness or the earlier onset of the ED.

Use of ADHD medications in Sweden: a nationwide study

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Objectives: To describe trends in incidence and prevalence rates of adhd medication use in children and adults in Sweden. In addition, to describe medication persistence and comorbidity.

Methods: Data on dispensations of adhd medications and psychiatric diagnoses since 2006 were obtained from Swedish national registers held by the National Board of Health and Welfare in Sweden. **Results:** Since 2006 there has been an increase in both incidence and prevalence of adhd medication use. The highest relative increase has been among adults, especially women. The prevalence however is highest among children 10–17 years. Among boys, 5.6% had at least one dispensation of an adhd-drug 2017. The corresponding number among girls was 2.5%. The majority, about 70–90% depending on age

group, continued treatment during a follow-up period of 5 years. One out of 3 patients had a break from treatment during the follow-up. Comorbidity was high, especially anxiety and depressive disorders, as well as substance use disorders among adults. Among children, other neurodevelopmental disorders, such as autism, were common.

Conclusions: The increase in adhd medication use in Sweden will likely continue as incidence is still increasing and patients often continue treatment for longer periods. Comorbidity among patients is high and represents a special challenge in addition to adhd diagnosis.

Role of Glutamic Acid Decarboxylase (GAD1) gene polymorphisms (Rs 3749034 and Rs11542313) in susceptibility to ADHD: an Egyptian study

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Objectives: ADHD is a common childhood-onset psychiatric disorder and may persist into adulthood. ADHD is a complex and heterogeneous disorder with a strong heritability estimates averaging 75% in children. Recent studies suggested a role for the γ -aminobutyric acid (GABA) on ADHD hyperactive/impulsive symptoms due to behavioral disinhibition resulting from inappropriate modulation of glutamatergic and GABAergic signaling. The glutamic acid decarboxylase (GAD1) gene encodes a key enzyme of GABA biosynthesis. The study aims to explore the potential association between (ADHD) and (GAD1) gene polymorphisms (rs3749034 and rs11542313).

Methods: A group of 20 children meeting DSM-5 diagnostic criteria for ADHD and their biological parents were compared with a group of 30 healthy age and gender-matched children. GAD1 SNPs (rs3749034 and rs11542313) were evaluated by Real-time polymerase chain reaction.

Results: Most of our children were boys (85%) in school age (9.4 ± 2.6 years). Regarding the rs3749034 SNP, having the GG allele caused the highest risk for the child to have ADHD (OR 29.3), followed by the AG allele (OR 5.6). On the other hand, having the TT or the CT alleles in the rs11542313 SNP both increased the likelihood for the child to have ADHD (OR 4.4 and 3.8 respectively). The rs11542313C allele was over-transmitted from parents to ADHD probands. No preferential transmission from rs3749034 or haplotypes from rs3749034/rs11542313 were observed ($P = 0.799$ and $P = 0.821$, respectively).

Conclusions: Our results suggest that the GAD1 gene might be associated with susceptibility to ADHD.

Early detection of mental and behavioral disorders of young children: a nationwide population-based pilot study in Russia (data 2017)

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Objectives: The Ministry of Health of the Russian Federation introduced the second stage of the pilot study—the total screening of children 18–48 months of the general population. The screening is focused on early detection of children from the risk group for the occurrence of mental and behavioral disorders.

Methods: The study was conducted in two levels. Level I—the survey was conducted by the total screening in primary health care

facilities in the nine largest regions of Russia. Level II—consultation by a psychiatrist (clinical diagnosis of ICD-10).

Results: In 2017, 329,424 parents of children aged 18–48 months of life were questioned. According to preliminary data, the risk group for the occurrence of psychopathology was 51,325 children (155:1000). This condition can last for several years and, over time, become either a disease or practical health. Some children at risk of mental illness were consulted by a psychiatrist (23,158 cases) on a voluntary basis. In 3585 children (11:1000), clinical disorders qualified by ICD-10 were revealed. The distribution of patients by nosological groups is given in table.

Conclusions: As the study showed, with an increase in the age coverage of children in the general population, the risk group increased, and the detection of clinically pronounced mental disorders increased. For example, the incidence of ASD in children under 2 years was 0.5:1000 (data 2016), and in children under 4 years old it was 1.8:1000. Children at risk have a soft predisposition of mental pathology, they need comprehensive preventive measures to improve mental health.

The Prevalence of Mental and Behavioral Disorders in Children 1.5–4 age in Russia (data 2017).

ICD-10 diagnostic codes		%
Mental retardation	F70–F79	6,45
Disorders of psychological development	F80–83 Specific developmental disorders of speech and language, of scholastic skills, of motor function	60,06
	F84.0–F84.8 Autism spectrum disorder	16,68
Behavioral and emotional disorders with onset usually occurring in childhood and adolescence	F90–F98	16,77
Schizophrenia, childhood type. Childhood type schizophrenia is available in the USSR's adapted version of the ICD-9 (299.91) and in the Russian adapted version of the ICD-10 (F20.8xx3) (1994, 1999).	F20.8xx3	0,06

Tunisian military children with ADHD

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Objectives: Children's mental health is affected by a number of stressors experienced by the family; and influenced by the parents' mental well-being. As ADHD is one of the most common pediatric mental health disorders and we have noticed a significant increase in the number of ADHD patients whose parents serve in the military, we decided to orient our work towards the prevalence of the disorder in offspring associated with military service.

Methods: Retrospective cohort study of children aged 1–16 years in the Military Hospital of Tunis (2017–2018) compared to the same study conducted in the University Hospital of Mahdia (2016–2017).

Results: Results have shown that 75 out of 371 children were diagnosed with ADHD in the Military Hospital (21%), whereas only 20 out of 257 children were diagnosed in the University Hospital (7%). It is essential to mention that the age demographic and gender equilibrium were unaltered in both groups. We have also discerned the military offspring as more vulnerable and negligent to their

medication. This dominant behavior accentuated ADHD into a case of depression, as 10 out of 75 ADHD military-associated patients were diagnosed with depression.

Conclusions: Throughout our study, we realized that children diagnosed with ADHD, whose parents are in military service, are triple the number of those whose parents aren't. This can be due to hereditary several factors seeing that ADHD is more common in the ranks of adults who are professionally-engaged in the military, in comparison with those who are employed in the civil service. Parents who work in the military service encounter a critical number of stressors, leading to conjugal conflicts especially during pregnancy and therefore running a high risk of ADHD children. Constant separation between military parents and their children due to deployment is a direct cause of depression, and the subsequent unavailability of ADHD children to attend their scheduled appointments and improper medication complicates their ADHD case. In this respect, curative and preventive measures must be taken in order to restrict the expansion as well as the potential complications of the disorder.

Exposure to air pollution in early childhood and the association with ADHD

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Objectives: Exposure to air pollution early in life has been linked to cognitive deficits and adverse neurodevelopmental effects. However, studies examining associations between air pollution and ADHD have had conflicting findings. Hence, further investigation of this association is needed.

Methods: In this nationwide cohort study, all individuals born in Denmark 1992–2007 (n = 809,903) were followed for the development of ADHD, during 1997–2016. Data with daily concentrations of NOX, NO2, O3, CO, PM2.5, SO2, SO4, NO3, NH4, EC, OC and sea salt was linked to the residential addresses of each cohort member, from birth to their 5th birthday. In one-pollutant models, we estimated incidence rate ratios (IRRs) for ADHD, according to an increase in exposure, while adjusting for age, calendar year, sex, obstetric factors, parental education and income, and family history of psychiatric disorders.

Results: During the period of follow-up, 20 674 (2.6%) individuals developed ADHD. Exposure to the highest quintiles of NOX, NO2, PM2.5, CO, SO2, SO4, EC and OC during early childhood was associated with an increased risk of ADHD, when compared to exposure to the lowest quintiles of these pollutants. Estimates were robust across all geographical regions and adjustments for covariates did not influence the results. In contrast, exposure to higher concentrations of O3, NO3, NH4 and Sea salt was not associated with the risk of developing ADHD.

Conclusions: This is the first nationwide study to document, that children exposed to high levels of NOx, NO2, PM2.5, SO2, SO4, EC and OC may have an increased risk of developing ADHD. This result supports the hypothesis that, although ADHD is a highly heritable disorder, the etiology of ADHD also includes important environmental risk factors. Our future studies will examine the effects of each of these pollutants, adjusted for the effects of the other pollutants.

Comorbid psychiatric disorders and executive functioning of Latino male prisoners with ADHD and substance use disorders

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Objectives: To examine the prevalence and comorbidity patterns of ADHD and substance use disorders (SUD) among Latino male prisoners. We compare prisoners with and without ADHD in terms of comorbid conditions and clinical characteristics including: SUD severity, nicotine use, depression, generalized anxiety, personality disorders and suicidality. We examine predictors of SUD symptom severity such as ADHD and executive functioning deficits.

Methods: We collected data via a cross-sectional study of 500 randomly selected male Latino prisoners in the Puerto Rico Correctional System. We used the ASRS, DIVA 2.0, CIDI-SAM, MINI, SCID II, PHQ9, BDEFS to collect information on ADHD and SUD diagnosis, comorbidities and executive functioning (EF).

Results: We found the prevalence of ADHD among Latino prisoners to be 16.98%, higher than in the general population and consistent with previous prison studies. Substance use disorder prevalence among prisoners was also high (around 74% for lifetime and 30% for current (12 month). Prisoners with ADHD were at greater risk for SUD (p 's = .025 and .003) and all comorbid psychiatric disorders and suicidality (OR 3.53–2.91, p 's < .001); they also had a significantly greater number of comorbid disorders, including SUD, depression, anxiety and personality disorders (p < .001). Prisoners with ADHD and those with executive function deficits also had significantly more severe substance use disorders. Nicotine use was prevalent among prisoners, with about 50% reporting it. It was not significantly associated to ADHD or current SUD.

Conclusions: Findings highlight the need to attend to the complex mental health needs of incarcerated populations, where SUD, ADHD and other psychiatric disorders are prevalent and interrelated. Particular attention needs to be paid to screening for ADHD and SUD, as well as meeting the challenges treatment presents within the correctional setting.

Predictors of ADHD symptoms in childhood and adolescence over time: results of the longitudinal BELLA study

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Objectives: ADHD is a common and impairing mental disorder in childhood and adolescence. So far, longitudinal studies on risk and protective factors for the development of ADHD symptoms are scarce. Therefore, the present study investigates the cross-sectional and longitudinal influences of individual, familial and social factors on the development of ADHD symptoms in children and adolescents. **Methods:** Within the population-based longitudinal BELLA study, data on $n = 1384$ children and adolescents aged 11–17 years were collected at three measurement points covering a period of 2 years. We examined effects of parental mental health problems (risk factor) and self-efficacy, family climate and social support (protective factors) on symptoms of ADHD at baseline as well as over time using latent growth modelling and linear regression models. Sociodemographic factors, pre- and postnatal factors, and comorbid symptoms of

internalizing and externalizing mental health problems were considered as covariates. In additional regression models, we explored potential interaction effects between risk and protective factors.

Results: Parental mental health problems, stronger aggressive behavior, younger age and male gender were negatively associated with ADHD symptoms in children and adolescents at baseline. Longitudinal analyses revealed that increasing parental mental health problems, increasing aggressive behaviour, increasing symptoms of generalized anxiety, migration status and female gender were related to stronger increase of ADHD symptoms over time. However, improving family climate was associated with decreasing ADHD symptoms over time. We further detected moderating effects of social support on the relationship between parental mental health problems and ADHD symptoms.

Conclusions: The findings of the present study demonstrate detrimental effects of parental mental health problems as well as beneficial effects of family climate and social support on ADHD in children and adolescents over time. The results may be integrated in future prevention and early intervention programs that target affected children and adolescents.

Topic: Experimental models

Thyroid hormone-responsive gene overexpression in the striatum leads to the development of inattentive-like phenotype in mice

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Objectives: Identifying a domain-specific genetic risk variant may assist in uncovering potential genetic mechanisms in ADHD, thus we investigated whether the thyroid-hormone responsive (THRSP) gene has a role in the development of inattention in ADHD. Previously, we have identified THRSP as an inattention-related gene.

Methods: We generated a line of THRSP overexpressing (THRSP OE) mice. The gene and protein overexpression of THRSP in the striatum (STR) was confirmed by quantitative real-time polymerase chain reaction and western blotting. We assessed their behavior through an array of behavioral tests used to determine ADHD symptoms. Electroencephalography (EEG) was performed to assess their brain electrical activity. A separate cohort of THRSP OE mice was treated with methylphenidate (MPH; 5 mg/kg), a commonly used medication for ADHD, and evaluated their behavior. In addition, we measured expression levels of dopamine D1 and D2 receptor, dopamine transporter, and tyrosine hydroxylase genes in the STR.

Results: The THRSP OE mice exhibited inattention and decreased working memory during the novel objective recognition, Y-maze, and Barnes maze test. The mice did not show hyperactivity in the open-field test and impulsivity in the delay-discounting and cliff-avoidance test. EEG showed increased delta, theta, alpha, and beta waves in THRSP OE mice. We found that THRSP OE mice have increased dopamine D1 and D2 receptor, DAT, and TH gene expression levels in the STR. MPH treatment improved attention and normalized the dopamine-related gene expression levels.

Conclusions: Our findings indicate the potential role in the development of inattention in ADHD. The MPH-induced improved attention suggests the involvement of the dopaminergic system. Additional experiments are underway to determine how exactly THRSP overexpression contributes to the inattentive behavior in mice and affects the dopamine-related gene expression levels in the STR.

Nevertheless, this study suggests that THRSP OE mice may be used to elucidate the genetic mechanisms of ADHD.

Effects of acupuncture at “Sanyinjiao” (SP6) and “Baihui” (GV20) on the behavior and monoamine neurotransmitter in prefrontal cortex of ADHD model rats

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Objectives: To observe the effects of acupuncture at “Sanyinjiao” (SP6) and “Baihui” (GV20) on spontaneous activity, impulsivity, learning-memorial ability, and monoamine neurotransmitter dopamine (DA), noradrenalin (NE) and 5-hydroxytryptamine (5-HT) contents in prefrontal cortex of spontaneously hypertensive rats (SHR) as a model of attention-deficit/hyperactivity disorder (ADHD) rats, so as to study its mechanism underlying improvement of ADHD. **Methods:** 4-week-old SHR rats were randomly divided into the model group, methylphenidate (MPH) group, acupuncture group, the same age WKY young rats were selected as the normal control group, 10 rats in each group. Acupuncture was applied to “Baihui” (GV20) and “Sanyinjiao” (SP6) of SHR rats in acupuncture group for 15 min, once daily for 4 weeks. The rats in MPH group was gavaged with MPH (ritalin) at a dose of 2 mg kg⁻¹ day⁻¹. Rats were treated for 4 weeks in the dark-phase. Open field test (OFT), elevated plus maze (EPM) and novel object recognition test (NORT) were conducted to evaluate the spontaneous activity, impulsivity and learning-memorial ability of rats individually at the end of treatment and contents of DA, NE and 5-HT in PFC were detected by HPLC.

Results: Compared with the control group, acupuncture group had shorter movement distance, less rearing and grooming activities in the OFT, reduced percentage of the times entering the open arms and staying duration in the total period in the EPM, and the elevated preference index in the NORT after receiving 4 weeks treatment ($P < 0.05$), and the contents of NE and 5-HT in PFC of the acupuncture group rats were higher than that of control group ($P < 0.05$), but there was no significant difference in DA levels between the two groups ($P > 0.05$).

Conclusions: Acupuncture could relieve the spontaneous activity and impulsivity, improve learning-memorial ability of ADHD model rats, which may be related to elevated NE and 5-HT levels in the PFC.

Effect of catalpol on behavior and neurodevelopment in juvenile spontaneously hypertensive rat model of ADHD

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Objectives: Studies suggest that abnormal neurodevelopment of prefrontal striatal circuits is implicated in the pathogenesis of ADHD. In the present study, we investigated the effects of catalpol, an active ingredient of *Rehmannia radix preparata* which is the most frequently used Chinese medicinal herb in treating ADHD, on behavior and neurodevelopment in spontaneously hypertensive rats (SHR).

Methods: SHR rats were divided into SHR group (vehicle, i.g.), methylphenidate (MPH) group (2 mg/kg/day, i.g.) and catalpol group

(50 mg/kg/day i.g.), and Wistar-Kyoto (WKY) rats were used as control group (vehicle, i.g.). Open Field Test (OFT) and Morris water maze (MWM) were carried out to assess the impacts of catalpol on the behavior. Hematoxylin and eosin (H&E) staining were used to observe the morphology of the prefrontal cortical (PFC) and striatum, the expression of brain-derived neurotrophic factor (BDNF), cyclin-dependent kinase 5 (Cdk5), p35, fibroblast growth factor (FGF) 21 and its receptor (FGFR)1 were detected by Western blot and immunostaining analysis. Immunohistochemistry and immunofluorescence, and Western blotting.

Results: both of catalpol and MPH treatment decreased average speed, time spent in the central area, rearing times and central area visits, increased immobility time of SHR in OFT, and increased visiting times to the annulus and time spent in target quadrant in MWM test. Hematoxylin and eosin (H&E) staining showed that catalpol reduced irregular neuronal arrangement, ruptured nuclear and disappeared nucleolus in the prefrontal cortex (PFC) and striatum of SHR. Moreover, immunofluorescent staining analysis of NeuN and myelin basic protein (MBP) indicated that catalpol ameliorated neuronal loss and contributed to myelination. Finally, Western blot and immunostaining analysis suggested that several regulatory proteins involved in PFC development were up-regulated by catalpol treatment, such as BDNF, Cdk5, p35, FGF 21 and FGFR1.

Conclusions: catalpol can effectively ameliorate hyperactive and impulsive behaviors, improve spatial learning and memory of SHR, likely through affecting neurodevelopment.

Excitatory/inhibitory imbalance in the Gad1b ADHD zebrafish model

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Objectives: ADHD represents one of the most prevalent psychiatric disorders with 2–8% affected children and adolescents worldwide. The characteristic symptoms are diverse, ranging from hyperactivity and impulsivity over inattention to emotional dysregulation. Over the last couple of decades, the genetic basis for ADHD has been partly uncovered, identifying several candidate genes associated with the disorder. However, for most of the genetic variations it remains enigmatic how and to which extent they contribute to the disorder. The goal of the current study was to investigate the behavioural consequences of the loss-of-function of Glutamic Decarboxylase 1 (Gad1b) in zebrafish, an enzyme catalysing the production of gamma-aminobutyric acid from L-glutamic acid. Previously, the corresponding human gene was identified as ADHD candidate gene.

Methods: We performed developmental expression analysis using in situ hybridizations and generated a loss-of-function model in zebrafish larvae. Various behavioural assays were used to assess the developmental and functional role of Gad1b and the efficacy of pharmacological treatment using ADHD medications was investigated.

Results: Expression of gad1b could be confirmed in the nervous system at different developmental stages and is mainly restricted to the nervous system. Knockdown lead to a prominent loss of the transcript as shown with RT-PCR and in situ hybridizations. Morphants displayed higher locomotor activity compared to control conditions thus resembling human ADHD. Pharmacological phenocopy experiments in zebrafish showed an involvement of GABA-A receptors in the hyperactive phenotype.

Conclusions: Our results point towards an excitatory/inhibitory imbalance in the Gad1b ADHD zebrafish model. Further research is

needed to identify the underlying circuit responsible for the ADHD-like phenotype in this model.

An eye on ADHD: can the retina be used as a diagnostic support tool?

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Objectives: Our working hypothesis is that retinal alterations can elucidate about brain changes in ADHD. Thus, we aim to unravel brain and visual alterations in ADHD at the cellular levels, and also to investigate the effect of methylphenidate (MPH) on ADHD versus control conditions.

Methods: We applied functional and biochemical approaches to explore the early life chronic exposure of MPH on control and ADHD male rats (Wistar Kyoto and spontaneously hypertensive rats, respectively, SHR). Both strains were divided in two groups: vehicle (water) and 1.5 mg/Kg MPH (MPH 1.5). Individual administration was performed by oral gavage between post-natal days 28 and 55 (P28-P55). In vivo assessment of visual function and retinal structure was performed by electroretinography and optical coherence tomography, respectively, at P56–57. At P58, animals were sacrificed and molecular and cellular studies performed (qPCR, western blot and immunohistochemistry). Data were analyzed using Kruskal–Wallis or two-way ANOVA followed by multiple comparison test. The level of significance was $p < 0.05$ and the “n” represents the total number of animals used in each experimental group/condition. Statistical analysis was calculated using Prism 6.0 (GraphPad Software, San Diego, CA, USA).

Results: Blood–brain barrier (BBB) dysfunction triggered by MPH was only observed in control rats since there was an upregulation of both caveolin-1, known to be involved in the regulation of transcytosis across endothelial cells, and VCAM-1, which mediates leukocytes recruitment into the brain parenchyma. Simultaneously, there was also a neuroinflammatory response observed by alterations in glial cells and cytokine levels. On the contrary, in the ADHD model, MPH had a beneficial effect. Despite our interest to clarify the neurobiology of ADHD and the impact of MPH use in the brain, we also aim to unravel retinal alterations in these animal models. In fact, the concept of the retina as a window to the brain has raised much attention in the past years. Notably, our preliminary data suggest that the ADHD animal model presents a thinning of the retina as well as an impairment of retinal function, independent of MPH use, and

accompanied by an inflammatory response. Importantly, MPH-treated control animals present an amelioration on retinal function.

Conclusions: ADHD animals present brain and retinal alterations, and methylphenidate had a beneficial effect in these animals. Nevertheless, MPH induced a neuroinflammatory response in control conditions. Keeping in mind that retina may provide an easily accessible and non-invasive window to monitor brain alterations in ADHD patients, ongoing pre-clinical studies in our Lab will allow us to further clarify brain versus retina alteration in ADHD, as well as the impact of MPH treatment.

Knocking down cntnap2 displayed hyperactivity symptom of ADHD in zebrafish

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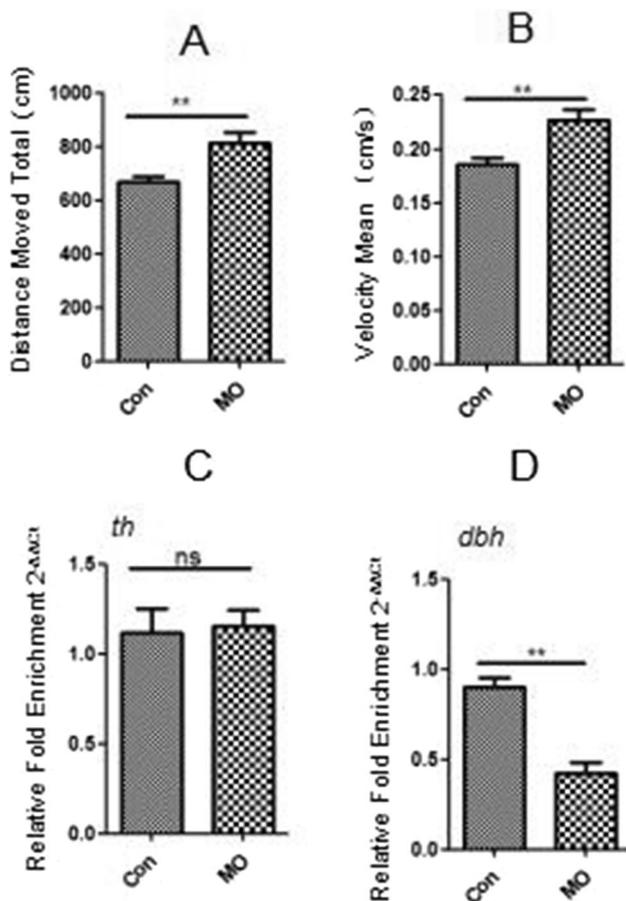
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Objectives: CNTNAP2 (Contactin-associated protein-like 2) is a member of the neurexin family which is essential for cortical neuron axon growth, synaptic functions and neural circuits assembly. Mutations in CNTNAP2 have been reported to be associated with a series of neurodevelopmental disorders, including intellectual disability (ID), autism spectrum disorders, and schizophrenia (SCZ). Besides, Cntnap2 variants were tightly related with attention deficit hyperactivity disorder (ADHD) based on our GWAS analysis. Therefore we explore correlation of cntnap2 and ADHD in zebrafish.

Methods: In this study, splicing modifying Morpholino (MO) and control MO (Con) were designed and were micro-injected into one cell-stage zebrafish embryos separately. When 6 days after fertilization, the Con and MO zebrafish larvae were placed into Noldus apparatus to detecting swimming distance and velocity. Quantitative Real-time PCR was used to assess the expression of dopamine β hydroxylase (dbh) which is involved in the conversion of DA into NE and tyrosine hydroxylase (th) which is the rate limiting enzyme in the biosynthesis of dopamine (DA) and other catecholamines.

Results: The expression of cntnap2 was knocked down by MO. The MO zebrafish larvae swimming distance was significantly increased compared with Con zebrafish. Swimming distance of MO zebrafish was significantly decreased after tomoxetine exposure. The expression of dbh during 72 h postfertilization (hpf) was decreased compared with Con. However, the expression of th during 72 hpf has no change.

Conclusions: This study provided some evidence for the relationship between CNTNAP2 and ADHD, though the results need further replication.



A: The total distance moved (cm) of Con and MO zebrafish larvae; B: The mean velocity (cm/s) of Con and MO zebrafish larvae; C: Relative Fold Enrichment of *th* in Con and MO zebrafish larvae at 72 hpf; D: Relative Fold Enrichment of *dbh* in Con and MO zebrafish.

Topic: Genetics

Genotyping of DRD4 and DAT1 genes may differentiate symptoms of ADHD and sluggish cognitive tempo

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Objectives: We aimed to investigate neuropsychological differences and genotyping of the DAT1 and DRD4 genes between diagnoses of Sluggish Cognitive Tempo (SCT) and ADHD.

Methods: We examined children aged between 6 and 15 years with the Child Behavior Checklist, the Attention-Deficit/Hyperactivity Disorder Rating Scale-IV and the Barkley SCT rating scale that fulfilled by parents. We used a standardized neuropsychological battery (CNS-VS) containing 5 domain (neurocognitive index, memory, psychomotor speed, reaction time, cognitive flexibility and complex attention) and the continuous performance test (CPT). The DAT1 (40 bp repeat region in the 3' UTR) and DRD4 (48 bp repeat region in the exon 3) genes were genotyped.

Results: We compared 31 cases with SCT w/o ADHD, 67 cases with SCT + ADHD and 146 cases with ADHD w/o SCT with 92 typically developing controls (TD). There was a significant difference between the groups for the DAT1 and DRD4 genes ($p < 0.05$). All groups presented higher prevalence of 10R homozygosity for DAT1 gene than TD group ($p < 0.05$). In terms of the prevalence of 4R homozygosity for DRD4 gene, only ADHD w/o SCT group was differed significantly from TD group ($p < 0.05$). SCT w/o ADHD group had significantly higher prevalence of 7-repeat allele for the DRD4 gene than ADHD w/o SCT group ($p < 0.05$). Both ADHD w/o SCT and SCT + ADHD groups had lower scores on psychomotor speed and commission errors than healthy controls, SCT w/o ADHD did not differ in these two indexes.

Conclusions: Our findings suggest that SCT and ADHD groups were distinguished by the prevalence of 4R homozygosity and 7-repeat allele for DRD4 gene and measures of psychomotor speed and commission errors. Alleles that we found higher in SCT cases were associated with unresponsiveness to methylphenidate, previously. We indicate the necessity of investigating the symptoms of SCT in ADHD candidate gene studies and pharmacogenetic studies.

Polygenic risk for childhood-onset psychiatric disorders predicts childhood psychiatric traits in the community

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Objectives: Psychiatric disorders may be the extremes of widely distributed traits in the general population. Studying these traits in community samples can rapidly increase sample size, avoid possible error from diagnosis thresholds and help identify the genetic underpinnings of comorbidity. Childhood-onset psychiatric disorders such as ADHD, OCD and anxiety disorders co-occur but the role of genetics in their co-occurrence is unclear. We examined if ADHD, OCD and anxiety traits shared polygenic risk with their respective disorders and their co-occurring disorders.

Methods: We recruited 5366 Caucasians (6–17 years) from the community with trait information from the Strengths and Weaknesses of ADHD Symptoms and Normal Behavior Rating scale (SWAN), Toronto Obsessive-Compulsive Scale (TOCS) and Child Behavior Checklist—anxiety problems subscale. We genotyped samples on Illumina HumanCoreExome beadchips and conducted standard quality control and imputation. We calculated polygenic risk scores from three discovery meta-analyses: ADHD (PGC; cases = 19,099, controls = 34,194), OCD (IOCDF, OCGAS; cases $n = 2688$, controls = 7037) and anxiety disorder (ANGST; 17,310 cases and controls). We examined if trait scores for ADHD, OCD and anxiety were associated with polygenic risk from their respective disorders as well as co-occurring disorders from discovery sets.

Results: 5154 samples in the target sample passed quality control (96%). Polygenic risk from ADHD was significantly associated with ADHD traits (p 's $\geq 1.73 \times 10^{-11}$). Neither polygenic risk scores based on OCD nor anxiety disorders predicted ADHD traits. Polygenic risk from OCD, and to a lesser degree anxiety disorders, was significantly associated with OCD traits (p 's $\geq 8.37 \times 10^{-5}$). ADHD polygenic risk was not associated with OCD traits. Anxiety traits were suggestively associated with polygenic risk for anxiety and OCD (p 's ≥ 0.01).

Conclusions: Our findings support mounting evidence that traits and disorders share genetic risk and that traits can co-occur with or without substantial shared polygenic risk. This study illustrates the utility of trait-based approaches in community samples for psychiatric genetics research.

ADHD polygenic risk and migraine

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Objectives: Migraine and ADHD have been associated in epidemiological studies. A recent large-scale genetic study further identified a significant genetic correlation between ADHD and migraine based on genome-wide data. Notably, this was one of very few significant genetic correlations across neurological and psychiatric disorders, warranting further investigation of the genetic link between migraine and ADHD. The objective of this study was to investigate whether ADHD genetic liability, summed into a polygenic risk score (PRS), is associated with migraine in a population-based sample.

Methods: We used data on 13,801 ADHD-cases and 19,980 non-ADHD controls born 1981–2001 from the Danish iPSYCH study, a unique case-cohort sample combining genetic and nationwide register data. Standardised ADHD-PRS (mean = 0, standard deviation [SD] = 1) were derived in iPSYCH based on summary statistics from the largest available meta-analysis of genome-wide association studies of ADHD. Migraine cases were identified via the National Patient Register and migraine drug dispensations in the Prescribed Drug Register. The association between ADHD-PRS and migraine was estimated as odds ratios (ORs) by logistic regression, in ADHD-cases and non-ADHD controls separately.

Results: There was no association between ADHD-PRS and migraine in ADHD-cases (OR 0.97, 95% Confidence intervals [CI] = 0.90–1.05, p value = 0.43). In contrast, we found a significant association in non-ADHD controls (OR 1.08, 95% CI 1.02–1.15, p value < 0.001), reflecting an 8% increased risk of migraine for every 1 SD increase in ADHD-PRS. Controls with ADHD-PRS in the highest quintile had a 32% higher risk of migraine, compared to those in the lowest quintile (OR 1.32, 95% CI 1.09–1.60, p value < 0.001).

Conclusions: In this population-based sample of typically developing children, ADHD genetic liability was associated with an increased risk of migraine, suggesting possible shared genetic mechanisms between ADHD-traits and migraine. The lack of association in ADHD-cases may reflect reduced PRS variance in ADHD-cases. In future studies interactions between ADHD-PRS, family history and other potential mediators could be investigated.

Describing the genetic architecture of ADHD using linked-read sequencing: a case–control study from the isolated population of the Faroe Islands

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Objectives: ADHD is a mental disorder characterised by an ongoing pattern of inattention and/or hyperactivity-impulsivity. ADHD is highly heritable and genetic studies show substantial contribution of common variants to disorder susceptibility. Moreover, a recent meta-analysis show genome-wide significance of 12 independent loci comprising evolutionarily constrained genomic regions and loss-of-function intolerant genes. In this study the potential enrichment of ADHD risk variants will be explored based on whole-exome data from linked-read sequencing of individuals from the isolated population of the Faroe Islands. The demographic history of the Faroese population may have induced enrichment of variants rarely seen in outbred European populations, including enrichment of risk variants for ADHD.

Methods: Cases in this study comprises 56 patients with ADHD, recruited to the ADHD outpatient clinic at the Department of Psychiatry, General Hospital in Tórshavn, Faroe Islands. Diagnosis has been verified by a psychiatrist/child and youth psychiatrist, a psychologist and a ADHD specialized nurse. Further, the diagnostics were verified with the diagnostic tools: ADHD-RS (Attention Deficit/Hyperactive Disorder-Rating Scale), TOVA (Test Vaiabels of Attention), BRIEF (Behavioural Rating Inventory of Executive Function) and in some cases DIVA (Diagnostic Interview for ADHD in adults) and QbTest (Quantified Behaviour Test Plus). Cases have been reviewed by experienced psychiatrists and the diagnostic most solid/robust cases have been selected for genetic analyses. Healthy controls in this study comprises 200 individuals voluntarily recruited to the FarGen infrastructure, at the Genetic Biobank of the Faroe Islands. Self-reported healthy status was confirmed by the diagnostic registry at the National Hospital of the Faroe Islands. High-molecular weight (HMW) DNA extracted from peripheral blood was barcoded by a gel-bead emulsion (GEM) process in the Chromium™ controller. The 256 exomes were captured using the SureSelectXT Human All Exon kit and sequenced on the NextSeq 500. The linked-reads were aligned to the reference genome (GRCh37/hg19) and variants were called using GATK.

Results: The exomes were sequenced with an average coverage of 56, > 98% of the reads were aligned to the reference genome. Due to the barcodes introduced to the DNA fragments in the GEM process we were able to perform molecular phasing, which assign > 85% of the genes under 100 kb to a haplotype and phased > 75% of the SNPs. Moreover, we will present results from single variant and gene-based association analyses, as well as possible structural variants will be presented.

Conclusions: To our knowledge this is the first study to use linked-read sequencing to identify susceptibility variants/genes for ADHD.

Family and case–control association study of the FKBP5 stress related gene with ADHD following by meta-analysis

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Objectives: ADHD is one of the most common psychiatric disorders in children and adolescents with over 5% of the population affected worldwide, often persists into adulthood. Although ADHD was found to be heritable with around 80% genetic predisposition, environmental factors, in particular stress, might play a role in this equation. FKBP5 gene variants (e.g. rs1360780 and rs3800373) have been linked with various stress related disorders, such as major depression, PTSD and recently described to associate with childhood ADHD, however no confirmatory study has been conducted to date.

Methods: We performed a case–control association study (220 children with ADHD, 152 healthy controls) and a family-based association analysis ($n = 202$ nuclear families total 724 individuals) investigating two SNPs on the FKBP5 gene (rs3800373 and rs1360780). Following, a meta-analysis has been conducted including the current findings and the findings published by Isaksson et al. (2014).

Results: Both SNPs did not deviate for Hardy–Weinberg equilibrium (p value > 0.05). We found a significant association with rs3800373 C-allele and childhood ADHD in the case–control sample (OR 1.486; 95% CI 1.062–2.078; $p = 0.0239$), while no association with rs1360780 T-allele (OR 1.329; 95% CI 0.955–1.850; $p = 0.0971$). We could not detect a significant transmission for both SNPs in the family study (OR 0.765 95% CI 0.554–1.056; OR 0.761 95% CI

0.558–1.038, respectively). We could conduct a meta-analysis only for the rs1360780, since this SNP was assessed by Isaksson et al. 2014. Significant heterogeneity between studies was found ($I^2 = 77.3\%$ $p = 0.0122$). The random effect meta-analysis resulted in non-significant association between rs1360780 and ADHD (total $n = 1243$, OR 0.8668 95% CI 0.547–1.372, $p = 0.542$). In the recent ADHD-PGC GWAS (Demontis et al. 2019) rs3800373 resulted in a trend toward association (OR 0.9719 SE = 0.015, $p = 0.0577$ uncorrected to genome-wide study), while rs1360780 was found not to be associated with European ADHD (childhood and adults; OR 1.020 SE = 0.0147, $p = 0.175$).

Conclusions: For the rs1360780 we could not confirm association with ADHD, however rs3800373 might confer as a risk SNP for ADHD, since a similar trend was observed in the ADHD-PGC GWAS. Moreover, interactions between these SNPs and aggression and impulsivity was reported in prisoners (Bevilacqua et al. 2012), while in healthy volunteers these SNPs showed association with impulsivity (Kawamura et al. 2013). Therefore, replication studies are needed to assess these findings as well as dimensional traits analysis might help in endophenotyping this gene.

Peripheral mitochondria DNA copy numbers are increased in Korean ADHD

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Objectives: Several reports suggest mitochondrial dysfunction in the pathophysiology of ADHD. Mitochondrial DNA (mtDNA) copy number is a common biomarker for mitochondrial dysfunction. The purpose of this study was to compare the mtDNA copy numbers and also the methylation ratios of the PPARGC1A and D-loop region of mitochondria DNA in ADHD.

Methods: An age and gender matched sample of 70 ADHD children and adolescents (age 6–18 years) and 70 unrelated healthy controls was recruited in this study. The relative mtDNA copy numbers, the methylated/unmethylated DNA ratio for the PPARGC1A promoter and D-loop regions of mtDNA were compared between the ADHD and healthy controls groups using independent t-test s or Mann-Whitney U tests.

Results: The demographic and clinical characteristics of the participants are presented in Table 1. ADHD patients had significantly higher relative mtDNA copy numbers compared to healthy controls ($p = 0.010$). The methylated DNA/unmetDNA ratio of the PPARGC1A promoter region and also the D-loop region was significantly decreased in ADHD patients compared to healthy controls.

Conclusions: This is the first study to investigate changes in mtDNA copy numbers in ADHD subjects. We suggest that mtDNA copy numbers could be increased as a compensation mechanism for mitochondrial dysfunction. Our findings suggest that mitochondrial dysfunction and elevated mtDNA copy number may be a biological subtype of ADHD affection by epigenetic changes.

The relationship among ADHD polygenic risk scores, stressful life events, and ADHD symptoms in healthy adults

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Objectives: Literature suggests that both genetic factors and stressful life events (SLEs) are associated with ADHD. In addition, it is now clear that ADHD symptoms in the population and the clinically diagnosed form of ADHD are continuous in terms of many risk factors. However, the specific relationships between ADHD genetic liability, SLEs, and ADHD symptoms in healthy individuals is less clear. We therefore sought to investigate whether ADHD polygenic risk scores (ADHD-PRS) are associated with SLEs and ADHD symptoms and examined the mediation effect exists among these variables in a sample of healthy adults.

Methods: The sample included 1531 adults (mean age 26.9 years; 55.8% female) recruited by the Brain Imaging Genetics (BIG) project. ADHD symptom scores were measured by the ADHD DSM-IV-TR Rating scale. SLEs were assessed by the list of Threatening Events Questionnaire and were operationalized as lifetime-SLEs, recent-SLEs, and childhood trauma (CT). ADHD-PRS were derived based on the results of the largest ADHD GWAS meta-analysis (20,183 ADHD patients and 35,191 controls). Correlation analyses were used to test associations among these variables and mediation model analyses were applied to examine the mediational effect of SLEs on ADHD-PRS and ADHD symptoms scores.

Results: SLEs were significantly correlated to the overall ADHD symptoms scores (lifetime-SLEs: $r^2 = 0.11$, $p < .001$; recent-SLEs: $r^2 = 0.18$, $p < .001$; CT: $r^2 = 0.10$, $p < .001$), as well as to inattention (IA) score (lifetime-SLEs: $r^2 = 0.11$, $p < .001$; recent-SLEs: $r^2 = 0.14$, $p < .001$; CT: $r^2 = 0.08$, $p = .003$) and hyperactivity/impulsivity (HI) score (lifetime-SLEs: $r^2 = 0.08$, $p = .001$; recent-SLEs: $r^2 = 0.18$, $p < .001$; CT: $r^2 = 0.10$, $p < .001$). ADHD-PRS was associated with HI score ($r^2 = 0.07$, $p = .0006$), lifetime-SLEs ($r^2 = 0.06$, $p = .0016$), and CT ($r^2 = 0.054$, $p = .036$) in healthy adults. Furthermore, we found evidence that lifetime-SLEs and CT may be independently mediating the association between ADHD-PRS and HI scores SLEs (Sobel test statistic: lifetime-SLEs: 2.39, $p = 0.017$; CT: 2.27, $p = .023$).

Conclusions: Our results indicate that ADHD-PRS and lifetime SLEs are robust predictors of HI score in healthy adults. Lifetime SLEs may be involved in mediating the effect of ADHD genetic liability on the development of ADHD symptoms.

Family-based association study on functional alpha-synuclein polymorphisms in ADHD

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Objectives: There is strong evidence for a disturbed regulation of dopaminergic neurotransmission in ADHD and Parkinson's Disease. Furthermore, a genetic and phenotypic overlap between both disorders has been discussed. A well-studied risk gene for PD is the gene coding for alpha-synuclein (SNCA). This protein is located primarily in presynaptic vesicles and has been suggested to play a role in the modulation of dopamine transporter (DAT) function. DAT is the target of psychostimulants and plays a key role in regulating the dopamine concentrations in the synaptic cleft. In our sample

consisting of German families with children affected by ADHD we tested for association of allelic variants of two functionally relevant polymorphisms of SNCA (NACP-Rep1, rs356219).

Methods: Participants were recruited in children and parents, and phenotypically characterized by a team of experienced child and adolescent psychiatrists in the outpatient unit of the Department of Child and Adolescent Psychiatry, Psychosomatics and Psychotherapy, University of Würzburg (NACP-Rep1: 156 families, 232 children; rs356219: 195 families, 284 children). Genotyping were performed using the ABI PRISM SNaPshot Multiplex kit, followed by capillary electrophoresis on an ABI 3100 Genetic Analyzer.

Results: Transmission disequilibrium test analysis revealed no over-transmission for NACP-Rep1 (OR 1, $p_{nom} = 1$, $p_{adj} = 1$) and rs356219 (OR 1.28; $p_{nom} = 0.288$) in affected siblings. A sub-analysis on trios with index children showed a nominal association of rs356219 with ADHD (OR 1.43, $p_{nom} = 0.020$), which survived Bonferroni correction ($p_{adj} = 0.039$) while again no association for NACP-Rep1 (OR 0.8, $p = 0.317$, $p_{adj} = 0.634$) was detected.

Conclusions: In conclusion, we found in our pilot study a trend for an association of the rs356219 genotype in SCNA that may affect alpha-synuclein function and contribute to the aetiology of ADHD. Despite the small sample size our findings underline an interesting potential link in dopamine related neurobiology between PD and ADHD. Future studies on SNCA in large ADHD samples should focus on specified symptoms and traits e.g. attentional capacities or emotional dysregulation.

Shared genetic risk between verbal and visual spatial working memory deficiency of ADHD

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Objectives: Impaired working memory is thought to be a core feature of ADHD. The genetic architecture underlying it is complex. In the present study, we explored the genetic components contribute to the performance of both verbal and visual spatial working memory of ADHD.

Methods: In this study, two consecutive samples were recruited from a homogeneous Han background. After quality control, 800 samples with phenotype and covariate data were included in the first sample, whereas 877 samples were included in the second one. All participants received a comprehensive cognitive assessment. Verbal and visual spatial working memory were mainly assessed with Digit Span and Rey Complex Figure Test (RCFT) respectively. Genome-wide association study (GWAS) of verbal and visual spatial working memory were performed separately. Principle component analysis was used to extract common features from reverse digital span which assesses verbal working memory, and immediate structure and detail accuracy which assess visual working memory. Then using this principle component we performed association analyses on the single-marker, gene-based and polygenic level.

Results: Both SNP and gene level analyses yielded no significant results associated with verbal, visual spatial or the principle component after multiple comparison correction. GWAS identified several nominal significant loci, among which rs3829817 (uncorrected P value $4.053E-06$) for the principal component was located in zinc finger genes and repeats that expressed in brain germinal matrix. Based on the GWAS of the principle component from the two type of working memory in the first stage, the model of the polygenic risk score significantly predicted the principle component of working memory in the second stage (corrected P value 0.0012).

Conclusions: Our results emphasized the common genetic component to visual and verbal working memory and provided new evidence for the underlying genetic structure related to working memory deficiency in ADHD.

Topic: Neuroimaging

Aberrant developmental neuroanatomical changes associated with ADHD symptoms changes: a longitudinal image study of youths with ADHD

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Objectives: Atypical brain morphology that disrupts the cognitive and behavioral functions have been previously investigated in individuals with ADHD. However, it is unclear whether variation in developmental brain structural changes parallels ADHD symptoms changes, and whether deviations from typical brain development trajectories are associated with differential outcomes. Hence, this work aimed to identify the neural correlates of attentional problems and determine neonatal predictors of those neural correlates and attention problems.

Methods: The sample included 50 youths with DSM-IV ADHD (21 girls, 29 boys) and 63 typically developing (TD) youths without ADHD (28 girls, 35 boys). They received MRI and ADHD symptoms (by parent reports on the SNAP-IV) assessments at two-time points: ADHD, 1st scan: 11.0 ± 2.1 years old, 2nd scan: 16.8 ± 3.5 years, time latency: 4.5 ± 1.2 years; TD, 1st scan: 11.6 ± 3.7 years old; 2nd scan: 17.71 ± 3.22 years old, time latency: 4.8 ± 1.3 years. FreeSurfer was used to automatically process with the longitudinal stream of brain structure to extract reliable volume and cortical thickness estimates. Specifically, an unbiased within-subject template space and image were created using robust, inverse consistent registration. The linear mixed effects model was used to conduct longitudinal data analysis including gender, the first scan age, Full-IQ score, and duration time between two scans as covariates.

Results: Five developmental neuroanatomical changes that related to phenotypic variations were identified: the anterior to the medial corpus callosum, the right cerebellum cortex, the lateral orbitofrontal cortex/rostral middle frontal cortex/postcentral cortex, bilateral superior temporal cortex, and overall brain structure. For all the structural changes, ADHD youths showed significantly greater slopes of volume reduction than TD youths. Moreover, these developmental brain volume reductions were positively correlated with ADHD symptoms reduction (both inattention and hyperactivity-impulsivity symptoms) except only hyperactivity-impulsivity symptoms relating to changes of the anterior to medial corpus callosum and the bilateral superior temporal cortex. Lastly, the greater developmental overall brain reduction in ADHD was particularly demonstrated in girls with ADHD.

Conclusions: The findings of differential developmental changes of brain structures that correlate with ADHD core symptoms changes from childhood to late adolescence provide evidence of neural correlates for the developmental aspect of behavioral phenotype changes.

Structural covariance in internet gaming disorder with comorbid ADHD

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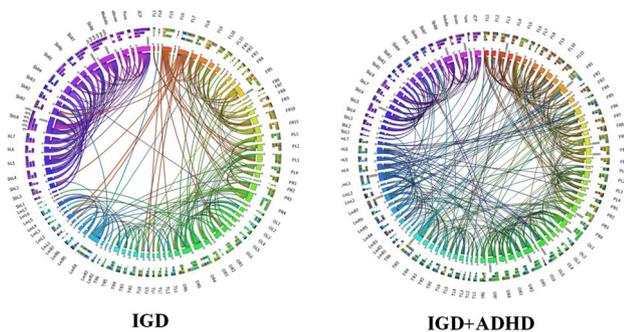
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Objectives: Internet gaming disorder (IGD), a type of addictive disorder in DSM-5, frequently associated with several disorders such as attention-deficit/hyperactivity disorder (ADHD). We explored properties of structural covariance in IGD subjects with or without ADHD comorbidity.

Methods: Forty-eight subjects with IGD only (mean age 21.1 ± 5.1) and 46 age-matched subjects IGD with ADHD (mean age 19.4 ± 4.0) were recruited by advertisements at psychiatric clinic in Chung Ang University Hospital. Chung Ang University Hospital Institutional Review Board approved all procedures. Mean score of Young's Internet Addiction Scale was 58.1 ± 10.2 in IGD only group, comparing 68.3 ± 11.8 in IGD with ADHD group. The severity of ADHD symptoms evaluated with the Korean version of Dupaul's ADHD rating scale showed significant difference between groups (mean 25.0 ± 9.9 vs. 11.4 ± 6.6 , respectively). T1-weighted images of 94 subjects (IGD: 48, IGD with ADHD: 46) were acquired with 3T MRI. Both cortical parcellation and subcortical segmentation were performed via Freesurfer 6.0 pipeline. Using normalized cortical thickness and intracranial volume-controlled subcortical volume in each subject, partial least squares regression analysis for each region of interest (ROI) was performed with the rest ROIs across each group. The permutation test was performed to get structural covariance matrix consisting of statistically significant, against null distribution, edges. Finally, group difference in covariance at each edge was acquired.

Results: IGD subjects with ADHD showed more complicated covariance network showing more between ROIs in different lobes and had a cluster consisting larger number of ROIs. Increased structural covariance of left insula with other brain regions is a characteristic for ADHD comorbidity.

Conclusions: Our results suggest that complicated structural covariance network is a characteristic feature in ADHD comorbidity in IGD. Circulograms of structural covariances.



Blunted opioid release after stimulant medication in adults with ADHD: a carfentanil-PET study

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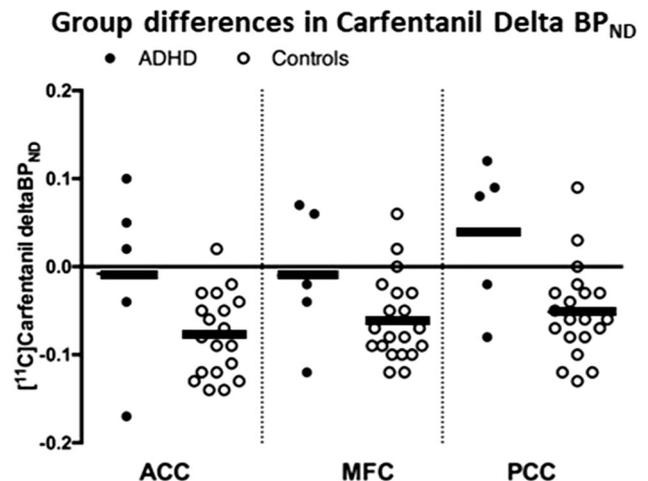
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Objectives: The established view is that psychostimulant medication acts via dopamine/norepinephrine (DA/NE) systems, which are abnormal in ADHD. We have recently shown, however, that in healthy adults, the stimulant dexamphetamine (d-AMPH) releases endogenous opioids in fronto-limbic regions. This raises the possibility that opioid systems may be involved in the mechanisms of action of stimulant medication and be abnormal in ADHD. This pilot study tested whether ADHD adults relative to healthy controls have abnormalities in stimulant-induced endogenous opioid release in fronto-limbic areas and in their baseline mu-opioid system.

Methods: Five medication-naïve and drug abuse free adult men with ADHD and 20 age and gender-matched healthy controls were scanned using positron emission tomography (PET) with [^{11}C] carfentanil, a selective mu-opioid receptor agonist PET radioligand, to investigate group differences in endogenous opioid tone at baseline and after a single oral challenge dose 3 h after 0.5 mg/kg d-AMPH.

Results: ADHD relative to healthy adults had reduced [^{11}C] Carfentanil binding potential at baseline in several frontal and cingulate regions. Repeated measures ANOVA showed that compared to controls, ADHD patients had reduced [^{11}C] Carfentanil binding potential in medial frontal and anterior and posterior cingulate regions after the stimulant dose relative to baseline, suggesting blunted stimulant-induced opioid release in regions of the mesolimbic reward system.

Conclusions: These preliminary findings indicate that abnormalities of the endogenous opioid system are linked to ADHD and their treatment response. If found in a larger group in association with clinical and neurocognitive impairments, it would change the pathomechanistic view of ADHD and of stimulant effects implicating a novel neurotransmitter system in both. A blunted endogenous opioid system could also be an alternative explanation for ADHD deficits in reward processing and motivation, co-mediated by the opioid system, and for their typically higher risk of substance abuse.



Sluggish cognitive tempo symptoms in ADHD may be associated with occipital compensatory mechanisms

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Objectives: The construct of Sluggish Cognitive Tempo (SCT) is characterized by daydreaming, mental confusion, staring blankly and hypoactivity. There is a lack of studies examining biological factors in relation to SCT.

Methods: The main goal of the current study was to compare functional magnetic resonance imaging (fMRI) and diffusion tensor imaging (DTI) findings between Sluggish Cognitive Tempo (SCT) cases comorbid with ADHD and typically developing controls (TD). In this study, 576 patients were screened from the outpatient clinic of the child and adolescent psychiatry department. Finally, 18 SCT cases comorbid with ADHD-combine presentation (ADHD-C), 24 SCT cases comorbid with ADHD-Inattentive presentation (ADHD-IA) and 24 TD were included. We applied tract-based spatial statistics to the DTI measures for obtaining fractional anisotropy (FA), axial, radial and mean diffusivity (AD, RD, MD) to explore white matter differences for the whole brain.

Results: Significant hyperactivity was detected during the Go task in the SCT and ADHD-C group when compared with the TD group in terms of fMRI findings. However, there was no significant difference in the SCT and ADHD-IA group compared to the TD group. Using tract-based spatial statistics to the DTI measures, we detected increased FA in the bilateral anterior and posterior limb of internal capsule, bilateral cerebral peduncle and the fornix comparing SCT and ADHD-IA with TD. Comparing SCT and ADHD-Combine presentation with TD, we did not find any differences for all DTI measures.

Conclusions: In our study, it was found that the posterior brain regions were more active when a task requiring attention was given to SCT and ADHD-C group. This activation in the posterior region is considered a compensatory mechanism for lifelong attention deficit symptoms. On the other hand, SCT and ADHD-IA group differed from TD group in terms of white matter structure. ADHD is a heterogeneous disorder with various clinic presentations, impairment domains, and biological traits. And, heterogeneous findings support that we need more homogenous groups to understand ADHD well. And, taking into account symptoms of SCT may help deep phenotyping.

Do hypo- and hyper-dopaminergic states simulate ADHD in healthy participants? Evidence from a pharmac-fMRI study

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Objectives: Pronounced impulsivity is a cardinal symptom of ADHD and can be seen as the need for immediate reward in contrary to delayed rewards. Reward delay reflects how much a person devalues a reward depending on the time span until it gets the reward. Steep delay discounting is considered a hallmark deficit of ADHD. To systematically look at the effect of reward and a hypothesized deficit in the mesolimbic dopaminergic system, we wanted to pharmacologically challenge the reward system with LDOPA, a dopamine precursor, and amisulpride, a D2/D3-receptor antagonist while participants underwent a delay discounting task.

Methods: 45 healthy volunteers were scanned three times with a 3 Tesla Siemens-TRIO scanner. 75 min before each scanning session they took 200 mg amisulpride (D2/3-antagonist) or 100 mg LDOPA + 25 mg Carbidopa or placebo. They completed a previously published delay discounting fMRI task. Participants had to make 40 consecutive decisions like “Would you prefer 10 € now or 11.50 € in 2 weeks”, representing immediate versus delayed rewards.

Results: During the amisulpride and the LDOPA session, there was a highly significant effect of a lower BOLD-response in the striatum and other parts of the mesolimbic system than in the placebo session.

Conclusions: Pharmacological challenge with LDOPA leads to a diminished reward signal, mainly in the striatum. The same direction of effect was found for amisulpride in comparison to placebo. This argues against a step-wise increase activation following the hypothetical dopamine concentration amisulpride < placebo < LDOPA. Instead it underlines an inverted U-shape in these young volunteers. Both LDOPA and amisulpride lead to an effect in the same direction, a decrease in immediate versus delayed reward. In summary, both hypo- as well as hyperdopaminergic states converge to a striatal hypoactivation resembling ADHD.

Methylphenidate and atomoxetine normalise fronto-parietal activation in ADHD during sustained attention

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Objectives: Problems with sustained attention in ADHD are evident in performance scores and functional Magnetic Resonance Imaging (fMRI) correlates. Methylphenidate and atomoxetine are widely used to improve inattention symptoms and have been shown to improve attention performance. This is the first fMRI study testing the comparative neurofunctional effects of methylphenidate and atomoxetine during performance of a sustained attention task in ADHD adolescents.

Methods: Fourteen medication-naïve ADHD youths (10–17 years) and 27 age-matched healthy controls performed a parametric sustained attention/vigilance task in a 3T MRI scanner. The task required to respond to a visual stimulus presented after varying long and short delays. Patients were scanned in a double-blind, placebo-controlled, randomised crossover design under a single dose of either placebo (Vitamin C, 50 mg), methylphenidate (Equasym, 0.3 mg/kg), or atomoxetine (Strattera, 1 mg/kg). Controls were scanned once, unmedicated, and compared to patients under each drug condition to test for potential normalisation effects of each drug. fMRI data were analysed using non-parametric data analysis in XBAM (www.brainmap.co.uk).

Results: ADHD patients under placebo were impaired in task performance relative to controls which was normalised with methylphenidate but not atomoxetine. ADHD patients under placebo relative to controls had reduced activation in predominantly right-hemispheric dorsolateral/inferior prefrontal, posterior cingulate/pre-cuneus, inferior parietal, and striato-thalamic areas. When patients were compared to controls under methylphenidate and atomoxetine the differences were no longer observed.

Conclusions: This study shows shared normalisation effects of methylphenidate and atomoxetine on fronto-parietal brain dysfunction in ADHD during sustained attention. The findings extend previous findings of shared normalisation effects on inferior frontal dysfunction during cognitive control and timing by showing more widespread shared normalisation effects on typical fronto-parietal and striato-thalamic regions mediating sustained attention. The shared

normalisation effects of methylphenidate and atomoxetine on attention network dysfunction in ADHD may underlie their clinical efficacy in improving inattention symptoms in ADHD.

Neurobiology of ADHD: the state of art

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Objectives: ADHD involves a persistent pattern of inattention and/or hyperactivity-impulsivity that is associated with impairment in at least two domains of functioning, such as at school and in the home (American Psychiatric Association 2013). There are many theories about the neurobiology of ADHD currently in the literature, and it is mainly considered that the disease is caused by inappropriate connection of neural network. This review aim to discuss the findings of atypical brain connectivity in subjects with ADHD and integrate findings from functional connectivity studies with those from studies on structural connectivity.

Methods: Literature review of ADHD neurobiology published at pubmed.

Results: While changes in fronto-striatal networks supporting executive and reward functions in ADHD have often been reported, recent neuroimaging findings point to broader functional alterations in the disorder. Specifically, functional magnetic resonance imaging investigations have suggested that altered executive and reward processes in ADHD are related to deregulations in brains networks encompassing frontal, parietal, and occipital cortices as well as the striatum in ADHD. Studies demonstrate connectivity disturbances in ADHD that implicate attention control networks and default network, with significant right-lateralization of connectivity abnormalities. Collectively, these studies suggest that the core symptoms of ADHD might derive from dysregulated modulation of cortical plasticity in the developing brain, resulting in altered patterns of cortical connectivity that might persist into adulthood.

Conclusions: The new etiological models of ADHD shift the focus of the assumed pathology from regional brain abnormalities to dysfunctions in distributed network organization and there is growing consensus that ADHD is associated with abnormal function of diffuse brain networks. Moving toward a neural systems concept of ADHD and aiming for a better understanding of how cortical networks are specifically altered may be the key for better understanding ADHD.

Early sexual dimorphism in brain development trajectory among preschoolers with ADHD

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Objectives: Neuroimaging studies of ADHD suggest a pattern of sexual dimorphism, including sex-specific regional cortical differences. Despite emergence of most ADHD symptoms during the preschool years, little is known about the trajectory of brain development among young children with ADHD, including whether the sex differences observed in older individuals are evident at this age.

Methods: Participants included 112 children—65 with ADHD (40 male) and 47 typically developing (TD, 24 male), ages 48–71 months at baseline visit. Subsequent visits were scheduled annually for 3 years—1 visit (n = 109), 2 visits (n = 83), 3 visits (n = 68), 4 visits (n = 1). ADHD was diagnosed using modified DSM-IV criteria; all

participants were screened for language and mood disorders. Scans were obtained on a 3.0T Philips GyroscanNT; MPRAGE images were used for volumetric assessment within Freesurfer. A series of multi-level (mixed) linear regression models were used to examine changes in total cerebral volume (TCV) over time (age in months) between groups, using linear and quadratic terms, as well as interactions between the quadratic term and diagnostic group. All models included SES, race, and medication use (stimulants: 6%, non-stimulants: 5%) as covariates.

Results: Older age and male sex were associated with greater TCV, while lower SES and ADHD were associated with lower TCV (all $p < .05$). The (quadratic) age-by-diagnosis interaction on TCV was significant ($p < .05$); however, when trajectories were examined separately within sex, the significant age-by-diagnosis effect on TCV was observed only in girls ($p < .05$). No significant effects of race or medications were observed.

Conclusions: Between ages 4 and 7 years, “typical” cerebral growth is slowed in girls (but not boys) with ADHD. Among preschoolers with ADHD, cerebral growth trajectory may be a sensitive biomarker of anomalous brain development in earlier maturing girls. In boys, who mature later, slowing of cerebral growth as a biomarker of ADHD likely occurs after age 7.

Fronto-striatal glutamatergic dysregulation in adult patients with ADHD: a 1H-MR spectroscopy study

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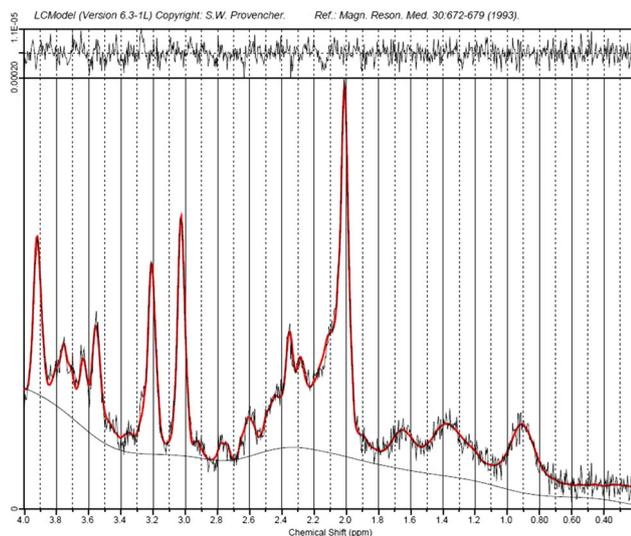
Objectives: ADHD is closely linked to the dysregulation of dopaminergic and noradrenergic neurotransmission in the fronto-striatal neural network, including the anterior cingulate cortex (ACC) and the nucleus accumbens. Additionally, increasing evidence supports the involvement of the glutamatergic system in the pathophysiology of ADHD; e.g. impulsivity, a core symptom in patients with ADHD, has been repeatedly associated with glutamatergic neuro-transmission (Ende et al. 2015, Miller et al. 2014). Also, pharmacological treatment of ADHD has been shown to reduce glutamate levels in the prefrontal cortex (Spencer et al. 2014).

Methods: 29 adult patients with ADHD [11 female, mean age 31.5 years (SD 8.3)] and 31 healthy controls [14 female, mean age 30.1 years (SD 7.79)] were included in our study. Clinical diagnoses were verified with the Diagnostic Interview for ADHD in Adults (DIVA 2.0). All patients were off medication at least 24 h prior to scanning. 1H-MR spectroscopy at 3T (PRESS, TE 32 ms) was applied to investigate in vivo concentrations of glutamate and glutamate/glutamine (Glx) in the rostral ACC (BA 24) and the nucleus accumbens. For glutamate and Glx a corrected significance level of $p < .025$ ($.05/2$) for each VOI was assumed.

Results: In the ACC, Glx levels were significantly higher in ($t(58) = -2.53$, $p = .014$), whereas differences in glutamate ($t(58) = -1.92$, $p = .060$) did not reach statistical significance. In the nucleus accumbens, glutamate ($t(58) = 2.62$, $p = .011$) and Glx ($t(58) = 2.45$, $p = .017$) were significantly decreased in patients with ADHD.

Conclusions: We were able to reproduce our previous finding of increased levels of Glx in the ACC (Bauer et al. 2016). Interestingly, opposing changes of glutamate in frontal and striatal brain areas in patients with ADHD might be related to the differential frontostriatal dopaminergic neurotransmission.

Representative spectrum in one ADHD patient in the ACC (PRESS, TE 32 ms).



Attentional lapses and ADHD: amplitude variability over trials in hemodynamic responses in the posterior default mode network during Go/No-Go task performance

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Objectives: Attentional lapses are among the most consistently found cognitive abnormalities in ADHD. Such lapses typically are operationalized in laboratory testing as intra-individual reaction time variability (IIVRT) on speeded motor response tasks such as of inhibitory control (suppressing prepotent motor response). IIVRT has been hypothesized to stem from spontaneous brain activity of low frequency fluctuations of the intrinsic default mode network (DMN). Indeed, prior neuroimaging studies have linked high ADHD IIVRT to hemodynamic responses in the anterior DMN regions. However, the posterior regions of the DMN such as precuneus and posterior cingulate cortex were originally identified as especially important for the down-regulation of the low-frequency resting-state brain. As such, these regions represent a more likely, logical neurobiological correlate for ADHD IIVRT. This study approached the identification of IIVRT-related regions in ADHD using a different approach than prior research using fMRI data.

Methods: The sample included ADHD ($n = 57$) and non-ADHD adolescents ($n = 56$) between 12 and 19 years old who performed an attentionally-demanding Go/No-Go task. Independent Component Analysis identified canonical networks in the brain including DMN.

Using component timecourses, single-trial estimates of network signal change to Go/No-Go task events were extracted and their variability quantified. Between group differences in this hemodynamic variability, in Go/No-Go task frequent 'X' Go stimuli reaction time variability, and the relationship of these two factors were examined.

Results: Six independent components represented regions within the DMN, while five of these involved the posterior DMN. The adolescents with ADHD had higher levels of hemodynamic response variability in posterior DMN regions than the healthy controls.

Conclusions: The results show that inconsistency of neural responses to individual attention-eliciting stimuli is specifically found in the posterior DMN in ADHD. This suggests that investigating trial-to-trial brain function variability in ADHD provides information beyond that detectable through analyses of behavioral data.

Alterations of cerebral perfusion and functional brain connectivity in medication-naïve male adults with ADHD

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Objectives: Functional brain abnormalities, including altered cerebral perfusion and functional connectivities, have been illustrated in adults with ADHD. The present study attempted to explore the alterations of cerebral blood flow (CBF) and resting-state functional connectivity (RSFC) simultaneously to understand the neural mechanisms for adults with ADHD complementarily.

Methods: Resting state arterial spin labeling (ASL) and blood oxygenation level dependent (BOLD) magnetic resonance imaging (MRI) data were acquired for 69 male aADHD and 69 matched healthy controls (HCs). The altered CBFs associated with aADHD were explored based on both categorical (aADHD vs. HCs) and dimensional (correlation with aADHD core symptoms) perspectives. Further, the seed-based RSFCs analyses were developed for the regions showing significant alterations of CBF.

Results: Significantly decreased CBFs in the large-scale resting state networks regions (e.g. frontoparietal network, default mode network) were indicated in ADHD compared with HCs. The correlation analyses indicated that the hypoperfusion in left putamen/global pallidum and left amygdala/hippocampus were correlated with ADHD inattentive and total symptoms, respectively. Further, decreased negative functional connectivity between left amygdala and bilateral supplementary motor area, bilateral superior frontal gyrus and left medial frontal gyrus were found in adults with ADHD.

Conclusions: The present findings suggested alterations of both cerebral perfusion and functional connectivity for the left amygdala in ADHD. The combination of CBF and RSFCs may help to interpret the neuropathogenesis of ADHD more comprehensively.

Alterations of cerebral perfusion and functional brain connectivity in medication-naïve male adults with attention-deficit/hyperactivity disorder.

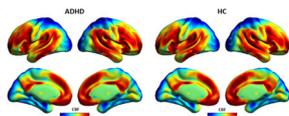


Fig. 1 Spatial distribution maps of CBF at the group level. For each group (i.e., ADHD or HC), the individual CBF maps were normalized to z-scores and then averaged across subjects to generate a group-level map. CBF, cerebral blood flow; HC, healthy controls; ADHD, attention-deficit/hyperactivity disorder.

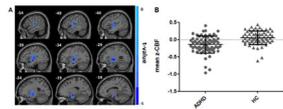


Fig. 2 Group differences in CBF between ADHD patients and healthy controls. The independent two sample t-test was conducted between the ADHD group and the healthy control group. All results were corrected for multiple comparisons to a significant level of $p < 0.05$ through a permutation test (10,000 permutations, individual voxel $p < 0.01$). The cold colors denote significantly decreased CBF in the ADHD patients. Abbreviations: CBF, cerebral blood flow; HC, healthy controls; ADHD, attention-deficit/hyperactivity disorder.

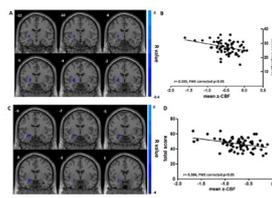


Fig. 3 The correlation between regions of the group differences (ADHD vs. HC) in CBF and ADHD core symptoms. The correlation analysis was performed within ADHD patients with inattention, hyperactivity/impulsivity, and total symptom scores measured by ADHD RS-IV. All results were corrected for multiple comparisons to a significant level of $p < 0.05$ through a permutation test (10,000 permutations, individual voxel $p < 0.01$). Abbreviations: CBF, cerebral blood flow.

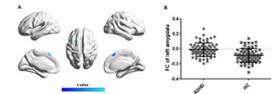


Fig. 4 Between-group comparisons for the seed-based functional connectivity with the seeds of left amygdala. The independent two sample t-test was conducted between the ADHD group and the healthy control group. All results were corrected for multiple comparisons to a significant level of $p < 0.05$ through a permutation test (10,000 permutations, individual voxel $p < 0.01$). Abbreviations: FC, functional connectivity.

Prediction of ADHD based on subcortical brain regions and subdivisions of the hippocampus and amygdala

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Objectives: The diagnostic process to detect ADHD is still based on the evaluation of symptoms development and severity as well as on behavioral observations. Imaging studies using structural magnetic resonance imaging (MRI) revealed morphological alterations of subcortical brain regions (Hoogman et al. 2017) and diagnostic potential to distinguish patients with ADHD and controls (Qureshi et al. 2016). Here, the aim of this study was to predict ADHD using structural MRI and volumes of subcortical brain regions and subfields of the hippocampus and amygdala.

Methods: Twenty-two patients (mean age \pm SD: 30.7 ± 10.4 ; f/m: 15/7) and 21 controls (31.2 ± 10.6 ; 14/7) were measured once with 1.5 Tesla MRI. We used FreeSurfer software version 6.0 (<https://fsl.fmrib.ox.ac.uk/fsl>) to generate subcortical volumes as well as detailed segmentation of the hippocampus and amygdala (Iglesias et al. 2015; Saygin et al. 2017). The statistical software “R” and “randomForest” was used to assess most informative sets of predictive features from subcortical regions and subfields in a fivefold cross-validation (CV) approach.

Results: Considering subcortical regions without sub-regional assortment, a maximal accuracy of 0.58 (± 0.12) for the validation sets across repeats could be achieved. Implementing hippocampus subfields enabled a higher accuracy of 0.64 (± 0.20) and nuclei of the amygdala yielded the best accuracy for the validation sets across repeats 0.77 (± 0.17). Combining amygdala and hippocampal subfields did not increase accuracy (0.74). The most informative predictors were the left presubiculum head and right hippocampal tail as well as the left cortical and right central nucleus of the amygdala.

Conclusions: Only by using subfields of the hippocampus and especially the amygdala, we found substantially predictive accuracy of above 0.7 to distinguish between ADHD and controls. This approach potentially amplify identification of feature (i.e. brain region) implicated in ADHD pathophysiology. Our finding implicates abnormal volumetric patterns of subcortical regions in ADHD (Plessen et al. 2006) and underline the importance of predictive

analytics that are based on subcortical structures, partitioned according to functional units.

Effect of atomoxetine hydrochloride on working memory in children with ADHD: a functional near-infrared spectroscopy study

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Objectives: Previous studies have found that functional near-infrared spectroscopy (fNIRS) can be used to assess activation of the prefrontal cortex (PFC) and significant deficiencies were found in children’s working memory with attention deficit hyperactivity disorder (ADHD). This study will investigate the effect of atomoxetine hydrochloride (ATX) on activation of the PFC in children with ADHD during working memory tasks.

Methods: We recruited 8 children with ADHD who were drug-naïve. Functional blood oxygen were recorded by using fNIRS during N-back task. Clinical symptoms were assessed by parent’s Swanson, Nolan, and Pelham-IV rating scales (SNAP-IV) at the same time. After 8 weeks of treatment with ATX, the children were evaluated by fNIRS and SNAP-IV again. Statistical methods were used to compare fNIRS and SNAP-IV between off- and on-ATX conditions.

Results: Based on performance data, children showed a higher accuracy, a lower omission error and commission error during N-back task after treatment with ATX. The hemodynamic changes between off-ATX and on-ATX condition suggest that high-level activations in channel 5, 36, 38 were found in children with on-ATX condition. The associated channels located in FPC and DLPFC. And enhanced trends were also found in channel 7, 10, 12, 17, 48. Rating-Scale Scores: In comparison, children with off-ATX condition showed relatively low inattention scores, hyperactivity scores, and total scores of SNAP-IV after treatment. The mean value of inattention scores, hyperactivity scores, and total scores were 23.6 ± 1.5 , 18.7 ± 1.8 , 56.8 ± 4.8 respectively, while after treatment scores were 16.8 ± 1.3 , 15.5 ± 1.4 , 43.8 ± 3.2 . These values were statistically significant different.

Conclusions: ATX can improve the core symptoms and executive function of children with ADHD. fNIRS shows to be a helpful tool for identifying the effects of ATX on children.

ADHD traits in general population: white matter alterations and ADHD related polygenic risk

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Objectives: ADHD symptoms are often viewed as a continuum in the general population. However, the underlying connection between ADHD traits in general population and the clinical ADHD diagnosis remains unclear. The current study aims to explore the relationships between ADHD traits in the general population, white matter features of the brain and polygenic risk for ADHD.

Methods: A total of 1190 healthy adolescents (all aged 14 years, 574 males and 616 females) were recruited across 8 European cities via the IMAGEN consortium1, see <https://imagen-europe.com/#>. For each individual, three different indicators were calculated. (1) ADHD

traits were assessed with the Strength and difficulty questionnaire (SDQ) (parent rating). (2) Mean fractional anisotropy (FA, which represents the white matter integrity) was extracted in candidate regions of interest (left and right internal capsule, left and right anterior corona radiata, genu/body/splenium of corpus callosum) using masks made from the ICBM-DTI template. (3) Individual polygenic risk scores (PRS) for ADHD risk were calculated in PRSice software using summary statistics from the psychiatric genomics consortium (PGC) (<http://www.med.unc.edu/pgc/>) 2.3. To study the correlation between ADHD traits, FA values of our regions of interest and PRS for ADHD risk, we performed linear regression models in R (<https://www.r-project.org/>), correcting for sex, scanning sites and first 4 components from MDS.

Results: We found that (1) The mean FA of the left and right Internal Capsule (IC) were significantly negatively associated with ADHD traits in the general population, which means lower FA is associated with higher ADHD scores in SDQ ($p = 0.00061$ and 0.0038 , respectively). (2) Mean FA of the left and right IC were found nominally associated with polygenic risk of ADHD ($p = 0.036$ and 0.00698 , respectively), but these did not survive Bonferroni correction.

Conclusions: The white matter features of the internal capsule, which has been repeatedly shown to be involved in the pathophysiology of ADHD, is related to ADHD traits in the general population. This finding further supports the hypothesis of shared underlying mechanisms of ADHD symptoms in clinically diagnosed patients and in the population.

The resting-state baseline index of degree centrality predicts long-term therapeutic response to atomoxetine in children with ADHD

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Objectives: This study was aimed to explore the characteristics of resting-state brain functions at baseline to predict long-term (3 months) therapeutic response to atomoxetine treatment in children with ADHD.

Methods: We calculated the degree centrality (DC) on 38 ADHD children followed by atomoxetine treatment and 30 healthy controls using resting-state functional magnetic resonance imaging (fMRI) data. For all ADHD children, scores of the ADHD Rating Scale IV Parent Version (ADHD RS-IV) were reported by their parents at the baseline when take fMRI scanning and after 12 weeks atomoxetine treatment. Two sample T-test between ADHD group and healthy controls and correlation analyses between symptoms improvements and DC in ADHD group were performed. All results were corrected for multiple comparisons using Gaussian Random Field (GRF) theory (minimal $Z > 2.3$, cluster significance: $p < 0.05$).

Results: The DC values in the right precentral and postcentral ($t = -4.60$, $p < 0.05$) and left postcentral ($t = -4.16$, $p < 0.05$) in ADHD were lower than those in healthy controls (Figure 1a). As for the correlation analysis, there was a positive correlation between the reductions in inattention symptoms and the DC in the left angular ($p < 0.05$), and negative correlations in right precentral and postcentral ($p < 0.05$), left postcentral ($p < 0.05$) and left inferior frontal gyrus ($p < 0.05$) in ADHD (Figure 1b). Reductions in hyperactivity/impulsivity symptoms were positively correlated with DC in bilateral medial frontal gyrus ($p < 0.05$), left angular ($p < 0.05$) and left cerebellum posterior lobe ($p < 0.05$), and negatively correlated in

bilateral precentral and postcentral ($p < 0.05$), right superior temporal gyrus ($p < 0.05$) and insula ($p < 0.05$) (Figure 1c, d).

Conclusions: The brain functions (i.e. DC value) at baseline may be a predictor for long-term therapeutic response to atomoxetine in children with ADHD.

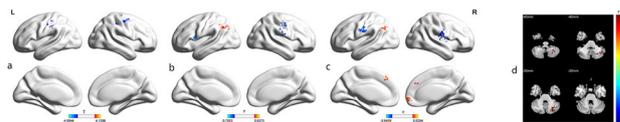


Fig. 3 .

Topic: Non-pharmacological treatment

Organizational skills training or neuro-feedback, combined with pharmacotherapy in the treatment of school-aged children with ADHD

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Objectives: To assess the efficacy of use of either behavioral therapy (organization skills training, OST) or cognitive neuro-feedback training, (NFT) as interventional modality combined with medication for improving the core symptoms of ADHD and its co-morbid conduct problem among school aged children with ADHD.

Methods: Participants were 45 school aged children (age range from 6 to 10 years) with diagnosis of ADHD according to DSM-5. Children were recruited from Alexandria University Children Hospital Behavioral Clinic, Egypt and they were randomly allocated into 3 groups; group1: OST and MED ($n = 15$). OST was in the form of Clinic-based sessions individually applied including modeling, rehearsal, and point systems or token economies; group 2: NFT and MED ($n = 15$). Children were subjected to a standard protocol of inhibiting θ amplitude (4–8 Hz), muscle movement (43–59 Hz), and rewarding $\beta 1$ (15–21 Hz) plus θ/β ratio training either on CZ or C3. Pre and post assessment after 3-month duration of intervention using Arabic form of Conners' Parent Rating Scale short form (CPRS-48). All children received 24 sessions either once or twice per week; group 3: MED only ($n = 15$) served as control group. All studied children were receiving atomoxetine (ATX).

Results: The three groups were not significantly different their demographic characteristics. Combined OST and MED showed significant decrease of hyperactivity/impulsivity ($p = 0.011$) and item hyperactivity index ($p = 0.041$) and co-morbid conduct problem ($p = 0.030$) scores. However, no similar significant difference was found in inattention scores on post interventional assessment. No statistical significant difference was found among the group 2 (NFT and MED) and group 3 (MED only), either on ADHD core symptoms or its co-morbid conduct problem.

Conclusions: The combination of OST and MED is significantly effective intervention in improving impulsivity and hyperactivity, and comorbid conduct problems among school-aged children with ADHD compared to combination of NFT with ATX, or ATX only.

fNIRS-based neurofeedback training normalizes brain functioning in children with ADHD

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Objectives: ADHD in children is associated with abnormal brain functioning measured using electroencephalography (EEG) or functional near-infrared spectroscopy (fNIRS), for instance. Abnormalities comprise an underactivation of prefrontal cortical areas as, for example, evidenced by a reduced concentration of oxygenated haemoglobin and an anteriorisation of the P300 brain electrical field under NoGo conditions. In aiming to teach patients self-regulation skills allowing them to regulate brain activity, neurofeedback trainings (NF) specifically target these abnormalities. Effective NF should therefore result in a reduction of ADHD symptoms as well as in a normalisation of brain activity.

Methods: N = 20 children with ADHD participated in 15 sessions of an fNIRS-based NF of the dorsolateral prefrontal cortex (n = 12) or an electromyogram (EMG)-based control training (n = 8). They trained in a virtual reality classroom visualised through a head-mounted display. Besides further measures, parents and teachers reported about changes in ADHD symptomatology on the Conners 3 while children completed a Go/NoGo-Task during a combined fNIRS-EEG-measurement before and after the 15 training sessions.

Results: Parents reported significant symptom reductions through the training in both conditions while teachers reported reductions on trend level only. Children's response inhibition (i.e. commission errors in the Go/NoGo-Task) did neither improve in the fNIRS -, nor in the EMG-condition. Inhibition-associated brain activity normalised in the fNIRS-condition only, manifesting itself in an increasing frontal field component of the NoGo-P300, for instance.

Conclusions: The results suggest that both, fNIRS-based NF and an EMG-based control training effectively reduced ADHD symptoms in children with substantially larger effects reported by parents, however. Additionally, fNIRS-based NF, but not an EMG-based control training, effectively normalised brain functioning. This normalisation did however not extend to the children's performance during the Go/NoGo-Task. Implications and directions for future research will be discussed. Please note that this is an ongoing study and results may therefore change as the sample size increases.

Mediterranean diet and ADHD: a cross sectional study

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Objectives: There are several studies that relate ADHD to environmental factors, one of the most important environmental factors is nutrition. The Mediterranean diet is possibly one of the diets with the most beneficial effects. Our intention is to study the relationship between ADHD and the Mediterranean diet.

Methods: A total of 89 children and adolescents (41 with diagnosed ADHD and 48 controls) were studied in an observation case-control study. Anthropometry, nutritional status, adherence to a Mediterranean diet with the Mediterranean Diet Quality Test for Children and Adolescents (KIDMED Index).

Results: There were statistically significant differences between individuals in case group and control group when analysing KidMed's final score ($P = 0.004$), and when analysing those cases that obtained a higher than 7 score (indicative of a healthy diet) ($P = 0.046$). When

itemizing the analysis of the KidMed questionnaire, statistically significant differences were observed in fish ($P = 0.001$), cereal ($P = 0.002$), no breakfast ($P = 0.007$), and commercially baked goods ($P = 0.01$) consumption.

Conclusions: We found a positive relationship between a lower adherence to the Mediterranean diet and ADHD diagnoses. The current findings suggest that certain dietary habits may play a role in ADHD development, even though further work is required to investigate causality and to determine if dietary manipulation could reverse the symptoms of ADHD.

When parents refuse psychopharmacotherapy for ADHD in their children: mindfulness-based intervention as an add-on to behavior therapy in an 8 year boy with ADHD

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Objectives: The effectiveness of current care-as-usual (psychoeducation, pharmacotherapy and/or cognitive-behavioural therapy) for ADHD is limited and a substantial subgroup of children with ADHD has remaining symptoms and impairment. Research has shown positive effects of Mindfulness-Based Interventions (MBI) for children and adolescents with ADHD.

Methods: A case report presentation of MBI as an add-on to behavior therapy in an 8 year old boy with ADHD whose mother refused pharmacotherapy.

Results: The boy was referred for persistent difficulties with inattention, hyperactivity and impulsivity that were negatively impacting his school work, family and peer interactions. The diagnosis of ADHD with no comorbid disorder was established following multi-disciplinary assessment (child and adolescent psychiatrist, clinical psychologist, speech and education specialist, EEG and neuropediatrician). The mother refused pharmacotherapy and behavior therapy (BT) was started. BT partially reduced child conduct problems. MBI as an add-on to behavior therapy was applied and yielded positive results on ADHD symptoms and child overall functioning.

Conclusions: Mindfulness-Based Interventions (MBI) as add-on to behavior therapy may be effective in children with ADHD. However, randomized and controlled (clinical) trials with large samples, standardized interventions, objective measures, and that are generalizable outside the intervention context are needed.

Intervention for executive functions and self-regulation in the classroom context reduces indicators of inattention and hyperactivity in elementary school children

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Objectives: Impairments in Executive Functions (EF) are present in several neurodevelopmental disorders, such as ADHD, and are related to low academic success and professional underachievement. The aim of this study is to verify the effects of an intervention program in EF and self-regulation on the behavioral profile (general behavioral

problems and those associated with inattention/hyperactivity and competences), reported by parents and teachers in elementary school children.

Methods: A total of 149 children, between 6 and 9 years old, regularly enrolled between 1^o and 3^o years of Elementary School I (ES I), in São Paulo downtown—Brazil, their parents or guardians and the classroom teachers has participated. The children were divided into two groups: Experimental Group (EG), which participated in the Intervention Program in EF and Self-Regulation (PIAFEx) and Control Group (CG), which did not take part on the intervention. The results of the Child Behavior Checklist ages 6–18 (CBCL/6–18); Teacher Report Form for ages 6–18 (TRF/6–18) and Executive functioning, regulation and delay aversion difficulties Inventory (IFERA-I) were compared before and after the intervention. After using the PIAFEx in the classroom, for 4 months, tests were performed comparing the means for independent samples, analysis of variance (Pre X Post separated by school year) and also the Post–Pre difference, called “gains”, comparing the experimental and control groups, over the 3 years studied.

Results: In the IFERA-I analyzes, answered by the teachers, there is a reduction of problems in the EG, as compared to the CG, for the Working Memory index ($p = 0.056$). When comparing school years separately, there was a reduction in the first year for Delay aversion index ($p < 0.001$), for the second year there was a reduction of problems in the EG compared to the CG for the Inhibitory Control Index ($p = 0.037$); Working Memory ($p < 0.001$); Flexibility ($p < 0.001$), Delay aversion ($p = 0.067$) and Regulation ($p = 0.024$) and for the 3rd year, the differences were Working Memory ($p = 0.082$); Flexibility ($p = 0.008$) and Delay aversion ($p < 0.001$). For CBCL, it was observed a reduction in the Isolation indicators ($p = 0.008$), especially for the 3rd year, as well as attention problems ($p = 0.041$), behavior of breaking rules ($p = 0.008$) and aggressiveness ($p = 0.072$) for the first year.

Conclusions: The intervention promoted the development of EF skills and reduction of indicators of behavioral and emotional difficulties. These effects were different in relation to school years. In the initial grades, for example, there was a greater gain in basic skills such as attention and in the more advanced years (as in the 2nd and 3rd years) the improvement was more related to social interaction (as seen in CBCL). In the data obtained by the IFERA-I, CBCL and TRF tests, it was observed that the higher the score of the indicators of problems reported by parents and teachers, the lower the score in the applied neuropsychological tests. Thus, intervention program was effective in reducing behavioral difficulties and in improving cognitive performance. This study has received financial support from Programa de Excelência Acadêmica (Proex), Process no. 0653/2018 of the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior—Brasil (CAPES)—Financing Code 001. It has also received financial resources from Fundo Mackenzie de Pesquisa (MackPesquisa) da Universidade Presbiteriana Mackenzie.

Dietary intervention as additive option in ADHD therapy

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Objectives: The influence of food intake on the behavior in children with ADHD has already been described in the early 20th century. Referring to the INCA study of Pelsser (2011), changing diet according to individual food intolerances lead to significant

improvement of ADHD symptoms in more than 2/3 of the patients. The objective of our study was, to evaluate whether a standardized oligoantigenic diet can be established as diagnostic tool to identify individual food intolerances in the context of ADHD symptoms in a blinded rating context.

Methods: Twentyfour children (18 m/6f; age 7–14 years) diagnosed with ADHD according to the ICD-10 were tested before and after 4 weeks of oligoantigenic diet. The children’s behavior was accessed by ADHD-Rating-Scale (ARS) parent report. Results under blinded and none blinded conditions were compared.

Results: Children showed a high compliance to the dietary intervention: 22 of 24 participants completed the 4 weeks of ambulant oligoantigenic diet. After diet, the ARS dropped significantly to about 60%. Blinded rating was not different to non-blinded condition. Significant reductions of the symptoms were found in subscales for inattention and for hyperactivity/impulsivity as confirmed to parent’s ratings. Patients who responded to the diet (60%), reported an improvement in quality of life.

Conclusions: Restricted elimination diet reduces symptoms in food sensitive children suffering from ADHD evaluated under blinded conditions. It can be used as diagnostic tool to identify individual foodintolerances in the context of ADHD.

Increased left inferior fronto-striatal activation during error monitoring after fMRI neurofeedback of right inferior frontal cortex in ADHD

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Objectives: ADHD is associated with poor self-control, underpinned by inferior fronto-striatal deficits including poor self-monitoring skills typically associated with reduced activation in error monitoring networks of left inferior frontal cortex (IFC), insula, cingulate and striato-thalamic regions. We showed previously that 11 runs of 8.5 min of real-time functional magnetic resonance imaging neurofeedback (fMRI-NF) of right IFC in 18 ADHD adolescents resulted in increased activation in rIFC as well as of entire fronto-cingulo-striatal networks, which were associated with clinical symptom improvement. Furthermore, rIFC-NF also increased activation in rIFC and parietal areas during successful Stop task performance. In this study, we investigated whether fMRI-NF would also improve the neural correlates of error monitoring during failed stop trials.

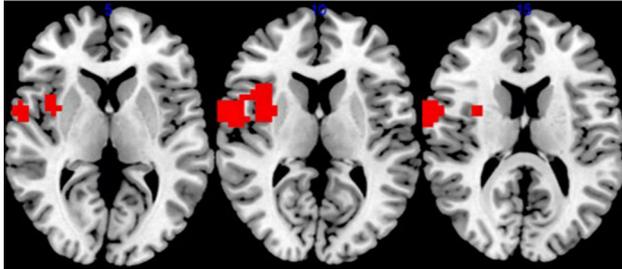
Methods: Twenty-seven boys with ADHD underwent fMRI-NF; 16 in the active group received fMRI-NF of the rIFC and 11 in the control group received fMRI-NF of the left parahippocampal gyrus. They performed a tracking fMRI Stop task before and after fMRI-NF. An ANOVA time (pre- vs. post-fMRI NF) x group (active vs. control) was applied to brain activation and performance to failed stop trials. We furthermore tested for correlations between brain changes and performance and clinical changes.

Results: The active relative to the control group showed increased activation in left IFC, insula and putamen during the failed stop trials, after relative to before fMRI-NF. This activation change was furthermore correlated with decreased post-error reaction times, indicating more efficient error monitoring, and trend-wise with decreased clinical symptoms.

Conclusions: fMRI-NF of rIFC improved performance and activation of left-hemispheric IFC-insular-striatal regions during error monitoring in association with clinical symptom improvement. The findings show that rIFC-NF of rIFC has more widespread upregulation effects—not limited to right IFC—that extend to contralateral

fronto-insular-striatal areas of error monitoring, which have previously been shown to be upregulated with stimulant medication. Change in error monitoring related activity after fMRI neurofeedback in ADHD.

Increased activity after fMRI neurofeedback



Left inferior frontal cortex, insula, putamen, precentral gyrus

FocusLocus: management gaming system for educational achievement and social inclusion for ADHD

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Objectives: Design of the study, pre-post evaluation metrics and description of participants (age, gender, IQ and ADHD symptoms).

Methods: Participants were recruited from Hospital Sant Joan de Déu (HSJD), Centre de Salut Mental Infantil i Juvenil (CSMIJ) from Mollet and from Vilanova. Clinical questionnaires were used for the pre-evaluation (ADHD RS IV, Conners 3, Brief 2, CBCL, CHIP-CE/PRF, SCARED, SCQ—A/B, YSR and CDI) and standardized tests to evaluate children (K-SADS, CGI, CGAS, WISC-V, CPT-3, ENFEN and CANTAB). Before the study began five participants withdraw from the study and currently during the study ten dropped out. The FocusLocus intervention has been implemented in two modalities: Virtual World Management (VWM) and Multisensory Mixed Reality (MMR).

Results: The pilot recruited children ($n = 75$) with ADHD diagnosis following inclusion criteria (36% inattentive subtype; 3% hyperactive subtype and 61% combined). Participants (75% boys) aged between 8 and 14 years old (mean age = 10.1; $SD = 1.83$) and with a mean IQ of 94.6. Participants were pseudo-randomly assigned into four active groups (A, B, C and D) without pharmacological treatment and in one control group (E) following their Treatment As Usual (TAU).

Conclusions: The study is not finished yet; post-evaluations are currently taking place at HSJD using clinical questionnaires and standardized tests. More work has to be done to determine the results of FocusLocus cognitive training intervention.

Cognitive-behavioral group therapy for ADHD inattentive type: a pilot study of a new treatment protocol

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Objectives: Even though ADHD is a heterogeneous condition with three different clinical presentations, patients with ADHD are often offered the same psychological treatment irrespective of presentation. This is a limitation as patients with primarily high levels of inattention (ADHD-I) struggle with different difficulties in daily life compared to those with the combined or hyperactive/impulsive presentation (e.g. procrastination and passivity). Treatments tailored to the specific needs of ADHD-I are therefore warranted. The aim of the current pilot study was to evaluate the feasibility, acceptability and preliminary effectiveness of a newly developed cognitive-behavioral therapy (CBT) protocol delivered in a group format and designed to address ADHD-I in adults.

Methods: In this open trial, 39 ADHD-I patients at four psychiatric outpatient care centers were included and received the CADDI protocol. The CBT for ADHD-I (CADDI) protocol includes skills to organize and initiate activity to counteract procrastination and passivity. Inattention is addressed with mindfulness training.

Results: Results showed that the treatment was well-received by participants and feasible. Reductions of moderate effect sizes were observed in symptoms of inattention as assessed by clinician rating and patient self-report. Reductions were also obtained in symptoms of depression, but no change was noted on measures of general anxiety, stress, functional impairment and quality of life. An increase, of a large effect size, was observed in mindful awareness, as a third measure of attention.

Conclusions: If the CADDI protocol proves effective in randomized controlled trials, it would contribute to widening the repertoire of psychological treatments for inattentive symptoms in ADHD.

VR.school: a virtual reality training for children and adolescents with ADHD

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Objectives: Traditional attention trainings for adolescents with ADHD are known to suffer from several issues such as static, poor and merely minimally engaging materials which may all decrease a patient's motivation and impede skill transfer. Here, virtual reality (VR) creates a loophole by introducing ecologically valid tasks with elements of gamification to better engage the individual. Thus far, however, VR has mainly been used for the assessment of ADHD. Hence, the main objective of the current pilot study was to evaluate a novel, fully immersive and interactive VR-based attention training "VR.school" in young patients with ADHD.

Methods: 8 adolescents with ADHD aged 12.8–18.0 years were trained in 12 sessions using a Head-Mounted-Display (HTC vive), full body tracking and hand-held controllers. The following four modules targeted specific attentional functions: (1) Whack-A-Mole to improve response inhibition, (2) Card sorting to increase focused attention, (3) Catching butterflies to train sustaining attention and (4) Hopscotch to improve working memory.

Results: Descriptive analyses show a considerable decrease (ranging from 18 to 37%) in core ADHD symptoms as assessed by self-report questionnaires. Similarly, attentional functions (vigilance, working

memory, response inhibition, focused attention) increased considerably (between 8 and 37%) post training.

Conclusions: Although these findings are preliminary, and a control group is currently being tested to evaluate the training's efficacy, it is safe to say that the program "VR.school" succeeded in engaging the patients and improved attentional functions. In general, VR-based trainings hold the promise of constituting particularly useful therapy tools for the generation of digital natives.

A qualitative analysis of parent' adaptive tasks and coping skills during the shared decision-making stimulant titration in ADHD care

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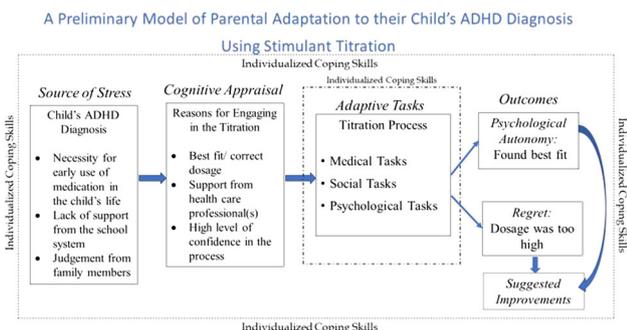
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Objectives: This study aimed to understand how parents' experience of titration contributes to the adaptive tasks and coping skills associated with their child's ADHD diagnoses. The adaptive tasks and coping skills were examined during the parent's participation in a stimulant titration trials using shared decision making. We adapted the individualized randomized placebo-controlled trials in the NIMH-funded Multimodal Treatment of Attention Deficit Hyperactivity Disorder (MTA) study to determine the "best dose". We replaced the expert approach of the MTA titration by a shared decision model, using the blinding not only as a way to control bias in assessing the effects of medication, but also as a way to transform the asymmetric relationship between a helpless family and a specialist with power and into a partnership between equals, which enables shared decision making.

Methods: The participants included 4 parents who have undergone 4–6 years before the titration and the shared decision process as a part of the ADHD treatment for their child, as well as 2 parents just after the titration process. We also completed an interview with the lead physician. The analysis was conducted via an adapted grounded theory approach.

Results: 12 themes related to the core emergent theme of titration. Themes that were representative of the titration experience were related to the participant's source of stress, cognitive appraisal of the ADHD diagnosis, adaptive tasks, coping skills, outcomes, and suggested improvements.

Conclusions: The results emphasize how titration has promoted adaptive tasks and coping skills which assisted participants to feel more in control and create a new sense of normalcy regarding their child's ADHD diagnosis. The results have important implications for improving the titration process.



Two-year follow-up from baseline of the AIMAC randomised controlled trial: does treatment of mothers in multigenerational ADHD also help children with ADHD in the long term?

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Objectives: ADHD often affects multiple generations in one family. Studies suggest that children of parents who also have a diagnosis of ADHD benefit less from treatment, since parental ADHD symptoms can interfere with the implementation of the intervention. Our two-group randomised controlled trial examined whether targeting maternal ADHD improves the efficacy of parent-child training (PCT) for symptoms of ADHD and oppositional defiant disorder (ODD) in the child. We report on follow-up data 2 years from baseline.

Methods: We examined mothers of 144 mother-child dyads at five university hospitals for eligibility (T1) and randomized them to either 12 weeks of intensive multimodal treatment (TG, n = 77) or clinical management (CG, n = 67) for Step 1. For Step 2, all dyads participated in 12 weekly PCT sessions. In Step 3, participants received maintenance treatments for 6 months. At 24 months after baseline (T5), we performed follow-up assessments. The primary endpoint was an observer blind rating child ADHD/ODD score. We evaluated outcomes at T5 using ANCOVA.

Results: Data from 101 children (TG n = 58, CG n = 43) and 95 mothers were available at T5. Adjusted means (m) of ADHD/ODD symptoms (range 0 – 26) in children did not differ between the TG and CG (mean difference = 1.0; 95% CI – 1.2 to – 3.1). The advantage of TG over CG in terms of maternal ADHD symptoms on the CAARS-O:L ADHD index (range 0–36) at T3/T4 were no longer observed at T5 (mean difference = 0.2; 95% CI the advantage of TG over CG in terms of maternal ADHD symptoms on the CAARS-O:L ADHD index 2.3 to – 2.6). Sensitivity analyses controlling for medication and significant predictors of follow-up attendance revealed unchanged outcomes. Within-group outcomes remained improved from baseline.

Conclusions: TG and CG converged at the 24-month follow-up and the superiority of intensive treatment regarding maternal ADHD symptoms disappeared. In the long term, cross-generational treatment including maternal ADHD treatment seems to be effective (BMBF grant 01GV0605; registration ISRCTN73911400).

Evaluation of a group-based parenting intervention for parents of young people diagnosed with ADHD in a community NHS Child Adolescent Mental Health Service (CAMHS)

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Objectives: To examine the effect of a Group-Based parenting intervention (PI) for young people diagnosed with ADHD in a community CAMHS service. We hypothesized that the perceived overall parents' experience and satisfaction of the ADHD Group-Based PI will be positive with an improvement of young people's behavioural symptoms.

Methods: The ADHD Group-Based PI at CAMHS-Newham (East London) is a 6-week group programme for parents of young people with ADHD. Its run by two senior systemic family psychotherapists. Session content includes: psychoeducation, impact of ADHD on young people/family, positive relationships within family and parental self-care. This is a mixed methods evaluation using qualitative and quantitative data. The qualitative data was derived from in-depth interviews with 8 parents using purposive sampling. Findings from Thematic Analysis will be integrated with quantitative results. Quantitative analyses included: change in ADHD symptoms (hyperactivity) and conduct problems (CD and ODD symptoms). The Strengths and Difficulties Questionnaire was collected from 30 families pre-and-post ADHD Group-Based PI. Data indicating change in hyperactivity, CP and parental efficacy was analyzed using independent and paired samples t-tests, to examine between and within group differences.

Results: Males comprised 82% of the sample, and about half were on ADHD medication. There were significant decreases on CP scores, and an increase in parental efficacy scores post-treatment (all $p < 0.001$). So far qualitative findings indicate a positive experience with increased parental confidence, specifically in improving the self-esteem of their children diagnosed with ADHD—and confidence in mention of parenting strategies like praise, reward and firm boundaries.

Conclusions: Given that the ADHD Group-Based PI is the first-line treatment for young people as per NICE guidance, the present service evaluation will improve the quality of this intervention to young people and their families with deprived socio-economic backgrounds and inner-city young people with comorbid CP.

Effects of a dialectical behavioral therapy based group treatment for adults with ADHD: a controlled multi-center study

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Objectives: To test if a 14 week structured skills training group treatment based on dialectical behavioral therapy (DBT-bGT) is superior to 'treatment as usual' (TAU) in reducing ADHD core and related symptoms in adults.

Methods: Adults with ADHD stabilized on medication, or unmedicated, from seven outpatient clinics in Western/Southern Norway were randomized to 14 groups of either DBT-bGT or TAU (non-standardized). The delivered DBT-bGT was based on the original German manual by Hessler et al. (2004), later translated to Swedish by Hirvikoski et al. (2010), and modified to include individual coaching at the end of each weekly group session. Main outcome measures were change of self-reported symptoms from before to after treatment, and at 6 months follow-up, on the Behavior Rating Inventory of Executive Function (BRIEF-A), Difficulties in Emotion Regulation Scale (DERS) and Adult ADHD self-report scale (ASRS).

Results: A total of 121 patients (68 females, mean age 37.0 years, range 21–59) were included. Compared to TAU, patients receiving DBT-bGT ($n = 60$) reported significantly larger mean reductions on the ASRS and the BRIEF total scores (-7.89 vs. -0.17 , $p < .000$, and -12.84 vs. -3.85 , $p = .002$, respectively), whereas the change on DERS total score did not differ significantly between the groups (-7.50 vs. -3.92 , $p = .39$). The reductions on the ASRS (-11%) and BRIEF (-6%) persisted at 6 months follow-up after ended group treatment.

Conclusions: This 14-week DBT-bGT was more effective than TAU in reducing core symptoms of ADHD, and of executive functioning, in adult patients already receiving pharmacological treatment for ADHD. The lack of impact on emotional dysregulation may reflect that temperamental traits may require more specific skills training, or possibly require interventions of longer duration. The symptom improvement was maintained at least 6 months after treatment.

PEGASUS psychoeducational groups for adults with ADHD and their significant others/family members

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Objectives: Information about ADHD and treatment options is important after established diagnosis at adult age. Until now, no interventions included significant others/family members to adults with ADHD. We have examined the feasibility, efficacy, and effectiveness of PEGASUS, a group-based structured psychoeducation for adults with ADHD and their significant others.

Methods: After an open feasibility study ($n = 108$; 51 with ADHD and their 57 significant others) we conducted a pragmatic parallel group add-on design multicenter randomized controlled trial. In the RCT, the 8-session program PEGASUS (allocated $n = 97$; 48 with ADHD and 49 with significant others) was compared to treatment as usual (TAU, allocated $n = 82$; 39 with ADHD and 43 significant others). Both studies were conducted in a psychiatric outpatient context. Self-rating scales were used to measure outcome.

Results: Over 90% of the participants completed the program. Overall treatment satisfaction was good among both individuals with ADHD and their significant others. Knowledge about ADHD increased following the PEGASUS participation. Improvements were also observed in secondary outcomes e.g. global life satisfaction, relationship quality and psychological well-being. No important adverse effects or side effects were observed.

Conclusions: Group-based structured psychoeducation PEGASUS for adults with ADHD and their significant others is a feasible, efficacious, and effective treatment option to increase ADHD knowledge and general life satisfaction in psychiatric outpatient care. The PEGASUS program has been translated into Norwegian language and other translations are in progress.

Mindfulness-based behavioral group therapy for adult ADHD: a pilot study

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Objectives: ADHD symptoms are often assumed to decrease in adolescence. However, in up to 60% of children ADHD persists into adulthood. Despite the researched effects of pharmacological interventions there are side effects, contraindications and non-responses. This results in disapproving the use of medication and asking for alternative treatments. The following pilot study aims to investigate whether mindfulness-based treatment approaches are an effective psychotherapeutic treatment option for adult ADHD patients.

Methods: Mindfulness, acceptance, commitment and cognitive behavioral group therapy (MAC-CBT) combines 3rd wave therapies

focusing on mindfulness meditation, acceptance of unchangeability, commitment to new goals with elements of cognitive behavioral therapy. Participants were assessed before and after treatment. To evaluate long term effects we are going to repeat the questionnaire assessment 6 months after treatment. A questionnaire battery was used to obtain results regarding a possible change in symptoms, quality of life and mindfulness.

Results: A total of 8 ADHD patients (4 women) with a mean age of 39.6 years (SD = 8.2) were included in the analysis. We conducted the nonparametric Wilcoxon Rank-sum test for repeated measurements and calculated correlation coefficient r as an effect size measurement. We found significant quality of life improvements for social relationships ($p = .04$, $r = .73$). Furthermore we found trends for reduction of ADHD symptoms ($p = .08$, $r = .64$) and depressive symptoms ($p = .08$, $r = .65$). A 6 month follow up is currently outstanding.

Conclusions: This pilot study found positive effects of third wave psychotherapeutic group therapies on adult ADHD. Due to the lack of a control group and a very limited sample size further research is needed and currently in progress.

Neurofunctional and behavioural predictors of fMRI-neurofeedback learning in ADHD

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Objectives: fMRI neurofeedback (fMRI-NF) targeting dysfunctional regions based on fMRI research is a promising novel neurotherapy for ADHD. Our fMRI-NF study in 31 ADHD adolescents showed that NF of right inferior frontal cortex was associated with clinical improvements, which, however, were also observed in the control group who was trained to enhance left parahippocampal gyrus. However, in EEG-NF, typically only about 50% of ADHD patients learn to successfully self-regulate their brain through NF and a key question is whether we can predict those who benefit from fMRI-NF. We therefore investigate whether baseline brain function, clinical or cognitive measures differed in regulators and non-regulators and whether they can predict successful fMRI-NF learning in ADHD. **Methods:** Successful brain-regulators were defined as patients who showed a positive correlation between the number of NF runs and brain activation in their respective target region. ANOVAs were conducted to test for group differences between regulators and non-regulators in baseline brain activation during the fMRI Stop task. T-tests and a logistic regression model were conducted for predictor analysis of clinical and cognitive performance measures.

Results: Forty-eight percent of ADHD adolescents successfully learned to regulate their respective brain regions. Brain regulators ($N = 15$) showed increased activation in left inferior fronto-cingulo-striatal regions during successful and failed stop trials while non-regulators ($N = 16$) showed increased temporo-parietal/precuneus activation during stop trials. Baseline mean reaction time in a sustained attention task differed between groups and was a significant predictor of successful brain regulation.

Conclusions: The frontal pattern of self-regulators reflects a more mature inhibition pattern relative to the more immature posterior activation pattern in non-regulators, suggesting that developmental maturity in fronto-cingulo-striatal cognitive control regions may be related to self-regulation capacity. Cognitively, faster response to targets in a sustained attention task, presumably reflecting superior, more mature attention skills, predicted successful brain-regulation ability for fMRI-NF.

The effects of peer co-led educational group intervention for adults with ADHD: preliminary results of a randomized controlled pilot study

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Objectives: Peer co-led education describes educators who are expert patients, user representatives or former patients, participating and teaching in educational interventions in cooperation with health care professionals. Peer co-led education is included in the Norwegian national guidelines for treatment of mental disorders. Despite some promising results for the treatment of other conditions, little is known about the efficacy of peer co-led educational group interventions for adults with ADHD. This study will present a peer co-led educational group programme developed in cooperation with user representatives from ADHD-user organisations and health personnel at a community mental health centre. The main objective is to investigate the preliminary effects of a two-session educational group programme added to treatment as usual. The educational intervention was designed to address specific challenges faced by adults recently diagnosed with ADHD.

Methods: Design: a randomized waitlist-controlled trial at an outpatient clinic in mid-Norway. Methods: All participants will receive standard treatment during the intervention period. Patient satisfaction, patient activation, general self-efficacy, ADHD-related quality of life and self-reported symptoms were assessed at the time of recruitment prior to randomisation, during the waiting time, at pre- and post-intervention, and at 10-weeks follow-up.

Results: Preliminary results on patient satisfaction and secondary outcomes will be presented.

Conclusions: This is the first RCT documenting an educational intervention for adults with ADHD where user representatives co-develop and co-deliver the educational group interventions. The aim of the trial, evaluating patient satisfaction, will provide information about the beneficial effect for the patients, as a potential intervention to be used as an adjunct to treatment as usual.

A brain-computer interface based programme for comorbid ADHD and autism spectrum disorder

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Objectives: In this pilot study, we aim to examine the efficacy of the BCI-based intervention in treating both the inattentive symptoms of ADHD, as well as ASD symptoms, in children with co-existing ADHD and ASD.

Methods: We have previously developed an intervention programme for treating the inattentive symptoms of ADHD, which utilized the brain-computer interface technology. In this study, we added additional computer-based training activities involving skills such as facial recognition and emotion identification. We also included eye tracking technology to help guide the users' eye gaze. This intervention programme takes place over 8 weeks, involving a total of 24 sessions. We enrolled 20 children with comorbid ADHD as well as ASD and randomized them into the intervention and control group. The control group will not receive any BCI intervention. Parents completed the ADHD-Rating Scale and Social Responsiveness Scale (SRS) at weeks 0 and 8, while a blinded clinician completes the ADHD Rating Scale at weeks 0 and 8.

Results: The mean change (reduction) in the inattentive symptoms on the ADHD-Rating Scale for the intervention was significant when compared to the control group, both for parents' and clinicians' ratings. However, there was no significant difference on the parent-rated SRS between both groups, although the intervention group did improve more.

Conclusions: Children with comorbid ADHD and ASD can still benefit from the BCI intervention. Further studies on the optimal training intensity for ASD symptoms will be useful.

Goal management training in the enhancement of measures of inhibitory control and cognitive flexibility

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Objectives: Goal Management Training (GMT) is a metacognitive technique that aims to train the individual to stop more automatic behaviors in order to set goals and analyze the consequences of their behaviors, minimizing the executive dysfunctions. The aim of this study is verify the efficacy of this training in the flexibility and inhibitory control.

Methods: This study included 25 adolescents with complaints of executive dysfunctions in the social environment who underwent a neuropsychological evaluation that included domains of working memory, inhibitory control, flexibility, reasoning, problem solving, planning, intellectual capacity, culinary activity and executive function scales, for the formation of the baseline. Immediately after they were allocated, randomly in a control group, who underwent psychoeducation sessions, and experimental group, which was stimulated through the GMT in eight sessions. Then the participants went through another evaluation and a follow-up after 4 weeks. However, this work will consider only the measures of flexibility and inhibitory control measured by the Five Digits Test (FDT).

Results: The FDT showed an increase in abilities, with a large effect on inhibition and flexibility capacities, in terms of time with significant effect according to the Anova analysis, and with average effect in flexibility, in terms of score, but without effect (pre-intervention measures), already in gain 2 (follow-up measures—pre-intervention), the control group showed average effect in the Hedges analyzes. For the inhibitory control score, small size effect on gain 1 and average size on gain 2 were observed.

Conclusions: More evidence of the effects of the intervention was observed in the results of the measures of flexibility and inhibitory control measured by the FDT test, such results suggest that the training in 8 sessions was able to potentiate these functions, which could suggest improvements in the social environment.

A comparison of efficacy between group cognitive behavioral therapy versus cognitive behavioral therapy combined with medication in adult ADHD

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Objectives: Studies have confirmed that both pharmacotherapy and cognitive behavioral therapy (CBT) are effective in Attention deficit hyperactivity disorder (ADHD) in adulthood. Efficacy of CBT in unmedicated versus medicated adults remains uncertain. We compared the effects of group CBT treatment alone (CBT group) versus

CBT combined with medication (CBT + M group) on core symptoms, emotional symptoms, self-esteem, impulsivity and functional outcomes in adult ADHD patients.

Methods: 124 adults with ADHD received 12 week manualized group CBT sessions, either with ($n = 57$) or without ($n = 67$) medication. Treatment effects were evaluated at baseline and at each week of the 12-week therapy. The mixed linear models (MLM) were used to compare the effects between the two groups on the changes of core symptoms (ADHD-RS), emotions (SAS and SDS), impulsivity (BIS-II), self-esteem (SES), executive function (Brief-A) and life quality (WHOQOL-BREF).

Results: Both groups showed robust improvement in both core symptoms, emotional symptoms and functional outcomes (all $p < 0.01$). The use of medication did not prove the superiority on core symptoms, emotional symptoms, self-esteem and impulsivity. The CBT group showed a greater improvement in physical domain of WHOQOL-BREF ($p < 0.01$) than CBT + M group. For BRIEF-A, CBT + M group presented improvements of more domains, i.e. shift ($p = 0.049$), self-monitor ($p = 0.006$), task monitor ($p = 0.004$) and organisation of materials ($F = 16.436$, $p < 0.01$) respectively.

Conclusions: This study replicates previous work demonstrating that CBT is an effective treatment for ADHD in adults, both with and without medication. A combination of CBT and medication presented more domains of improvement in executive function, but failed to present more improvement in clinical symptoms.

Day-to-day effects of a self-regulation intervention on the ADHD symptoms of school children

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Objectives: Children with an ADHD are less able than peers to regulate their behavior (Gawrilow 2012). These self-regulation deficits are linked to various challenges in children's everyday lives, in particular their academic behaviour (Wirth, Reinelt, Gawrilow, and Rauch 2015). Mental contrasting with implementation intentions (also known as WOOP), improves self-regulation in schoolchildren and helps individuals to reach their self-set goals (Gawrilow, Morgenroth, Schultz, Oettingen, and Gollwitzer 2013). Whether this intervention has the potential to support children's self-regulation especially on a day-to-day-level and thereby decreasing their ADHD-symptoms is still unknown. We expect an effect of a day-to-day-level self-regulation intervention on ADHD-symptoms.

Methods: The current study tries to answer the research question with ambulatory assessment via smartphones: for a duration of 18 days children took part in three daily assessments, as well as a pre and post measurement for children and parents. The sample consists of 49 school-aged-children ($M = 11.2$ years, $SD = 8.4$ months). ADHD-symptoms were measured with the Conners 3 scale (Lidzba, Christiansen, and Drechsler 2013) and self-regulation with the german adaptation of the Brief self-control scale (Bertrams, and Dickhäuser 2009). Participants were randomly assigned to two conditions: Condition 1 went through the mentioned WOOP intervention, whilst thinking about their wishes, outcomes and obstacles on this path and in the end formulated an if-then-plan; Condition 2 thought about wishes, outcomes and further positive feelings on this path, but did not think about obstacles and accordingly did not formulate if-then-plans to overcome these.

Results: Preliminary results suggest that all children do indeed benefit from the intervention, with a stronger decrease of ADHD-symptoms in the WOOP condition as compared to the second condition.

Conclusions: Further results and conclusions will be discussed.

Metacognitive executive function training for preschool children with ADHD: a randomized controlled study

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Objectives: This randomized controlled study explore the efficacy, feasibility, and acceptability of Metacognitive Executive Function Training for Preschool children (MEFP) with attention deficit hyperactivity disorder (ADHD). We conducted a randomized parallel group, single-blinded trial.

Methods: In total, 72 children aged 4–5 years old were randomized after an ADHD diagnose and informed consent. In the MEFP group, 35 out of 36 participants completed the 8-week program, compared with 30 out of 36 in the waiting group. The outcomes were ADHD symptoms and the executive function (EF) evaluated by both neuropsychological tests from NEPSY and Behavior Rating Inventory of Executive Function (BRIEF). The assessments were administered and scored by examiners who were blind to the diagnostic and treatment status of the participants. All of the participants were not on medication. Participants attended once-weekly 90-min sessions (60-min for children, 30-min for parents) for 8 weeks. The MEFP are designed to help the preschool children with ADHD to improve their EF through activities, plays, tasks and practices.

Results: The MEFP is feasible to administer and acceptable to participants with 97.9% attendance rate. In terms of the parent's opinion of MEFP, none of them found it difficult to understand and carry out. 95% of the parents felt usually or always satisfied with the program. Results show that after intervention, the oppositional defiant symptoms ($p = 0.017$) and visual-motor perception ($p = 0.034$) are improved significantly, the improvement tendency of working memory ($p = 0.093$). The rest differences of symptoms of ADHD and EF evaluations have not been found significant change through MEFP.

Conclusions: The MEFP is an feasible, acceptable, and potential effectiveness on symptoms and EF for preschool children with ADHD. Next step is to extend the program to longer time and more frequent practices during real life, aiming to get more obvious effectiveness.

Mindfulness for children with ADHD and mindful parenting (MindChamp): a qualitative study on facilitators, barriers and effects

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Objectives: The MindChamp study (ClinicalTrials.gov Identifier: NCT03220308) examines the effectiveness of a mindfulness-based intervention for youth with ADHD and their parents, using both quantitative and qualitative designs. Here we describe the first qualitative study which provides a rich systematic exploration of experienced facilitators and barriers to participating in the mindfulness training (i.e. feasibility), and of effects on child, parent and child-parent interactions.

Methods: Children with ADHD ($N = 17$, ages 8–15 years) and their parents ($N = 6$ fathers, $N = 14$ mothers) participated in the 8-week protocolised MYmind mindfulness training. After the mindfulness training, individual semi-structured interviews were conducted with children and parents, selected using purposive sampling, and with the mindfulness teachers ($N = 3$). Interviews were transcribed verbatim, and analysed using Grounded Theory (Atlas.ti). Consolidated Criteria

for Reporting Qualitative Research were followed. We report preliminary results.

Results: The following themes emerged for feasibility, most could act as facilitator or barrier: contextual factors (family, medication, time/place of training, time investment), training characteristics (homework, training content, mindfulness teachers, other participants), participant characteristics (ADHD-/comorbidity-related, personal characteristics, view on mindfulness, age of child). Effects concerned the themes of: awareness/insight, acceptance, autonomy/confidence, cognition, emotion regulation/reactivity, calmness/relaxation, relational changes and generalisation. Themes included mindfulness-specific (e.g. increased compassion, changed view of self/child) and more general ones (e.g. being in a group similar experiences). There was much heterogeneity in facilitators, barriers, and effects.

Conclusions: The MYmind mindfulness training is feasible, and can lead to diverse positive effects other than or beyond ADHD symptoms alone. Results inform clinical practice and research to improve mindfulness programmes, to personalise intervention, and to select relevant outcome domains for assessing intervention effects in quantitative designs. Relational changes are not captured thoroughly in the assessment battery of the MindChamp quantitative study, but should be emphasised more based on qualitative results. Heterogeneity indicates effects may be hard to identify in quantitative research using mean-based approaches.

Auditory noise treats cognitive symptoms in ADHD more efficiently than stimulant medication: is the Smartnoise application a new possible treatment of inattention in school children?

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Objectives: Auditory noise is typically perceived as detrimental for cognitive performance; particularly in people with attention deficits and ADHD, that is associated with vulnerability to distraction. Counter to this, we have experimentally shown that sensory noise improves neural function under certain conditions, in particular among subjects where function is impaired to start with. The theoretical underpinning of noise benefit is described in the framework of the Moderate Brain Arousal model.

Methods: In a recent study we compared the effect of 80 dB auditory noise with the one of stimulant medication on two cognitive tasks (episodic- and visuo-spatial working memory). Twenty children with an ADHD diagnosis and twenty typically developing children were tested at two different occasions.

Results: Results showed a significant noise benefit in both tasks for the ADHD group. In the visuo-spatial task the noise benefit was even larger than the one of medication. The effect of medication was marginal in both tasks.

Conclusions: We conclude that this opens up a possibility to use auditory noise as an alternative non-pharmacological treatment of inattention in school children. Based on these findings we have developed an iPhone/iPad application, Smartnoise, that utilize the benefits of noise exposure during demanding cognitive tasks like school work. The Smartnoise tool is portable and easy to use in the classroom and at home during homework. A randomized control trial study to evaluate the Smartnoise application in a school setting is planned to take place during the Spring 2018 conducted by the Vestfold Hospital in Norway.

Using memory techniques to learn: how students with attention deficit disorder can benefit from the use of mnemonics

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Objectives: In previous research we have shown that for “regular” (non-ADHD) students, memorization using mnemonics is a more effective strategy than classical memorization (cramming). To study whether the use of mnemonics could be an effective strategy for students with ADHD we have performed a review of the literature as described below. In this poster we will describe the theoretical advantages of using mnemonics for memorization in students with ADHD. We will show the findings of our literature study and suggest future clinical research options.

Methods: Our aim was to perform a systematic review using the Rapid Evidence Assessment procedure as described by the Center of Evidence Based Management. Setting and participants: Studies included limited to those that tested the use of mnemonics in people with ADHD. Interventions and main outcome measure of the primary studies: We planned to include studies that compared memorization using mnemonics with “regular” memorization (cramming).

Results: We searched 4 databases (EMBASE, PubMed, ERIC and PsycInfo) using a structured query. We found a total of 22 papers. After a first analysis we found that all articles had to be excluded because none of them researched our subject of interest: the use of mnemonics in people with attention deficit disorder.

Conclusions: The use of mnemonics has the potential to have major advantages for people with attention deficit disorder, especially compared to regular rote learning (a.k.a. cramming). People with ADHD may overcome memorization issues by using mnemonics because of the inherently “fun” way of learning (creating weird associations to enhance memorization), which may help in concentration, enhance (hyper)focus, and help students gain confidence. Much to our amazement, no studies were found studying the effect of mnemonics on memorization in people with ADHD. This is an important finding, as it shows future research should focus on the use of mnemonics in memorization among students with ADHD.

Effectiveness of cognitive training for school-aged children and adolescents with ADHD: a systematic review

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Objectives: As it has been proposed that cognitive training for improving executive functioning can reduce Attention Deficit/Hyperactivity Disorder (ADHD) symptomatology (e.g., Cortese et al. 2015), our aim is to review the current literature on cognitive training interventions for executive functions (EF) in children and adolescents diagnosed with this disorder.

Methods: From 2008 to 2018, the following databases were searched: Academic Search Complete, ERIC, MEDLINE with Full Text, PsycARTICLES, PsycINFO and Psychology, and Behavioral Sciences Collection. The search keywords were: executive function* OR executive functioning AND cognitive training OR intervention* AND Attention Deficit Hyperactivity Disorder OR ADHD. As detailed in Figure 1, inclusion and exclusion criteria were applied.

Results: Twenty-six studies were included in this review. Of the 21 studies that reported performance-based measures of EF, 16 found improvements and four did not. Moreover, 20 studies found improvements in parent, teacher, and/or clinicians rating scales. Twenty-one studies showed positive transfer effects on ADHD symptomatology, academic improvement, reduced off-task behavior, and enhanced social skills. Of the 11 studies that performed follow-up sessions, nine concluded that the treatment effects were maintained over time.

Conclusions: Although these studies have limitations, results show that cognitive training can be an effective intervention for children and adolescents with ADHD and might be a complementary treatment option for this disorder.

Predictors of neurofeedback training outcome in ADHD and healthy participants

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Objectives: Neurofeedback (NF), a computer-based training for neuronal regulation, is known as a complementary treatment for different neuropsychiatric disorders such as ADHD and can also be used for optimizing cognitive abilities in healthy individuals. Even though encouraging findings have been reported, research results indicate that not everybody can profit from such a training with non-learner/non-responder rates of about 30%. Hence, the selection of patients who are likely to respond to this treatment is crucial to enable its efficient application. However, this is only possible if sufficient information is available on factors determining training outcome.

Methods: The present review included 16 studies investigating predictors for the outcome of NF trainings for ADHD patients and healthy participants. We selected these studies based on searches in EBSCOhost using combinations of the keywords “neurofeedback” and “predictor/predictors”. As “NF training” we defined all NF applications/trainings with at least two sessions.

Results: We provide a detailed description and evaluation of currently known predictors showing that the best available evidence exists for neurophysiological baseline parameters. Among them, the target parameters of the respective training seem to be of particular importance. Age or intelligence, however, did not affect training outcome. The findings did not differ between healthy participants and ADHD patients.

Conclusions: Differences of the experimental designs of the included studies restricted the interpretability of some of the information we extracted. In addition, the available evidence is still rather scarce, so that a systematic and reliable selection of participants/patients on the basis of predictors is not possible so far. Further research will be necessary to confirm the tentative conclusions drawn from this review.

Non-invasive brain stimulation in ADHD: a systematic review and meta-analysis

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Objectives: Non-invasive brain stimulation (NIBS), such as repetitive transcranial magnetic stimulation (TMS) and transcranial direct current stimulation (tDCS), can modulate cortical excitability, with

potentially long-lasting functional gains in targeted brain regions. In ADHD, there is promising evidence of improved executive functions and clinical ADHD symptoms, thus NIBS may have the potential to offer a side-effect free, brain-based, neuroplastic treatment alternative to psycho-stimulants. However, no review or meta-analysis has systematically evaluated the effectiveness of NIBS on cognitive and clinical measures in ADHD which is needed given that NIBS is already being offered clinically and commercially without a solid evidence base.

Methods: A search of Web of Knowledge, Scopus, PubMed, and Ovid for single-/double-blind, randomised controlled trials (until Oct 2018) identified 17 studies (rTMS = 4; tDCS = 13) targeting (mainly dorsolateral) prefrontal (dlPFC) regions. Meta-analysis included 11 studies using anodal tDCS of mainly left dlPFC. Due to heterogeneity in cognitive tasks, outcome measures were clustered into three cognitive domains, Attention, Inhibition, and Processing Speed, which were analyzed in three separate meta-analyses.

Results: In our systematic review, four studies tested and found improved inattention symptoms, two using rTMS of right dlPFC and two using anodal tDCS of left dlPFC. Twelve tDCS studies reported improvements in some attention, inhibition and/or working memory tasks, but the meta-analysis showed only a small improvement in Processing Speed with anodal tDCS of left dlPFC ($g = 0.19$ [95% CI, 0.03–0.35]) and no effects on attention or inhibition measures.

Conclusions: This review and meta-analysis do not support the use of rTMS and tDCS of dorsolateral prefrontal cortex to improve clinical or cognitive measures of attention or self-control in ADHD. However, this does not rule out that larger, multi-session NIBS studies targeting other ADHD relevant regions such as right dorsal and ventral prefrontal areas in combination with cognitive training could potentially achieve larger effects.

fMRI neurofeedback of right inferior frontal cortex leads to increased functional connectivity in a fronto-cingulo-striatal cognitive control network in adolescents with ADHD

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Objectives: ADHD is associated with poor self-control, underpinned by inferior fronto-striatal deficits. We showed previously that 11 runs of 8.5 min of real-time functional magnetic resonance neurofeedback (fMRI-NF) of the right inferior frontal cortex (rIFC) in 18 ADHD adolescents resulted in progressively increased activation in 2 regions of the rIFC which furthermore was associated with clinical symptoms improvements. In this study, we used functional connectivity (FC) analyses to investigate whether fMRI-NF of rIFC resulted in dynamic FC changes in underlying neural networks.

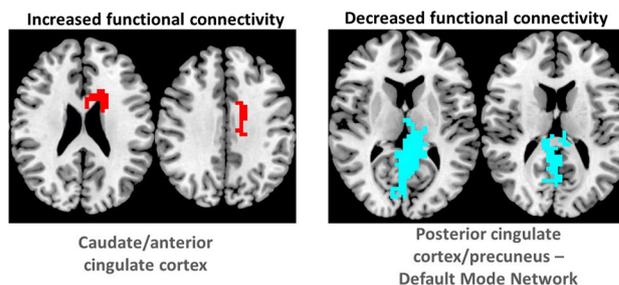
Methods: Whole-brain seed-based FC analyses were applied using as seed regions the two clusters that showed progressively increased activation in rIFC to test for changes in positive and negative FC before and after 11 runs of fMRI-NF. Furthermore, we tested whether the resulting positive and negative FC changes were associated with improvements in clinical symptoms.

Results: rIFC showed increased positive FC after relative to before fMRI-NF with dorsal caudate and anterior cingulate and increased negative FC with posterior regions of the default mode network (DMN), including posterior cingulate, precuneus, striato-thalamic and occipital areas. Furthermore, both the increased FC between rIFC and cingulo-striatal regions and the increased negative FC between rIFC

and DMN regions were associated with clinical symptom improvements.

Conclusions: The findings show for the first time that fMRI-NF of a typical dysfunctional frontal region in ADHD adolescents such as rIFC leads to a strengthening within entire ventral fronto-cingulo-striatal networks of self-control and to a weakening of FC with posterior DMN regions, presumably decreasing mind-wandering, and that this may be underlying clinical symptom improvement. The fMRI-NF effects of improving the FC of inferior fronto-cingulo-striatal self-control networks and of improving the anticorrelation between a self-control region and the DMN reflect a more mature network pattern and are furthermore similar to the effects of psychostimulants.

Changes in connectivity after fMRI neurofeedback in ADHD.



Topic: Pathophysiology

The awareness Project. Differences between children diagnosed with ADHD and healthy control children as to sleep difficulties and some behavioural aspects

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Objectives: The research aimed at determining differences between children diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) and healthy control children aged between 5 and 12 years old as to sleep and some behavioural aspects. The importance of the theoretical study lies in the scarcity of Arabian researches and studies, and Saudi ones in particular, which have studied the differences between the two groups of the study (within the knowledge of the researchers).

Methods: The study sample consisted of two groups: children diagnosed with ADHD and a group of healthy control children. The measurements for the children diagnosed with ADHD were complete and available from the Good Night Project: Behavioural sleep interventions for children with ADHD: A randomised controlled trial, in the Kingdom of Saudi Arabia (ALAMmar 2018). The measurements of healthy control children were collected in this research. They were selected randomly by the researchers in the current study. Each group included 32 children of both sexes and their ages varied between 5 and 12 years. The researchers used the comparative method to determine the differences in sleep and some behavioural aspects between the two study groups. The study used the following tools:

1. Primary Information Form prepared by the researchers.
2. Children sleep habits questionnaire prepared by Owens, Spirito, and McGuinn (2000); translated by Abu-Khadhr (2012).

3. Children Behavior Rating Scale by Conners “Parents Rating 48”; translated by Dr. Abdulraqib Ahmed Al-Buhairy. The researchers used repetitions, percentages and the T test for independent samples to analyse the results of the study. The obtained results were discussed in the light of the previous studies, and conclusions with suggestions and recommendations were presented.

Results: The results of the study showed:

- There are differences with statistical significance between the score of children diagnosed with ADHD and healthy control children on the scale of sleep habits of children. The value of $T = 2.33$, which is statistically significant at the 0.05 significance level.
- There are differences with statistical significance between the score of children diagnosed with ADHD and healthy control children on the Children Behavior Rating Scale by Conners “Parents Rating 48”; the value of $T = 3.63$, which is statistically significant at the 0.05 significance level.

Conclusions: The researchers recommend benefitting from the application of the Good Night Project: Behavioural sleep interventions for children with ADHD: A randomised controlled trial, taking into consideration the important recommendations referred to in the project (ALAMmar 2018).

Basic processes as foundations of cognitive impairment in adult ADHD

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Objectives: ADHD in adulthood is characterized by impairment of multiple aspects of cognition which negatively impact the individual’s everyday functioning. However, little is known about how these impairments intertwine. This study explored whether impairments in basic processes (processing speed and distractibility) in adults with ADHD explain impairments in higher order functions, namely executive functions, memory and complex attention. Furthermore, it was explored whether pharmacological treatment with methylphenidate (MPH) affects basic processes and higher order functions.

Methods: A between subjects design compared patients with ADHD without stimulant drug treatment ($N = 53$) and patients with ADHD treated with MPH ($N = 31$) with a healthy control group ($N = 80$). A neuropsychological test battery assessing basic processes and higher order functions was administered. Hierarchical logistic regression analyses were conducted to evaluate the contribution of basic processes to impairments in higher order functions.

Results: Patients with ADHD not treated with MPH showed impairments in basic processes and higher order functions compared to controls. The impairments in basic processes explained a substantial proportion of the impairment in the higher order function, i.e. 41–43% of impairments in executive functions, 27–29% in memory, and 56–74% in complex attention. In patients with ADHD treated with MPH, basic processes were not impaired and did not contribute significantly to impairments of higher order functions.

Conclusions: Basic processes may constitute part of the foundation of cognitive impairments in adult ADHD. MPH may improve cognitive performance, presumably through improving basic processes. Thus, impairment in basic processes could indicate to clinicians that MPH administration could be beneficial. Focusing on basic processes in clinical settings could guide test selection and potentially optimize the

neuropsychological assessment. Basic processes may constitute a good target for treatment interventions, as improving basic processes may result in improvements in higher order functions.

Comparison of voluntary and automatic orienting of attention in different age children with ADHD

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Objectives: Voluntary and automatic orienting of attention enable proper processing of environmental information. Few studies have assessed how this process varies during development in children with ADHD. This study analyzed the voluntary and automatic orienting of attention in different age children with ADHD.

Methods: Experiments 1 and 2 were designed to assess the differences regarding the voluntary and automatic attentional orientation, respectively. Both experiments used the manual RT to visual targets as a measure of attention manipulation in 30 children with ADHD (Experimental group—EG) and 30 age-matched controls (Control group—CG). In Experiment 1 (Voluntary orienting) the participants had to fixate on central point, directing their attention to the position indicated and responding pressing a key. In Experiment 2, the participants had to fixate on central point, ignore the first stimulus, and respond to the target. The RT medians calculated for each condition and participant were analyzed using the General Linear Model.

Results: Children with ADHD exhibited higher RTs than the CG group even for Experiment 1 and 2. For Experiment 1 we observed a significant interactions involving group and cue validity ($F[1, 56] = 5.6627, P = .02076$), demonstrating an increase of RT for the EG in the invalid condition. The second two factors interaction, between group and cue-target interval ($F[1, 56] = 15.773, P = .00021$), demonstrating a significant increase of RT for CG ($P < .001$) for the short interval. For experiment 2 A significant effect of group was found ($F[1, 56] = 3.9641, P = .05$), whereby EG were globally slower than CG. We also observed a significant difference ($F[1, 56] = 9.7897, P = .00279$) in relation to Age (Half-Younger \times Half-Older). Younger ($RT = 575$) were slower compared with Older children ($RT = 475$). A significant interaction of this factor with cue-target spatial correlation ($F[1, 56] = 4.7154, P = .03415$) demonstrated that the Half-Younger children were slower in the contralateral condition than in the ipsilateral, but not the Half-Older children.

Conclusions: Children with ADHD have higher RT in comparison with healthy controls. They also have prejudices in the reorienting process as observed during the invalid condition in Experiment 1 (voluntary orienting) and in directing their attention for shorter intervals (SOA of 300 ms). In Experiment 2 (automatic orienting), there was no interaction involving the group factor. This fact may be dependent on ADHD diagnosis and the age of the children. This paper received financial support from Programa de Excelência Acadêmica (Proex) Process no. 0653/2018 of the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior—Brasil (CAPES)—Financing Code 001. Also received financial resources from Fundo Mackenzie de Pesquisa (MackPesquisa) da Universidade Presbiteriana Mackenzie.

Cognitive profile of a Brazilian adults sample with complaints of inattention compatible with ADHD

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Objectives: ADHD is a condition that begins in childhood and mostly persist into adult life causing damage in various sectors. Although the characteristics of ADHD are theme of many researches, demands remain open especially in relation to adults of more advanced ages. Broadening the knowledge about this topic is relevant to improve diagnostic and interventional practices. This study aims to characterize, using a cognitive and behavioral assessments, the complaints of inattention and hyperactivity/impulsivity along aging in a Brazilian adult sample.

Methods: We analyzed performance in attention, cognitive flexibility, inhibitory control and working memory tests and behavioral indicators of inattention, hyperactivity, impulsivity, functional impairments, anxiety and depression, somatic problems, problems with thinking and personal strengths. We evaluated 49 participants between 20 and 68 years old using:

1. Adult Self-Report Scale (ASRS 18).
2. Mini-Mental State Exam (MMSE).
3. Wechsler Abbreviated Scale of Intelligence (WASI).
4. Psychological Battery for Attention Assessment (BPA).
5. Five Digit Test.
6. WMI of Wechsler Adult Intelligence Scale.

The sample of 49 participants was divided into two groups: Group 1 (n = 25), young adults between 20 and 30 years old and Group 2 (n = 24), older adults between 31 and 68 years old.

Results: Pearson correlation and comparative analyzes using Student's T-Test were performed. The increase in ADHD complaints showed associations with: decline in personal strength; increased functional impairment (academic, domestic, financial and social); increased level of impulsivity; increase of indicators of anxiety, depression, somatic problems and decline in working memory performance; declining performance in concentrated and divided attention, and increased errors and omissions in tasks of attention; and increased execution times due to inhibition interference and cognitive flexibility deficits. With the increase of the age we observed improvement in the performances in working memory; decline in performance in concentrated, divided and alternated attention, increased level of impulsivity, increased functional impairment (financial and traffic); decline of indicators of anxiety, depression, somatic problems and problems with thinking; and increased indicators of personal strength. There were no differences in inhibition, cognitive flexibility, and number of ADHD signs with increasing age.

Conclusions: These findings demonstrated possible relationship between adult aging and presence of ADHD signs. The set of data express the same sense of the heterogeneity model in the characterization of ADHD. The study also ratified the importance of neuropsychological and behavioral assessment in diagnostic processes of inattention complaints of adults. This study received financial support from Programa de Excelência Acadêmica (Proex) Process no. 0653/2018 of the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior—Brasil (CAPES)—Financing Code 001. Also received financial resources from Fundo Mackenzie de Pesquisa (MackPesquisa) da Universidade Presbiteriana Mackenzie.

Is eveningness preference associated with the presentation and severity of ADHD? Study in an adolescent clinical sample and high risk siblings

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Objectives: Describe the role of eveningness preference in the presentation and severity of ADHD in Adolescents and their Siblings.

Methods: Observational Analytic, Cross Sectional design Study sample was obtained from an adolescent outpatient clinic, composed of probands and siblings with and without ADHD. The sample was evaluated with Brief Psychiatric Rating Scale (BPRS-29 items), the Morningness–Eveningness Scale for Children (MESC) and ADHD Rating Scale IV (ADHD-RS IV) by expert clinicians.

Results: Out of the 113 participants, 58 were siblings. Siblings that had an eveningness preference where up to 2.22 times more at risk for ADHD, and, we found that the scores on ADHD RS- IV had a negative correlation with the MESC scores, ($\beta = -0.42, -0.21, -0.49$) $P < 0.05$ for probands versus ($\beta = -0.31, -0.18, -0.27$), $P < 0.05$ for Siblings, inattention symptoms, hyperactivity/Impulsivity and combined symptoms, respectively.

Conclusions: Eveningness preference may be included as one of the variables to look for in ADHD adolescents and their siblings in order to establish prognostic characteristics like severity of symptoms. Relationship between ADHD-RS -IV and MESC scores, comparison total sample versus siblings with ADHD.

Type of Symptoms	Total Sample (n 113)	Siblings n 58	CI 95%
Inattention	$\beta = -0.42^{**}$	$\beta = -0.31$	$P < 0.05, (-0.48 a -0.29)$
Hyperactive/Impulsive	$\beta = -0.21$	$\beta = -0.18$	$P < 0.05, (-0.24 a -0.16)$
Combined Symptoms	$\beta = -0.49^{**}$	$\beta = -0.27$	$P < 0.05, (-0.55 a -0.21)$

Table 1. Shows correlation between scores in ADHD-RS IV and MESC in the total population and siblings with ADHD. MESC = Morningness-Eveningness Scale for Children. ADHD-RS = ADHD Rating Scale IV.
* $P < 0.001$.

Correlation of the hereditary characteristics between parents and children with ADHD through the virtual tools AULA® and AQUARIUM®

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Objectives: ADHD is the most frequent neurodevelopmental disorder that presents different clinical manifestations throughout life. The approaches used for the study of ADHD are divided into: genetic, neurochemical, structural and functional. Through different genetic, family and adoption studies, the existence of heritability in ADHD has been demonstrated up to 76%. The diagnosis of ADHD is clinical, there are several subjective scales that can guide us to establish the

diagnosis. Efforts to find improved evaluation methods that offer greater ecological validity, as well as better sensitivity and levels of specificity, have led to new techniques for evaluating ADHD that are based on the use of Virtual Reality (VR) as an AULA and AQUARIUM. Currently, new technological developments in the field of Virtual Reality offer novel and interesting options in the neuropsychological assessment of many cognitive processes, so that through these tools you can find the hereditary characteristics between parents and children. Correlating hereditary clinical characteristics between parents and children with a diagnosis of Attention Deficit Hyperactivity Disorder through AULA and AQUARIUM tools.

Methods: Correlating hereditary clinical characteristics between parents and children with a diagnosis of ADHD through AULA and AQUARIUM tools. Type of study: Descriptive and analytical.

Results: There is concordance between parents and children in the diagnosis of ADHD in 80% of the cases analyzed, the most frequent presentation diagnosed in pediatric age was the combination in terms of concordance between parents and children by type of presentation are patients with presentation where there is significant agreement of 62% with a predominance in the female sex, patients with hyperactive-impulsive presentation presented a 40% concordance with their parents, predominantly male.

What is the relation between attachment and ADHD? A theoretical review

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Objectives: Since the development of Attachment Theory of John Bowlby, systematic research on the patterns of attachment has occurred in a slow rhythm. In the last decade, a numerous of publications about institutionalized children and attachment occurred. However, few studies have been published as to the patterns of attachment in clinical general population (where there is a lower risk for negligence and Attachment Disorders as described in DSM-5/ICD-11) and its association with child psychopathology, specifically ADHD in school age children. The aim of this study is to do a non-systematic bibliographic review of the possible association between attachment difficulties and ADHD in school age children.

Methods: Review of literature was performed using Medline, Cochrane, Pubmed and UpToDate databases with the keywords “ADHD”, “Child Psychiatry”, “Attachment Disorders”, “Secure Attachment” and “Insecure Attachment”.

Results: Most of the studies that have been performed make the hypothetic connection between difficulties in attachment and ADHD. Some review studies (Storebo 2013) of attachment and ADHD have been conducted. Major factors that justify the difficulty of making a clear association between attachment and ADHD were identified. Factors as the ambiguous criteria of patterns of attachment classification; the difficulty of having a homogenous and reliable scale to classify attachment competences; and differences in studies which consider ADHD full criteria compared to others that consider ADHD-like symptoms.

Conclusions: Prospective studies in Child and Adolescent Psychiatry, specifically in attachment difficulties and ADHD, are needed.

The Weiss Functional Impairment Rating Scale in a Norwegian clinical sample of adolescents with ADHD

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Objectives: Functional impairment is an essential part of ADHD and is an important measure in assessment and evaluation of treatment outcome. Weiss Functional Impairment Rating Scale (WFIRS) has shown good psychometric properties in assessing impairment in children and adolescents with ADHD, but no studies have been published using Scandinavian populations. In this study we address three main questions; what is the relationship between ADHD symptoms and functional impairment? What is the relationship between parent report and self-report? To what extent do comorbid psychiatric disorders, gender and IQ mediate and moderate functional outcome?

Methods: Adolescents (14–18 years old) diagnosed with ADHD according to DSM-IV criteria were recruited from Child and Adolescent Psychiatric Outpatient Clinics in Mid-Norway. The adolescents and their parents filled out the WFIRS-S and WFIRS-P respectively. The ADHD Rating Scale IV was used to measure ADHD symptoms. Clinicians scored the Children Global Assessment Scale (C-GAS). We also recorded co-existing psychiatric diagnoses and included a measure of global IQ from the WISC-IV.

Results: Data collection is ongoing. Data analyses of approximately N = 80 cases, will be completed prior to the ADHD conference in Lisbon in April 2019, where results will be presented.

Conclusions: Results from this study will add to the understanding of functional impairment in adolescents with ADHD. Examining the impact of IQ and comorbid psychiatric illness will add to current knowledge on functional impairment in this patient group, and provide recommendations for further use of the WFIRS as a supplemental tool in clinical assessment and treatment in adolescents with ADHD.

Improved executive functioning but not ADHD symptoms in children with ADHD at 1-year follow-up

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Objectives: To investigate whether the executive functioning of children with ADHD (1) differ from controls at baseline, and (2) change over 1-year period.

Methods: 37 children with an ADHD diagnosis (mean age = 10.2, range = 8–16; 3 females), and 24 healthy controls (mean age = 9.7, range = 8–12; 12 females), two executive functioning tasks Visuo-motor Children's Color Trails Test 2 (CCTT2) and Verbal Fluency subtest of Delis-Kaplan Executive Functioning System (DK-VF). The scores from these tasks were age-corrected. Parents of the children filled out Conners-3 Parent questionnaire (CP) measuring ADHD symptoms. Children with ADHD and their parents repeated the procedure 1 year later.

Results: Compared to the controls at baseline, children with ADHD had significantly more ADHD symptoms in all of the CP scales ($p < .001$), and worse executive function performance as measured by both CCTT2 time ($p < .05$) and DK-VF letter fluency ($p < .001$), category fluency ($p < .01$) and switching accuracy ($p < .05$) sub-scales. One year later the executive performance of children with

ADHD in DK-VF letter and category fluency had significantly improved ($p < .05$), but there was no change in their ADHD symptoms.

Conclusions: Children with ADHD show more ADHD symptomatology and verbal and motor executive dysfunction at baseline. One year after receiving diagnosis their verbal executive functioning was improved but their ADHD symptoms reported by their parents did not reduce. Brief, cost-efficient neuropsychological tools have a potential to complement parent-report measures and support clinicians with making a more comprehensive neurodevelopmental assessment and treatment recommendations for ADHD.

Sex differences in the patterns of executive dysfunctions in adults with ADHD as compared to healthy adults

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Objectives: Emerging evidence supports the sex difference in neurobiology in neuropsychiatric disorders. However, little is known about potential sex differences in the executive functions in adults with attention-deficit/hyperactivity disorder (ADHD). We tested the null hypothesis that there are no sex differences in executive functions in adults with ADHD as compared to healthy adult controls without ADHD.

Methods: We assessed 343 18–40-year-old adults with DSM-5 ADHD (215 men, 25.2 ± 5.6 ; 128 women, 26.9 ± 5.7) and 333 age-matched healthy controls (193 men, 24.4 ± 5.2 ; 140 women, 25.1 ± 5.0) with psychiatric interviews to confirm ADHD and other psychiatric diagnoses. They also performed Reaction Time (RT), Rapid Visual Information Processing (RVIP), Spatial Span (SSP), Spatial Working Memory (SWM), Intradimensional/Extradimensional Shift (IED), and Stocking of Cambridge (SOC) of the Cambridge Neuropsychological Testing Automated Battery (CANTAB). All the analysis controlled for age and Full-scale IQ.

Results: Adults with ADHD showed deficits in a wide range of executive functions assessed by the CANTAB. Specifically, four group comparisons with Bonferroni's correction for p values revealed that both ADHD groups showed the shorter span of short-term visual memory (SSP) and spatial working memory (SWM) than controls. However, only women with ADHD showed impaired sustained attention (RT, RVIP), inhibition control (RVIP), planning/problem solving (SOC), and set-shifting (IED), and more short-term visual memory (SSP) errors than controls and ADHD men as well. We further tested the main effects of sex and ADHD diagnosis and their interactions and found that significant group effects on all these CANTAB tasks, better performance in men than women regardless of ADHD status, significant interactions in the total usage errors of SSP, reaction times (simple and 5-choice RT) and completed stages of IED.

Conclusions: Our findings support that given same level of ADHD symptom severity, women with ADHD showed more severe deficits in several executive functions than men with ADHD. Implication will be discussed in the presentation.

Sensory processing issues and assessment in children with ADHD

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Objectives: Recent research suggests an increased recognition of and assessment for sensory processing difficulties in children with ADHD. This review aims to establish the prevalence of specific sensory processing difficulties in children with attention deficit hyperactivity disorder and to examine current measures of sensory processing for school age children with ADHD.

Methods: The review protocol was registered with PROSPERO (CRD42018091730). PRISMA guidelines were adhered to. Two databases were searched using a predetermined search string.

Results: Of 224 studies, 19 met the inclusion criteria. Sensory processing difficulties are more likely to be found when caregiver-report measures are used, relative to physiological or behavioural methods. Despite the focus to date on difficulties in auditory and tactile processing in this patient population, the reported studies show no evidence for these difficulties being more prevalent than difficulties in other sensory domains.

Conclusions: This review provides a greater understanding of the prevalence of sensory processing difficulties in children with ADHD. The best practice for assessing sensory processing difficulties, and their implications for clinical practice, are also considered.

Task switching in adult ADHD: impairments due to attentional set shifting?

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Objectives: Task switching is impaired in ADHD (e.g., Cepeda, Cepeda, and Kramer 2000). However, many tasks that have been used confound task switch (e.g., alternating between tasks like classifying number or letter) and attentional set shift (e.g., alternating between local and global focus). The current study investigated the ability of adults with ADHD to shift attentional sets in the context of switching tasks.

Methods: 38 adults with ADHD (M age = 36.14 years, SD = 12.17; 17 women) and 39 adults without ADHD (M age = 33.61 years, SD = 9.81, 19 women) were matched with regard to age, gender, educational level and IQ. The task switch experiment combined orthogonally task-switch versus repetition (i.e., classifying either letter or number), and attentional set shift versus no shift (i.e., focusing on local or on global attribute).

Results: When the attentional set was kept constant (classifying only on the global letters and number) there was no interaction of group and task switch cost ($F(1,75) = 0.595$, $p < 0.443$, $\eta^2 = 0.008$; Figure 1, left). However, the interaction of group and task switch cost was significant when a shift of attention between global/local attentional sets was required ($F(1,75) = 11.846$, $p < 0.001$, $\eta^2 = 0.136$; Figure 1, right). This also correlated significantly with diagnostic scales for inattention and impulsivity.

Conclusions: Adults with ADHD were impaired in task switching if they also had to shift the attentional set. Therefore, ADHD is associated with a deficit in flexible deployment of attention to varying sources of stimulus information. The contribution is based on the publication: Luna-Rodriguez, A., Wendt, M., Kerner auch Koerner, J., Gawrilow, C., and Jacobsen T. (2018). Selective impairment of attentional set shifting in adults with ADHD. Behavioral and Brain Functions. DOI: 0.1186/s12993-018-0150-y This research was funded by a grant within the Priority Program SPP 1772 of the German Research Foundation (Deutsche Forschungsgemeinschaft) to Thomas Jacobsen (JA 1009/13-1).

Mean reaction times and mean error percentages as a function of group (patients with ADHD, controls), target levels (constant, mixed), and task sequence (repetition, switch).

Inhibition dysfunctions and working memory in children with ADHD: a pilot study

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Objectives: The objectives are twofolds: (1) To identify the behavioral manifestations of the inhibition dysfunctions in children with ADHD and; (2) To better understand the role of the 3 inhibition subprocesses in working memory in ADHD.

Methods: A pilot study has been done on a group of 6- to 11-year-old children with ADHD ($n = 18$) and a control group of age-matched children without ADHD ($n = 9$). Children with ADHD were recruited from Child Psychiatric Clinics and mainstream schools. All children performed tasks measuring the 3 inhibition subprocesses (i.e., interference inhibition, inhibition of prepotent responses, and inhibition of ongoing responses) and their working memory. Dysfunction of a specific inhibition subprocess is defined as 1.5 SD below the Control mean in corresponding subprocess. The extent of inhibition dysfunctions in ADHD was presented using descriptive statistics. The predictive role of the 3 inhibition subprocesses in working memory was tested using Pearson's correlations.

Results: Our pilot data showed that about 50% children with ADHD displayed inhibition dysfunctions, 90% of them exhibited deficit in only one inhibition subprocess. In addition, the most frequently observed problem is Interference inhibition; it correlates with both verbal and visuospatial working memory significantly.

Conclusions: Inhibition dysfunctions or impulsivity are commonly observed in children with ADHD. However, our pilot study found that not all children with ADHD had difficulty inhibiting their behaviors. Among those children with inhibition dysfunction, majority of them presented only one type of inhibition problems and interference inhibition is the most common deficit that they had. In order to confirm these preliminary findings, a larger sample size is required.

Stress biomarkers and cognition in adolescents with ADHD

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Objectives: ADHD is a neurodevelopmental disorder with negative impact on cognitive processes and a high prevalence in childhood and adolescence. Previous studies from our research group have shown a correlation between stress-related hormones (cortisol, prolactin) and cognition in psychotic patients. The present study assesses the correlation between these hormones with cognition variables in a sample of adolescents with ADHD.

Methods: A sample of 51 adolescents diagnosed with ADHD, currently being treated at the CSPT Mental Health Center. Thirty-five subjects were male, and ages ranged from 14 to 17 years old. An early morning fasting sample of blood was drawn for cortisol and prolactin determination. Cognition variables were assessed with a complete test battery consisting of 8 subtests, using the Cambridge Cognition digital assessment system (CANTAB). Sex-stratified analyses were performed. Spearman correlation analyses were used for comparing associations between continuous variables. Significance was defined as $p < 0.05$ (two-sided).

Results: Over 86.3% of patients were receiving specific pharmacological treatment for ADHD (either psychostimulants or non-psychostimulants). No correlation was found between neither prolactin nor cortisol levels with pharmacological treatment. In males, a significant association was found between prolactin levels and stimulus rating time ($r = -0.39$, $p = 0.025$) in an executive function task (Multitasking Test). In females a significant association was found between prolactin levels and stimulus rating time ($r = -0.59$, $p = 0.026$) in a different executive function task (Stop Signal Task). Furthermore, a significant correlation was found between prolactin and poorer planning strategies on a spatial working memory task (Spatial Working Memory) ($r = 0.63$, $p = 0.016$). Cortisol levels were not associated with poorer cognitive performance.

Conclusions: Prolactin levels are related with cognition and executive functions in ADHD patients. Higher prolactin levels correlate with an improvement in several cognitive tasks (MTT, SST) but also with poorer planning strategies (SWM). Such association is not found for cortisol neither in males nor females. This correlations and its clinical implications will be discussed.

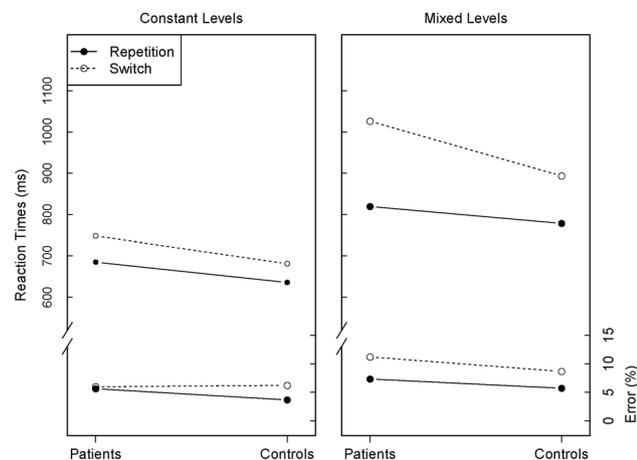


Fig. 4 .

ADHD is linked to procrastination: role of expectancy and impulsiveness

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Objectives: The relationship between ADHD and procrastination is recognized among therapists and educators. However, only a small number of studies confirm this correlation and offer a theoretical explanation. A model of procrastination that attempts to explain the tendency to delay the execution or completion of tasks, despite the intention to perform them, exists in Steel's Temporal Motivation Theory. According to this theory, procrastination is fostered by several motivational factors including the low expectancy of completing the task successfully, task aversiveness, and impulsiveness, the sensitivity to the delay until realization. The temporal motivation theory has been validated using scales designed to probe the different

motivational factors. This study aims to establish the correlation between procrastination and ADHD and to identify factors that mediate this correlation.

Methods: Ninety-nine adult participants completed an online survey containing demographic background and scales of adult ADHD symptoms, procrastination, expectancy, task aversiveness and impulsiveness.

Results: Level of ADHD symptoms correlated with higher levels of procrastination, task aversiveness and impulsiveness, as well as with lower expectancy. Mediation analysis suggested that the link between ADHD and procrastination was partially mediated by level of expectancy and impulsiveness.

Conclusions: These findings help establishing the correlation between ADHD symptoms and procrastination, while demonstrating that the relationship is partially explained by low expectancy of completing task successfully and by high levels of impulsiveness. Future research is warranted for further understanding the relationship between procrastination and ADHD, and for designing effective interventions for managing this functional impairment.

Emotional dysregulation: a case of ADHD perceived as cyclothymic disorder on an adult patient

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Objectives: Emotional Dysregulation (ED) is characterised by impulsivity, low frustration tolerance, irritability and mood lability. Clinically significant levels of ED are present 70–90% of adults with ADHD, with marked functional impairment associated. Some authors consider poor emotional regulation the third core domain of ADHD. ED is also present in bipolar disorder (BD), spectrum related disorders and borderline personality disorder (BPD), contributing to a challenging differential diagnosis. Description of a clinical vignette of an ADHD patient presenting with an atypical, overlapping and ambiguous presentation, resulting in a late accurate diagnosis.

Methods: Literature revision was made by searching for studies about ED in ADHD at PubMed and Cochrane databases; review of patient's clinical process.

Results: A 44-year-old woman, referenced by her general practitioner for sadness, restlessness and multiple somatic symptoms, allegedly secondary to anxiety and depression. At the first appointment, patient described consecutive days feeling depressed, alternated with others feeling euphoric, however the episodes never lasted more than 2 weeks, had mild intensity and no labour repercussions. No previous history of major affective episodes. Persistent instable mood was accompanied by sensation of confused thinking, forgetfulness, anxiety and insomnia. Symptoms were perceived as cyclothymia, and a mood stabilizer and an anxiolytic were initiated with only partial response: fewer, but still frequent, mood swings; less anxious, but still restless. Only 2 years later, after various treatment adjustments, the hypothesis of instable mood could result from a poor emotional regulation in ADHD was advanced. DIVA scale was applied and revealed positiveness in 8 of 9 items, both for inattention and hyperactivation. Methylphenidate extended release was then started, with excellent response in attention, hyperactivity and mood.

Conclusions: This case report highlights the importance of a careful diagnostic approach in patients with persistent minor mood swings due to emotional dysregulation, which could be confounded with affective or personality disorder, maintaining ADHD undiagnosed.

Evaluation of teacher ratings regarding emotional intelligence in primary school children with ADHD

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Objectives: Primary school children with Attention Deficit Hyperactivity Disorder (ADHD) may show deficiencies in social skills in school settings. Students who have low emotional intelligence (EI) were reported by their teachers as having more behavioral problems. This study aims to evaluate EI and teachers' behavioral ratings in a group of children between 7 and 13 years who referred to child psychiatry outpatient clinic with ADHD complaints compared with controls having similar age and sex.

Methods: Clinical psychiatric diagnoses were established by using the Kiddie Schedule for Affective Disorders and Schizophrenia Present and Lifetime Version. Teachers filled out Conner's Teacher and DSM-IV ADHD Checklists. EI was rated by using Bar-On EI Quotient Inventory Youth Version. Intelligence Quotient (IQ) assessments were made by using Wechsler Intelligence Scale for Children-Revised. Student's *t*-test is used for further comparative analysis, whereas regression analysis was used for predictive factors (SPSS 20.0 descriptive statistics).

Results: The treatment-naïve ADHD group consisted 65 children (mean age: 10.34 ± 1.86 ; 48 male, 17 female) and 61 healthy controls (mean age: 10.16 ± 1.69 ; 21 male, 40 female). The ADHD severity was determined as moderate according to Clinical Global Impairment Scale and the diagnosis age was 8.6 ± 2.11 . EI domains ($p < 0.001$) in children with ADHD were significantly lower than the control group. Hyperactivity subscale scores of Conners' ratings revealed significance inversely in relation to EI scores ($p < 0.05$). Verbal IQ scores were positively related to higher EI levels in ADHD group ($p < 0.05$). Moreover, absence of an ADHD diagnosis was a predictive factor of the level of EI in children.

Conclusions: The identification of possible deficits of EI in ADHD subgroups might enhance the possibility of early intervention that could lead to better academic fulfillment in school settings. Teachers may play an important role in directing families about psychosocial issues related to ADHD.

Examining the neuropsychological functions and psychosocial problems in preschool ADHD: from the situational perspective

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Objectives: Although in DSM-5, the criteria symptoms of ADHD, inattention, hyperactivity, and impulsivity have to present different cross situations (e.g., home, and school). However, studies found some children with ADHD symptoms were not concordance between parents' and teachers' report, and their ADHD symptoms are present in only one setting, either at home or at school. The current study aimed to examine the situational ADHD might have different problems behavioral pattern, neuropsychological functions, and family characteristics compared to children with pervasive ADHD (ADHD symptoms presented in most settings, including at home and school).

Methods: The current study enrolled 37 pervasive ADHD, 29 school-only ADHD, 29 home only ADHD, and 110 typically developing (TD) preschoolers. The neuropsychological function measured by the Conners' Kiddie Continuous Performance Test, flanker task, and day

night stroop, ADHD symptoms, external and internal problem behavior, and parental stress were assessed.

Results: The pervasive ADHD had impairment in neuropsychological function. Their parents also had higher parental stress than TD. The school-only ADHD had similar impairment in neuropsychological function. However, their parents had equal parenting stress compared to the TD group. Also, the family-only ADHD had higher parental stress than TD; they did not show deficits in neuropsychological function.

Conclusions: The current study supported that the parental reports of ADHD symptoms are sensitive to parenting stress rather than neurocognitive functions, whereas teacher reports tend to be more strongly associated with neurocognitive functions. However, the ecological relevance of different informant ratings should be clarified in future studies.

Understanding the neuropsychological mechanism of a self-monitoring intervention in the classroom for symptoms of ADHD: a pilot study

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Objectives: Self-monitoring interventions can be applied in the classroom to reduce off-task behavior of students. The objective of this study was to replicate previously found behavioral effects of a self-monitoring intervention in children with symptoms of ADHD, and to explore effects on executive functions. It was hypothesized that off-task behavior would reduce and that the intervention might improve inhibition, working memory and/or attention.

Methods: Seven boys in primary special needs education participated in an intervention using an interval timer during math classes to remind them to monitor whether they were still on task. Behavioral effects were assessed by means of observations and teacher ratings before, during and after three intervention weeks (ABA-design), and tested using a GLM repeated measures analysis. Effects on executive functions were assessed pre- and post intervention by means of neuropsychological tests for inhibition, working memory and attention, and analyzed using t-tests.

Results: The classroom observations showed a decline in off-task behavior in the intervention period compared to baseline and these effects lasted in the week after cessation of the intervention (post intervention) ($p < .001$), and both results were confirmed by teacher ratings ($p < .001$). The effects of the intervention on executive functioning were less consistent than the effect on behavior, and only significant improvements in inhibition were found ($p < .001$ and $p = .047$). The teachers as well as students evaluated the intervention mainly as positive.

Conclusions: Some students with ADHD-symptoms clearly benefit from a self-monitoring intervention, with an average to large effect on observed classroom behavior. The effect on cognition seems pertained to inhibition. Further research with a control group is necessary to control for a potential testing effect and confounding factors. The evaluations with teachers and students support the promising conclusions and social validity of the intervention.

Inhibition in the antisaccade task: an endophenotype for ADHD

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Objectives: A deficit in response inhibition has been documented in individuals with ADHD (Munoz, Armstrong, Hampton, and Moore 2003) and hypothesized to underpin the characteristic behavioral manifestations of the disorder (Barkley 1997). In this study we aim to (1) assess if higher levels of inhibition errors (deficit) differentially predict higher levels of ADHD traits in late childhood and, (2) assess the heritability of both these measures, using a classic twin design.

Methods: We embedded a response inhibition eye tracking task (the antisaccade task) within a twin study of children from the general (twin) population. The final sample consisted of 298 pairs between the ages of 9–12 years (50% Monozygotic) from the Child and Adolescent Twin Study in Sweden (CATSS). We use linear regression (accounting for intra-pair relatedness) to predict response inhibition deficits (commission errors and anticipatory eye movements in the antisaccade task) from inattention and hyperactivity behaviors (Conners-3P), while controlling for IQ, age, sex, and autistic-like traits. We estimate genetic and environmental effects comparing intra-class Pearson correlations of monozygotic (MZ) and dizygotic (DZ) twin pairs.

Results: There was a unique significant relation between the percentage of anticipatory eye movements and inattention ($p = .042$), but not with Hyperactivity. This, relation held after accounting for sex, age, and IQ. Intra-class correlation comparisons confirmed the expected genetic effect on ADHD traits (MZ: $r = .715$, $p < .001$; DZ: $r = .153$, $p = .031$) and percentage of anticipatory eye movements (MZ: $r = .526$, $p < .001$; DZ: $r = .137$, $p = .044$). We found no relation between ADHD traits and the % of commission errors.

Conclusions: The relationship between percentage of anticipatory eye movements and inattention traits, combined with the strong genetic effects for both measures suggested by the intra-class correlations of MZ and DZ twins, suggests potential for this measure as an endophenotype for inattention. Future analyses will use multivariate twin modeling to directly assess the nature of the observed association.

Prevalence and impact of under- or misdiagnosed ADHD in adults referred for the treatment of mood and anxiety disorders

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Objectives: The comorbidity between Attention-Deficit Hyperactivity Disorder (ADHD) and psychiatric disorders has been well documented. Still, many clinicians fail to screen adult patients for ADHD, despite evidence that adolescents with a history of ADHD are significantly more likely to develop anxiety and depression by adulthood. The aim of this study was to determine the percentage of patients with under- or misdiagnosed ADHD referred for the treatment of mood and anxiety disorders.

Methods: Data was collected from consecutive referrals (N = 160) to a tertiary-care mood and anxiety clinic. Diagnosis was established by the Mini International Neuropsychiatric Interview Plus (MINI) 6.0.0, ADHD module, and semi-structured interview. Chi-square analyses were performed to assess group differences and predictive factors.

Results: Adult ADHD was present in 36.9% of referrals, 29.4% had comorbid anxiety, and 20.6% had comorbid depression. Misdiagnosed ADHD occurred in 28.7% of referrals $X^2(4) = 44.8, p < .001, \Phi = .529$. In treatment-resistant referrals 38.2% of GAD and 34% of depression had comorbid ADHD, with 4.4% and 100% undetected respectively. The main predictive factor of misdiagnosis was number of referral diagnosis $X^2(9) = 39.5, p < .001, \Phi = .597$.

Conclusions: ADHD is a common and treatable disorder that it is often under- or misdiagnosed in adults presenting with mood and anxiety disorders. This study signifies the importance of early and accurate diagnosis of ADHD in adults presenting with mood and anxiety disorders. Increased awareness and use of screening tools may allow for selection of targeted treatment and improved clinical outcomes.

The distinguishing characteristics of pure Sluggish Cognitive Tempo from ADHD with and without Sluggish Cognitive Tempo in an epidemiological sample

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Objectives: Sluggish Cognitive Tempo (SCT) is a distinct disorder from Attention Deficit Hyperactivity Disorder (ADHD) and has unique symptom domains such as daydreaming, thinking slowly, decreased energy and absent-mindedness. The objectives of our study are to ascertain distinguishing features of pure SCT from ADHD and ADHD comorbid SCT and determine the correlations between SCT symptom severity and several psychopathological fields.

Methods: 198 Turkish school children aged 7–11 years in 4 cities were evaluated. As parents filled out Child Behaviour Checklist (CBCL), teachers completed Teacher's Report Form (TRF). Barkley Child Attention Survey were filled out by all participants' parents and teachers. We divided the epidemiological sample into four groups: participants having no psychopathology, having pure SCT, ADHD without SCT and ADHD with comorbid SCT. These 4 groups were compared in terms of 11 domains in CBCL and TRF. Also psychiatric diagnoses were assessed using K-SADS (Schedule for Affective Disorders and Schizophrenia for School-Age Children).

Results: CBCL scores showed us the whole CBCL subscale scores except delinquency were significantly higher in SCT + ADHD group than the group without psychopathology ($p < 0.05$). When TRF scores were reviewed, interestingly all SCT groups (pure SCT, SCT + ADHD) had greater somatization problems scores than non-SCT groups ($p < 0.001$). Moreover we found significantly higher scores in 8 subscales in pure SCT group than in ADHD group ($p < 0.05$). However delinquency, aggression and externalization problems scores were not significantly higher in pure SCT compared to ADHD group ($p = 0.387; p = 0.646; p = 0.746$). It was ascertained that there are medium–high level of positive correlations between SCT symptoms and attention problems, withdrawn and internalization problems ($p < 0.001, r = 0.667; r = 0.666; r = 0.601$).

Conclusions: Current study corroborate SCT to be seen more likely with internalizing problems and to have a negative relationship with externalizing problems, unlike ADHD. Furthermore results suggest that somatization problems are much more relevant with SCT than ADHD.

Evaluation of joint attention abilities in children with ADHD: an eye tracking study

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Objectives: The aim of this study is to investigate autistic traits linked to responding joint attention (RJA) abilities using eye tracking in children with ADHD, and compare typical developing children.

Methods: Male children (6–10 years) with ADHD ($n = 31$) were first diagnosed and 30 typically developing children matched for age and gender were included. K-SADS was conducted and diagnosed ADHD according to DSM-5. Sociodemographic Data, CBCL/6-1Parent Form, CPRS-R/L,SRS were completed by parents.Intelligence levels of children were assessed with WISC-IV.RJA abilities were evaluated by an eye tracking system.Congruent/incongruent and male/female children videos were displayed on the computer screen without any task.Gaze to the target and face,eye,mouth regions of children were determined as area of interests (AOIs).Dwell times were measured.Statistical evaluations and analyses were performed using IBM SPSS 24.0.Eye tracking datas were recorded using SMI iView X™ systems (500 Hz).

Results: Children with ADHD had significantly higher scores of CBCL/6-18, CPRS-R/L, SRS. In CBCL, ADHD group had significantly positive AT profile versus controls (38.7% vs. 0%), elevated ratings of ASD traits in SRS, lower Processing Speed Index (PSI) scores. Autistic traits were positively correlated with CBCL/6-18, CPRS-R/L (anxious/shy), negatively correlated with PSI in the whole sample. Healthy children looked significantly longer at the target ($p < 0.001$) Target dwell time on incongruent conditions were significantly longer than congruent conditions in both groups. Unless there was no significant difference in terms of dwell time on faces and eyes, dwell time on mouth is significantly longer in ADHD group. There were significant relationships between autistic traits and dwell times for target and mouth.

Conclusions: This research showed that in children with ADHD, RJA difficulties are found to be associated with autistic traits as well as ADHD symptoms.ADHD group is more interested in the mouth region of the face.These differences during visual attention to social stimuli in this group bring about insufficiencies in social interaction and communication.Poor RJA ability has an important role in the interventions on social development focusing autistic traits in ADHD.

ADHD/autism spectrum disorder traits and exposure to pesticides: a systematic review

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Objectives: The etiology of neurodevelopmental disorders is multifactorial. Exposure to chemicals may adversely affect neurodevelopment through various toxicological pathways. There is an increasing amount of research showing that pesticides and agrotoxics may increase the risk of neurodevelopmental disorders. However, to date no evidence synthesis has been conducted. To fill this gap, we conducted a systematic review of population-based studies assessing the relationship between pesticides and agrotoxics during pregnancy and early childhood Attention-Deficit/Hyperactivity Disorder (ADHD) or Autism Spectrum Disorder (ASD).

Methods: Studies published in English up to December 2018 were searched using PubMed, Ovid, Medline, PsycINFO and Web of Science databases. Studies that assessed pesticide exposure (e.g., via

questionnaire or interview) or measured pesticide or metabolite levels in biological specimens from study participants or their immediate environment were eligible for inclusion. Two researches selected independently the studies. Disagreements were solved by a third senior author.

Results: From a pool of 772 potentially relevant studies, 28 were retained, including 12 focusing on ADHD, 14 on ASD, and two on both ASD and ADHD. Of these, eight reported a significant association between exposure to pesticides (Organophosphate, Pyrethroid pesticide, Organochlorine pesticides, Trichlorophenols) and ADHD symptoms. Twelve studies reported a significant association between exposure to pesticides (Organophosphate, Pyrethroid pesticide, Organochlorine pesticides, Imidacloprid) and ASD or ASD traits.

Conclusions: The majority of the studies included in this systematic review suggest a significant association between exposure to pesticides/agrotoxics and ADHD or ASD, albeit their results should be considered with caution due to a number of methodological issues. A meta-analysis is warranted to gain quantitative insight into this possible association.

Shared and distinct executive function profiles between ADHD and autism spectrum disorder: a meta-analysis

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Objectives: Autism spectrum disorder and ADHD are commonly comorbid and often exhibit overlapping executive dysfunction. Existing studies on the profiles of executive function (EF) comparing ASD and ADHD are highly inconsistent. Clarification of shared and distinct EF profiles in patients with ASD, ADHD and ASD + ADHD may be critical for understanding and differentiating biological substrates and cognitive phenotypes associated with these disorders. The primary objective of this meta-analysis was to analyze specific executive function profiles among these groups.

Methods: The Embase, Medline and psychINFO databases were searched to identify peer-reviewed studies published since the inclusion of Autism in DSM-III (1980) up to the end of Dec 2018 that compared EF in ASD with ADHD.

Results: A total of 46 studies comprising 12,683 participants were included (N, ASD = 4210, ADHD = 8473). Results showed that individuals with ASD and with ADHD didn't show different profile in overall EF ($g = -0.02$, $[-0.12, 0.08]$), working memory ($g = -0.01$, $[-0.14, 0.12]$), and inhibition ($g = 0.13$, $[-0.05, 0.31]$), but individuals with ASD were slightly impaired in flexibility ($g = -0.28$, $[-0.67, -0.08]$ $p = 0.01$), fluency ($g = -0.3$, $[-0.51, -0.09]$ $p < 0.001$), and planning ($g = -0.34$, $[-0.60, -0.09]$ $p < 0.01$). Two separate meta-analyses were conducted to compare ASD and ADHD with ASD + ADHD. There is no difference between ADHD and comorbid ASD + ADHD ($g = 0.05$, $[-0.10, 0.19]$) while ASD performed better than individuals with ASD + ADHD ($g = 0.37$, $[0.22, 0.51]$) in overall EF profile.

Conclusions: This meta-analysis confirmed similar overall executive dysfunction in ASD and ADHD, but ASD have specific EF deficit profiles in flexibility, fluency, and planning. In terms of EF, comorbid brought extra impairment on ASD, while it had no significant influence on ADHD. Our results provide insights into the shared and distinct executive function profiles between ADHD and ASD, suggest possible endophenotypes for etiological research, and specific targets for intervention.

Topic: Pharmacological treatment

Examination of different responder criteria applied post hoc to select short-term, randomized, controlled trials of lisdexamfetamine dimesylate in children and adolescents with ADHD

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Objectives: Lack of consensus regarding how best to define treatment response hinders translation from trials to the clinic. These post hoc analyses examine three commonly used response criteria in four late-phase trials of lisdexamfetamine dimesylate (LDX) in children and adolescents with ADHD.

Methods: Data were analysed from four short-term, randomized, clinical trials of LDX (30 mg to 70 mg) that included placebo and/or active comparators. Response was defined post hoc as Clinical Global Impressions-Improvement (CGI-I) score of 1 (very much improved) or 2 (much improved) plus a reduction in ADHD-RS-IV total score of $\geq 30\%$ or CGI-I scores of 1 or 2 plus a reduction in ADHD-RS-IV total score of $\geq 50\%$ or an ADHD-RS-IV total score ≤ 18 .

Results: At endpoint, LDX response rates varied between studies but were generally higher for the least stringent criterion of a CGI-I score of 1 or 2 plus a reduction in ADHD-RS-IV total score of $\geq 30\%$ (range 69.6%–82.6%) than for the stricter and roughly equivalent criteria of a CGI-I score of 1 or 2 plus a reduction in ADHD-RS-IV total score of $\geq 50\%$ (range 59.8%–74.8%) or an ADHD-RS-IV total score ≤ 18 (range and 56.7%–79.9%).

Conclusions: These post hoc analyses demonstrated that response rates were similar for an ADHD-RS-IV total score of ≤ 18 and at least a 50% reduction in ADHD-RS-IV total score plus CGI-I score of 1 or 2. The least stringent criterion of a $\geq 30\%$ reduction in ADHD-RS-IV total score plus a CGI-I score of 1 or 2 resulted in higher response rates and may be considered a partial response. Some variability in response rates across different trial designs was observed.

Long-acting form of guanfacine: better as a combination therapy with stimulants?

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Objectives: How well were children and young people prescribed Long Acting Guanfacine doing either as a monotherapy or in combination with stimulant medications for ADHD.

Methods: Records of 46 children prescribed Long Acting Guanfacine (Intuniv) over the last 18 months in Mid Essex where studied and parents contacted about how well they are getting on?

Results: 10 children had stopped the medication due to side effects or lack of response. Out of the 36 children on medication 18 where on Guanfacine as a monotherapy and 18 where taking it along with a stimulant (10 on Lisdexamfetamine and 8 on Methylphenidate). The children on a combination therapy had an average satisfaction score of 8/10 satisfaction score compared to 6.5/10 on Guanfacine alone. There was no statistical difference between LDX + Guanfacine versus MPH + Guanfacine.

Conclusions: It seems that combination treatment may be better than monotherapy for Guanfacine.

Evaluation of the response of lisdexamfetamine in children and adolescents with ADHD: quasi-experimental study

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Objectives: To evaluate the Lisdexanfetamine response in Mexican pediatric patients with ADHD.

Methods: We designed a quasi-experimental, uncontrolled before and after study to evaluate the LDX response in patients with severe ADHD. We established a diagnosis of ADHD according to DSM-5 criteria. We formed three groups: without previous treatment (group A), in treatment with stimulant drugs (group B) or in treatment with non-stimulant drugs (group C). Prior to the start of the study, letters of consent and informed consent were signed. We evaluated the effect of LDX based on the difference between ADHD-RS scores at the beginning and after 6 months.

Results: We recruited a total of 144 patients (group A: 48 patients, group B: 57 patients, group C: 39 patients). All the groups showed a significant decrease in the mean score of ADHD-RS (Attention Deficit Hyperactivity Disorder Rating Scale) at 6 months (group A 37.57 vs. 22.34, $p < .01$), (group B 36.72 vs. 24.45; $p < .01$), (group C 38.54 vs. 24.3, $p < .01$). Fewer than 30% of the subjects showed a significant adverse reaction, the most frequent ones being: sleep disturbance (primary insomnia) 24% and decreased appetite in 20%.

Conclusions: Treatment with LDX is an effective, well-tolerated pharmacological option for Mexican pediatric patients with ADHD.

ADHD polygenic risk and drug treatment response in over 15,000 ADHD cases

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Objectives: Stimulant drugs are first line pharmacological treatment for ADHD, yet there is considerable variability in treatment response. Approximately 25–30% of individuals receiving stimulant ADHD-treatment have poor treatment response or adverse side effects, often leading to treatment discontinuation or switching to non-stimulant drugs. Few individual characteristics have been robustly associated with treatment response, and there is lack of well-powered pharmacogenetic research in ADHD. The objective of this study was to investigate whether ADHD genetic risk is associated with drug treatment response, using the largest pharmacogenetic sample on ADHD to date.

Methods: The Danish iPSYCH study is a unique population-based sample including genetic and nationwide prescription data on 15,385 ADHD-cases born 1981–2005. We estimated individual polygenic risk scores (PRS) for ADHD-cases and defined treatment outcomes from redeemed prescriptions in the Danish National Prescribed Drug Register between 1995 and 2016. Outcomes included drug treatment-initiation and treatment response, defined by switching from stimulant to non-stimulant drugs or discontinuation within 365 days of treatment-initiation. Associations between ADHD-PRS and treatment outcomes were estimated as Odds Ratios [ORs] using logistic regression.

Results: A total of 13,459 ADHD-cases (87%) initiated drug treatment during follow-up, of which 12,650 (94%) received stimulants as first-line treatment. Among these, 1080 individuals switched to a non-stimulant drug and 1789 discontinued treatment, within 365 days of treatment-initiation. There were no significant associations between

ADHD-PRS and treatment-initiation (OR 1.04, 95% CI 0.99–1.10), switching (OR 1.05, 95% CI 0.98–1.12), or discontinuation (OR 0.98, 95% CI 0.93–1.03).

Conclusions: Our findings suggest that common genetic variants linked to ADHD, and captured by a PRS, do not predict the likelihood of receiving ADHD drug treatment or treatment response defined from prescription data, in those diagnosed with ADHD. As such, ADHD-PRS cannot currently be used to predict individual treatment response in a clinical setting. Next, we will estimate the SNP-based heritability of ADHD-treatment response and test for association with genetic variants previously linked to stimulant-drug efficacy.

Relationship between baseline ADHD severity and the efficacy of pharmacological treatment for ADHD: a meta-analysis and meta-regression

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Objectives: To determinate the relationship between baseline ADHD symptom severity in randomized, placebo-controlled clinical trials (RCT) and its efficacy in improving the severity of symptoms in patients with ADHD. In addition, to determinate the proportion of between-RCT efficacy variability that is due to differences in baseline ADHD symptom severity.

Methods: We carried out a systematic review of RCT investigating the efficacy of pharmacological treatment for patients with ADHD whose ADHD symptom severity was assessed with an ADHD rating scale ranging from 0 to 54. Mean difference (MD) and 95% confidence interval (CI) of the efficacy results from each RCT were calculated. MD were pooled using a random effects model. Heterogeneity was assessed using the I² parameter and publication bias by drawing a funnel plot. The relationship between baseline ADHD symptom severity and efficacy was studied by means of meta-regression. Publication bias was investigating by drawing a funnel plot. Statistical analysis was performed with Comprehensive Meta-Analysis software.

Results: Up to 72 RCT that investigated the efficacy of pharmacological treatment were included. These RCT involved 79 drug-placebo comparisons, enrolled 16,083 patients and had a mean baseline ADHD score of 38.5 ranging from 30.4 to 46.9. Overall efficacy was -7.46 (95% CI from -8.28 to -6.64) with a high heterogeneity (I² = 75.15%). Funnel plot was reasonably symmetrical. The effect of baseline ADHD severity over efficacy was -0.31 (p value = 0.006). The moderating effect of baseline ADHD severity explained 19% of between-RCT efficacy variability.

Conclusions: Baseline severity modifies the efficacy of pharmacological treatment for patients with ADHD in the following way: the more severe the ADHD symptoms are, the greater the efficacy of pharmacological treatment.

A clinical observation on curative effect of Jing Ling oral liquid on 33 children with ADHD

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Objectives: Jing Ling oral liquid (JLOL), a kind of Chinese herbal medicine compound, which consists of Rehmannia Radix Praeparata, Moutan Cortex, Polygalae Radix, Acori Tatarinowii Rhizoma, Cortex

Phellodendri et al, has been used to treat attention deficit hyperactivity disorder (ADHD), based on traditional Chinese medicine (TCM) theory for more than 20 years and obtained good therapeutic effect. In this study, we observed the curative effect of Jing Ling oral liquid on 33 children with ADHD who are of Liver-Kidney Yin deficiency, so as to evaluate the effect of Jing Ling oral liquid on ADHD and find a better way to treat ADHD.

Methods: The self-control experiment was conducted over 33 cases of children with ADHD (between the age of 6–12) who were of Liver-Kidney Yin deficiency. They were selected according to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) and guidelines for the diagnosis and treatment of common diseases in traditional Chinese pediatrics (published by China Press of TCM in 2012). These children were treated with Jing Ling oral liquid for 12 weeks and contrast was made before and after treatment. Swanson children's behavior scale (Swanson, Nolan and Pelham IV, SNAP IV) and audio-visual integrated continuous attention tester (IVACPT, made by Brain train USA) were used before and after treatment to record the changes of attention deficit, hyperactivity and impulsivity. Meanwhile, we also observed the syndrome changes according to TCM syndrome score scale.

Results: (1) SNAP-IV: Compared with those before treatment, 18 cases had a reduction rate of more than 40%. The overall curative effective rate was 54.5%. The scores of hyperactivity-impulsivity and Oppositional defiant disorder (ODD) showed a significant decrease and the difference between the before and after treatment was statistically significant ($P < 0.01$). There was no statistically significant difference in scores of attention deficit ($P > 0.05$). (2) IVA-CPT: The control quotient (CQ) of children with ADHD increases after the treatment. Difference between the before and after treatment was statistically significant ($P < 0.01$). But the change of attention quotient (AQ) has no statistically significant difference ($P > 0.05$). (3) TCM syndrome score scale: Compared with those before treatment, the main symptoms such as hyperactivity, restlessness, talkativeness, impulsiveness, petulance, irritability, and subsymptoms such as dry mouth and drinking too much, short and yellow urine, dry stool, were significantly improved ($P < 0.01$). Meanwhile, the main symptom of attention deficit and the sub-symptom of learning difficulty were not significantly improved, and the difference was not statistically significant ($P > 0.05$).

Conclusions: Jingling oral liquid can effectively improve the core symptoms of ADHD children—hyperactivity and impulsivity, and reduce the degree of ODD, with few adverse reactions. The results of this study showed that jingling oral liquid did not significantly improve the attention deficit and learning difficulties, which may be due to the short observation time of treatment, or the small sample size. Because education and training are also important in improving attention deficit and learning difficulties. In addition to drug treatment, only by developing a good study habit can they have a good academic achievement.

Use of ADHD medication in pregnancy in Norway, 2005–2015

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Objectives: To describe recent trends in ADHD medication use in pregnancy in Norway, characteristics of users, and patterns of use.

Methods: We used data from the Norwegian Prescription Database linked to the Medical Birth Registry to evaluate use of ADHD medication in pregnancy from 2005 to 2015. We described the prevalence of use defined as ≥ 1 prescription filled from 3 months

before pregnancy to delivery, by age and year. We described characteristics, including co-medication with other psychotropic drugs, of pregnant women who used ADHD medication versus those without use. We also interpreted the patterns of use based on prescriptions filled within each pregnancy trimester, and in the 6 months before and after pregnancy.

Results: From 2005 to 2015, 1380 women used ADHD medication in 1538 pregnancies (0.24%) and increased from 0.4 users per 1000 pregnancies to 3.9/1000. 86.9% used methylphenidate, 7.5% atomoxetine, 6.6% dexamphetamine, 1.6% amphetamine; 2.6% used more than one drug during pregnancy. Prevalence was highest amongst the youngest women (< 20 years, 16.8/1000) and decreased with age. Pregnant women who used ADHD medication more likely to be nulliparous, single, and to smoke. 19.6% also used anxiolytics, hypnotics and sedatives, 15.4% antidepressants, 15.0% opioids, 7.7% antipsychotics, and 4.9% antiepileptic drugs. In 42.3% of pregnancies, prescriptions were filled only during 3 months before pregnancy while 57.7% filled within at least one trimester. The use was highest in the first trimester and decreased in the subsequent trimesters (Figure 1). 88% discontinued use, 11% continued use, and 1% initiated ADHD medication during pregnancy. Among those who discontinued, 34% re-initiated in the 6 months following pregnancy.

Conclusions: Use of ADHD medication in pregnant women has increased substantially in recent years. However, most discontinue use in pregnancy and only around one third of those women re-initiate in the 6 months after giving birth.

Timing of ADHD medication use in relation to pregnancy.

Indications for antipsychotic use in children and adolescents with neurodevelopmental disorders: a retrospective study

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Objectives: To explore indications for initiating antipsychotics in terms of symptom profile of those patients attending neurodevelopmental clinics in Northumberland.

Methods: A retrospective chart review was carried out in those patients attending neurodevelopmental clinics in Northumberland who were prescribed antipsychotics in the time period between January 2017 and December 2018 (24 months).

Results: The study sample included 28 males and 2 female clients (male: female ratio of 14:1). In terms of symptom profile, the recorded indications for antipsychotic use included motor/vocal tics ($n = 4$, 13.33%); short-term treatment of severe aggression associated with conduct disorder ($n = 4$, 13.33%); short-term treatment of severe aggression in autism ($n = 8$, 26.66%); impulsivity, oppositionality and aggression associated with ADHD ($n = 14$, 46.66%). There was no statistically significant difference between indications/symptom profile based on age, gender or the antipsychotic used.

Conclusions: Frequent use of antipsychotics in ADHD in this population youth is potentially associated with adverse effects (both short and long term) including (but not limited to) extra-pyramidal effects, sedation, prolactin changes and age-inappropriate weight gain as well as metabolic abnormalities. It also gives rise to the question of possibly missed comorbidities including conduct disorder or intermittent explosive disorder (with ADHD). These results may also suggest that non-medication treatment options for ADHD treatments including behavioural and parenting training are underutilised. Also, in some cases, this may indicate sub optimal doses of ADHD medication which might have been optimised first to avoid the need for antipsychotic use. In particular, off-label use of antipsychotics in this

vulnerable population merits special attention considering the rapid expansion in scope of these medication for different indications, the absence of definitive guidelines for prescribing off-label antipsychotics, lack of objective markers for aiding decision making, need for regular physical health monitoring and the lack of standardisation of use in different clinical settings including child mental health and paediatric clinics.

Combination therapy with stimulants and non stimulants in ADHD: effectiveness and tolerability

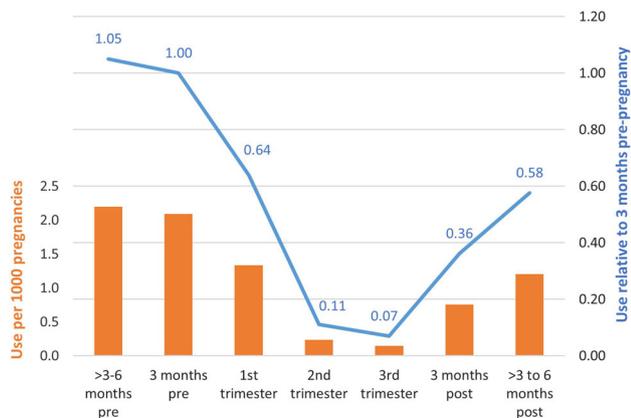


Fig. 5

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Objectives: 1. To identify clinical profile and prescribing pattern of those children and adolescents prescribed a combination of stimulants and non-stimulants for ADHD 2. To evaluate clinical effectiveness and safety profile of this combination.

Methods: We carried out a retrospective review of those children and adolescents attending neurodevelopmental clinics in Northumberland who were prescribed a combination of stimulant (methylphenidate/lisdexamfetamine) and non-stimulant medication (atomoxetine). The time frame for the review was January 2017 to December 2018 (24 months).

Results: We identified 18 out of a total of 300 patients who were prescribed the above combination of medication ($n = 6\%$). The mean age of the study population was 13.67 years (SD: 1.24). While 16 out of 18 were on preparations of methylphenidate, other 2 were on lisdexamfetamine (in addition to atomoxetine). The daily dose range for methylphenidate was 27–63 mg (Mean: 36.78; SD: 1.45); 30–50 mg for lisdexamfetamine (Mean: 42.87; SD: 1.29) and for atomoxetine was 10–40 mg (Mean: 32.88; SD: 1.89). The most common diagnoses recorded for these patients include ADHD ($n = 11$, 61.11%); ADHD with tic disorder ($n = 4$; 22.22%) and ADHD with ASD ($n = 3$, 16.67%). Methylphenidate was started first in 14 out of the 18 patients (77.77%) and atomoxetine was started earlier in the other four patients (22.23%). The reasons cited for use of this combination included a transient period of cross tapering one medication with another ($n = 10$; 55.56%); partial effectiveness of one of the medication ($n = 4$; 22.22%) and balancing of side effects (including effect on sleep, appetite, anxiety symptoms and tics) ($n = 4$; 22.22%).

Adverse effects were reported in only 1 out of 18 patients (5.56%) who complained of light headedness and giddiness while it was tolerated well in all the other patients. The mean CGI-S score at baseline (at the time of combining medication) was 4.87 (SD: 0.67) and the mean CGI-S score at the subsequent appointment (after combining medication) was 2.24 (SD: 0.23) ($p < 0.01^{**}$).

Conclusions: This study in addition to the previous literature suggests there is a definite role for combining stimulants with non-stimulants in at least a group of patients with ADHD and that the tolerability to this combination is generally satisfactory. Complementary mechanism of action of these two medication on dopamine and norepinephrine; differing half-life/duration of action and the milder (though similar) side effect of profile of atomoxetine as compared to methylphenidate provides a theoretical rationale for this combination. More prospective studies on patients with ADHD on this combination regimen are required to shed more light on the same.

Summary of clinical profile and indications for medication use.

Table 1: Characteristics of study population

Variable	N/Mean	%/SD
Age	13.67	1.24
Gender		
Male	16	88.89
Female	2	11.11
First started medication		
Stimulant	14	77.77
Non-stimulant	4	22.23
Indications		
Cross tapering	10	55.56
Partial effectiveness	4	22.22
Balancing side effects	4	22.22

Pharmacological interventions for ADHD in preschool children: a systematic review

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Objectives: ADHD is estimated to affect between 1.5 and 5.7% of preschool-age children. Despite there are good scientific evidence of preschool-onset ADHD diagnostic validity and stability, this subpopulation is far less studied than school age-onset ADHD children. Specifically, there are several unanswered questions regarding the treatment. Here we report the preliminary results of the first review of pharmacological treatments (stimulant and non-stimulant) of preschool children with ADHD.

Methods: We conducted a systematic and comprehensive search for papers, published and unpublished RCTs meeting the inclusion

criteria until July 2018 in Medline, EMBASE, WHO -ICTRP, and ClinicalTrials.gov. Studies were included if they met the following criteria: 1. Included at least some children younger than 6 years of age that had a diagnosis of ADHD, or exhibited behavior problems that are part of the ADHD diagnostic criteria; 2. Involved pharmacological intervention aimed at ADHD symptoms, and included an outcome measure to monitor ADHD symptoms. We used common MeSH terms for participants (all variants of ADHD), young children, preschool children (the terms “child*” or “preschool*” were used to capture research on children in the target age group, and the terms were not restricted to titles or keywords), and medications. Risk of bias was also assessed for each included study using the Cochrane risk of bias tool for randomized controlled trials.

Results: Only 4 studies evaluated non-stimulants (atomoxetine, risperidone). For stimulants, 8 RCTs were found. Using the Cochrane risk of bias tool, among the 12 RCTs only one study presented a fair overall quality.

Conclusions: Based on the existing literature, stimulants, particularly methylphenidate, should be the preferred medication for treatment of preschoolers with ADHD. There is scarce literature on the efficacy of nonstimulants for this population. More studies are needed, especially with more rigorous methodologies.

ADAPT - ADHD medication and predictors of treatment outcome

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Objectives: In clinical RCT studies, the response rate to ADHD medication in children is high (70–90%). However, there is little data on the response rates in the ordinary clinical practice context. We sought to study the outcome of pharmacological ADHD treatment within the ordinary child and adolescent psychiatry services in Stockholm and Gotland County. Eventually we also aim at investigating any possible predictors of the individual treatment outcome.

Methods: In a prospective observational study, approximately 500 children between 6 and 17 years have been included so far. ADHD symptoms are measured using parent SNAP-IV ratings at start, 1 month, 3 months, 6 months, and 12 months. The follow-ups also include measures of weight, length, pulse, and blood pressure, as well as side-effects (P-SEC), anxiety (SCAS-P) and autism symptoms (ASSQ) ratings. Saliva is collected for future DNA analyses.

Results: Preliminary data suggest that about 1/3 of the included children had a good response to the medication ($\geq 40\%$ reduction in ADHD symptoms), about 1/3 had a partial response to the medication ($\geq 20\%$ but $< 40\%$ reduction in symptoms), whereas about 1/3 had poor or no response ($< 20\%$ symptom reduction) to medication at the 3 month follow-up. Interestingly, some children with no or poor response at the 12 month follow-up were still using ADHD medication.

Conclusions: Response rate to ADHD medication seems to be poorer in ordinary clinical praxis, than in clinical RCTs. Data collection is still ongoing. Future analyses will aim at identifying any predictors of treatment outcome in the ordinary clinical praxis setting.

Analysis of projects funded by NSFC to study ADHD with traditional Chinese medicine

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Objectives: To keep abreast of the latest research on ADHD in the area of Traditional Chinese Medicine (TCM), and also provide references for applying for the projects of National Natural Science Foundation of China (NSFC) in the future. We analyzed all the projects on ADHD in TCM funded by NSFC.

Methods: We received all of the projects of TCM intervention in ADHD funded by NSFC and made a descriptive research and statistical analysis.

Results: Since the first project was funded in 2007, there have been 15 projects funded by NSFC for TCM treating ADHD research (Table 1). Nanjing University of Chinese Medicine obtained four supported projects. These 15 funded projects are mainly about mechanism study, including nine researches on dopamine. In addition, neurotransmitters such as norepinephrine, glutamate and gamma-butyric acid and the related pathways are also included. Since 2015, Chinese scholars have begun to study the mechanism of TCM treating ADHD from perspective of metabolism, immunity, neuron development, gut brain axis and other aspects, among which, immunity, gut brain axis and metabolism have been the focus of ADHD research in recent years. Young spontaneously hypertensive rats (SHR) were selected as the animal model for ADHD in all projects. SHR is internationally recognized as the animal model of ADHD. Chinese herbal medicine such as polygala tenuifolia rhizoma acori graminei, astragalus mongholicus bunge, radix rehmanniae praeparata as well as the rhynchophylline, were studied in these projects.

Conclusions: A survey of these projects funded by NSFC, shows that Chinese scholars’ research direction of ADHD tends to be diversified. They are trying to explore the incidence of ADHD and the therapeutic effect of TCM from multiple perspectives, which is in accordance with its various aetiology and complicated pathophysiology. Treatment based on syndrome differentiation is an important feature of TCM, which shows the unique advantages of TCM in treating ADHD. However, in terms of experimental studies, there are no perfect animal models combining TCM syndrome and disease, which is a bottleneck in animal experimental research of Chinese Herbal Compound. As is seen in Table 1, NSFC are funding more and more projects for TCM-treating ADHD, reflecting the advantages of TCM in treating ADHD.

Clinical characteristics and pharmacotherapy of adults with ADHD in Japan

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Objectives: ADHD is now one of the most common neuropsychiatric disorders not only in children but in adults. In recent years, the number of adults with ADHD visiting healthcare centers for treatments has been increasing in Japan, as well as the interest in appropriate treatment interventions including pharmacotherapy. In spite of the growing need, only two drugs, atomoxetine and extended-release methylphenidate, are currently approved on-label by the Japanese Ministry of Health, Labor, and Welfare for adults with

ADHD, and studies on pharmacological treatments in Japan are scarce. To assess the current medication use for ADHD in the adult population, we investigated clinical characteristics and pharmacotherapy of adults with ADHD at Showa University Karasuyama Hospital in Tokyo, Japan.

Methods: Subjects were 262 adults with ADHD, according to DSM-5 criteria, who visited the specialty clinic for ADHD at Showa University Karasuyama Hospital between May 2017 and June 2018. Data on sociodemographics, clinical characteristics, and pharmacotherapy were collected on those individuals by a retrospective chart review.

Results: There were 152 males and 110 females with mean age of 32.1 years old (SD 10.7). The average years of education was 14.7 years (SD 2.0). For the employment status at the point of their first consultation, 125 (47.7%) had regular employment, 64 (24.4%) were either students or housewives, 46 (17.6%) had a part-time job, 27 (10.3%) were unemployed. 201 patients had a previous history of psychiatric treatment; 190 (72.5%) at outpatient, 11 (4.2%) at inpatient. Only 51 patients had received a previous diagnosis of ADHD. Of the 262 subjects, 157 received pharmacotherapy; and for the first ADHD drug prescribed, 69 were with atomoxetine and 67 with methylphenidate.

Conclusions: Despite the growing need, appropriate diagnosis and early treatment intervention of adult ADHD is still an issue in Japan. Though medication is considered appropriate for ADHD treatment, research evidence on the current use and efficacy in adult population remains less established. We found similar prescription rates for atomoxetine and methylphenidate as a starting drug, and a further study on efficacy in relation to clinical characteristics is planned.

A novel, modified release drug delivery technology containing amphetamine-ion exchange complexes

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Objectives: The proprietary immediate and extended drug delivery technology LiquiXR™ utilizes an ion-exchange resin complexed with any protonated, water-soluble active moiety.

Methods: The moiety complexes with ion-exchange polymers in the resin and formed into micron-sized particles. Some particles are coated with aqueous, pH-independent polymer to provide immediate or sustained release. The polymer is of varying thickness, allowing for extended release of drug. Solid, coating-free particles provide for immediate release. The micron-sized particles are formulated into appropriate dosage forms (solid/chewable tablet, liquid, orally-disintegrating tablet, film, capsules). Active drug is released in millions of particles, driven by ion exchange and diffusion. After drug release, the ion-exchange resin is excreted.

Results: Release characteristics of LiquiXR™ permit customized, sustained release of drug up to 24 h post-dose. Mechanistically, drug particles enter the gastrointestinal tract. As positively-charged ions from gastrointestinal (GI) fluids diffuse across the coating, ionically-charged drug diffuses through the coating and into the GI fluids. As the coating is of variable thickness, some drug product takes longer to diffuse, providing for delayed drug release.

Conclusions: The LiquiXR™ technology is utilized in Dyanavel® XR, for treatment of symptoms of ADHD. It comprises 2.5 mg/mL amphetamine base complexed with LiquiXR technology to provide an immediate and extended-release profile. The efficacy of Dyanavel® XR was established in children ages 6–12 years in a Phase 3, placebo-controlled laboratory classroom study, where ADHD symptoms in children on an optimized dose of amphetamine (10–20 mg/day) were

statistically significantly improved compared with placebo. For children treated with Dyanavel® XR, onset was demonstrated at 1 h, and efficacy was observed through 13 h. The effect size was comparable to other psychostimulants in similar studies. The efficacy data reported for Dyanavel® XR provides an example of the clinical application for other drug products requiring immediate release and extended release profile.

Pulse rate and blood pressure outcomes from a long-term study of guanfacine extended release in children and adolescents with ADHD

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Objectives: To report pulse rate and blood pressure outcomes from the first 2-year study of guanfacine extended release (GXR) \leq 7 mg/day in children and adolescents (aged 6–18 years) with ADHD.

Methods: SPD503-318 was a phase 3, open-label extension study for European participants of studies SPD503-315 and SPD503-316. Participants received dose-optimized GXR (maximum permitted dose: children, 4 mg/day; adolescents, 4–7 mg/day depending on weight).

Results: Of 215 enrolled participants, 214 were included in the safety population and 133 completed the study. The mean age of participants at baseline was 11.7 years and 73.8% were male. Any treatment-emergent adverse events (TEAEs) were reported in 177 patients (82.7%). Cardiovascular-related TEAEs were reported in 35 participants (16.4%), most were mild in severity and none were serious. The most frequently reported cardiovascular-related TEAEs were hypotension (n = 4 [5 events]; 1.9%), hypertension (n = 4; 1.9%) and bradycardia (n = 4; 1.9%). The incidences of these cardiovascular TEAEs by weight-adjusted dose were: hypotension, 0.05–0.08 mg/kg, n = 2; 0.09–0.12 mg/kg, n = 2; 0.13–0.16 mg/kg, n = 1; hypertension, 0.01–0.04 mg/kg, n = 1; 0.05–0.08 mg/kg, n = 3; bradycardia, 0.05–0.08 mg/kg, n = 3; 0.13–0.16 mg/kg, n = 1. One mild cardiovascular TEAE of first degree atrioventricular block led to discontinuation on day 352, and subsequently resolved. There were small changes from baseline to final assessment in mean (standard deviation) supine pulse (– 5.5 [12.98] bpm) and blood pressure (systolic, 0.6 [9.32] mmHg; diastolic, 0.2 [9.17] mmHg), which were not considered by investigators to be clinically meaningful.

Conclusions: In this 2-year trial of GXR \leq 7 mg/day, cardiovascular TEAEs were predominantly mild in severity, with no consistent pattern of increasing incidence with increasing dose. Modest changes in pulse rate and blood pressure were not considered by investigators to be clinically meaningful.

Randomized, double-blind, placebo-controlled, phase 3 study of guanfacine extended release in adults with ADHD

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Objectives: To assess guanfacine extended release (GXR; Intuniv[®]) efficacy and safety in Japanese adults with ADHD (JapicCTI-163231).

Methods: Patients received GXR (n = 101) or placebo (n = 100) titrated from 2 mg/day to 4–6 mg/day (dose-optimization; 5 weeks), followed by maintenance doses (4–6 mg/day; 5 weeks), then tapered doses to 2 mg/day (2 weeks). The primary endpoint was change from baseline in ADHD-Rating Scale (RS) IV with adult prompts total score at Week 10. Secondary endpoints included ADHD-RS IV with adult prompts subscales, Clinical Global Impression-Improvement (CGI-I) and Patient Global Impression-Improvement (PGI-I) scales (percentage of patients very much improved or much improved), and incidences of treatment-emergent adverse events (TEAEs) and TEAEs leading to discontinuation. Endpoints were analyzed using mixed-effects models for repeated measurements (ADHD RS IV with adult prompts) or Fisher exact test for between group comparisons (CGI I, PGI I).

Results: Compared with placebo, there was significantly greater improvement in GXR group for ADHD-RS IV with adult prompts total score reduction (least square mean \pm standard error: GXR vs. placebo, -11.55 ± 1.10 vs. -7.27 ± 1.07 , $P = 0.0005$, effect size 0.52). There were significantly greater improvements in GXR group for inattention (-7.39 ± 0.79 vs. -4.89 ± 0.76 , $P = 0.0032$) and hyperactivity-impulsivity (-3.84 ± 0.54 vs. -2.10 ± 0.52 , $P = 0.0021$) ADHD-RS IV with adult prompts subscale scores, CGI-I (48.1% vs. 22.6%, $P = 0.0007$), and PGI-I (25.3% vs. 11.8%, $P = 0.0283$). More patients in GXR versus placebo group reported TEAEs (81.2% vs. 62.0%); however, most TEAEs were mild-to-moderate in severity. One serious TEAE (suicide attempt, unrelated to GXR) occurred in GXR group; no deaths reported. More patients in GXR versus placebo group discontinued due to TEAEs (19.8% vs. 3.0%). The main TEAEs resulting in discontinuation from GXR group were blood pressure decrease and somnolence.

Conclusions: In Japanese adults with ADHD, GXR improved ADHD symptoms without any major safety concerns.

Development of a drug treatment pathway for formulary approval for young people with ADHD in a secondary care setting in UK jointly by pharmacist and pediatrician (specialist) in 2017

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Objectives: This innovative process was undertaken to examine the most effective route to ensure that young people consistently received evidenced-based cost-effective treatment for ADHD.

Methods: A formulary approval pathway was developed for ADHD medication, following consultation, for a consistent approach. A Specialist expressed interest in medication, reviewed by the formulary team, which involved a series of questions to be answered: Demonstrates evidence of benefit to the recipient and the health economy. Is there a strong evidence base for medication? In what cohort of young people should the medication be used? If accepted,

would the medication be initiated or continued in primary care by General Practitioners (GPs), where a shared care protocol would be developed to ensure the roles and responsibilities of the specialist, GP and patient were clear to ensure appropriate prescribing and monitoring.

Results: Following this appraisal, a positive evaluation and subsequent approval from the National Health Service (NHS) resulted in submission of application to the Area Prescribing Committee (APC) covering 3 cities, UK. The APC consists of varied healthcare individuals including the original sponsor to assess the formulary application and reach an informed decision. Once successful the medication is colour coded: Green enables all prescribers in health care to prescribe without restriction. Amber defines that initiation is performed by specialists in secondary care setting and prescribing transferred to GPs when the medication has been stabilized. Red requires initiation and maintenance only by the specialist.

Conclusions: This pathway for the approval of medication to treat ADHD was designed in order to provide a consistent process and enable young people to receive evidence-based cost-effective treatment. This enables clinicians to have a transparent process across different health care settings. This approach can be transferred across regions and would be useful to compare in future to processes in other regions/countries.

A retrospective study to understand emerging themes from using long acting guanfacine in 70 children and young people with ADHD in a secondary care setting in UK

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Objectives: As most clinicians are still not confident about using Guanfacine since its license in 2016 in UK, this study was undertaken to identify any gender differences, comorbid factors and side effects in patients which would impact on its usage.

Methods: Data was collected from clinical notes in all our patients with ADHD who have been on Guanfacine over the past 1 year. We looked at demographics, co morbidity, tolerance and dosage needed. Emerging themes were identified in addition.

Results: 70 children and young people aged 4–5 years (12 girls and 58 boys) received treatment with Guanfacine. Co-morbidity was noted in 48 patients (69%): autism spectrum disorder was commonest (16), developmental coordination disorder (13), learning disability (10) and some had other conditions such as conduct disorder, tic disorder and dyslexia. Guanfacine was discontinued in 36 patients (51%), the commonest side effect was sedation in 20 patients (29%) and other reasons for discontinuation include headaches, aggressive behavior and ineffective control of ADHD symptoms. The success rate was 98.8% in teenage girls. The dose range was 1 mg (19) to 6 mg (1), and most patients (36) needed 2–3 mg for effective control of symptoms.

Conclusions: This is a small study and larger studies comparing the side effects and efficacy of low dose Guanfacine in teenage girls should be investigated across different regions. Following on, low dose poly-therapy regimes with stimulant medication which minimize side effects and improve overall efficacy should to be explored in UK and Europe as is proven to be effective in other countries.

Stimulant treatment in patients with ADHD and comorbid autism spectrum disorder

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Objectives: In ADHD around 20% are also affected by Autism Spectrum Disorder. Pharmacological treatment with psychostimulants in ADHD has been shown to be highly effective, but it is not known whether patients with ADHD and comorbid ASD respond differently to the pharmacological treatment.

Methods: We used a cohort design where we identified individuals 18 years or older with a diagnosis of ADHD and followed up on their pharmacy dispenses of methylphenidate from 2005 until 2014. Swedish register data on pharmacy-dispensed medications of methylphenidate was retrieved from the Swedish Prescribed Drug Register and diagnostic information was retrieved from the National Patient Register. For the statistical analyses we used logistic regression and the results were adjusted for age, year of birth and the presence of substance abuse (alcohol or narcotics).

Results: We have identified 37,701 adults 18 years or older with a diagnosis of ADHD and of those 5119 individuals had a combined diagnosis of ADHD and ASD. We found that adults with ADHD and comorbid ASD were less likely to be receive pharmacy dispenses of methylphenidate as compared to individuals with ADHD and no ASD (ASD 63%; No ASD 67%; OR 0.87, 95% CI 0.82–0.93).

Conclusions: There may be differences in the use of methylphenidate in ADHD patients with or without a comorbid diagnosis of ASD and the research question needs further evaluation.

Open-label dose-optimization of an amphetamine extended release oral suspension in children with ADHD

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Objectives: Report efficacy of open-label (OL) amphetamine extended-release oral suspension (AMPH EROS) for treatment of children with ADHD. AMPH EROS has a 1-h onset and duration of efficacy of 13 h. A significant treatment difference in change from pre-dose SKAMP-combined score was observed at the primary endpoint of 4 h ($p < 0.0001$) and each post-dose timepoint (1, 2, 4, 6, 8, 10, 12, 13 h). Data are from the 5-week OL dose optimization.

Methods: Males/females aged 6–12 years with ADHD enrolled and began OL treatment with 2.5 mg or 5 mg/day of AMPH EROS titrated in 2.5–10 mg/day increments until optimal dose (maximum 20 mg/day). Doses were decreased for tolerability. Subjects took AMPH EROS for 5 weeks. ADHD-RS (ADHD-Rating Scale), CGI-S (Clinical Global Impression of Severity), CGI-I (CGI-of Improvement) and CPRS (Conners' Parent Rating Scale) and safety were also reported.

Results: Treatment with AMPH EROS ($n = 99$) was associated with a mean change in ADHD-RS-IV of 28.2 (± 9.03) (Baseline score = 41.3 ± 7.95). 90.9% of subjects had change from baseline to OL week 6 of $\geq 50\%$ in the ADHD-RS-IV total score. The CGI-S scores decreased continuously from baseline, from 4.8 at baseline to 2.0 at OL week 6. The percentage of subjects classified as moderately ill or greater decreased from 97% at Baseline to 1% at OL week 6. CGI-I decrease was similar to decrease in CGI-S. CPRS for most categories decreased from Baseline to OL week 6. Mean change from baseline to

OL week 6 on the CPRS inattention T-score subscale was -25.3 (± 14.38) and -24.4 (± 13.87). Adverse events ($> 5\%$) reported were decreased appetite, insomnia, affect lability, upper abdominal pain, mood swings and headache.

Conclusions: AMPH EROS was effective in reducing symptoms of ADHD in this OL dose optimization. The AE profile of AMPH EROS was consistent with other amphetamine products.

Duration of pharmacological treatment of ADHD: a Norwegian population-based study

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Objectives: To examine early discontinuation and duration of pharmacological treatment of ADHD in Norway among children and adults.

Methods: We used data from the Norwegian Prescription Database, which includes all prescription drugs dispensed from pharmacies in Norway. Medications approved for treatment of ADHD were included: methylphenidate, atomoxetine, amphetamine, dexamphetamine, lisdexamphetamine and guanfacine. We included new users (initiators) of ADHD medications during 2007–November 2016, defined by not having filled prescriptions during the run-in period 2004–2006. We defined early discontinuation as not filling a second prescription within 180 days after initiation of treatment. For analysis of duration of treatment, we examined time from initiation until cessation of treatment, death or end of study period and presented as Kaplan–Meier plots. Cessation of treatment was defined when 180 days had passed without the patient filling prescriptions.

Results: 32,006 children (6–17 years) and 28,004 adults (18 + years) initiated ADHD medications during the study period (over 90% on methylphenidate). 8.5% of children and 12.4% of adults discontinued treatment early with a decreasing proportion over time. Duration of treatment was similar for males and females. Time until 50% of patients had stopped treatment (median treatment duration) was longest among patients initiating treatment as children (6–12 years old) with 3.73 years, while it was 1.28 years in 13–17 year olds. Duration was shortest among young adults (18–29 years) with 1.16 years, while it was 1.75 years for 30–44 year olds and 1.66 years for patients over 45 years. Treatment durations were higher among patients initiating treatment during latter half of study period. **Conclusions:** Treatment duration was longest among children and shortest in young adults. Duration of treatment with specific medications will be further examined. Other measures of adherence as well as characteristics of the treated population will be explored by linkage with diagnostic codes in the Norwegian Patient Registry.

Combination treatment with guanfacine extended release and blonanserin for Tourette's Disorder comorbid with ADHD: a case report

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Objectives: Tourette's Disorder (TD) is a neurodevelopmental disorder with several tic behaviors, and frequently comorbid with Attention-Deficit/Hyperactivity Disorder (ADHD). Atypical antipsychotics are usually used in TD, however, tolerability is limited. We report a case who had severe TD with ADHD, recovered with both a

selective α 2A-adrenergic agonist, guanfacine extended release (GXR) and a dopamine-serotonin antagonist, blonanserin (BNS).

Methods: A case report.

Results: A 10-year-old boy with severe vocal and motor tics including head shaking and eye blinking was visited in our University Hospital. He was bullied because of his tic behaviors and had a school refusal since 9-year-old. He was diagnosed as TD with ADHD by DSM-5. BNS 12 mg/day was prescribed, however it was small effects for his tic symptoms. We added GXR and then 8 weeks of follow-up, his vocal tics were resolved. The final doses of GXR and BNS were 3 and 8 mg/day, respectively. He had a good adherence with medication for more than 1 year without any side effects till now. He recovered from tics, however, his ADHD-RS score had not major changed.

Conclusions: GXR is selectively on post-synaptic α 2A-adrenergic receptors in the prefrontal cortex and may work for TD through the function of dorsolateral PFC. This case supports a pharmacological approach of GXR to treat severe tic symptoms.

Treatment adherence and domains of dysfunction in female and male patients with adult ADHD: a retrospective chart review

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Objectives: Medication non-adherence can significantly predict reduced response to treatment and may add to the burden of functional impairment in multiple domains of life. We aimed to explore and compare medication adherence and domains of dysfunction between males and females with ADHD.

Methods: Using a retrospective chart review design, adult patients with a diagnosis of ADHD were enrolled. Data regarding demographics, comorbidities, medications, and domains of functional impairment were collected. We used the Chi-square test to assess the relationship between categorical variables; the Mann–Whitney U test to compare two means and binary logistic regression to assess the predictors of adherence.

Results: Two hundred and five patients (55% male) with a mean age of 30.5 (SD = 9.4, range = 18–56) entered the study at two treatment centers. The majority of both women and men was a university graduate, single and employed. Men and women did not differ in age, education, marital status and the severity of ADHD symptoms. The combined type was the most prominent in both genders (84.8% of males, 74.2% of females). Twenty-nine % of the sample was non-adherent to treatment with no significant difference among genders. Women were more likely to have two or more comorbid psychiatric disorders ($p = 0.004$) whereas men were more likely to have a substance use disorder ($p = 0.001$). Patients who had two or more comorbid disorders were more like to adhere to the ADHD medication ($p = 0.001$). Gender was not associated with dysfunction in work, education, family and romantic relationships, however, females were more likely to have dysfunctions in social contacts ($p = 0.001$) free time activities and hobbies ($p < 0.001$), self-confidence and self-image ($p < 0.001$) compared with men.

Conclusions: More than one-fourth of women and men with ADHD is non-adherent to medication treatment. Women's pattern of functioning may differ from that of men; related to a pervasive range of social dysfunction and low self-confidence.

Stimulant therapy in a case of ADHD and multiple sclerosis

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Objectives: Attentional deficits can occur in ADHD as well as in inflammatory brain disorders (e.g. multiple sclerosis). When attentional deficits occur in a patient with an anamnesis of ADHD since childhood and inflammatory brain disorder it may be difficult to differentiate the cause of attentional deficits.

Methods: We report a case of an adult patient with a history of ADHD symptoms since childhood and the diagnosis of multiple sclerosis (MS) in adulthood. Adult ADHD was diagnosed and a stimulant therapy was started.

Results: Stimulant therapy was efficient and well tolerated. During the course of the therapy the immunosuppressive MS-prophylaxis was switched several times. There were no interactions of prophylactic agents and stimulant therapy. Finally Teriflunomid was efficient and well tolerated together with MPH.

Conclusions: The present case report shows that brain organic disease does not preclude the diagnosis of ADHD in adulthood and that, despite cerebral postinflammatory lesions, stimulant treatment may be effective. Likewise, the present case demonstrates that current immunosuppressant strategies and stimulant therapy could be prescribed without deleterious interactions or adverse effects. Therefore, in cases of ADHD and proven brain organic disease, we recommend not to rule out the diagnosis of ADHD and stimulant therapy from the outset.

Herb-drug interaction causality assessment in pediatric adverse event reports associated with ADHD medication

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Objectives: Natural Health Products (NHPs) are generally considered to be safe when they are used properly. However, they are complex in nature and can interact with other substances being used concurrently, with potential for adverse reactions. The objective of this study is to: i) identify adverse event reports (AERs) involving commonly used NHPs and ADHD (Attention Deficit Hyperactivity Disorder) prescription medicines; ii) to evaluate the quality of collected AERs; and iii) to assess whether herb-drug interactions can be causally linked to reported adverse events.

Methods: We systematically searched the FDable database for NHPs commonly used by patients (4–18 years old) who were also taking ADHD drugs from 1997 to 2015. We assessed the completeness of the AERs and used three causality assessment tools modified for NHPs (Naranjo, HORN Drug Interaction Probability Scale and World Health Organization Uppsala Monitoring Centre Scale).

Results: Of the 23 identified AERs involving both a NHP and an ADHD drug, most involved multiple (> 3) substances with inadequate detail to assess multiple potential interactions. Following data extraction and evaluation of completeness, five AERs involving only one NHP and one ADHD drug were evaluated for causality. A herb-drug interaction was assessed to be probable in one case and to be possible in another. Both these reports involved a methylphenidate formulation and St. John's Wort.

Conclusions: St. John's Wort has been known to inhibit numerous drug-metabolizing enzymes and transporters but the effects of St.

John's Wort on methylphenidate metabolism and carboxylesterase 1 (responsible for the metabolism of methylphenidate) have yet to be studied.

Evaluating the use and knowledge of complementary and alternative medicines in pediatric ADHD

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Objectives: We aimed to determine: (1) the use and knowledge of popular complementary and alternative medicine (CAM); (2) communication between CAM users and healthcare practitioners; and (3) adverse events experienced with the use of CAM by pediatric patients with ADHD at the Children's Hospital of Eastern Ontario.

Methods: We developed a one-time electronic questionnaire on REDCap which was distributed to families of 75 eligible patients. The sample was drawn from patients under the age of 18 years with an ADHD diagnosis. Data were analyzed using descriptive statistics.

Results: The mean child age was 10.5 years (range 4–18), and 81% were boys. Preliminary results show that 44% of patients had ever used some form of CAM and 22% had ever used herbal medicine. The most commonly used forms include nutrient and dietary supplements, elimination diet, homeopathy, physical therapy, echinacea, melatonin, and evening primrose oil. Only 9.6% of families said they felt knowledgeable about CAM. 34.5% of families reported never discussing CAM use or potential use with healthcare practitioners though most families (63%) reported being comfortable discussing the topic. Three families reported mild adverse events from the use of an elimination diet, and one for nutrient and dietary supplements. 28% of families reported they would not use CAM for their child due to concerns about potential negative side effects.

Conclusions: Various modalities of complementary and alternative medicine are commonly used by children with ADHD. Healthcare practitioners should initiate conversations about the use of CAM with families, provide reliable resources for information about safety and efficacy, and aid families in making an evidence-based decision about the use of CAM.

Sociodemographic and treatment features of girls with ADHD referring to a "ADHD Outpatient Clinic" in a University Hospital in Turkey

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Objectives: The aim of the present study is to evaluate demographic features, symptoms, diagnosis, comorbidity and treatment of ADHD girls who referred to ADHD outpatient clinic at Child and Adolescent Psychiatry Department of Ankara Medical School in Turkey, between January 2018 and December 2018, retrospectively.

Methods: All subjects were evaluated with Child Behavior Checklist 6–18 (CBCL), The Turgay DSM-IV Based Disruptive Behavior Disorders Child and Adolescent Rating and Screening Scale (T-DSM-IV-S), Conners' Parents and Teachers Rating Scale, and CBCL.

Results: 40 ADHD girls who were between 8 and 18 years mean age was 12.87 ± 2.83 years. The overall mean age at first diagnosis of ADHD was 7.8 ± 1.97 years and the average follow-up duration was 5.25 ± 2.88 . The predominant form of ADHD subtypes was combined type (52.5%) and inattention subtype (45%). Most common

complaints of the patients were inattention and school failure (50%). In the 40% of the patients both parents and teachers were the difficulties of children. According to T-DSM-IV-S and r- CPRs and r-inattentiveness scores was the highest score. Most common comorbid disorder is Learning Disorder (57.5%). 95% of patients use Methylphenidate (50% OROS-MPH, 32.5% Extended release MPH and 12.5% immediate release MPH). In the follow-up period, OROS-MPH was most changed drug (25%) due to ineffectiveness and side effects. The particular items of CBCL that related with sluggish cognitive tempo were also assessed (items 81,780,102). There were CBCL scores of 31 patients. Total scores of these 4 items were ≥ 3 score of 20 patients (72.5%).

Conclusions: To know the most common subtypes of ADHD, comorbidity diagnoses, effective treatment for girls with ADHD will be useful for improving treatment effectiveness and quality of life in ADHD girls.

Quantitative strategies to compare a priori efficacy of methylphenidate regimens based on pharmacokinetic models

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Objectives: Different methylphenidate (MPH) formulations, immediate release (IR) or extended release (ER), are available to treat ADHD. The selection of their administration times, dosage and combination is crucial to attain optimal therapeutic effect while minimizing their adverse effects. We present a quantitative strategy to identify drug regimens that provide the best therapeutic performances and respects patients' specific needs.

Methods: Using pharmacokinetic models of various MPH formulations and a formerly developed metric for MPH regimen performance, we propose three statistical strategies for regimen comparison: a sequential comparison, an overlapping coefficient comparison, and a probability-over-threshold approach. The first is hierarchical in nature and sequentially compares the regimen performance, the total daily dose and the administration frequency. The second compares two regimens by quantifying their similarity. The third computes the probability of an incremental regimen performance over a specified threshold. The first two comparison approaches are used for naïve patients, while the third one is for patients under treatment.

Results: Pharmacokinetic models of one compartment effectively describe both the IR and ER data. Applied to three frequent MPH clinical situations, the three-method strategy is able to distinguish the regimens proposed for each.

Conclusions: The proposed statistical strategy is able to differentiate ADHD regimens in various clinically relevant situations. It provides an accessible computational tool for objectively selecting MPH regimens that could be implemented in web- or mobile-based applications.

Lisdexamfetamine in ADHD and comorbid bulimia nervosa

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Objectives: To illustrate the utility of Lisdexamfetamine in Bulimia nervosa (BN) with comorbid ADHD through a case report.

Methods: The clinical history of a 18-year-old patient diagnosed with purgative BN and comorbid ADHD, in treatment with Lisdexamfetamine.

Results: After onset with stimulant treatment, a reduction in the number of bingeing episodes, and subsequent purgative behaviors is evidenced, as well as an attentional and emotional improvement, as measured with the Conners' CPT-II, before and after treatment with Lisdexamfetamine.

Conclusions: 1. In the case we present, treatment with Lisdexamfetamine improves eating symptomatology and executive functions in a patient diagnosed with BN and comorbid ADHD. 2. We suggest that Lisdexamfetamine may be a good therapeutic option for the treatment of patients diagnosed with BN and comorbid ADHD.

Comparative efficacy of methylphenidate and atomoxetine on social problems in youths with ADHD

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Objectives: The present study aimed to directly compare the efficacy of methylphenidate and atomoxetine in improving social problems among children and adolescents with ADHD.

Methods: The study sample included 168 drug-naive children and adolescents 7–16 years of age, with DSM-IV-defined ADHD, randomly assigned to osmotic-release oral system methylphenidate (OROS-methylphenidate) ($n = 83$) and atomoxetine ($n = 85$) in a 24 week, open-label, head-to-head clinical trial. Efficacy measurement was based on Social Adjustment Inventory for Child and Adolescent (SAICA) ratings by mothers and subjects. Evaluation timepoints were set at baseline, week 8, week 16 and week 24.

Results: Both methylphenidate and atomoxetine were effective in improving school functions at week 24 (methylphenidate: Cohen $d = -0.82$, $p < 0.001$; atomoxetine: Cohen $d = -0.62$, $p < 0.001$) and peer relations at week 24 (methylphenidate: Cohen $d = -0.50$, $p < 0.001$; atomoxetine: Cohen $d = -0.33$, $p = 0.005$) by mother-reported SAICA. Atomoxetine was effective for behavior problems at home (Cohen $d = -0.41$, $p < 0.001$), and methylphenidate was effective for sibling relationships (Cohen $d = -0.24$, $p = 0.037$) and behavior problems at home (Cohen $d = -0.43$, $p = 0.002$). There was no significant difference between the two treatment groups in mean reduction in school functions, peer relationships and home behaviors of SAICA at week 8 and week 24.

Conclusions: Our findings lend evidence to support that both methylphenidate and atomoxetine were effective in improving social problems in children and adolescents with ADHD, including school functions and peer relationships. Comparing the methylphenidate group and the atomoxetine group, there was no between-group difference in improving social function, peer relationships and home behaviors at week 8 and week 24.

Clinical, neuropsychological and pharmacogenetic predictors of methylphenidate response in a sample of children and adolescents with ADHD

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Objectives: To develop a predictive model of methylphenidate response using a longitudinal and naturalistic follow-up study in a Spanish sample of children and adolescents with ADHD.

Methods: 518 children and adolescents with ADHD treated with methylphenidate (MPH) were included. We collected ADHD-RS-IV.es and CGI-S scores at baseline and at follow up, and neuropsychological testing (WISC-IV, CPT-II and Stroop). We analyzed seven SNPs in four DA-related candidate genes (COMT's rs4680 and rs6269, DAT1's rs27072 and rs2652511, MAO A's rs3027399, and MAO B's rs1799836) and BDNF's rs6265. Clinical response was defined as $> 30\%$ reduction from baseline of total ADHD-RS-IV.es score and CGI-S final score of 1 or 2 maintained for the previous 3 months.

Results: Mean (SD) age of patients was 11.4 (3.3) years old (79% male, 51.7% without comorbidity); 37.6% had a complete and 35.8% had a partial response) to a mean MPH dose of 1.2 mg/kg/day. We did not find significant group differences in MPH dose between responders/no-responders (t -test, $p > .1$) (ANOVA, $p > .1$). Higher baseline ADHD-RS-IV.es scores ($B = -0.020$, $p = .021$), presence of comorbidities (oppositional-defiant symptoms [$B = -0.054$, $p = .017$], alcohol [$B = -0.78$, $p = .032$] and cannabis use [$B = -1.304$, $p = .008$]), lower total IQ ($B = 0.21$, $p = .032$) and low commission errors in CPT-II ($B = -0.13$, $p = .049$) were significantly associated with worse MPH response (partial or no-response). Moreover, presence of DAT1's rs2652511 was significantly higher in complete responders ($p < .05$).

Conclusions: This study suggests that absence of comorbidities, less impairment at some neuropsychological performance and the presence of DAT1's rs2652511 may predict a positive response to MPH. Other genetic or non-genetic factors may be involved in the variability of response to MPH, as our model only explains approximately a 5% of the response to MPH.

Monitoring ADHD in children treatment with a new biological marker of ADHD

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Objectives: Recently we described a new method for diagnosing ADHD in children. The method consist of recording miniature eye movements (1), which are implicated in attentional processing. We showed that these eye movement are absent or weak in ADHD children (2) and can be used as an objective biological marker for ADHD (called Cognitive Vergence). In order to know whether the biological maker can be useful for monitoring treatment, we investigated the possible effect of typical pharmaceutical intervention to reduce ADHD symptoms on the level of the biological marker.

Methods: After extensive clinical diagnosis some children ($N = 14$; 7–14 years of age) with ADHD received pharmaceutical treatment (Methylphenidate or Lisdexamfetamine Dimesylate) while others ($N = 7$) did not receive pharmaceutical medication. Before treatment all ADHD children performed the BGaze test (Braingaze, Spain) to assess the probability and severity of ADHD based on the level of biological marker (Pre). Six to eight months after treatment or the initial diagnosis these children were re-tested with the BGaze test (Post). For statistics we applied Student t -tests.

Results: Preliminary results (mean \pm std) of this pilot suggests a lowering of the severity score measured by the biological marker in the medicated group (Pre: 0.46 ± 0.24 ; Post: 0.38 ± 0.20 ; $p = 0.08$) and not in the non-medicated group (Pre: 0.36 ± 0.34 ; Post: 0.34 ± 0.14 ; $p = 0.46$). The reduction in severity score was significantly stronger ($p < 0.001$) in the medicated group than in the non-

medicated group. The probability scores the remained similar (Medicated group: Pre: 0.55 ± 0.08 ; Post: 0.56 ± 0.08 ; $p = 0.38$; Non-medicated group: Pre: 0.53 ± 0.20 ; Post: 0.54 ± 0.15 ; $p = 0.39$).

Conclusions: These findings suggest that pharmaceutical intervention lowers the severity of ADHD measured by the biological marker (Cognitive Vergence) of the BGaze test. A study (currently undertaken) with larger patient sample is needed to confirm whether Cognitive Vergence assessment can be used as a tool to monitor pharmaceutical treatment.

Chart review of Canadian children/adolescents with ADHD receiving guanfacine extended-release: patient subgroup analyses

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Objectives: Guanfacine extended release (GXR) is used to treat ADHD in children/adolescents [1,2]. These analyses provided real-world data on patients, including certain subgroups.

Methods: Data from children/adolescents (6–17 years) with ADHD prescribed GXR (monotherapy/adjunct therapy) with ≥ 6 months' follow-up data were extracted. Changes in ADHD symptoms and functionality were classified as improvement, no change or worsening. Subgroups analysed post hoc: specific comorbidities; and initiated on GXR to reduce atypical antipsychotic (AAP) use. Treatment-emergent adverse events (TEAEs) were recorded.

Results: 330 patients with ADHD were included. After GXR initiation, 70%, 63% and 65% of patients overall had improvements in ADHD symptoms, home-life and school performance, respectively. Among those with oppositional defiant disorder (92/330), 70%, 55% and 59% had improvements in ADHD symptoms, home-life and school performance, respectively. Among those with learning disability (70/330), 74%, 69% and 73% had improvements in ADHD symptoms, home-life and school performance, respectively. Among those with anxiety (53/330), 74%, 68% and 72% had improvements in ADHD symptoms, home-life and school performance, respectively. Among those with autism spectrum disorder (35/330), 69%, 60% and 69% had improvements in ADHD symptoms, home-life and school performance, respectively. For patients initiated on GXR to reduce AAPs ($n = 44$), ADHD symptoms improved for 32 (72.7%), home life improved for 25 (56.8%) and school performance improved for 24 (54.5%) patients. TEAEs were reported by 45% of patients.

Conclusions: In a Canadian population, GXR treatment improved ADHD symptoms and functioning at home/school in patients with ADHD, including those with oppositional defiant disorder, learning disabilities, anxiety, autism spectrum disorder or those initiated on GXR to reduce AAPs. Prior presentation: EUNETHYDIS 2018 (23–26 September; Edinburgh, Scotland).

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Machine learning based ADHD medication response prediction

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Objectives: To develop prediction model for ADHD medication response using machine learning technique, with clinical and genetic predictors separately.

Methods: A total of 237 participants were recruited and randomly assigned to receive either osmotic release oral system methylphenidate (OROS MPH) ($n = 119$) or atomoxetine (ATX) ($n = 118$). All participants received a comprehensive assessment before assignment and at the end of the treatment (142 participants left). Remission was defined as an ADHD-RS-IV average score ≤ 1 or a CGI-ADHD-S scale score ≤ 2 . Based on machine learning algorithms, Gradient Boosting Decision Tree (GBDT), with top-related clinical indexes, medication efficacy prediction models were built for OROS MPH and ATX separately, identifying the index combination with the best predictability. Polygenic risk score and another machine learning algorithms, XGBoost, were used for prediction with neurodevelopmental genes variants suggested in Han Chinese ADHD GWAS and neurotransmitter genes suggested in previous pharmacogenetic studies.

Results: (1) Using symptom severity and cognitive function, classification accuracy by GBDT for OROS MPH was 78.8% and for ATX was 87.5%. The best index combination for the prediction model was composed of the CGI-ADHD-S scale score and indexes stand for executive function. (2) Based on the Han Chinese GWAS, the model of the polygenic risk score predicted a small variance of ADHD-RS-IV score decrease at the threshold of 0.0001 (P value 0.0181, variance interpreted). (3) Classification accuracy by the neurotransmitter genes reached 75% overall. SNPs that contributed most located within NET1 and ADRA2A.

Conclusions: Applying machine learning to establish predicting model with either clinical or genetic markers for ADHD medication response could be a potential method in the pathway to develop individualized medicine.

Topic: Quality of life/Caregiver burden

The awareness Project. Differences between mothers of children diagnosed with ADHD and mothers of healthy control children as to sleep disorders and symptoms of anxiety, depression and stress

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Objectives: The research aimed at determining differences between mothers of healthy control children and mothers of children diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) as to sleep disorders, anxiety, depression and stress.

Methods: The study sample was composed of multiple regions in the Kingdom of Saudi Arabia; 32 mothers of healthy control children whose measurements were collected in this research and 32 mothers of children diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) with the help of samples from a previous study whose measurements were complete and provided by the Good Night Project: Behavioural sleep interventions for children with ADHD: A

randomised controlled trial, in the Kingdom of Saudi Arabia (ALAmmar 2018) which measured 32 mothers of children diagnosed with ADHD. The comparative descriptive method was used.

Results: The results showed: First: There are differences with statistical significance for each of anxiety, depression and stress; they were higher for mothers of children diagnosed with ADHD. Second: There are no differences with statistical significance on the scale of sleep disorders.

Conclusions: Recommendations 1. Provide care and support for mothers of children with ADHD to improve psychological health via counselling programmes and periodical meetings for exchange of experience among mothers. 2. Train mothers on skills of time management and co-ordination between her and her child diagnosed with the disorder and her other life responsibilities.

ADHD and learning disabilities in school aged children: an example of multimodal intervention

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Objectives: ADHD is one of the most common childhood mental health disorders. Twenty to thirty percent of ADHD children have associated learning disabilities (LD) in reading, writing and arithmetic.

Methods: António was a boy with ADHD, who displayed weaknesses in academic achievement, namely in reading fluency and written expression. His 4th grade teacher was concerned about his academic progress. António was continually frustrated because he seemed unable to sustain the attention level required for learning. Parent and teacher rating scales confirmed that elevated levels of inattention, hyperactivity and impulsivity were associated with lower grades and poor peer relationships. A multimodal intervention combined medication and a psychosocial and behavioral approach was implemented from 4th grade to the end of 5th grade. The intervention focused on three areas: parenting practices (e.g., empathy, consistency), self-regulation skills (e.g., self monitoring) and academic skills (e.g., written expression and reading fluency). The intervention was based on four modalities: (1) psychopharmacological treatment (e.g., methylphenidate); (2) individual counseling with the student, (3) psychoeducation with the parents and (4) school consultation.

Results: Parent and teacher rating scales after intervention showed reduced levels of inattention, hyperactivity and impulsivity associated with greater social adjustment. António showed greater autonomy and effectiveness in the performance of school tasks. He adapted well to the academic and social requirements of 5th grade and finished the 5th grade with positive results in all subjects.

Conclusions: This brief case study illustrates how multimodal intervention, in conjunction with interventions targeting parenting practices, self-regulation skills and academic skills, can be used to promote academic success in students with ADHD.

Tell me with whom you walk, and I will tell you who you are: a social network analysis of adolescents with ADHD

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Objectives: Peer rejection and poor mutual friendship are among the possible causes of an impaired social functioning in children and adolescents with ADHD. Very few studies have explored this field with modern tools of Social Psychology. The objectives of the present study are: (1) To study the impact of ADHD on the process of social selection of best friends using social network analysis (SNA) techniques in a network of adolescents attending a public school. (2) To investigate the occurrence of homophily (the extent to which individuals form ties with similar vs. dissimilar others) in adolescents with ADHD.

Methods: Sample consists of 108 sixth and seventh-graders (10–16 years) recruited at a public school of a low-density Brazilian city. Parents and teachers were interviewed using standardized and validated questionnaires. ADHD was ascertained as per the DSM-5. A rank of the top three friends was requested from the adolescents. SNA techniques were applied as Exponential Random Graphs Model (ERGM) to verify the impact of ADHD on the selection of friendships, relational configurations and attributes of the actors in the selection of best friends. Homophily was evaluated according to Pearson's correlation coefficient (C Constraint).

Results: Of 108 adolescents 7 (6.5%) met DSM-5 criteria for ADHD. Those with ADHD tended to occupy the periphery of the social network and to develop a relational pattern that expressed less autonomy (C Constraint = 0.249, $p < 0.01$), whereas students without ADHD were more likely to be selected as best friends. The homophily mechanism was not observed based on the diagnosis of ADHD.

Conclusions: The present study adds to the literature original findings to better understand the impact of ADHD on social functioning, helping clinicians to a more comprehensive approach and more effective therapeutic intervention.

How's the practice of general psychiatrists for ADHD in adults?

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Objectives: Even though there is a growing body of research on the persistence of childhood ADHD through adolescence to adulthood, professional and public awareness of adult ADHD has to be improved. Child and adolescent psychiatrists are familiar with the trajectory of ADHD, because they have completed four-year residency in general psychiatry and after then, two-year fellowship in child psychiatry. General psychiatrists have less chance to be exposed to symptoms and signs of ADHD. As a primary step to establish a practice parameter for adult ADHD, we surveyed the expert consensus of general psychiatrists how they diagnose and choose medication for adult ADHD in Korea.

Methods: The survey was conducted with Korean psychiatrists in 2018. The questionnaire contains; clinical experience of adult ADHD in practice, chief complaints at initial visit of the outpatient clinic, comorbid psychiatric diagnosis, steps to diagnosis and differential diagnosis, preferred treatment options, preference of anti-ADHD drugs, and average and optimal treatment duration. Descriptive analysis was performed.

Results: Among 139 respondents, 42.5% of respondents met 10–50 patients with adult ADHD. 38.7% of respondents answered 6 month to 1 year as average treatment duration, and over 3 years as optimal treatment duration. The most important step for differential diagnosis was clinical psychiatric interview (71%). The preferred treatment option was pharmacotherapy (71%), and the optional second step

were psychoeducation, and cognitive behavioral therapy (CBT). The most preferred medication was Concerta®.

Conclusions: Although ADHD is life-long condition, public and even experts still aware the ADHD as childhood disorder or self-limited. Continuous medical education for the experts and collection of data with long-term prognosis in adults are needed.

Differences in emotional dysregulation and well-being among German and Latin American adults with ADHD

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Objectives: This study compares emotional dysregulation (ED) and well-being among German and Latin American adults with ADHD with the aim to examine the role of cultural influences on ED and its relation to well-being.

Methods: We use an online-administered survey with a German and a Spanish version. Currently, 126 German (39.8 years, 38.1% male) and 41 Latin American (35.7 years, 38.5% male) adults were surveyed using the Adult Self-Report Scale (ASRS-6), the Difficulties in Emotion Regulation Scale Short Form (DERS-SF), the Emotion Regulation Questionnaire (ERQ) and the Satisfaction With Life Scale (SWLS) to measure ADHD symptoms, difficulties in emotion regulation, emotion regulation strategies and subjective well-being.

Results: Both samples show similar mean ASRS (16.7 vs. 16.2), DERS-18 (57.1 vs. 54.7) and SWLS scores (17 vs. 18.3). A multiple regression analysis showed that among Germans ASRS scores correlated more strongly with ED in the Latin American sample than in the German (R^2 0.41 vs. 0.08; $p < 0.0001$ vs. 0.0015). Dissatisfaction with life correlated more strongly with DERS among Latin Americans (R^2 0.38 vs. 0.1; $p < 0.0001$ vs. 0.0004) and only correlated with ASRS among Latin Americans (R^2 0.21; p 0.0034). In both groups, the correlation was strongest between ASRS scores and the DERS subscale goals and symptoms associated with the inattentive subtype correlated more strongly with both DERS and SWLS. The ERQ subscale suppression correlated with dissatisfaction with life in both samples (R^2 0.16 vs. 0.1; p 0.0092 vs. 0.0004).

Conclusions: Our preliminary results show significant differences between the German and the Latin American sample regarding the correlation of ASRS scores with both ED and well-being. Possible explanations for these findings include regional differences in the treatment of adult ADHD and cultural differences regarding emotion regulation strategies and ideals. We will examine both hypotheses with a second survey and focus group interviews in the next project phase.

Young people with ADHD: a qualitative investigation of factors for a successful personal recovery

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Objectives: Personal recovery has become a standard of mental health care. A recovery-oriented framework comprises: Connectedness, Hope and optimism, Identity, Meaning and purpose, and Empowerment-CHIME. Extending on the findings from a related parent/carer inquiry that sought to understand factors promoting their child living a satisfying, hopeful and contributing life, the present

study investigated factors adolescents and young adults perceived as promoting them living a satisfying, hopeful and contributing life while exposed to the challenges of ADHD.

Methods: Guided by a phenomenological theoretical framework, a data-driven thematic content analysis approach for collecting, organising, analysing and interpreting qualitative data received with purposive sampling was adopted. Approval was granted by the Human Research Ethics Committee at the University of Western Australia. The sample consisted of $N = 24$ individuals ($N = 9$) aged 14–19 years old and ($N = 15$) aged 20–34 years old. Data were gathered through open-ended interviews. Interviews were audiotaped. The text transcriptions were entered into NVivo 11 software. Transcripts were analysed using a constant comparative method. Credibility of the data was further established by member checking.

Results: Multiple themes relevant to living a satisfying, hopeful and contributing life while exposed to the impacts and challenges of ADHD were identified and combined into nine (9) primary themes: Time investment, Having a plan, Routine and structure, Identity, Valued social supports, Educating and collaborating, Self-awareness, Self-acceptance, and Symptom control-THRIVESSS. Parents and young people placed differing emphasis on specific aspects of THRIVESSS. An overarching goal for parents using THRIVESSS was establishing their child's positive identity. Young adults found transition (taking over THRIVESSS from parent) challenging and emotional dysregulation in personal relationships a primary concern.

Conclusions: The CHIME adult recovery-oriented framework holds some common elements with a young person's journey living and thriving with ADHD. The term 'personal recovery' is problematic given its inference for absence of the condition. Developing a specific child and adolescent personal recovery lexicon is indicated.

Barriers and facilitators in understanding ADHD in primary care

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Objectives: The process of access to care for ADHD is complex and variable across countries. This systematic review aims to establish the barriers and facilitators with regard to attitudes, beliefs and experiences of ADHD within primary care.

Methods: Electronic searches of multiple databases identified 3898 articles of which 48 met our inclusion criteria—primary care professionals from any country, understanding, knowledge, awareness, attitude and recognition of ADHD.

Results: Four main themes were identified, (1) need for education, (2) misconceptions and stigma, (3) constraints with recognition, management and treatment, (4) multidisciplinary approach.

Conclusions: The findings suggest many interacting factors are at play in the recognition of ADHD by primary care practitioners with a strong recurring theme of a significant need for better education on ADHD. Implications for research and practice are discussed, suggesting that educational interventions for primary care practitioners could improve the recognition of ADHD.

The role of executive functions in hyperfocusing and flow experiences in people with ADHD traits

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Objectives: To explore the association between hyperfocusing (a state of intense concentration on a task associated with the failure to attend to other stimuli) and flow (a state of optimal experience during task performance) in individuals with varying degrees of ADHD traits. Higher degrees of ADHD traits were hypothesized to be associated with more self-reported hyperfocusing but not with higher flow proneness. Additionally, we proposed that deficits in executive functioning mediate the relationship between the ADHD traits and hyperfocusing/flow.

Methods: First-year Psychology students of the University of Groningen (N = 320) participated in an online survey in exchange of course credits. A multiple regression model investigated the association between the Hyperfocusing Scale (HS), the Swedish Flow Proneness Questionnaire (SFPQ) and the Conners Adult ADHD Rating Scale (CAARS) ADHD index. We used mediation analysis to investigate the role of executive functions, as measured by the Barkley Deficits in Executive Functioning Scale (BDEFS for Adults), in mediating these effects.

Results: A significant multiple linear regression equation ($R^2 = .26$, $F(2, 318) = 55.75$, $p < .001$) supported the hypothesis that the ADHD index scores were positively predicted by the HS scores ($\beta = .36$, $p < .001$) and negatively by the SFPQ scores ($\beta = -.31$, $p < .001$). Mediation analysis revealed a significant indirect effect of ADHD traits on hyperfocusing through executive functions deficits, $ab = 0.15$, BCa CI [0.05, 0.24] with the mediator accounting for more than one third of the overall effect, $PM = .36$. Mediation analysis also revealed a significant indirect effect of ADHD traits on flow proneness through executive functions deficits, $ab = -0.01$, BCa CI [-0.016, -0.006]. Executive functions accounted for more than two thirds of the total effect of ADHD traits on flow proneness, $PM = .68$.

Conclusions: More problems in executive functions in individuals with ADHD traits may explain difficulties to attend to the world and personal needs during states of intense attentional focus on a range of activities. Such difficulties are also likely to play an important role in the lesser sense of control, effortless attention and enjoyment in everyday tasks. In the future, interventions targeting executive functions may significantly reduce the negative consequences of hyperfocusing and promote the positive consequences of flow states among individuals with ADHD traits.

ADHD in adults: five components for effective treatment

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Objectives: To articulate the optimal conditions for treatment of adults with a diagnosis of ADHD. To describe the parameters of each of these components through case study method.

Methods: Using specific case studies, the components for effective treatment (stimulant medication, safety, psycho-education, trauma therapy, and context re-engineering) are presented as requiring to be implemented in parallel and in complement, rather than as additives to a pharmacological regime. The model was developed over the course of 7 years of practice focused upon adults diagnosed with ADHD, who have had many other life challenges due to the secondary effects of unregulated ADHD.

Results: The benefits of using a multi-interventional approach are described, as well as some of the problems of not using an approach that accommodates all five factors.

Conclusions: The five components approach to treatment needs to be a beginning point for all ADHD treatments. Each clinician needs to work in a team, but needs to be aware of coordinating the

interventions in a synthetic whole. The clinician who is most focused on enabling a sense of safety is best placed to coordinate the treatment package if tasks are distributed. The lone mental health practitioner can do such coordination so long as the pharmacology is well monitored.

Thinking outside the text: utilizing video to engage Latino families in global ADHD research and service utilization

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Objectives: We utilized the Behavioral Impairment Video (BIV: 9-min, silent video depicting a child with ADHD) to conduct a needs assessment and recruit for a school-based treatment pilot (Collaborative Life Skills program in Mexico: CLS-FUERTE) in a Mexican public elementary school district.

Methods: We invite all families and school personnel to an introductory gathering in participating CLS-FUERTE schools. After a greeting, we present the BIV as context for needs assessment questionnaires and treatment referrals. To-date, N = 313 participants from 8 schools consented to the needs assessment and we reached our desired sample size of 6–8 families/school for the treatment pilot (N = 46).

Results: Most participants (78%) identified “ADHD/ADD” as the disorder in the BIV and biopsychosocial factors as the etiology (89%), with the most common causes identified being the family (56%) and biology/genetics (41%). Almost all (90%) reported they would be “pretty” or “very” likely motivated to seek help for the child in the BIV and only 13% reported that the behaviors are “pretty” or “very” likely to resolve without help. The most common help sources identified as appropriate for the child in the BIV were school personnel (78%), mental health professionals (74%), friends/family (45%), pediatricians/doctors (36%) and parent groups (33%). Regarding their own children, 15% endorsed a clinically-significant number of ADHD symptoms and 10% identified “ADHD/ADD;” only 5% reported ADHD service utilization (all medication).

Conclusions: Results imply unmet ADHD treatment need in Mexico, with 10–15% of our participants identifying ADHD in their own children versus 5% reporting service utilization. It is encouraging that most who viewed the BIV identified ADHD, endorsed biopsychosocial etiology, and reported help-seeking motivation. Our informational gathering presenting the BIV helped yield adequate power for our needs assessment -and- treatment pilot. Using novel methods (such as the BIV) may encourage recruitment and retention of under-reached communities in global ADHD research and treatment.

Unhealthy eating patterns of adults with ADHD

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Objectives: Individuals with ADHD have higher body mass index (BMI) and a higher prevalence of obesity than controls, with odds ratio increasing with age (Cortese et al. 2006). Several studies suggested that ADHD is linked to overeating, including emotional eating, external eating and binge eating (Kaisari et al. 2017). A different set

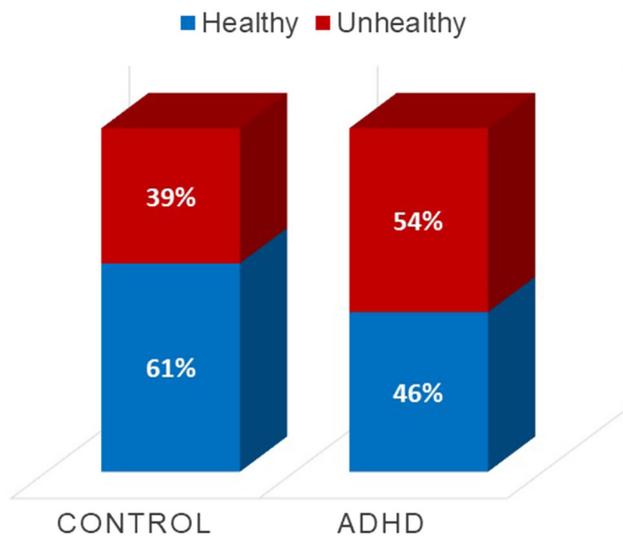
of studies, focused on food choices, found that people with ADHD consumed less healthy foods (such as vegetables, fruits and dairy products) and more unhealthy foods (fatty, sweet and processed foods like snacks, sweets, soft drinks and “fast food”) (e.g. Howard et al. 2011; Azadbakht et al. 2012). In the current study we examined whether ADHD in adult students is associated with unhealthy food choices.

Methods: We designed two studies, both were conducted on university students with and without ADHD (aged 20–30). In study 1, sixty participants completed the food frequency questionnaire (FFQ). In study 2, two hundred students reported what they had just chosen to buy in the university cafeteria. All the subjects completed the ASRS (Adult ADHD Self-Report Scale) and reported their height and weight.

Results: We found that students with ADHD had a higher BMI compared to students without ADHD. Students with ADHD reported lower daily consumption of healthy foods and higher daily consumption of unhealthy foods. Respectively, they chose less healthy items and more unhealthy items in the cafeteria.

Conclusions: These findings demonstrated that students with ADHD make unhealthy food choices in daily life and specifically in the cafeteria: They consume less healthy foods and more unhealthy foods. As dietary patterns continue to evolve, and obesity rates continue to rise worldwide, it is important to determine whether and why people with ADHD are among those vulnerable to poor health outcomes, and to develop intervention programs.

Eating patterns of students with and without ADHD.



Questionnaire development needs of adults with ADHD: results of the pre - unmet needs inventory - adult ADHD

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Objectives: The purpose of this study was to investigate the factor structure and reliability of the Pre- Unmet Needs Inventory-Adult ADHD (Pre-UNI-AA) and to reduce data in order to develop a short instrument to assess the unmet needs of adult patients with ADHD.

Methods: A total of 123 (34 women) participants with ADHD were included in the analysis. The mean age was 32.56 years (SD = 10.65, range = 17–62). An exploratory factor analysis was conducted with a principal axis analysis and oblique rotation as a structure-discovering method.

Results: FitRevelle was 0.9, the RMSEA index was 0.087. The cumulated explained variance over the six factors was 39%. The Analysis revealed six factors which cover areas such as expectations of medicinal or non-medicinal treatment at symptom level, needs and impairments in social relationships, needs for understanding and social support, needs for independence and needs for control and control experience. Cronbach's alpha ranged from $\alpha = 0.686$ to $\alpha = 0.828$ for factors with four to eight items.

Conclusions: In conclusion, there are distinguishable areas of needs which have to be confirmed in a second survey. This survey will be conducted in the following months and the factors described above will be examined with a confirmatory factor analysis. The resulting questionnaire can help patients and practitioners by providing information about the patients' needs and simplifying the process of treatment since the assessment would be standardized and economical.

Behaviors of children with ADHD that increase their risk to be bullied in school

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Objectives: Our aim was to identify, among patients diagnosed with ADHD) those who were physically, verbally or emotionally bullied at school, also which of their behaviors upset, annoy and provoke their colleagues, prior transforming into a victim of bullying.

Methods: We compiled a questionnaire with 20 closed and open questions, applied to patients aged 10–18 years, diagnosed with ADHD, who were brought by parents for evaluation in our Clinic. The first 10 questions were aimed at identifying bullying (e.g. “Have you ever been hit by a colleague of yours at school?”). The following 10 questions were designed to identify the behaviors that preceded the bullying (an example of a closed question “Have you insulted your colleague before he has offended you?” An open one “What did you do before being hit by your colleague?”). The period of application was set between 1 November 2018 and 1 February 2019, the final number of patients being established at 50. We mention that patients with ADHD who were not bullied, were excluded from the study.

Results: Looking at the data collected so far, we expect the results to be consistent with other studies. The identified behaviors were: verbal and physical aggression, impatience with interruption of others, lack of response to requests. Identifying these behaviors can improve the intervention by raising awareness, understanding social needs and relationships, increasing the possibility of developing effective coping methods.

Conclusions: The final interpretation of the results and study conclusions will be available by February 28, 2019.

Reviewing peer functioning in school-aged girls with ADHD

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Objectives: To gain insight into peer functioning difficulties in school-aged girls with ADHD. These girls experience many peer interaction problems and are at risk of peer rejection and victimisation. Although many studies have investigated problematic peer functioning in boys with ADHD, disregarding inherent sex differences. Hence this literature review focused on peer functioning in girls with ADHD compared to typically developing (TD) girls.

Methods: A systematic electronic database search was performed to identify relevant literature comparing peer functioning in school-aged girls with ADHD to their TD counterparts. Peer relationship domains were grouped into 'friendship', 'peer status', 'social skills/competence', and 'peer victimisation and bullying'. In total, thirteen studies were included in the review.

Results: All included studies reported increased difficulties in the domains of friendship, peer interaction, social skills and functioning, peer victimization and externalising behaviour in girls with ADHD relative to TD girls. Studies consistently showed higher 'social disability', very high levels of peer victimisation (large effects), very high levels of social impairment and social skills deficits (large effects), lower rates of friendship participation and stability (small to medium effects) and higher levels of peer rejection (small to large effects) in girls with ADHD. The latter were predicted by girls' conduct problems. Peer rejection in turn predicted poor social adjustment and multiple problem behaviours. Levels of pro-social behaviour varied across studies, but were mostly lower in girls with ADHD (small to large effects).

Conclusions: Congruous evidence was found for peer functioning difficulties in the peer relationship domains of friendship, peer status, social skills/competence, and peer victimisation and bullying in girls with ADHD. Externalising and gender-atypical behaviours often seen in girls with ADHD put them at risk of impairment in many aspects of social functioning. These findings are discussed in light of a social learning model describing a negative spiral of problematic peer functioning and the development of social skills [Mikami and Hinshaw, *J Abnorm Child Psychol*, 2003].

Links between life satisfaction, aggression, cognitive profile, inflammatory and neuropeptides in adults with ADHD: preliminary study

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Objectives: The primary objective was to determine the differences between adults with ADHD and healthy controls, with regard to satisfaction with life, predisposition towards aggressive behaviour, cognitive functioning and serum concentration of interleukin 6 (IL-6), neuropeptide S (NPS), neuropeptide Y (NPY) and galanin (GAL). The second purpose was to analyse a link between the aforementioned biomarkers and cognition, life satisfaction and aggression.

Methods: The participants completed Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria for ADHD and Adult ADHD Self-Report Screening Scale for DSM-5 (ASRS-5). The diagnosis was confirmed based on interview with clinician. Both patients (age range 21–55) with ADHD (N = 14) and control group (N = 11) completed the Polish adaptation of Life Satisfaction Questionnaire (Fragebogen zur Lebenszufriedenheit-FLZ), Inventory of Psychological Syndrome of Aggression (IPSA) and performed a series of cognitive tests using the CNS Vital Signs computer test battery. The laboratory analysis was performed to investigate serum concentration of biomarkers.

Results: Adults diagnosed with ADHD, in comparison to healthy controls, declare lower satisfaction with their free time ($p = 0.009$).

They are also characterized with a higher level of aggression syndrome and they are more susceptible to particular aggressive behaviours ($p < 0.05$). The patients also present lower level of sustained attention ($p = 0.011$) and processing speed ($p = 0.024$). In ADHD adults GAL correlates significantly with neurocognition index ($r = -.405$; $p = 0.045$) and verbal aggression ($r = -.642$; $p = 0.018$). IL-6 correlates significantly with psychomotor speed ($r = .507$; $p = 0.010$) and motor speed ($r = .537$; $p = 0.006$). There is significant correlation between NPY and visual memory ($r = .584$; $p = 0.002$), complex attention ($r = -.527$; $p = 0.007$), cognitive flexibility ($r = -.494$; $p = 0.012$) and executive function ($r = -.409$; $p = 0.042$). NPS correlates significantly with visual memory ($r = -.494$; $p = 0.014$) and reaction time ($r = .477$; $p = 0.018$).

Conclusions: Neurobiological basis of adult ADHD symptoms may include GAL, NPY and IL-6 activity.

Development of social skills rating scale for ADHD adolescents: preliminary study

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Objectives: Adolescents with ADHD often have problems in social interactions with peers and are confronted with peer rejection and social isolation. The most common approach to social problems in adolescents is social skills training. This intervention concept represents a variable mixture of cognitive-behavioral intervention elements. We tried to make an assessment tool specifically designed for social skills in ADHD adolescents. This instrument was developed to identify the presence of social skills deficits and to find out the specific dimensions of impaired social skills.

Methods: For the purpose of constructing the questionnaire of sociability skill scale, a comprehensive study focusing on prior studies and theories in the interpersonal relations and the behavioral characteristics of ADHD adolescents were sampled. For adolescents with ADHD, their social skills characteristics were collected and summarized. We collected them and modified them in the form of questionnaires. We also gathered previously published rating scales to assess the social skills in the adolescents. Those scales include Relationship Change Scale, Rathus Assertiveness Scale, Self Efficacy Scale, Rosenberg Self Esteem Scale, Self-control rating scale, social intelligence rating scale, social perception, interpersonal stress scale, peer relationship evaluation test, and peer relationship skill scale.

Results: The development procedure of a scale was carried out in the preliminary scale development. We have developed a preliminary scale which has 4 dimensions—Self-control, Cooperation/Empathy, Assertion/Self-esteem, and interpersonal relationship. This scale is composed of 32 items. Each item is the 5-point scale that offers a range of answer options—from "not at all" to "definitely yes." This scale also includes reverse scoring items.

Conclusions: Further validation is needed. More than 100 adolescents enrolled from the local schools in the typically developing control group and 50 adolescent ADHD patients who visit the child and adolescents psychiatry clinic participate in the validation study. In the later data analysis stage, the descriptive statistic analysis, the internal consistency coefficient (α), the exploratory factor analysis and the confirmatory factor analysis results will be performed and presented. These information could be used to design the personalized social skills training program for ADHD adolescents. This scale also could continuously monitor changes in these skills.

Social skills rating scale for ADHD adolescents.

Read each sentence and mark it where you think best suits you.

	Questionnaire	Not at all	Sometimes	Usually	Mostly yes	Definitely yes
1	I tend to express my opinion immediately to others.					
2	I believe that I'm as valuable as anyone else.					
3	There are times when I feel it is difficult to say "no or I don't want to".					
4	When I meet someone for the first time, I approach them before they approach me.					
5	When difficult problems arise, I avoid dealing with them.					
6	Even when others hurt my feelings, I try my best not to hurt others' feelings.					
7	I talk to my friend(s) about my worries and/or problems.					
8	I think others will think of me as a decent person.					
9	When someone else did something well, I compliment him/her.					
10	When a friend is being criticized unfairly, I stand by his/her side.					
11	I ask for permission before I use others' belongings.					
12	I obey the rules of games, sports, or any other type of playing.					
13	I finish my task or class assignments on time.					
14	I talk to my friend(s) about my problem and ask for help if needed.					
15	I can feel others' emotions by listening to their voice or by observing their behavior.					
16	I admit it when I make a mistake.					
17	I usually act as I feel like and get angry easily.					
18	I often get commented on for not listening to others.					
19	When I receive negative comments from others, I feel best to react immediately upon it.					
20	Even when my opinion is different from that of the adults, I express my opinion well without fighting or debating.					
21	I think deeply enough before I say something rather than carelessly chatting my thoughts out loud.					
22	All the things I do is relatively similar in terms of completeness.					
23	When I get angry, I tend to break things that I lay my hands on.					
24	Others say that I am careless.					
25	It is easy for me to communicate with others.					
26	When I disagree with others, I deal with it rather well.					
27	I hang out well with same-sex friends.					
28	I hang out well with friends of the opposite sex.					
29	I feel more comfortable spending time by myself than hanging out with friends.					
30	There are not many friends who truly understand me.					
31	I am jealous of someone who is more competent than me.					
32	I easily grow apart from my friend(s).					

Systemic deficit of attention of child protection children: implications for assessment, intervention and diagnosis

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Objectives: To demonstrate how trauma can obscure the diagnoses for children entering care, To present a method where diagnoses and interventions can be identified using the Neurosequential Model of Therapeutics (NMT) (Perry 2009, The Child Trauma Academy) and the Sensory Profile (SP2A) (Dunn 2014).

Methods: De-identified case studies will review initial diagnosis and demonstrate the utility and efficiency of the NMT and SP2A in identifying domain functioning and relational and sensory based activities that can assist the child's self-regulation and development. The NMT reviews developmental history and current functioning on sensory integration, self-regulation, relational and general cognitive functioning. The SP2A examines auditory, visual, tactile, and movement processing, along with the behavioural correlate of sensory processing.

Results: The diagnosis of PTSD arose in the cases due to the information available, To better inform ongoing care, consideration of ADHD as the most likely primary diagnosis needs to be given. The challenges to the recognition and medical management of ADHD with this population were described.

Conclusions: NMT and SP2A bring a capacity to help the child understand and self-regulate in relationship with key persons. The inter-relationship between biological predisposition, neural atypicality and environmental harm needs to be considered and responded to with appropriate interventions.

Women and ADHD functional impairments: beyond the obvious

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Objectives: The purpose of this qualitative, phenomenological study is to explore the impact of functional impairments on the internal lived experience of women with ADHD. Research indicates that functional impairments play a significant role in reducing the overall quality of life for those who live with ADHD. When the ADHD functional impairments of women were studied and compared to men, it was found that women tend to internalize their impairments. (Guendelman et al. 2016; Holthe and Langvik 2017; Nussbaum 2012; Owens and Hinshaw 2016; Safren et al. 2010; Smyth et al. 2016) Yet no research was found that looked at the impact of the internalization of impairments on women who have ADHD. This prompts the research study question: How do women describe the internal experience of living with functional impairments caused by ADHD?

Methods: During a two-week recruitment window, women were invited to complete an online version of the Weiss Functional Impairment Rating Scale—Self Report. 140 women completed the scale. The responses were then broken into decades, and participants were chosen using a random number generator. The researcher then interviewed 15 of these women about their lived experience of functional impairments caused by ADHD. Once the interviews were transcribed, the researcher applied a phenomenological method of data analysis. Through the use of this method of analysis, several specific themes emerged from the data.

Results: Theme One: Internal Emotional Impact of Functional Impairments The women interviewed were found to be significantly emotionally impacted by ADHD functional impairments. When a functional impairment happens in their lives, it elicits intense emotions that are felt internally and not always externally expressed. Theme Two: Negative Automatic Thoughts The women interviewed reported that functional impairments trigger specific, negative, self-deprecating automatic thoughts. These automatic thoughts were reported to always be negative, and to be very difficult to control. The thoughts are aimed directly at the woman, not the situation. These internal, automatic thoughts, were described as intense, difficult to get out of, exhausting and overwhelming. It is evident from the interviews that the automatic thoughts caused by functional impairments are taking a significant toll on these women's mental and physical health. All of the women interviewed reported physical responses caused by functional impairments that were uncomfortable, painful, and caused distress. Theme Three: Functional Impairments misunderstood by others When asked what they wanted others to understand about living with ADHD functional impairments, each woman said that they wished the people around them understood that any hurtful or frustrating actions were not malicious, deliberate, or willful. They asked those in their lives to approach their relationship and interactions with the knowledge of how ADHD may impact them and their functional capacity. It was evident from what was shared in the interviews that functional impairments are causing immense tension, strain, pain, and frustration for both these women and those in relationship with them. *NOTE: These are the preliminary findings, this study will be fully completed by the beginning of April 2019.

Conclusions: There is evidence from these interviews that there is a need to seek to understand the internal impact of functional impairments. Negative emotions, self-deprecating automatic thoughts, and the misunderstandings caused by ADHD functional impairments are reducing these women's overall quality of life. All of the interviewed women reported "constantly having to fight against these impairments". If these internal lived experiences are not addressed, the treatment of ADHD may be significantly less effective, and

frustration will continue to be acutely experienced. These interviews point to a need to create evidence-based interventions that address the internal impact of functional impairments as well as reduces the functional impairments that cause the most internal distress. Targeted treatment for functional impairments identified as most distressing by the patient or client is a next step in ADHD care that will improve outcomes and client well-being.

Comparing parental stress levels between fathers and mothers of boys with ADHD

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Objectives: Many parenting stress studies of children with ADHD rely on maternal reports. Information about paternal stressors is minimal. This study investigates differences in parental stress levels between mothers and fathers of boys with ADHD. We hypothesise that mothers, typically the main caregivers, experience more parental stress.

Methods: A total of 15 fathers and 15 mothers (of children aged 6–19, diagnosed with ADHD at an outpatient psychiatric clinic) filled up the Parental Stress Scale (PSS) and Patient Health Questionnaire-9 (PHQ-9), a depression screener. Children of father respondents were matched to gender (all boys) and Clinical Global Impression-Severity (CGI-S) rating to control for parental stress attributable to gender differences and severity of functioning. Their responses were compared using an independent sample T-test.

Results: There is no significant difference in parental stress levels ($t(28) = 1.726, p = .095$) and depression scores ($t(28) = -1.066, p = .295$) between fathers and mothers overall, although there is a trend towards fathers experiencing more stress ($M_{father} = 49.47, M_{mother} = 44.40$). Fathers hold a significantly less optimistic future outlook than mothers ($t(28) = 2.646, p = .013$) and appear to experience more financial-related stress ($t(28) = 1.804, p = .082$). Fathers also tend to find their children less enjoyable ($t(28) = 1.775, p = .087$).

Conclusions: Mothers and fathers of boys with ADHD experience similar parental stress levels and mood overall. However, fathers report significantly less optimism for the future and show a propensity for higher stress than mothers in several areas. A larger sample size would possibly yield more significant results. Recommendations include appropriating clinical services for this population.

Screen time exposure and sleep among children with ADHD

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Objectives: Children with ADHD are at risk of excessive screen time and sleep disorders. The aim of this study was to determine the extent of screen time use in children with ADHD and its relationship with sleep duration.

Methods: Children aged 6–10 years were recruited from the ADHD population followed in the neurodevelopment clinic of a district hospital. Cases with comorbidities such as other developmental disorders and severe behavioural problems were excluded. The parents of the selected children were asked to answer an electronic

questionnaire about sleeping habits and screen time use. Univariate statistical analysis (t-test and Chi-square test) were, then, performed.

Results: Parents of 24 children completed the questionnaire. Most children were male (83%) and had 10 years of age (54%). The mean daily total screen time exposure was 5h09 min (SD 184 min). Nine hours and fifty eight minutes (SD 38 min) was the mean amount of sleep per weekday. In children with greater screen exposure (≥ 4 h per day), sleep time was reduced, on average, by 23 min (9 h45 min vs. 10 h08 min). Bedtime electronics use was also associated with less sleep (9 h47 min vs. 10 h15 min). Older children tended to sleep less and to have more screen time.

Conclusions: Among children with ADHD, greater daily screen time and bedtime use of technology seems to be associated with lower sleep duration. It is highly recommended that clinicians routinely ask about screen time exposure, especially in older children, to provide appropriate guidance and prevent sleep disorders.

ADHD characteristics in Brazilian adults: an online survey

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Objectives: The study purpose was to investigate characteristics of adults with ADHD who were registered in “Academia do TDAH”, an online program to promote ADHD psychoeducation and psychosocial support. Specifically, it aimed to explore subjects’ socio-demographic and clinical data as ADHD comorbidities, treatment, and diagnosis, as well as to assess ADHD symptoms, and evaluate executive dysfunctions.

Methods: We conducted an exploratory, cross-sectional, and quantitative study on July 2018. Brazilian adults diagnosed with ADHD registered at “Academia do TDAH” were recruited based on a convenience sampling strategy through internet advertising to respond an online survey. The instruments used included Adult Self-Report Scale (ASRS-18), Barkley Deficits in Executive Functioning Scale (BDEFS), and a questionnaire developed for the present study. The data collected was analyzed using descriptive analysis and Spearman correlation using STATA. The research was approved by Ethics Council.

Results: A sample of 237 Brazilian adults (147 women) was enrolled with an average age of 31.28 years (SD = 9.27). Most of them presented complete or incomplete higher education (55.7%). The great majority was only diagnosed in adulthood (84%), presented severe or moderate ADHD (93.2%) and had at least one comorbid disorder (78.1%). The ADHD current presentation prevalence was: inattentive (28.7%), hyperactive (1.7%) and combined (67.9%). Significant correlation was obtained between the total scores from ASRS-18 and BDEFS ($r = 0.533; p < 0.001$), suggesting that deficits in executive functions are correlated with the ADHD symptomatic severity.

Conclusions: The evidence shows that the diagnosis of ADHD continues to be missed until adulthood for a substantial proportion of patients in Brazil and that Brazilian adult subjects from this sample present similar characteristics than those diagnosed with ADHD worldwide. Further research on the topic should be conducted in order to proper understand the characteristics of this group.

A process evaluation of the ADHD changing lives initiative

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Objectives: The Incredible Years Parenting Programme is empirically supported across a range of emotional and behavioural disorders. However, the acceptability of such interventions for ADHD-type problems is currently unclear as is programme activities and challenges of implementation. The objectives of this study are to identify the process by which a 20-week Incredible Years Parenting Programme for behaviours consistent with ADHD (known as the “Changing Lives Initiative”) operates across three jurisdictions Ireland, Northern Ireland, and Scotland and to explore the factors that contribute to or impede its implementation and value for money in diverse settings.

Methods: A mixed methods approach was adopted, with parents ($n = 120$) completing a structured questionnaire at three time points (before commencing, on completion, and 6-month post-programme). Programme stakeholders ($n = 16$) facilitators and managers took part in semi-structured, one-to-one interviews to examine their perspectives and experiences.

Results: Preliminary findings indicate that parents report improved family functioning and overall quality of life following completion of the programme. Peer support and skills gained from the programme were identified as key contributing factors.

Conclusions: Group-based prevention and early intervention programmes such as these may offer an accessible and cost effective alternative for the amelioration and management of ADHD. Factors that contribute to and impede optimal implementation, engagement, and delivery are discussed.

Interventions to improve social competence in adolescents with ADHD: a systematic review and meta-analysis

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Objectives: ADHD is associated with social impairment in peer relationships. Interventions to improve social competence have predominantly focused on elementary-aged children, despite clear evidence that ADHD-related social difficulties persist into adolescence, with more adverse consequences. This review identifies trials of interventions targeting social competence in adolescents with ADHD, to assess the current state of evidence.

Methods: To maximize eligible studies, all studies of non-pharmacological interventions to improve social competence with peers were eligible for inclusion, with the exception of single case designs. Adolescents aged 10–18 years with a diagnosis of ADHD were the recipients of the intervention. Following PRISMA guidelines, a systematic search identified 1615 non-duplicate articles from which 11 trials reported in 13 records were included for systematic review. Four randomized, and four non-randomized trials reported results eligible for inclusion in meta-analyses. Overall, included studies evidenced a high risk of bias.

Results: A random effects meta-analysis of the randomized controlled trials found there were no statistically significant differences between treatment and control groups as measured by parents ($g = -0.08 [-0.34, 0.19]$, $k = 4$, $N = 354$) or teachers ($g = 0.17 [-0.06, 0.40]$, $k = 3$, $N = 301$). A random effects meta-analysis of

the non-randomized trials found a statistically significant improvement in social competence from pre- to post-intervention according to parents ($g = 0.54 [0.13, 0.95]$, $k = 4$, $N = 48$), but not according to teacher report ($g = 0.04 [-0.75, 0.83]$, $k = 2$, $N = 16$), or self-report ($g = 0.45 [-0.05, 0.95]$, $k = 2$, $N = 32$).

Conclusions: The weight of evidence does not currently support the efficacy of interventions to improve the social competence of adolescents with ADHD. Tailoring interventions to address individual differences in social difficulties may improve their efficacy. Limitations in measuring change, along with the inherent difficulties in designing efficacy trials are also discussed.

Short-term effects of a peer co-led educational programme to parents with ADHD children: a study protocol

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Objectives: Significant parts of children with ADHD display behavior problems that interfere with their relationship development and academic achievement, and may have multiple problems, which strain family dynamics and influence their child’s treatment. Parent activation, described as parents’ knowledge, skills and confidence in dealing with their child’s health and healthcare, has been shown to be important for improved health outcomes. Research suggests that parents need edification to learn skills, which are crucial for treatment, and management of their children’s healthcare, probably by promoting positive parenting techniques and reducing negative parenting factors in the families. This study aims to assess the effect of a peer co-led educational programme for parents of children with ADHD on the Parent Patient Activation Measures (P-PAM) and secondary outcomes.

Methods: Parents ($n = 55$) of children between 6 and 15 years newly diagnosed with ADHD referred to pediatric psychiatric outpatient clinics, will receive a peer co-led educational programme and will be compared with a control group of parents ($n = 55$) receiving standard. The main outcome is the P-PAM, assessed at the inclusion and 3 months follow-up. Secondary outcomes include measures of parent satisfaction, and parent reported ADHD symptoms and problems (Swanson, Nolan, and Pelham). Parents in the intervention group will receive the educational programme after confirmed diagnosis of the child. Parents in the control group will receive regular parenting involvement, referred to as ‘treatment as usual’, and not the peer co-led intervention.

Results: This is the first RCT assessing the efficacy of a peer co-led educational programme for parents of children with ADHD, involving educators who are user representatives and parents of children with ADHD, participating and teaching in educational interventions in cooperation with healthcare professionals.

Conclusions: This study may prove to be a valuable contribution to the healthcare of families with ADHD, and target the family’s needs.

Sleep patterns in an ADHD sample: a latent class analysis

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Objectives: The aim of the study was to determine sleep profiles in a outpatient population with ADHD by using latent class analysis (LCA).

Methods: Cross-sectional study in a clinical sample of 228 attention deficit and hyperactivity disorder (ADHD) patients (Mean age = 11 years old. Parents filled out the Children Sleep Habits Questionnaire-Abbreviated (CSHQ-A). LCA was used to classify each child into a class according to their demographical and clinical variables, and to sleep patterns.

Results: The model of 4 classes for the sleep profile in ADHD was selected: class 1: only children, males the majority with combine presentation, with comorbidity especially disruptive learning or language disorders, and with the higher score in the scale (M: 25.98). Class 2: mostly female adolescents, two-thirds with inattentive presentation and comorbid anxiety, they had the lower score in the scale (M: 12.78). Class 3: males with ADHD combine presentation, exclusively adolescents, with comorbid depression, and with high score in the scale (M: 24.28). Class 4: only male children with highly comorbid (especially disruptive learning or language disorders), and some sleep problems by scale (M:20.1).

Conclusions: This is an alternative analysis for and ADHD sample according to sleep. Classes 1 and 3 presented a greater number of sleep problems as indicated by the CSHQ-A score: class 1 represented by children male, and class 3 with adolescent male, both with combine presentation and comorbidity (disruptive, depressive and learning disorders). Besides, class 2 represented by adolescent women with anxiety and inattentive presentation, had few sleep problems. LCA allow to find a possible relationship between ADHD presentation, comorbidity and sleep: classes 1, 3 and 4 have the highest scores on the scale, and are those represented by ADHD combine type and highly comorbid. Through the latent classes model, ADHD groups that present more sleep problems were identified.

Prognostic factors related with “unmet need” in adolescents with ADHD

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Objectives: To determine the “Unmet needs” for seeking mental health care in ADHD adolescents non- referred versus their siblings also with ADHD.

Methods: Study sample was obtained from 2 outpatient centers and was composed by 83 probands (MET group) and 38 siblings both adolescents with ADHD (UNMET group). The subjects were evaluated by clinicians with at least 5 years of experience and the diagnostic determination was made by clinical consensus with at least one expert with 20 years of clinical experience. The sample was evaluated by a clinical interview based on DSM IV: For the current study, we define “unmet need” for ADHD care as meeting diagnostic criteria without having received ADHD treatment across the life span.

Results: Around 61% of the ADHD adolescents (n = 121) were male, average age was 15.32 (DE = 2.08). We found more than 2 times more likelihood that a female ADHD adolescent was in UNMET group (UNMET group, 52.6% vs. MET group, 35.2%; 95% CI 1.05–5.05). Even 3 times more likely when adjusting for severity of the disorder (OR 2.7; 95% CI 1.2–6.2). No differences regarding age between groups (UNMET group 15.8 DE ± 2.6 vs. MET group 15.1 DE ± 1.7, $p = 0.187$).

Conclusions: When we evaluate subjects with suspected ADHD, it’s important to consider the role played by sex of affected subjects in the clinical presentation. It’s important to consider of school information regarding to performance in different areas Utilization of these services in adolescence may be particularly salient for preventing persistence of psychopathology into adulthood. To eventually reduce the impact of ADHD in subjects and their families, health policies should be aimed at detecting high-risk populations that have not yet received attention and timely treatment.

ADHD: straight talk about suicide

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Objectives: This review aims to investigate the association between ADHD and the risk of engaging in suicidal behavior.

Methods: A PubMed research were performed in December 2018 using the search keywords “ADHD”, “suicidal behavior” and “suicide risk”.

Results: Attention deficit/hyperactivity disorder (ADHD) is a persistent neurodevelopmental condition characterized by persisting inattention, hyperactivity and/or impulsivity with significantly impaired functioning and development. Evidence that ADHD symptoms persist across the life course has led to a growing body of research examining the effects of ADHD among adults. ADHD has been linked with a variety of detrimental health outcomes, including a greater risk for suicidal behavior. Some authors defend that ADHD increased the risk of suicidal behavior by intensifying the severity of comorbid disorders such as depression. However other studies have demonstrated that the association between ADHD and attempted or completed suicide remained robust even after controlling for the presence of comorbid mental disorders such as oppositional defiant disorder, conduct disorder, anxiety, depression and substance use disorders. It is uncertain what underlies between ADHD symptoms and an increased risk of suicidal behavior, although several potential mechanisms/explanations have been proposed. First of all, symptoms of ADHD, namely impulsivity and inattention, directly contribute to suicidality. Secondly, ADHD patients have worse outcomes across a variety of different life domains, including work, health, emotional response, quality of life, life satisfaction, relationship difficulties and social support.

Conclusions: Adults with ADHD have an increased risk for suicide ideation and suicide attempts, which is independent from the presence of comorbidities. This knowledge underlines the need for research in order to better understand this relation and the factors associated with it.

Just being a kid, or an ADHD kid: a qualitative study of on how young people experience receiving and living with a diagnosis of ADHD

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Objectives: The objective of this study was to examine how young people experience receiving and living with a diagnosis of ADHD over an 8-year period. We aimed to develop our understanding of such an experience, and to fill the gap in the literature concerning the relationship between living with a diagnosis of ADHD and self-esteem.

Methods: The study has a qualitative retrospective design. The participants were selected from Helse-Nord Trøndelag, Child and Adolescent Psychiatric services, Hospital of Nord Trøndelag. Eight adolescents and young adults diagnosed with ADHD in 2007–2008, were interviewed using a semi-structured interview during 2015 and 2016. The data were analyzed using Systematic Text Condensation.

Results: Self-esteem, normalization and maturation emerged as themes from the analysis. These young people had strong self-esteem, they shared the importance of being a unique person regardless of the diagnosis, and their self-esteem was stronger than suggested by previous literature. They wanted to be treated equally without special interventions in school as this made them feel different from others. They wanted to succeed in life despite their diagnosis.

Conclusions: Receiving a diagnosis of ADHD and being treated with medication in childhood may offer a protective effect on self-esteem. They express themselves as individual persons independent of their diagnosis and the diagnosis motivated them to show that they could manage to achieve as much as their peers. Nevertheless, these young people perceived that they were stigmatized by the diagnosis which they felt marked them out to be different to others.

ADHD symptom fluctuations and experience of nature in children's daily life

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Objectives: ADHD is a disorder frequently diagnosed in children and adolescents showing symptoms of inattention, impulsivity and hyperactivity according to the dimensional approach of ADHD also children without an ADHD diagnosis frequently show ADHD symptoms (Coghill and Sonuga-Barke 2012). ADHD symptoms fluctuate within children from day to day (Schmid et al. 2016). Therefore, ADHD symptoms can be seen as context dependent. Whether nature as context can reduce inattention in children with ADHD was assessed by Faber Taylor and Kuo (2009). The authors found out that the children were able to concentrate better after walking in a green area compared to walking in a city. In our study, we assessed with ambulatory assessment whether there is a covariation of daily fluctuations of inattention and the experience of nature in children with ADHD symptoms.

Methods: Students from German comprehensive and middle schools ($N = 55$; age in years: $AM = 10;9$, $SD = 0;6$), rated their daily ADHD symptoms (Lidzba et al. 2013) as well as their daily natural experience, over eighteen consecutive days. Items from the original questionnaires were adapted to daily measurement and assessed via smartphones once or three times a day. In addition, attention was objectively assessed via a working memory task on the smartphone.

Results: The children's ratings revealed an intra-individual standard deviation (MISD) of inattention of 0.70 ($SD = 0.47$), and for natural experience an MISD of 1.02 ($SD = 0.62$). Mixed model analyses for the covariation of inattention and the daily experience of nature will be discussed on the poster.

Conclusions: Children showed daily inattention fluctuations as well as fluctuations of their daily experience of nature. Further analyzes and implications of the study will be discussed on the poster.

Living with ADHD: a meta-synthesis review of qualitative research on children's and adolescents' experiences and understanding of their ADHD

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Objectives: The aim of the following study was to systematically search for and review qualitative research on children's and adolescents' everyday experiences and understanding of their ADHD, and to suggest an integrative synthesis of the results.

Methods: The method that was used as a guide for the synthesis of the qualitative studies is the one suggested by Sandelowski and Barroso (2007). This broadly used method in the context of health-care research (Saini and Shlonsky 2012) aims to systematically review and integrate the findings from various qualitative research reports and to suggest an understanding of the phenomenon in a manner entailing more than merely the sum of all the studies' results (Sandelowski and Barroso 2007). The method consists of three stages: firstly, a systematic search for and retrieval of qualitative research reports; secondly, a critical appraisal of the identified reports according to inclusion criteria; and thirdly, an interpretative integration of the findings of those studies regarded as eligible by creating a categorisation of these findings.

Results: In total, 16 published and unpublished qualitative studies on the subject were identified. The analysis identified four categories: (1) experiences related to one's body and psychological abilities: lack of control, having difficulties, and the biological determination of these experiences; (2) ambivalent experiences related to one's own psychological needs: a need to adjust oneself and a need to be accepted as 'who I am'; (3) ambivalent experience related to social others: demands and expectations are a problem, experiencing lack of belonging and stigma, but also receiving help from close social others; and (4) experiences related to the formation of personal identity. **Conclusions:** Knowledge regarding children's and adolescents' everyday experiences of ADHD and their understanding of these experiences is valuable for the further development of interventions.

Managing children with challenging behaviour. Parents' meaning-making processes in relation to their children's ADHD diagnoses

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Objectives: This study investigates parents' lived experiences of having a child diagnosed with ADHD. The particular aim was to explore parents' meaning-making processes in relation to their children's ADHD with a focus on understanding the potential impact that receiving a diagnosis had on the parents' perceptions of, and ways of managing, their children's challenging behaviours.

Methods: Drawing on data collected through semi-structured interviews with 12 parents recruited to the study by school psychologists in Sweden, we carried out a content analysis of the parents' accounts, producing a range of categories describing different aspects of the parents' meaning-making processes in relation to their child receiving an ADHD diagnosis.

Results: Five conceptual categories were identified, describing components of a process of adaptation through which the parents — using the diagnosis as a tool — were able to transform feelings of distress over their difficulties in managing their child's challenging behaviours into feelings of being able to cope with these challenges of integrating the ADHD diagnosis into everyday family life.

Conclusions: This research suggests that understanding the long-term processes involved in parents' meaning-making of an ADHD diagnosis is important and can open up a pathway to developing initiatives to support parents in dealing with their child's challenging behaviours in everyday life.

ADHD in urban China: implementing ADHD pathways in a pediatric and in a mental health care system

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Objectives: In the context of modern China, children experience a tremendous pressure to perform academically at high levels. This stressful environment is associated with depressive symptoms, suicidal ideation and attempts in adolescence. Children with a diagnosis of ADHD are at high risk in such a stressful environment, despite a generally normal intellectual potential. ADHD treatments are very effective but dependent on the quality of care and on the coordination of different interventions, planned according to individual needs. We aim at developing, implementing and evaluating a model of care based on the Canadian experience while adapting it to the Chinese urban context.

Methods: Based on a review of the literature and group discussions, we designed interviews that were conducted with primary care providers to identify the main barriers to care, the existing resources and the relevance of the shared care model developed in Canada for the Chinese context. The primary care providers were either working in the pediatric or the mental health care systems. The analysis was done via an adapted grounded theory approach.

Results: The main common barriers are the shortage of qualified clinicians, the lack of training, and the lack of referral system. The main difference was a much more pronounced stigma for seeking help in the mental health system.

Conclusions: In response, we will train the different practitioner focusing on their specific needs, implement shared care pathways between general and specialized practitioners in two target districts, within a stepped care in which the patient is treated at the most appropriate level of care, depending on complexity or outcome.

The assessment of marital adjustment amongst parents of children diagnosed with ADHD

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Objectives: ADHD is one of the most common neurodevelopmental disorders which may functionally have an impact on family life regarding the marital relationships. The aim of this research is to compare the marital status adjustment levels between the parents of primary school children who referred to child psychiatry university clinic diagnosed as ADHD compared to the control group of similar age and sex.

Methods: Clinical psychiatric diagnoses of ADHD were established by using the Kiddie Schedule for Affective Disorders and Schizophrenia Present and Lifetime Version. Parents were assessed by "Marital Adjustment Scale" (MAS) including 15 multiple choice questions, developed by Locke and Wallace (1959). SPSS 20.0 descriptive statistics are utilized and Chi-square is used for further comparative analysis.

Results: The treatment-naïve ADHD group consisted 51 children (mean age: 10.34 ± 1.86 ; 43 male, 8 female), and 104 healthy controls (mean age: 10.16 ± 1.69 ; 124 male, 31 female). 70.83% of ADHD group was combined subtype, the rest being predominantly attention deficit subtype. The ADHD severity was determined as moderate according to Clinical Global Impairment Scale. The ADHD group was 23% compatible in global scores in contrast to the 68.3% of the controls ($p < 0.05$), when the cut-off point for Locke-Wallace MAS scale was set as 43 points. Global Happiness Scale results of MAS were 39.2% versus 78.8% for ADHD group and controls, respectively ($p < 0.05$). Intimacy and Communication with Relatives subscales revealed similar results and did not differ in either groups.

Conclusions: A poor marital relationship could influence the adaptive functions and impact the satisfaction outcomes of parents having children diagnosed with ADHD. Future studies should be conducted to explore the impact of ADHD on caregivers' marital adjustment, especially in the aspects of contentment of marriage, leisure and social activities, and intimacy besides affection.

Reading components in ADHD and dyslexia: differential cognitive profiles in Brazilian adolescents

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Objectives: ADHD and Dyslexia are among the most frequent developmental disorders in school-aged students, and both often cause an impact on scholar reading performance. Therefore, it is fundamental to trace the differential profile in reading performance in such diagnoses. Competent reading occurs through the interaction of several cognitive processes such as decoding, comprehension and fluency. The study aimed to characterize the performance of students with ADHD and dyslexia.

Methods: We assessed 25 adolescents, aged between 11 and 14 years old, from 6th to 9th year of middle school of public and private schools in Brazil, divided into two groups: the group with ADHD (16 students) and the group with dyslexia (9 students). The diagnoses were established by a multidisciplinary center and there were no comorbidities for any case. The instruments used were:

Comprehension Test of Words and Pseudowords II (TCLPP II) to assess decoding; Reading Fluency Test (TFL) to assess fluency; Cloze Reading Comprehension Test (TCCL) to measure reading comprehension; and the WISC vocabulary subtest to assess auditory comprehension.

Results: Non-parametric analyzes revealed statistically significant differences in measures of textual comprehension, especially in the tasks that involved decoding and fluency processes, evidencing superior performance of the group with ADHD in these tests. Participants with dyslexia had a significantly higher performance in relation to the number of word omissions, that is, they had lower omission errors. There was no significant difference between groups in auditory comprehension.

Conclusions: A differential profile was found in reading performance, consistent with the cognitive deficits classically pointed out in the literature for each diagnosis: phonological deficits in dyslexia, with problems in decoding and fluency; and attentional deficits in ADHD, with omission errors.

Determining if ADHD has a causal role on educational attainment using Mendelian randomization

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Objectives: ADHD has been found to have genetic links to one of the strongest predictors of social and economic outcomes; educational attainment. Observational evidence indicates that children with ADHD, are at increased risk of poor school performance (Crump et al. 2013). However, it is currently unknown whether the disorder can have a direct causal effect on educational attainment or whether genetic variation for ADHD has pleiotropic effects that affect education. We examined the causal effect of ADHD on educational attainment in a two-sample Mendelian Randomisation (MR) framework designed to account for pleiotropic genetic variants.

Methods: We performed MR analyses, to test the causal effect of ADHD on educational attainment. We considered as instrumental variables for ADHD, 12 genome-wide significant SNPs, identified in the most recent GWAS meta-analysis on ADHD (Demontis et al. 2017). SNP outcome coefficients were extracted from the latest published GWAS on educational attainment (Lee et al. 2018) and combined using an Inverse Variance Weighted approach. To test the robustness of our findings, detect and account for pleiotropy, we performed sensitivity analyses including MR Egger and multivariable MR.

Results: There was strong evidence of a causal effect of ADHD on educational attainment. A 1-unit log-odd increase in liability to ADHD was associated with a 0.077 SD decrease in years of schooling (95% CI - 0.120 to - 0.035, $p = 0.00033$). The direction and magnitude of the causal effect estimate was consistent in sensitivity analyses assessing pleiotropy, as well as in the replication analysis with the most recent and largest educational attainment GWAS.

Conclusions: Our findings support causal effects of ADHD on life outcomes. We found that educational underachievement in ADHD is caused by the disease phenotype and is not due to shared genetics between ADHD and educational attainment. It provides a strong argument for treating ADHD appropriately to improve educational attainment.

You and me and ADHD: a course for couples

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Objectives: Building lasting love is a challenge. Being in a close relationship where one or both of the partners have ADHD does not make it easier, and has been described as an emotional roller coaster! The Norwegian course “Du og jeg og ADHD” (trans.: You and me and ADHD) was developed to function both a first-aid kit and a resource to be used in the life-long work of managing the ADHD-effect, and strengthening relationships, when one or both partners have ADHD.

Methods: Based on couple science, literature on adult ADHD and the ADHD-effect on close relationships, the course was developed in interplay with a systematic evaluation practice. During 2 years of time more than 100 ADHD-couples have attended one or more weekend courses (basic or more advanced) and have given valuable oral and written feedback about form and content of the course and the course materials. The written feedback has been collected during and immediately after the course, and some participants have even sent spontaneous e-mails some weeks or months after the course(s).

Results: The participants' feedback has been decisive for tailoring the course materials and the way the courses are conducted. Four main themes emerged as especially important, with respect to content: (1) Basic knowledge of adult ADHD and common experiences of living in close relationships where there is a third “member”, namely the ADHD. (2) An overview of main lessons from research on what makes marriages and other close relationships work, and on how biologically based attachment processes take priority in couple conflicts. (3) An introduction to how ADHD can affect intimacy and sex. (4) A conceptual formulation of ADHD as a meaning challenge, both for the ADHD-individual and for the ADHD-couple.

Conclusions: The course has been very well received and, as many participants have conveyed: It was long overdue!

Sickness absence recommendation among outpatients with ADHD and comorbidity: a latent class analysis

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Objectives: Analyze the distribution of sickness absence and work ability among young psychiatric outpatients diagnosed with ADHD. Identify clinically relevant categories of comorbidities affecting work ability.

Methods: Population-based patient chart review of ADHD outpatients aged 19–29 years. The outcome, SAR, included both available financial benefit forms; activity compensation and sickness benefit. Latent class analyses (LCA) of demography and psychiatric comorbidities were performed both with and without SAR (sickness absence recommendation) as an outcome variable.

Results: 516 patients with ADHD diagnosis was included in the study. Latent classes ranged from a small class of only females with personality disorders where all had SAR to larger groups characterized by lower comorbidity where 15–29% had SAR. 15.9% only ADHD/no diagnosed comorbidity, out of which 85.4% no sickness absence. Comorbidity of ADHD and anxiety disorders presents a higher risk for impairment of work ability than comorbidity between ADHD and unipolar mood disorders. High rates of personality and neurodevelopmental as comorbid disorders predict higher proportion SAR.

Conclusions: SAR was common for ADHD- patients treated at the outpatient psychiatric clinic Rates of SAR among patients with ADHD, either as primary or secondary diagnosis, were generally higher than in other studies. Rates of SAR vary depending on comorbid diagnosis. Rates of SAR were lower among ADHD-patients without comorbidity.

Maternal ADHD symptoms and infants temperament predict maternal stress and childhood maltreatment during the first year of life

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Objectives: To investigate if maternal attention deficit/hyperactivity disorder symptoms early on pregnancy predict maternal stress, attachment, and perpetration of physical abuse against their infants during the first year of life.

Methods: Eighty adolescents 14–19 years of age were included during the first trimester of pregnancy in a randomized controlled study testing the effect of a home-visiting program to improve maternal and childhood outcomes. Maternal ADHD symptoms were assessed before 16 weeks of pregnancy. Mothers-babies were assessed at 6 and 12 months of life for multiple outcomes, including PSI, BDI, PCCTS, IBQ-R. We conducted general linear model-repeated measures to test the effect of ADHD symptoms over maternal competence, attachment and childhood maltreatment controlling for the effect of the intervention, depressive symptoms, and infant temperament.

Results: Inattentive symptoms early in pregnancy predicted worse sense of competence and more childhood maltreatment during the first year of infant's life even controlling for the effects of the intervention and contemporaneous maternal depressive symptoms. The effects over childhood maltreatment were no longer significant when controlling for infant negativity, but significant when controlling for infant surgency and regulation. There were no effects on the maternal sense of attachment to the infant. Hyperactivity symptoms were not predictive of the investigated outcomes.

Conclusions: Maternal inattention contributed to higher stress and childhood maltreatment, which were partially explained by infant's temperament. Assessment and management of maternal ADHD symptoms and infant's temperament are important goals of early intervention programs.

Prevalence and characteristics of bullying and cyberbullying in adolescents with ADHD: a cross-sectional study in Granada (Spain)

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Objectives: Very few studies to date have investigated bullying conducts in psychiatric patients, although everything seems to indicate that they are a risk group. The main objective of this pilot study was to estimate the prevalence of bullying and cyberbullying behaviors in adolescents with ADHD and other mental health disorders, in order to develop a future bigger study.

Methods: A cross-sectional study was carried out by means of a questionnaire which was offered to patients between 11 and 17 years-old who attended the Child and Adolescent Mental Health Unit of the Hospital Universitario Virgen de las Nieves of Granada (Spain). The sample included 90 patients with a psychiatric diagnosis.

Results: In this clinical sample, 21.1% of the patients were victims of bullying, 6.7% of cyberbullying, and only 1.1% (1 patient) are aggressors. Significant associations were detected between being a victim of bullying and studying in a public school, and between suffering cyberbullying and being a woman. Also, the prevalence of being a bullying victim was higher in the group of patients with an internalizing disorder rather than ADHD patients. No further differences were found by gender, age, or academic performance.

Conclusions: The prevalence of bullying seems higher in adolescents with mental health disorders than in the general population, especially in those with internalizing disorder. Further studies are warranted. Specific and multidisciplinary intervention protocols should be created, and they should include the participation of mental health professionals.

Topic: Substance use disorders

Alcohol and drug use disorders among adults with ADHD: associations with ADHD symptom severity and emotional dysregulation

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Objectives: To examine the prevalence of alcohol use disorder (AUD) and drug use disorder (DUD) in a clinical sample of adults with ADHD, and to investigate its association with ADHD symptom severity and emotional dysregulation (ED).

Methods: The study sample consisted of patients who were admitted to a private psychiatric outpatient clinic in Oslo between 2014 and 2018. Out of 612 patients diagnosed with ADHD, 585 (96.5%) agreed to participate in the study. ADHD was diagnosed according to DSM-5 criteria. AUD and DUD were diagnosed using the Mini International Neuropsychiatric Interview (M.I.N.I.). ADHD severity was assessed by the Adult ADHD Self Report Scale (ASRS). Emotional Dysregulation (ED) was assessed by the eight-item version of Barkley's Current Behavior Scale-Self Report (CBS-SR).

Results: The 12-month prevalence of AUD and DUD was 5.3% and 13.7%, respectively. The lifetime prevalence was 12.0% for AUD and 27.7% for DUD. A history of DUD, but not AUD, was positively associated with hyperactivity-impulsivity ADHD core symptoms, as well as ED.

Conclusions: The prevalence of lifetime DUD among patients with ADHD is high and associated with higher levels of hyperactivity or impulsivity symptoms, as well as ED. Our findings suggest that comorbid DUD and AUD in ADHD patients are related to different symptom domains and probably also have different developmental trajectories and risk factors. Clinical implications: It is important to consider underlying or concomitant DUD in adult ADHD patients, particularly among individuals with high levels of hyperactivity-impulsivity ADHD core symptoms or ED. We suggest that a comorbid DUD may be considered to partially arise from self-medication against impulsiveness, restlessness and emotional dysregulation. Thus, early recognition and targeted interventions against such symptoms are essential to prevent such negative long term consequences of ADHD.

Getting psychotic while looking for tranquility: two sides of cocaine consumption in adult ADHD - a case report

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Objectives: Case report of adult ADHD comorbid with cocaine abuse (in search for symptom treatment). Dichotomic effect of cocaine with both ADHD symptom relief and toxic psychosis. Revision of literature.

Methods: Clinical history and literature revision using Pubmed with “Attention deficit hyperactivity disorder”; “Cocaine”; “Psychosis”.

Results: We present the case of a 38-year-old man without prior history of psychiatric illness, with regular consumption of cocaine (which he described as a means to calm down). He was admitted to our Psychiatric Ward with a diagnosis of Toxic Psychosis (cocaine related), was medicated with olanzapine 10 mg and showed symptom relief within 3 days. Further investigation revealed prior history of difficulties concentrating and restlessness since childhood. The probable diagnosis of ADHD was supported by the immediate and positive response to rapid acting Methylphenidate. He was discharged after 5 days with olanzapine 10 mg and modified release Methylphenidate 20 mg.

Conclusions: ADHD is composed by the triad of inattentiveness, hyperactivity and impulsivity. In adults, it has significant comorbidity with other mental disorders, mainly Substance Use Disorders (SUDs): approximately a quarter of SUDs are associated with ADHD, and those are the most severe and precocious cases. Treatment of ADHD with methylphenidate at an early age appears to reduce the risk of SUDs. Cocaine is an illicit stimulant with an action similar to methylphenidate; its addiction is one of the most common dependencies seen in patients with ADHD: it is believed that some ADHD patients may choose cocaine to self-medicate their symptoms. The effects of cocaine include transient psychotic episodes. This case emphasizes the need for a timely treatment of ADHD at an early age, while simultaneously serving as a reminder that ADHD, although an uncommon diagnosis in adult Psychiatry, must be considered as a comorbidity in patients with SUDs.

Cigarette smoking severity among adults in substance use disorder treatment by ADHD status: results from ICASA studies

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Objectives: To examine cigarette smoking severity among adults in Substance Use Disorder (SUD) treatment with and without ADHD. Cigarette smoking is associated to adverse health outcomes and increased mortality. Given the high prevalence of cigarette smoking among people with ADHD and among people with SUD, we examine the severity of cigarette smoking comparing adults in SUD treatment with and without ADHD.

Methods: We examine data from the International ADHD in Substance Use Disorders Prevalence Study Phase 2 (IASP-2), a cross-sectional multinational study. Participants are 402 adults in SUD treatment from Puerto Rico, Hungary and Australia (18–65 years, M 36.91 (11.87); 79.6% male). Data on ADHD, SUD, comorbid

disorders and cigarette smoking behaviors was collected using the CAADID, ASRS, MINI Plus, SCID-II, Fagerstrom Test of Nicotine Dependence (FTND) and K-SADS.

Results: Among adults in treatment for SUD, people with ADHD have significantly more severe cigarette smoking behaviors. People with ADHD smoke more cigarettes per day, report smoking more cigarettes at their most intense period of smoking, started smoking at an earlier age, and have higher scores on the Fagerstrom Test of Nicotine Dependence. These differences were all significant (all p 's < .05). People with ADHD also report having smoked more cigarettes for a greater number of years, although non-significant. Childhood ADHD significantly predicts current cigarette smoking and is associated to earlier age of onset of cigarette smoking.

Conclusions: Adults who have a SUD, and particularly those who also have ADHD, are at significantly increased risk for more severe cigarette smoking. These findings underscore the importance of screening for ADHD among this population. In both SUD treatment and smoking cessation interventions attention should be paid to participants' ADHD symptoms, as these are associated with more severe use of these substances and may complicate treatment. Prevention efforts targeting youth should also consider the impact of ADHD on smoking initiation.

Topic: Miscellaneous

Retrospective medical chart review evaluating burden of illness in adults with ADHD: follow-up data after 2 years

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Objectives: Approximately 2.5–5% of adults worldwide have ADHD [1,2]. Medical chart data can provide insights into the real-world burden of illness for these patients. The objective of this retrospective chart review was to describe progression of burden of illness at 2 years from initial assessment in adults with no previous ADHD diagnosis.

Methods: Medical chart data at an initial neuropsychiatric assessment (baseline) and 2 years later for adults (≥ 18 years) newly diagnosed with ADHD (2013–2015) at two Swedish neuropsychiatric specialist outpatient clinics were evaluated. Data analysed included comorbidities, employment status and ADHD pharmacotherapy.

Results: Data from 81 patients (mean [standard deviation] age 36.4 [13.2] years) were analysed. Somatic comorbidities were reported in 77% ($n = 62$) and 86% ($n = 70$) of patients at baseline and follow-up, respectively. Common somatic comorbidities (at baseline/follow-up) included pain (19%/25%) and gastrointestinal diagnoses (16%/21%). Diagnosed psychiatric comorbidities were reported in 44% ($n = 36$) and 47% ($n = 38$) of patients at baseline and follow-up, respectively. Percentages of patients reported as in full-time/part-time employment/on sick leave were 30%/11%/25% at baseline and 35%/9%/35% at follow-up. Unemployment was 6% and 7% at baseline and follow-up, respectively. Pharmacotherapy for ADHD was prescribed for 79% ($n = 64$) of patients following diagnosis and 62% ($n = 50$) at 2 years. At follow-up, 32% of patients had switched treatment.

Conclusions: This chart review in a small sample of adults with ADHD provides insights into the real-life burden of illness after 2 years; further studies of longer duration in larger samples may be warranted. Prior presentation: EUNETHYDIS 2018 (23–26 September; Edinburgh, Scotland).

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Implications of brief ADHD training sessions for increasing educators' knowledge and understanding of ADHD

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Objectives: This study evaluates the efficacy of brief ADHD Professional Information and Awareness Sessions based on Incredible Years' principles, by measuring early years (EY) educators' and primary school teachers' knowledge and understanding of ADHD.

Methods: EY educators and primary school teachers from 18 Irish schools and early years services participated in the study. A mixed-methods approach is employed for phase one, involving a descriptive, quantitative design utilising a profile survey and KADDS measure, followed up with focus groups. EY educators' and primary school teachers' knowledge and perceptions were measured pre and post provision of ADHD information and awareness training. Descriptive and inferential statistical analysis is utilised with qualitative survey and focus group data analysed via thematic analysis.

Results: Participant profile findings revealed 69% have worked with children diagnosed with ADHD despite 81% having no ADHD-specific training. Groups differed significantly at pre-training (T1) with higher mean scores for primary school teachers and EY educators scoring substantially lower. No significant difference presented between groups at post-training (T2). Total mean scores among both groups increased between T1 and T2 with overall total mean scores almost doubled at T2. With regard to self-rated confidence levels of working with children with ADHD, primary school teachers rated themselves significantly higher at T1 than EY educators, however no significant difference presented between groups at T2.

Conclusions: Findings demonstrate that brief ADHD training programmes can increase primary school teachers and early years educators' knowledge of ADHD. Results from this study strengthen the limited research regarding the impact of brief ADHD training programmes on educators. The findings suggest brief professional development training across both disciplines can greatly increase educator's ADHD knowledge and better equip them with evidence-based strategies to support ADHD in the classroom, thus providing an effective and efficient solution in addressing the well-evidenced gap in educator's ADHD knowledge and training.

What is known about ADHD? A study in a portuguese population

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Objectives: To evaluate the knowledge of the population about hyperactivity and ADHD and study its association with the educational level and reading habits.

Methods: We applied a questionnaire to 6th year medical students and to caregivers of patients that attended the emergency department (ER) or were admitted in the pediatric hospital ward. Persons whose

children had ADHD were excluded. We collected variables such as: family relationship to the child, gender, age, educational level, number of books at home. Statistical analysis was performed using SPSS Statistics, version 25. A value of $p < 0.05$ was considered statistically significant.

Results: The sample consisted of 44 students and 78 child caregivers (57 questioned at the ER and 21 at the ward). Most of them were females (73%) and young (76.2% aged < 40 years-old). The level of education ranged from elementary school (22.5%) to a university degree (37.5%). 73% reported having many books at home (≥ 1 bookcases). Concerning ADHD knowledge, the majority of the inquired (82.8%) knew the diagnosis is based on clinical criteria (77%) and that treatment is case oriented (87.4%). 46.3% reported being informed about the drug methylphenidate, with 83.9% of these stating that it acts as a stimulant. Over half of the inquired (62.8%) have read or tried to find out information about ADHD. We found a significant association between being a medical student, having a younger age, a higher educational degree and more books at home and the knowledge about ADHD diagnosis and treatment.

Conclusions: The majority of the population in our sample had a significant knowledge about ADHD, with schooling and reading habits contributing to it.

Searching for new ways to define and evaluate attention

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Objectives: Current attention tests primarily attach importance to speed and precision of rule-bound tasks. Thus, they neglect creative aspects of attention frequently relevant to solve everyday problems. To address creativity and to broaden the scope of current attention tests, a Tapping Test (TaTe) was designed to determine the degree of redundancy while attempting to create random patterns. Major goals of the study were (1) to discover new aspects of attention by means of the newly developed TaTe and (2) to extend and/or modify the concept of attention.

Methods: The TaTe was developed in cooperation with Helgi-Jón Schweizer and evaluated in preliminary pilot studies. The present study involved 34 pupils from an elementary school in Austria (aged 8.9–12.2 years). Based on assessments by parents, teachers and the pupils themselves, we divided all pupils into a group with (A) and a group without (B) attention problems (A: $N = 15$, age 10.4 ± 1.1 years, and B: $N = 19$, age 10.1 ± 0.8 years, respectively). Group A represented significantly more boys than group B. To validate the results of the TaTe, subjects were also submitted to established attention tests, the Number Connection Test and a Reaction Time Test. Following these tests, pupils underwent the TaTe. In addition to standard statistics, we calculated Shannon entropy and time factors for the tapping sequences.

Results: Results obtained with the TaTe significantly correlated with the distinction of the groups A and B. TaTe supported a high degree of validity. Reliability remains still to be confirmed.

Conclusions: We suggest that the TaTe could be a valuable diagnostic instrument in the field of ADHD and dementia research. Further, being creative while attempting to produce random patterns seems to depend on intact attention processes.

ADHD and success in military service in males in the Northern Finland Birth Cohort 1986

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Objectives: ADHD relates to various difficulties in the transition into adulthood. Military service is an important element in this transition in countries where it is obligatory for men. We studied ADHD and success in military service in a longitudinal population-based study sample.

Methods: The original study sample consisted of the Northern Finland Birth Cohort 1986 (NFBC1986, N = 9432, 99% of all births between July 1st 1985 and June 30th 1986 in the two northernmost provinces in Finland). In the follow-up study at 16–18 years 74 of the males were diagnosed adolescent ADHD after comprehensive assessment while 38 were diagnosed only childhood ADHD which had remitted. In a military call-up at 18 years they were classified either fit for service or not fit for service (permanent rejection, temporary rejection). They were compared to NFBC1986 men without ADHD in respect to fitness and progress in military service.

Results: Those with adolescent or only childhood ADHD considered themselves as healthy and fit for service as those without ADHD, although smoking and alcohol use were more prevalent among them. However, those with current ADHD were more often classified not fit for the service. Among those entering military service, those with adolescent ADHD were more often pre-term exempted, had more visits to military health care, had at least one offence in service, and received lower marks for leadership skills than those without ADHD. Males with remitted childhood ADHD did not differ from controls in terms of military fitness and success in military service. However, they did receive lower marks for team leadership skills than those without ADHD.

Conclusions: Current ADHD associated with poorer military fitness and success in military service among Finnish men, while remitted ADHD did not. When evaluating military fitness of individuals with ADHD current symptoms and impairments need to be addressed.

Negative association between inattention symptoms and mentalizing in community adolescents

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Objectives: Adolescence is a critical period for the development of mentalizing—the imaginative capacity to understand one's own and others' behaviour in terms of underlying mental states. Yet, factors and mechanisms underlying individual differences in adolescent mentalizing remain poorly understood. This exploratory study examined whether and how a) age and gender and b) self-reported psychological difficulties correlate with mentalizing performance in community adolescents.

Methods: 89 adolescents from the general population (54 females, age 12–17) were administered a computerized task of mentalizing—the Movie for Assessment of Social Cognition (MASC) and completed the Youth Self Report (YSR)—a widely used measure of emotional and behavioural problems in adolescents. Stepwise multiple regression analyses were conducted to identify which demographic (age, gender) and psychological variables (YSR syndrome scales) are particularly associated with mentalizing performance.

Results: Total MASC scores were best predicted by a model with age, gender, and YSR attention problems scores, which together accounted for over a third of the variance in the outcome variable. The key result of this study revealed that amongst eight studied syndromes of psychopathology, self-reported attention problems showed the strongest association with mentalizing scores.

Conclusions: The present study highlights a negative association between attentional difficulties and mentalizing performance in community adolescents. Importantly, these results are consistent with preliminary research demonstrating social cognition impairments in children and adolescents with ADHD. In light of considerable inter-personal problems prevalent in ADHD youth, interventions targeting mentalizing, or other socio-cognitive abilities may represent beneficial strategies specifically aimed at improving socio-emotional functioning in adolescents with attention difficulties.

Neural correlates of perspective-taking in adolescents: an fMRI study

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Objectives: The purpose of this study was to investigate the differences between adolescents and adults, in the perspective-taking ability, as well as the brain activation patterns during the perspective-taking situation.

Methods: We recruited healthy adolescents aged 13–15 years (n = 20) and adults aged 19–29 years (n = 20). All the subjects were scanned while performing the perspective-taking task, in which an emotional situation was presented in the form of statements comprising first person, as well as third person perspectives. Differences in brain activation between groups were assessed by contrasting neural activity during the tasks.

Results: In the between-group analysis, while performing the third-person perspective-taking task, the adolescent group showed greater neural activities in the middle frontal gyrus and precentral gyrus as compared to the adult group. Positive correlation was observed between the activity in the frontal areas (BA 6/9) and the score of scales related to perspective-taking and social cognition in the adolescent group.

Conclusions: This study suggests that the perspective-taking ability and the patterns of brain activation associated with perspective-taking in adolescents differ from those in adults. This result also suggests that adolescents may experience more difficulties in incorporating the perspective of others when compared to adults.

A clinic-based survey of teenagers with and without ADHD to understand their sleep habits, impact of poor sleep and whether gender differences exist

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Objectives: To ascertain the sleep habits of teenagers with and without ADHD, including sleep onset and duration of sleep, their use of gadgets before bedtime, the impact of poor sleep during the day and to learn if any gender differences exist.

Methods: We developed a sleep survey questionnaire for teenagers aged 13–18 years with ADHD and those without any medical conditions to anonymously report their sleep habits, including use of gadgets before bedtime, sleep onset, sleep duration and difficulties with tiredness/poor concentration during daytime.

Results: Teenagers, 52 with ADHD (40 boys and 12 girls) and 27 without any medical conditions (16 boys and 11 girls) completed the survey. 22 (42.3%) received ADHD medication and 21 (40.3%) had comorbidity including autism, anxiety or ODD. The gadget use before bedtime was more than 2 h in 21 (40.3%) with ADHD and 6 (22.2%) without ADHD. Whilst 7 (13.4%) with ADHD took more than 2 h to sleep, this was not observed in non-ADHD group. Inadequate sleep (less than 8 h) was noted in 50% of girls and 75% of boys with ADHD and 36% of girls and 44% of boys without ADHD. Problems with poor concentration/tiredness were reported by 44 teenagers

(84.6%) with ADHD (80% of boys and all girls) and 12 teenagers (44.4%) without ADHD (43% of boys and 45% of girls).

Conclusions: In our survey, a significant proportion of patients with ADHD spent more time on gadgets before bedtime, experienced major sleep onset delay and inadequate sleep compared to non-ADHD group. More boys than girls reported insufficient sleep in both the groups. Problems with poor concentration/tiredness were found in most teenagers, with girls affected more than boys. Sleep evaluation of all teenagers, especially those with ADHD should be essential in all assessments, along with tailored psychoeducation and sleep management.

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