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Declaration:

I, Simone Weissenberger, hereby declare that this doctoral thesis titled 'Adult ADHD Symptomatology and Lifestyles in the Czech Republic' has been compiled by myself under the supervision of Doc. PhDr. Radek Ptacek, Ph.D. and Prof. MUDr. Jiri Raboch, DrSc.

This thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. I also undertake that any quotation or paraphrase from published or unpublished work of another person has been duly acknowledged.

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1.0 THEORETICAL INTRODUCTION

1.1 DEFINING ADHD AND ITS CLINICAL PRESENTATIONS

ADHD is a *neurodevelopmental disorder* marked by its behavioral and symptomatological manifestations, although there currently isn't a universally accepted neurological definition it has been called a “neurobehavioral” disorder due to its marked behavioral and symptomatological profile as well as neurological profile and aspects that are still being discovered. It presents itself as Childhood and Adult ADHD, with childhood ADHD being far more common and well defined (Polanczyk et al., 2007). The marked symptoms of ADHD include general inattention, hyperactivity, impulsivity, and difficulty in focusing in tasks that require tediousness and/or sustained attention. These symptomatic groupings are divided in what were once called subtypes of the disorder in Diagnostic and Statistical Manual 4th Edition (DSM-IV TR) but are currently referred to in DSM-5 as presentations; they are Hyperactive Impulsive, Inattentive and Combined, which will be abbreviated as ADHD-HI, ADHD-I and ADHD-C (American Psychiatric Association, 2013).

Aetiologically speaking the three categories have greatly evolved since the original inattentive and hyperactive classification described in DSM II, as more and more is being discovered about the condition aside from its behavioral manifestations. This makes genetic classification and generalized treatments more difficult (ADHD vs ADHD-I or HI) as the presentations are often very different from one another, they sometimes evolve leading some to consider the disorder a continuum of symptoms. This is elucidated by the fact that the categories listed are not always stable as a child who is hyperactive-impulsive could calm down with age but retain certain inattentive symptoms (Pozzi-Monzo et al., 2012).

The disorder has a very strong genetic link both in its childhood and adulthood presentation (Franke et al., 2012; Ptacek et al., 2011). ADHD carries into adolescence approximately 50% of the time, indicating the strong possibility of independent remission (Moreno-Alcazar et al., 2016). Some researchers have made the case that the overall prognosis in children with ADHD tends to be positive with follow up studies often showing subsequent remission in adulthood and the absence of continuation in externalizing behaviors and impulsivity, signifying a “catch up” with other normally developing children (Mannuzza et al., 2000). Furthermore, longitudinal studies have confirmed the non-linear nature of the disorder with remissions happening during childhood and adolescence and with many individuals displaying ADHD symptoms in adulthood without any previous diagnosis or high self-reported symptoms from childhood

self report questionnaires like the Wender Utah Rating Scale (WURS). The most striking finding was that only a very small percentage of those with childhood ADHD in the longitudinal studies carried the disorder into adulthood. The rate was approximately 17% (Caye et al., 2016).

A different longitudinal twin study that looked at the environmental risks associated with the disorder had a similar result, only about 21% of children who had ADHD carried it into late adolescence and adulthood. Some factors that were commonly associated with carrying the disorder into adulthood included more intense symptoms as assessed by clinicians and self-assessment inventories (i.e. ASRS scale) and lower IQ scores. Furthermore these individuals who carried the disorder on had a great amount of difficulties in everyday life and were found to have more comorbidities such as general anxiety disorder and learning disorder compared with other ADHD diagnosed children (Agnew-Blais et al., 2016). Similarly, researchers found that the strongest predictors for the disorder being carried on into adulthood were low IQ and lower socio-economic status in the patients. This is due to all the stressors associated with lower socioeconomic conditions (i.e. less access to resources, poor diet and parental negligence). In the study low IQ and low SES were a much greater risk factor in bringing the disorder from childhood to adulthood than having both learning disorder and Oppositional Defiant Disorder (ODD) as comorbidities to ADHD. It is wise to view the disorder not only in the realms of psychiatry but also sociologically as the social components and influences have a very strong effect on the symptom intensity as well as prognosis (Cheung et al., 2015).

ADHD is associated with a very strong gender disparity, it disproportionately affects males at the rate of 2.4 males diagnosed per 1 female (Polanczyk et al., 2007). This is noted in terms of diagnosis and not necessarily actual symptomatology, the disorder tends to be more masked in females and thus could be misdiagnosed. Comorbidities such as eating disorders are also more noted in females with ADHD, externalizing behaviors are less noted possibly due to cultural gender roles and norms (Ptacek et al., 2016. Weissenberger et al., 2016).

Furthermore when looking at the primary and secondary effects of Adult ADHD it can be considered one of the most devastating mental disorders. In the long term it can affect all areas of one's life, primarily due to the vast amounts of comorbid conditions and associated lifestyles (i.e. Obesity, nicotine use, binge eating etc) (Franke et al., 2012. Nigg, 2013). Some of the most common adverse social effects that are seen in adult ADHD are difficulty in keeping the same job, difficulty in working on projects that require concentration and sustained effort as well as health and psychological issues like addictions, anger management troubles and difficulty in comprehending concepts in everyday situations such as conversations. These are additional to the classically listed symptoms needed to diagnose adult ADHD according to DSM-5 (Fields et al., 2017).

One of the questions that is still open and in need of investigation is how frequent

and common is adult ADHD compared to childhood ADHD, with some arguing it to be more rare in adulthood and with less intense symptoms than the childhood version. Furthermore symptoms like hyper-somnolence are more pronounced in adulthood which could have negative effects on concentration and everyday activities. Hyper-somnolence is not only defined as being tired often, it is associated with irregular sleeping and sleeping disorders that tend to exacerbate other mental health symptoms (Lopez et al., 2017).

Data from 2007 looking at ADHD worldwide found childhood ADHD to be around 5.3%, with lower rates in lower income nations and 3.4% for adult ADHD worldwide. The authors emphasized the importance of studying adult ADHD to a greater extent, as this was before the DSM-5 classification and the diagnostics slightly vary between ICD and DSM (Tripp et al., 1999). Furthermore most studies on ADHD have focused on the United States (Fayyad et al., 2007). There are cultural factors that are not to be underestimated as presentations and epidemiological studies have been conducted primarily in the United States and Western Europe, with rates of comorbidities associated with the disorder that vary greatly in other nations.

Turkey for instance has very high rates of childhood ADHD when compared to Western Europe but very similar rates to the United States (Ercan et al., 2012). Others have criticized only looking at the disorder in the realm of genetics or as an innately biological condition. They consider this view to be a hindrance for psychotherapists, seeing it as too deterministic and limiting for the patients and only benefiting the psychiatric field rather than looking at useful non-drug interventions (Pozzi-Monzo, 2012). As was previously mentioned the progression of the disorder is often nonlinear with remissions of symptoms from childhood to adolescence sometimes reported. Interestingly other cognitive deficiencies (i.e. learning disorder) and motor skill dysfunction are not always resolved (McAuley et al., 2014). Another important factor to note is that with the progression of the disorder the categories are not always permanent, for example a child with a combined hyperactive and inattentive presentation of the disorder may later become less hyperactive and more inattentive with age if the disorder persists into adolescence and adulthood. It is far more common for the the HI presentation to merge into the I presentation rather than vice versa (Larsson et al., 2011).

The myriad of lifestyles and comorbidities are what often constitute the core observable signs of ADHD. These lifestyles are especially relevant when dealing with adult ADHD due to individuals' increased autonomy and taking care of themselves most of the time. Clinicians need to rely far more on self-assessment inventories such as the WURS for assessing childhood ADHD in the past and the ASRS v 1.1 to assess the intensity of current symptoms. Before dwelling deeper into lifestyles and comorbidities it is crucial to look at a variety of recent studies that have shown marked differences in neurodevelopment and neuro-anatomy among individuals affected with ADHD.

1. 2 NEUROLOGICAL AND BIOLOGICAL FINDINGS

With the advent of more affordable and non-invasive neuroimaging studies using functional magnetic resonance imaging (fMRI) and other technologies, many advances have been made in discovering the anatomical basis of ADHD. The studies are focused on all the age groups and show differences among normally developing children (NDC) and those affected with ADHD. Neuroimaging studies have demonstrated some disparity in brain maturation as well as structural differences specifically in the cerebellum, the cortex, the splenium of the corpus callosum as well total and right cerebral volume (Cao et al., 2014; Moreno-Alcazar et al., 2016; Valera et al., 2007). In the early stages of human development ADHD is not diagnosable according to diagnostic criteria, but very often an irritable temperament can be observed from infancy to early childhood. It has been hypothesized that the role of the prefrontal cortex and impulse regulation is key even in early infancy clues for future ADHD but due the diverse nature of the disorder among the different clinical presentations it is hard to pinpoint a single predicting factor (Rabinovitz et al., 2016).

The dopaminergic pathway is involved in a variety of psychiatric disorders including ADHD; major differences in the development of connections between the substantia nigra and the limbic systems have been observed when comparing normally developing children (NDC) with those with ADHD. Shots from this study are presented at the end of the section (Tomasi & Volkow, 2014). Furthermore a study comparing children with ADHD Inattentive Presentation, Combined and normally developing children found significant differences in amounts of global grey matter in the brains of children from both ADHD groups. The study used structural magnetic resonance and found major differences in the brain volume of the ADHD children compared to the healthy controls (NDC) but no major differences reported between the Combined and Inattentive group of children (Vilgis et al., 2016).

Cortese et al. (2013) B conducted a 33 year longitudinal study on ADHD with neuroimaging; white matter differences were observed along with significant differences in the sensorimotor system. This confirmed via neuroimaging what were already known comorbidities and expressions in the disorder (motor-control differences or motor control dysfunction). Fractional anisotropy was measured and white matter deficiencies were found with a much higher frequency among individuals who had had childhood ADHD compared to controls. Similarly, Paddock (2013) reports that in a study testing the efficacy of methylphenidate there were surprising results, although the drug made both the ADHD individuals as well as those in the control group more alert and attentive, the main difference was in brain anatomy and connectivity. There were differences in grey and white matter volume, sheath and communication between various areas in the brains of the two groups, with the ADHD individuals showing less matter volume and decreased

communication among brain regions prior to the administration of the drug. This study is controversial as it challenges the “conventional wisdom” or generally accepted notion within the field of psychiatry that ADHD is a disorder primarily characterized by dopamine dysfunction. It instead focuses on anatomical differences in the brain and dysfunction in communication between various regions of the brain with methylphenidate greatly improving and normalizing brain functioning. The effects of ADHD drugs on those without ADHD had also already been reviewed with many students in the United States using the drugs to improve their ability to study and focus in school. The research shows that methylphenidate improved performance in novel tasks while amphetamines improved memory recollection.

Other recent studies seem to confirm the differences in total grey matter in the brains of adults with ADHD, especially in the right supplementary motor area and also found a positive correlation between drug therapy and brain improvement in those afflicted. The researchers hypothesize that long term methylphenidate or amphetamine treatment may have a positive supplementary effect and may normalize the areas of the brain that are lacking in those with the disorder (Moreno-Alcazar et al., 2016). Researchers in Germany studying a large sample of ADHD children and adolescents found that they had a very reduced pain perception which put them at higher risk for dangerous behaviors and physical injuries. Methylphenidate was found to normalize pain perception in those within the ADHD group even in the short term (Wolff et al., 2016). Psychiatrists have also argued that with neuroimaging we may also be able to diagnose ADHD more accurately, specifically by looking for these deficits and differences in amounts of grey matter, supplementing the traditional subjective self-assessment tests such as ASRS-V1 although this idea still remains highly controversial within the field (Iannacone et al., 2015).

One previously generally accepted part of ADHD when looking at the neurological and biological aspects is the direct connection with dopamine and the dopaminergic system. Genetically speaking the dopamine D4 receptor DRD 4 has been indicated as having a clear connection with ADHD as well as other disorders that involve impulsivity (Ptacek et al., 2011).

A well known review on ADHD was conducted by Lou (1996), where a high correlation between ADHD and premature births was noted. Dysfunction in the ventral striatum as one of the key aspects of ADHD and may very well be connected with premature birth. Previously the role of dopamine in the disorder was almost unquestionable due to the efficacy of the stimulant and dopaminergic drugs used to treat the disorder, specifically amphetamine and methylphenidate.

A more recent neuroimaging and genetic test was conducted by Dosis et al. (2012) in regards to the DAT1 gene and its influence on ventral striatum. During the Monetary Incentive Delay test the ADHD group showed differences in the striatum compared to the control group. One of the most impaired mental function in ADHD is visual-spatial

working memory, in a video game task would yield positive results in children with ADHD came to the conclusion that those with ADHD need higher monetary rewards and more motivation to start the task, they were also the more likely to stop the task prior to the control group.

The DAT1 dopamine transporter gene theory is controversial, but studies have found a link with this gene and enlarged striatums. As well as an association between this gene and ADHD throughout various life stages including adulthood. Specifically, Onnink et al. (2016) had 487 adults that were neurologically observed with fMRI technology, of these there were 301 with adult ADHD and/or a previous diagnosis of ADHD and 186 controls, and significant differences were noted in the striatums of the two groups. The link between DAT1 and the neurological implications of ADHD remains a hypothesis that has not been completely clarified, with some researchers arguing that it is too reductionistic and could that there are many more factors involved (Rutter, 2001. Sokolova et al., 2015).

Rutter (2001) in his book on psychiatric conditions and genetics explains and cautions that the genetic link to ADHD should not be seen as strictly deterministic and explains how traits are often triggered by improper parenting, poor environment along other social/environmental factors; he therefore makes the case for a more holistic and epigenetic look at ADHD and the field of psychiatry as a whole. Furthermore some recent studies continue to show that dopamine is responsible for higher impulsivity among those with ADHD, using PET scans and administering amphetamine the researchers showed that those with ADHD had regulated dopamine release in the striatum compared to the ADHD placebo group and had similar levels as the healthy controls only when the drug was administered; thus showing the paradoxical effects of amphetamine on those with ADHD as compared with those without (this refers to stimulants calming those with ADHD) something that is well known. A dopaminergic drug like amphetamine which would cause the release of higher than normal levels of the neurotransmitter in a healthy individual actually has a regulatory effect in a person with ADHD (Cherkasova et al., 2014). This is in contrast with the studies conducted by Onnink et al. (2016), Sokolova (2015) and Lou (1996), Von Rhein et al (2016) that found no striatal dysfunction in both medicated and unmedicated individuals with ADHD compared with controls. Developmental abnormalities were noted in local connectivity of the putamen with less functional segregation between the frontal and anterior part of this brain area. Similarly to previous studies animal studies have found dopaminergic abnormalities leading to ADHD. For example, a study conducted by Bock et al. (2016) demonstrated the effects of early life stress in the development of ADHD like symptoms and behaviors in rodents. There was a positive correlation between stressing the pregnant rodent and later exposing the young offspring to stress and a later development of ADHD or hyperactivity. Furthermore, various abnormalities were noticed within the rodents' dopaminergic system which the administration of methylphenidate helped to correct and regulate. Motor and executive

functions are often altered among those suffering from ADHD, most likely due to the neurological alterations previously mentioned. Interestingly there have been positive results from motor skill training in children diagnosed with the disorder. These include both motor skill improvements along with improvements in ADHD symptomatology (Ziereis & Jansen, 2016). When it comes to time processing, researchers in Germany found several differences in children with ADHD compared to TDC controls. Children with ADHD after watching a sequenced event tended to overestimate the time both in seconds and were more inattentive in the millisecond tasks, often not noticing changes. Furthermore the absolute threshold for perceiving a picture was often reported later for the ADHD group. The researchers hypothesize a pure time perception alteration in those with ADHD as well as difficulties in set shifting or preparing for a task. One important aspect to note in this research is that the researchers did not specify the presentations of ADHD in their test sample (Walg et al., 2015).

The dopamine theory of ADHD was also very recently challenged with studies conducted by Moreno-Alcazar et al. (2016) , and Volkow et al. (2010) that were cited in previous paragraphs showing more brain structural deficits than dysfunctions in the dopaminergic system, although this is a topic that remains highly controversial. One interesting hypothesis is an imbalance between ventral and dorsal systems, with those with ADHD having a disproportionately connectivity to the ventral system thus being more prone to distractedness and stronger responses to irrelevant stimuli (Sidlauskaite et al., 2016).

Another interesting neuroanatomical finding was that adults 18 and over diagnosed with the hyperactive impulsive (HI) presentation of ADHD were found to have much smaller amygdalas in terms of volume with the right amygdala being implicated in more trouble with emotional control and impulsive behavior (Tajima-Pozo et al., 2016). In children an overall function of the brain was found disordered, unsurprisingly with hyperactivity nodes being more stimulated, thus creating a sort of cluster where areas of the brain were highly functional with poor inter-connectivity between brain regions compared to the brains of controls, specifically white matter connectivity. The right-lateralized network linking the frontal, cingulate, and supplementary motor areas were the most dysfunctional compared to healthy controls (Cao et al., 2014. Hong et al., 2014). Unusual connectivity was visualized among both the ADHD Inattentive and Combined group during resting state and found significant differences in brain connectivity especially compared to controls, the abnormalities were not so varied between ADHD-I and ADHD-C (Fair et al., 2013). A breakthrough neurological imaging study looking at ADHD and its associated disorders in motor coordination found that children with ADHD that have comorbid motor coordination disorders had no noticeable neurological differences from those with just motor problems and without ADHD. The magnetic resonance results showed abnormalities in the cerebral cortex and the cerebellum of those with both the conditions (Shaw et al., 2016).

There are also parallels between ADHD and other disorders that are only being discovered recently. When comparing ADHD with another common neurodevelopmental disorder, Autism Spectrum Disorder (ASD) very interesting results were yielded. It was found that compared to ADHD individuals as well as controls (NDC) the children with autism had greater brain volume compared to both the ADHD group and the controls. Furthermore the people from the autistic group generally had larger amygdalas, but both ADHD and ASD children had similar dysfunction in the cerebellum (Dougherty et al., 2016). Researchers have gone so far as to consider ADHD and Autism Spectrum Disorder part of the same “continuum” of neurodevelopmental pathology, obviously with different symptoms and comorbidities. They claim similarities in brain dysfunction, in methylation as well as similar rates of the disorders in genders and even a possible connection with heavy metal toxicity contributing to both disorders (Kern et al., 2015).

In a Canadian study focusing on children suffering from ADHD premature birth as well as high levels of stress that were self reported by the mothers during pregnancy were associated with both ADHD and asthma (Grizenko et al., 2015). Further studies have found premature birth to be associated with neurological differences very similar to those previously stated. Specifically, lower grey matter volume in the right frontal and premotor cortex and communication issues between the different areas of the brain (Lawrence et al., 2014).

Similarly a longitudinal study conducted in Taiwan found prematurely born babies to be more affected with ADHD, although no neurological tests were conducted. The experimenters relied on behavioral and self assessment tests in follow ups with the parents (Chu et al., 2012).

More evidence for neurological differences in those affected with ADHD comes from a neuroimaging study that looked at drug naive adults with ADHD and compared them to healthy controls. What was found were many deficits in gray matter volume and structural deficits in the cerebellum, the study emphasize the drug naiveté as crucial so that the areas would not be supplemented by psycho-pharmacological means (Makris et al., 2015). When considering and taking into account certain symptoms, specifically hyperactivity and impulsivity in the young population it is crucial not to misdiagnose ADHD instead of just normal levels of impulsivity due to an immature brain. Risk-taking behaviors are common in early adolescence to mid adolescence and later decline in later adolescence and adulthood, the development of the prefrontal cortex takes the longest leading to possible bad decisions; this is especially pronounced in males. (Steinberg, 2008) Tomasi (2014) et al. also found many differences and abnormalities when comparing the brains of teenagers with ADHD and those of typically developing adolescents in an fMRI study.

1.3 ADULT ADHD

One of the most important points when studying ADHD is that there are still more questions than answers, especially when looking at adult-onset ADHD and the impact that lifestyles has on how we understand the disorder. As of now, the estimated prevalence of ADHD in the US is at about 5% of the population, the highest in the world. Just as with childhood ADHD the adult onset version has a strong genetic link and appears to be a sometimes separate condition from the one seen in childhood (Franke et al., 2012).

Researchers hypothesized that ADHD has a strong impact on character formation especially in adolescence. They set up a research to learn more about the personality types mostly associated with adult ADHD and found some very revealing findings which can elucidate what an individual with adult ADHD can look like in terms of a behavioral and symptomatological map. The researchers administered the Temperament and Character Inventory scale (TCI) to 119 adults with ADHD and 403 controls. They found that the most common traits among adults with ADHD were “high novelty seeking (NS), harm avoidance (HA) and self-transcendence (ST) scores as well as low self-directness (SD) and cooperativeness (C) scores were associated with ADHD”. Furthermore the researchers specify that NS was associated with the hyperactive-impulsive presentation of the disorder whereas HA was associated with the inattentive type. Both presentations showed very strong low self directness (SD), the authors point out that ADHD must be seen as a highly heterogeneous disorder and encourage more research in the field of adult ADHD (Perroud et al., 2016). One must keep in mind that as adult ADHD is associated with unique outcomes and behaviors there are several challenges associated with it. The criteria for assessing adult ADHD are different from the criteria of childhood ADHD. The disorder in adults is associated with addiction and anger issues. Furthermore the hindrance that adult ADHD puts on one's everyday life is something of utmost importance for the field of psychology and psychiatry as core issues to work with. The addictions and secondary issues form a considerable part of what constitutes the disorder (Fields et al., 2017).

In terms of neurology a major study looked at the differences in late-onset ADHD with those who had been previously diagnosed with the disorder either in childhood or adolescence and found striking similarities between the two. On the other hand those who had mild symptoms and a late-onset adult ADHD had brain scans almost identical to the healthy controls (Faraone et al., 2006). One of the best self-reported scale to assess ADHD symptomatology is the ASRS v. 1.1 which was found to be a reliable standardized instrument of assessment within the clinical realm (Adler et al., 2006). Other factors that were seen as controversial that were investigated include IQ levels in those with adult ADHD. Antshel et al. (2009) found that adults with ADHD with a higher than average IQ (>120) were prone to the same negative effects of those with average to lower IQ.

Furthermore the high IQ group was more likely to be involved in criminal activity, and more prone to accidents. On the other hand there have been many stories of success in adults with ADHD. The main aspect that makes all the difference is family support, and especially with counseling and coaching even adults with ADHD can achieve their goals. This is a very important factor as ADHD has strong social influences. Those with ADHD can thrive in a supportive environment (Barkley, 2017).

1.4 COMORBIDITIES AMONG THE DIFFERENT PRESENTATIONS OF ADHD

As was previously mentioned ADHD is not a uniform disorder, it has three clinical presentations; hyperactive impulsive (HI), Inattentive (I) and Combined Hyperactive Inattentive (CHI), The various presentations of ADHD differ in comorbidities, genetic factors as well as responses to drugs. The biggest differences are noted between ADHD HI and C compared to ADHD-I (Grizenko et al., 2010). This is particularly confounding and problematic as clinicians and researchers don't often properly differentiate the various presentations of the disorders, thus leaving it as ADHD within the literature. Even when looking at the symptoms and benefits of drug treatment it is important to assess the presentation. For example it was found that those with ADHD-I had more improvement with methylphenidate treatment than those with CHI or HI presentations who also required greater amounts of behavioral therapy and training for their poor behaviors (Grizenko et al., 2013).

It is worth noting that in the hyperactive impulsive presentation of ADHD comorbidities such as conduct disorder in childhood and antisocial personality disorder in late adolescence were more common than in the inattentive presentation.

The inattentive presentation of the disorder showed different comorbidities like depression and anxiety. Furthermore, the individuals showing higher inattentive symptoms also showed more frequent social isolation and lack of intimate relationships (Barkley, 2016; Halfon et al., 2013). Kolla et al. (2016) carried out a study in Canada looking at alcohol and cannabis abuse among adults with ADHD. The hyperactive impulsive adults with ADHD had the highest rates of cannabis abuse, alcohol abuse was highest in women with the inattentive presentation of the disorder. Generally, the higher the rate of externalizing disorders among the people the higher the comorbid drug and alcohol abuse. Similarly in a classic study carried out on children with ADHD hyperactive impulsive presentation by Gabel & Schmitz (1996) it was found that the intensity of the symptoms related to the disorder were positively correlated with the externalizing factors as well as the intensity of the comorbid behaviors. Obesity, another major comorbidity and lifestyle behavior, was prevalent among the inattentive group but not among the hyperactive impulsive group, with being overweight as an issue among the hyperactive impulsive group (Halfon et al., 2013).

1.5 OBESITY, WEIGHT PROBLEMS AND ISSUES WITH NUTRITION

Obesity has been linked with ADHD in several major longitudinal studies and meta analysis, with men being most afflicted with the condition (Cortese et al., 2013a,b). Similarly to the DRD 4 genetic pathway that is correlated both with ADHD and other impulsive disorders like alcoholism and drug addiction, a genetic link and shared genes for ADHD and obesity have also been isolated. Specifically the FTO gene has been associated have in both health conditions. It must be also mentioned that prenatal exposure to nicotine due to the mother smoking may have also been a factor in ADHD (Choudhry et al., 2013, Grizenko et al., 2015).

ADHD is often associated with motor skill dysfunction as mentioned in the neurological findings section. In a cross sectional study looking at obesity, motor dysfunction and ADHD it was found that motor dysfunction was very often associated with childhood obesity but children with just ADHD were most likely to be underweight, which was paradoxical for the researchers. This led to the conclusion that when studying this condition it is extremely important to differentiate and assess them separately (Goulardins et al., 2016). A longitudinal study found very strong links between childhood ADHD with both Hyperactive Impulsive and Inattentive showing greater risk for being obese or overweight. The study found a stronger correlation with the Hyperactive Impulsive group with hypertension, possibly due to their higher consumption of drugs like cocaine and increased smoking rates (Fuemeller et al., 2011).

The extremely high rate of comorbid ADHD among the obese was noted in a study in Israel wherein the researchers strongly advise physicians to check for or refer obese patients to clinical psychologists to assess for ADHD especially in childhood (Agranat-Megedger et al., 2005). In contrast a large cross-sectional study with a sample of 45,987 individuals aged 10–17 years in the United States found that the individuals with ADHD and a comorbid learning disorder, and youth with learning disorder alone were more much more likely to be obese than their peers (OR=1.464 and OR=2.094, $p=0.01$). However, the study did not find an association between children with only ADHD and obesity (OR=0.870). Those with ADHD and not obese were found to have lower levels of physical activity, furthermore the study did not differentiate among the clinical presentation of the disorder (inattentive, combined etc). After accounting for demographic factors (e.g., gender, age, ethnicity and socioeconomic status) ADHD patients with comorbid learning disability that were medicated had lower obesity rates than non-medicated patients (OR=1.393 and OR=2.516, respectively). This study suggests that ADHD symptoms alone are not associated with obesity, and points towards a different possibility: the presence of other comorbid psychiatric disorders and or social factors. The study supports the lower incidence of obesity in medicated patients, but the length of time of drug treatment or the type of drug used (methylphenidate or a non stimulant) was not reported (Cook et al.,

2015). One hypothesis that we expressed is that in many of the obesity and ADHD studies, medication could be a confounding factor in getting correct results and correlations in the realms of ADHD and obesity. This is due to the fact that most drugs used to manage ADHD are stimulants such as methylphenidate and amphetamine, both speeding up the metabolic rate and thus increasing weight loss. We reviewed a wide array of literature and found that many studies that are then included in meta-reviews often did not register the duration of drug treatment and at times even whether the drugs were being administered while looking at obesity and ADHD! In other instances comorbidities in childhood such as Oppositional Defiant Disorder or Conduct Disorder were not checked for. The long term metabolic effects of ADHD drugs needs to be studied to a greater extent, as in relationship to metabolic rate and long term changes, rebound effects and tolerance. Furthermore we strongly advise clinicians reading these association studies to carefully check whether drug treatments and other comorbidities are being taken into account by the researchers so as not to have confounding results (Weissenberger & Akotia, 2015). Along with obesity and issues with being overweight nutritional deficiencies in micronutrients have been consistently observed in those affected with ADHD. Specifically low levels of polyunsaturated fats (omega 3), and very low levels of zinc and magnesium. This is a controversial topic but supplementation has shown positive results in some cases (Verlaet et al., 2014). Furthermore it is crucial to note that some studies have also mentioned a much higher prevalence of obesity among those with a predominately inattentive presentation of ADHD but not so much in the hyperactive impulsive group (Fuemuller et al., 2011 Khalife et al., 2014).

A clinical study in Turkey found that children and teenagers with ADHD have a much lower tolerance to stress and frustration than normally developing children and thus may eat impulsively on junk food. The hypothesis is that they may actually be self medicating with food. In addition to this ADHD was correlated with both malnutrition and being overweight and obese. The researchers state that this shows ADHD to be a major risk factors not only for obesity but also for eating disorders, especially those that involve bingeing and purging such as bulimia nervosa (Gungor et al., 2016). A lower general threshold for stress in those with the disorder has also been noted in a meta-analysis by Barkley et al. (2016) that may drive individuals to self-soothing and self-medicating behaviors. A Korean study further linked bulimia, higher body mass index and obesity with ADHD while still emphasizing the influence that lower socio-economic status and lower access to resources plays in this (Kim et al., 2014).

1.6 FOOD ADDICTION

A comprehensive review looking at comorbid behavioral addictions and ADHD found correlations up to 77-80% on certain ones, the most prevalent included fast food addiction and binge eating, Internet Gaming Disorder/Internet addiction and gambling. Other addictive behaviors such as compulsive shopping and exercise addictions were not previously explored (Karaca et al., 2016). Although we all must eat to get nutrients and calories, unhealthy preoccupation and behavioral addiction to food has been noted. Most commonly individuals and animals will binge on high fat and salty food or high fat and sugary food, both combinations being rare in the natural world. Eating this combination of food also has a dopaminergic effect that is similar to taking a drug of abuse. Food addiction is now a recognized mental condition and there are standardized scales to measure it such as the Yale Food Addiction Scale. A study looking at the phenomena found that in an obese population the food addicts were most likely to have comorbid ADHD and those found with the comorbidity had higher emotional instability and were displaying the classical behavior noted in other addictions such as using the food to ease withdrawal symptoms, self-medicating with the food and soothe certain unpleasant states of consciousness such as anxiety and sadness. The study confirmed a new type of obese patient or subtype that was not previously officially recognized by the medical field, the food addict. Noting these comorbidities can serve as an effective indirect tool to look for ADHD (Davis et al., 2011).

Those with ADHD are most likely to abuse drugs, food and electronic media. A researcher in Canada points out how ADHD may not only be one of the most important risk factors for developing obesity but also one of the driving forces behind the impulsive eating previously mentioned. The researchers similarly to Davis (2011) argue that the treatment and improving of ADHD symptoms directly influence obesity and result in weight loss. They make the point that along with tools such as the Yale Food Addiction Scale classical self assessments for ADHD are also highly advisable for general practitioners. The researchers stick to the behavioral modifications in treating ADHD and do not seem to take the drugs used to treat the disorder into consideration (Yang, 2010). One common trait that was found consistently throughout the lifestyles and comorbidity literature is that there is a common element of poor discipline and self control with these individuals that we hypothesize is connected with a strong inclination towards a hedonistic lifestyle as well as an unbalanced time perception focused on the present (Weissenberger et al., 2016). In the case of diet it was found that when looking at those diagnosed with ADHD the association with a diet high in sugar, fat and fast food has a very strong link with the disorder. In contrast adherence to a healthy diet such as the “Mediterranean diet” was negatively correlated with ADHD. The diet includes eating fresh fruit and vegetables as well as fish and limiting unhealthy food such as fast-food (Rios-Hernandez et al., 2017).

Food addiction was just one of the many examples of addictive behavior found in the literature on the disorder.

1.7 CLASSIC AND NEW ADDICTIONS

Nicotinism, alcohol abuse and drug abuse were all noted behavioral and pathological comorbidities in the ADHD hyperactive impulsive “subtype” as it was defined in DSM-IV TR. Researchers claims that the comorbidities of ADHD are extremely important for the clinician to know as they constitute most of the health issues and dangers associated with this disorder either directly or indirectly (Nigg, 2013). In a more drastic tone Gillberg et al. (2004) claim that clinicians working with ADHD should have ample knowledge of neurology along with the vast arrays of comorbidities associated with the disorder, as it is almost impossible to work with the disorder as a single cause to treat.

When talking about Substance Use Disorder it has been estimated that almost one quarter of those suffering from SUD have comorbid ADHD and furthermore have a much worst prognosis in treatment compared to non ADHD substance abusers (van-Emmerik, 2015). Cocaine addiction and nicotine addictions are some of the most common addictions in those with ADHD, with some linking commencement of methylphenidate drug therapy in adolescence with higher rates of cocaine seeking behavior later on, paradoxically d-amphetamine was not associated with higher rates of cocaine use and addiction (Jordan et al., 2016).

In a study looking at cocaine addicted and nicotine addicted adults with ADHD and comparing them with other non addicted individuals diagnosed with ADHD, both the cocaine and nicotine addicted patients scored very high in the hyperactive/impulsive presentation scale and very low in the inattentive scale both in adulthood and in a self report childhood scale (Saules et al., 2003). Similarly in a 33 year long longitudinal study on ADHD conducted, higher rates of nicotine addiction and substance abuse were noted in the adults who showed what we now classify as Combined Presentation of the disorder in childhood but no major differences were seen in rates of alcoholism compared to controls (Klein et al., 2012). A Swiss study found young adults with a mean age of 20 with ADHD and comorbid Antisocial Personality Disorder to have been experimenting with legal and illegal drugs from an early age. This showed earlier experimentation than those with just substance abuse disorder. The study found higher rates of cocaine and nicotine use but not as much alcoholism even when compared to non-ADHD substance abusing controls (Estevez et al., 2016).

Cannabis use is also very common in those with the disorder especially among adolescent males (Kolla et al., 2016). In a Danish longitudinal study looking at gender and its influence on the comorbidity of Substance Use Disorder it was found that unlike the general population the rate of individuals with SUD and ADHD was at times higher in females. Different comorbidities were also reported in the female population such as higher rates of depression and eating disorders, the authors also point out the stereotype

that males with ADHD tend to be more dysfunctional when it is by all means false and just a different expression overall of the disorder (Otto et al., 2016). A meta-analysis in Sweden looking at substance abuse and addictions among relatives of those with ADHD found a very strong correlation between the two variables with long histories of nicotine and drug addictions. The researchers argue that this is due to genetics, as the genetic pathways responsible for ADHD are the same involved with proneness to drug addiction (Skoglund et al., 2015). Specifically, the dopamine receptor gene DRD2 that is associated with ADHD with its hyperactive impulsive presentation was also found to be associated with alcoholism (Jones, 2010). A study at a rehabilitation facility for problematic gamblers found that one third of the inpatients came out positive during assessment for ADHD and the majority of those suffering with ADHD had Cluster B personality disorders as a comorbidity with no major differences among sexes (Waluk et al., 2016).

A French study tested almost 1000 college students in France. Five assessment inventories were used including Wender-Utah, ASRS-V1, UPPS, Rosenberg Scale and CPPG to assess both ADHD in childhood and in adulthood came to specifically correlate adult ADHD Hyperactive Impulsive presentation as the most likely to be problematic gamblers and have the highest rates of video game addiction (Romo et al., 2015).

There are a gender differences in problematic computer use and psychiatric disorders. The analysis shows that females suffering from ADHD and/or other disorders such as Borderline Personality Disorders were most likely to be addicted to social media use. Males on the other hand were found more likely to fall for the addictive game usage. The group who came out as highest on the ASRS scale for ADHD had one of the strongest correlation for impulsive gaming. The gender difference was emphasized by the researchers to also point out the fallacy of the previously proposed Problematic Internet Use (PIU) as too broad and encompassing as the behaviors are very varied with this type of addiction (Andreassen et al., 2016). The PIU description/diagnosis was proposed as an affective disorder in the early 2000s consisting of an unhealthy preoccupation with the Internet as well as impulsive and addictive use of the internet not specifying exactly for which purposes (ie social media, gambling) but eventually was not added to the DSM (Shapira et al., 2000).

Despite the confusion with nomenclature the link with unhealthy technological habits in people with ADHD is one that has been widely noted. ADHD was one of the most prevalent risk factor for impulsive internet use and Internet Gaming Disorder (IGD), with neurochemical alterations noted in one ADHD study comparing compulsive gamers with diagnosed ADHD and without (Karaca et al., 2016; Hyun et al., 2015, Bae et al., 2016).

Similarly Yen et al. found a significant correlation between impulsive gaming disorder and ADHD, the researchers also assessed impulsivity and aggressiveness and found a strong correlation with it in individuals diagnosed with ADHD but not in those

who only had IGD. Another finding was that this high impulsivity was linked mostly with males (Yen et al., 2016).

1.8 CONVENTIONAL TREATMENTS OF ADHD

The symptoms of ADHD are managed via both drug therapy and psychotherapy. The most common conventional drugs prescribed for the disorder in all age groups are methylphenidate and mixed amphetamine salts (brand names Ritalin and Adderall, respectively). Other non stimulant drugs that are common in the management of the disorder include atomoxetine (brand name Strattera). In children it is currently recommended by physicians in the United Kingdom to refer patients to psychotherapy first and keep the drug interventions only for the more severe cases of the disorder or in case psychotherapy does not produce the desired effects (Thapar & Cooper, 2016). Cultural factors are also an important aspect of ADHD as differences and similarities in presentations of the disorder have been noted in various countries such as the US and Turkey with similar rates. Drug interventions and psychotherapy was found to yield great success in a six year study on children with ADHD in Turkey, the result of the treatments included higher rates of academic success, lower rates of antisocial and oppositional behaviors as well as lower rates of physical injuries that are often noted as a negative health outcome in those with ADHD (Ercan et al., 2012).

Treatments must also take into account the children communication with their family members as well as school teachers and peers. For this reason researchers and clinicians have found useful tools to manage ADHD include setting up token economies at home for parents to reward the desired behaviors in their children as well as similar methods in school classes that are useful to motivate children with ADHD to perform and participate. These types of techniques are generally very successful in the short term but once they are stopped it is very difficult for the individuals to have the intrinsic motivation to partake in school tasks and other similar tasks. Another issue that can be a confounding factor is drug administration from parents to children; due to the fact that many children with ADHD have parents with the disorder it is common that parents forget to administer the drugs to their children and thus there could be a confound in symptom management (Chronis-Tuscano et al., 2016). This has been confirmed by a study in the United States on adherence to the ADHD drugs where children and adults from poorer socioeconomic backgrounds were less likely to take the drugs with regularity. One major issue to note is that the participants often reported as helpful their general practitioner explaining how the drug works and the side effects, as well as an empathetic and caring attitude from the physician. Some groups felt particularly disrespected and ignored by their primary care providers thus leading to less trust in both the physicians' judgment and the drugs administered, the groups included members of ethnic minorities and those from the geriatric population (Sleath et al., 2017). The addition of specific courses aimed at improving communication among those with ADHD as well as motivation enhancement from teachers and parents/family is called *training interventions* (TI). These are useful for

a variety of reasons, not only in creating token economies for kids and adolescents to improve their behavior but also to train parents how to diffuse conflicts and administer drugs to their children and adolescents on a regular basis. More recently counselors and psychologists have also created TIs specifically suited to deal with some of the communication issues related with the disorder such as positive social bias and certain externalizing behaviors that are typically seen, with overall good success if the training is consistent. The improvements included better academic performance and achievements as well as better behavior at home as reported by the school teachers and parents, respectively (Schultz et al., 2017). Psychoanalytic interventions that include both parents and children have also yielded great results, the results were influenced to a great extent by the support given to the parents as they felt they were able to express themselves better emotionally as well as improve their parenting style and role for the children. This notion is crucial as we will see how cyclical ADHD tends to be in an holistic perspective. Furthermore this perspective ties in to later research regarding maternal stress and certain levels of negligence and their association to the disorder especially in early development (Pozzi-Monzo, 2012). This point is emphasized by Ladnier & Massanari (2000) who in their landmark book claim that the disorder should be considered more an attachment disorder rather than an attention disorder. This is due to the fact that inadequate bonding and care has been given to the child from the neonatal period to age two, leading to hyperactivity and distress. The authors mention many psychodynamic theories regarding this phenomena from the view point of classical psychoanalytic thinkers such as Klein and Bion, with the recommendation that the most advisable treatment option for children suffering ADHD is family therapy supplemented by drug therapy, when necessary. One important difference to note when addressing adult ADHD compared to childhood ADHD is that very often due to the age differences and comorbidities like obesity and poor diets those with adult ADHD may have to take blood pressure drugs to counter some of the negative side effects associated with stimulants such as methylphenidate. Overall the outcomes of drug treatment are better than abstaining and possibly be at higher risk of accidents or other negative outcome (Barkley, 2017b).

1.9 ADDITIONAL FINDINGS REGARDING DRUG TREATMENTS

As was previously mentioned in the neurological section, methylphenidate and other ADHD drugs do have several cognitive and neurological benefits for those suffering from the disorder such as normalizing certain brain communication deficits among the various parts of the brain. In regards to drug treatment adherence, adequate communication between family members in encouraging the children to stick to the therapy are crucial in order to properly manage the symptoms associated with the disorder. Positive and open dialogue regarding the disorder, treatment and associated lifestyles are not only important for children with the disorder, longitudinally they are associated with much better outcomes throughout the age groups (Hebert et al., 2013). In a study comparing children with ADHD who were medicated with those unmedicated the results were impressive. The patients were asked to perform certain tasks and sustain attention to other tasks. The medicated group performed much better overall, but the major benefits were found to be in lowering impulsivity and higher reaction times. The drug was not very effective in sustaining their attention, which led the researchers to suggest physicians look carefully for what symptoms are being displayed so as to avoid errors as well as misdiagnosis (Lufi et al., 2015). Another dynamic which was found in a two year longitudinal study on adolescents with ADHD is the gender differences in drug responses, females had much more improvements in symptomatology compared to males when taking the drug methylphenidate. Interestingly, after two years of treatment the gender disparity was lessened and improvements were reported both by parents and teachers, thus showing a dramatic difference in short term response to the drug among women but a later catch up with time among both groups (Wang et al., 2015).

One concern many have regarding certain stimulant drug treatments is side effects as well as later addiction to illicit drugs. Cocaine addiction is a noted and common comorbidity in those with ADHD along with nicotine addiction. Research has shown that in those who started methylphenidate therapy during childhood there is no higher than normal rates of cocaine addiction within the ADHD population. Methylphenidate is not advised during adolescence as in this age there is a higher cocaine seeking behavior correlated with the drug treatment. Alternatively d-amphetamine was found to have more positive effects on adolescents including school performance and was less correlated with later cocaine abuse both in lab animals and humans (Jordan et al., 2016).

Furthermore in extensive reviews amphetamine based drugs (d-amphetamine, lisdexamfetamine) were found to be the most effective drugs to manage ADHD, with a slight risk of side effects. Methylphenidate was found overall effective but very little data exists regarding prognosis or long term effects of the drug. Other drugs that are currently being tested for ADHD include certain non-SSRI antidepressants that work on the adrenaline and dopaminergic systems such as bupropion and non stimulants. In terms of

effectiveness amphetamine and methylphenidate are still the most advisable when compared with other drug treatments such as non-stimulants (Buoli et al., 2016). Pedraza & Newcorn (2015) also mention that non-stimulant drugs for ADHD are not as effective as stimulants for both adults and children but that there is strong potential for new development and research of these types of drugs and that in conjunction with psychotherapy they may be helpful. Another drug that was found to have potential for ADHD treatment is modafinil, in studies on this drug it was well tolerated and ADHD symptoms such as inattention and impulsivity improved, although it was not as effective as methylphenidate and d-amphetamine. Furthermore the antidepressant bupropion can also be advisable in those who have strong side effects from methylphenidate or other stimulant drugs (Coghill, 2013). In other studies the drug was found to help in concentration and sustaining attention and stated as a viable alternative to methylphenidate and amphetamines. Furthermore it was found to be more effective than atomoxetine in improving symptoms, at least in the short term (Bagot & Kaminer, 2014). A follow up study in Denmark on children and adolescents taking stimulant drugs found that their risk for having some kind of cardiac issue was double that of non-medicated ADHD individuals and controls. This was one of the biggest studies ever conducted on the topic (Dalsgard et al., 2014). Some have observed less side effects with extended-release version of the drugs such as methylphenidate extended with less sleeping problems noted in patients compared to the regular, immediate release version (Owens et al., 2016).

Driving infractions, recklessness and car accidents are all very typical in those with ADHD, specifically ADHD-HI. A study on the effectiveness of ADHD drugs on driving improvements found methylphenidate to have various benefits on driving ability and more careful driving. Amphetamine and atomoxetine were found no better than a placebo but none of the drugs had a negative effect on driving (Gobbo & Louza, 2014). Some of the biological origins/causes of ADHD have been discussed but it should also be mentioned that there are strong social and relational influences that must be taken into account.

1.10 PARENTING STYLES AND ADHD

The way parents raise their offspring is crucial to understanding most aspects of mental health as well as later lifestyles. It can be argued that each type of comorbidity and lifestyle can be at least to some degree influenced by parenting. From very early on, individuals who later develop ADHD show irritable temperament styles. Ineffective, inconsistent and especially negligent parenting were found to exacerbate ADHD symptoms and be predictive of later disruptive behavior disorders such as Conduct Disorder; furthermore children who had more positive and involved parenting manifested an improvement of symptoms (Ullsperger et al., 2016). ADHD in its childhood presentations is not only directly influenced by parenting styles but also by parental perception. Substance abuse is one of the most common lifestyle factor in ADHD as well as comorbidity in the case of problematic use and addiction as previously mentioned (Nigg, 2013).

Generally speaking, there are predictive and protective factors linking substance abuse and parenting. One of the most widely recommended parenting style with respect to ADHD is authoritative parenting. This parenting style includes warmth, communication and clear boundaries for the child. This style of parenting is compared with authoritarian which is less warm, with strict boundaries, low communication and strict rules. Permissive parenting consists of low boundaries and varying levels of communication where the parental role is not clearly defined; finally, there is negligence, where the child is not being properly taken care of and the parents are often missing from the households (Briesmeister & Schaefer, 2007). A systematic review of parenting styles and drug abuse consistently found a clear correlation with authoritative parenting and lower rates of drug abuse and addiction (Becona et al., 2012). In a South African study, authoritative mothers in families with children with ADHD had much better communicating styles and better educational outcomes for their children (Tancred & Greef, 2015). Similarly, when looking at children aged 7- 11 years with ADHD Inattentive presentation, the severity of their symptoms as well as academic and social well being were directly correlated with parenting: negative parenting such as harshness and/or neglect was associated with worse outcomes (Haack et al., 2017).

One of the most classically acclaimed examples is the Baumrind (2013) study that found that children raised with an authoritative parenting style in the United States not only had lower drug and alcohol abuse incidences but were more competitive and successful in their academic careers. Authoritative parenting is consistently advised and considered ideal for healthy outcomes in psychological development as well as a good preventive measure for substance abuse and addiction, in Europe in contrast indulgent (permissive) parenting was equally effective. Strict authoritarian parenting as well as negligent parenting were the

most widely implicated parenting styles associated with drug and alcohol abuse (Calafat et al., 2014). A Canadian study focusing on the families of children with ADHD found that not only were ADHD cases most likely among mothers with children with ADHD but that a major component was family dysfunction. Hostility and parental conflicts were correlated with ADHD as well as single parent households and lack of family structure (e.g. Undefined roles, inconsistent parenting) (Williamson & Johnston, 2016). It must be noted that correlational studies usually cannot exclude a reverse causality, for instance the disruptive child might have created the stress in the family or at least exacerbated the situation.

Studies looking into the parenting behaviors of adults with ADHD found significant differences in self reports and observations about their own relationship and parental style with their children. ADHD Inattentive parents were most likely to self-report negative parenting, as they were consistently ignoring their children and getting easily annoyed with them. In the Hyperactive Impulsive group much more positive interactions were observed, in the self-report ADHD parents had a tendency to conflate their positive parenting to higher self esteem or a result of exaggeration due to other comorbid mental illnesses often seen in ADHD-HI like antisocial personality disorder (Lui et al., 2013).

Parenting is also directly involved in comorbid obesity of ADHD children. It was found that harsh parenting in adolescence or, more specifically, what is classified as an authoritarian style as well as food insecurity due to lower SES correlate strongly with later obesity (Vannucci & Tanofsky-Kraff, 2014). The entire body of studies show the great importance of family cohesiveness in those affected with the disorder and point to often ignored extrinsic social factors, that we argue are equally if not more important than the genetic factors involved.

1.11 ALTERNATIVE TREATMENTS AND SYMPTOM MANAGEMENT

Traditionally ADHD symptoms are managed by a combination of psychopharmacology and psychotherapy, with drug treatment being administered indefinitely. Indeed, studies have shown stimulant drugs like methylphenidate to be far superior to placebos when treating ADHD symptoms in adolescents. Furthermore positive effects were noted in psychotherapy, specifically cognitive-behavioral therapy (CBT) with improvements seen even in those who had group therapy sessions (Philipsen et al., 2016). Within the realm of adult ADHD, CBT has shown great results in helping patients to keep their goals such as practical goals related to career and relationships. As was noted in other studies the ideal results were seen when the drug treatment was taken in combination with psychotherapy (Ramsay, 2016).

Many individuals today look to alternative treatments and nutritional supplements to help manage their symptoms, some would consider supplementing with herbs and nutrients also part of a lifestyle. One of the most common comorbidities associated with ADHD are sleeping disorders such as insomnia. In a metareview of studies related to both prescription drugs that are prescribed for insomnia and sleep disorders and comparing the results with certain supplements yielded surprising results. The population was children and adolescents with ADHD and the drugs and supplements compared were l-theanine which is an amino acid that is taken from the leaves of the camelia sinensis (tea plant) and the hormone melatonin which is produced by the pineal gland and is associated with regulation of the circadian rhythm and comparing them with the hypnotic drug zolpidem that is often prescribed for insomnia and other sleep disorders. L-theanine is generally sold and marketed for its anxiolytic and calming effects as well as for lowering jittering and other side effects of caffeine, melatonin is sold as a sleep aid. The results were that l-theanine and zolpidem did not significantly improve sleep in those with ADHD, zolpidem was associated with many side effects that those who had this drug administered to them had the highest drop out rates from the various studies. Melatonin on the other hand did provide improvements in sleep duration and quality of sleep with little or no side effects (Barrett et al., 2013). Bloch & Mulqueen (2014) found similar results in regards to melatonin, issues with sleep were helped by the supplement but there was no improvement of core ADHD symptoms. Other studies on l-theanine have found substantial neurological benefits to the substance, acting as a neuroprotectant and increasing alpha waves. Improvements were also seen in schizophrenia with a lessening of the positive symptoms and anxiety. In animal studies the substance was found to be beneficial in the treatment of depression. In the case of ADHD the substance may be beneficial in addition to conventional treatment (Lardner, 2014).

Other supplements that are often marketed for improving brain function and managing ADHD symptoms are the omega 3 and 6 fatty acids. This is due to the findings

that individuals afflicted with ADHD often have lower levels of beneficial fatty acids in their system, most likely the result of their poor diets. There are studies showing improvements in ADHD symptoms when supplementing with these fatty acids (Bloch & Mulqueen, 2014). In contrast, a large study on supplementation with fatty acids compared to a placebo in adolescents with ADHD found no improvement in either symptoms nor other externalizing behaviors that are typically associated with ADHD (Matsudaira et al., 2015). Incidentally, in a metareview on supplementation with omega 3 and omega 6 fatty acids the researchers argue that although the research on this type of supplementation does show inconclusive results, this can also be due to the fact that researchers have often attempted to supplement with a single fatty acid such omega 3. They argue that it is not so much adding one particular omega acid to the diet but having a proper balance between omega 3 and omega 6 acids and that in the few studies that did take this into account, improvements were seen in symptomatology (LaChance et al., 2016). Other researchers and physicians advise educating family members of those with ADHD about proper diet and if possible having the children tested for nutritional deficiencies such as zinc and iron deficiencies. The authors advise high quality fatty acid supplements from reputable sources and some herbal remedies alongside the more conventional medication. Furthermore, a healthy whole food diet can be combined with psychotherapy in terms of training and lowering impulsivity (Hurt & Arnold, 2014).

A practical example of supplementation alongside conventional medication for ADHD was conducted by Arnold et al (2011), the researchers were experimenting whether zinc supplementation for 8 weeks would have some effect on children and adolescents with ADHD. The researchers had a three set experiment where participants were divided in two groups the first group received 15 milligrams of zinc every day for eight weeks, the second a placebo. After four weeks the participants would further receive amphetamine along with the zinc or the placebo. What was found was that zinc had a positive effect on inattentive symptoms and that zinc supplementation along with amphetamine had better results than zinc alone or amphetamine alone, thus showing that nutritional supplementation alongside traditional methods can have very promising results. Other researchers have found similar results with iron; iron levels are often low in those affected with ADHD and many tested out whether supplementing with iron and raising base ferritin levels in the blood would have beneficial effects on ADHD. The results were inconclusive on whether iron alone could improve symptoms but it was found that iron supplementation increased the bio-availability of ADHD drugs and was therefore indirectly related to improvement of symptoms. This shows that supplementation can be of help in conjunction with regular treatments (Cortese et al., 2013a). A New Zealand study on adults with ADHD that had them supplement with micronutrients such as vitamins and minerals for 8 weeks did show some improvements in mood and overall well being in the patients but the improvement in core ADHD symptoms was greatly inconclusive. The researchers emphasize that much more research is needed into how supplements can help and work in combination with

traditional ADHD treatments (Rucklidge et al., 2014). The same authors, Rucklidge et al. (2014), make another point in defense of the administration of broad spectrum micronutrient supplementation in ADHD as well as other psychiatric conditions; they explain that these micronutrients are crucial in the production of brain transmitters and for maintaining a healthy brain. Without them any relatively healthy person would start having mental health issues. This also reaffirms the socio-economic influences of ADHD as often lower access to resources means poorer diets.

Other alternative treatments include biofeedback and neurofeedback that allows a patient to hear their physiological functions in an amplified way as well as certain electrical discharges in the brain with the use of electro-encephalogram (EEG). In the realms of alternative treatments biofeedback is one of the most promising with good results both in behavioral/impulse control as well as improvement in performance in school and work for those with ADHD (Monastra, 2005).

In a research conducted by Flisiak-Antoniuczuk (2015) on 115 children aged 6-17 years with ADHD of all presentations the results were very impressive. The researchers divided the children into the experimental group which consisted of 85 ADHD diagnosed children to undergo biofeedback therapy for two weeks and the control group to go through drug therapy with methylphenidate. The results were that biofeedback therapy was just as effective as methylphenidate in improving the symptoms of ADHD. Knouse (2005), claims in a substantial metareview that although biofeedback and other alternative treatments including yoga and meditation may have some potential benefits, clinicians should try to play it safe and advise these to be used as additional therapy along conventional treatments. In the latest metanalysis of randomized trials the most efficacious treatment option for ADHD were stimulant drugs like methylphenidate and amphetamines as well as a combination of cognitive-behavioral therapy and stimulants. Alternative treatments such as herbs were often not more efficacious than a placebo (Catala-Lopez et al., 2017).

2.0 EMPIRICAL RESEARCH

2.1 STUDY POPULATION AND DATA COLLECTION

A national sample of adults aged 18-60 from the Czech Republic was recruited by the STEM/MARK Agency, a professional polling and statistics agency in Prague. The participants aged 18-60 were either recruited online or via direct phone interview. The sample consisted of 1012 participants total, of which 507 were males and 505 were females. The participants were approached via a combination of methods. Those aged 18-50 via online questioning and those 50 and above via trained interviewers. This combination of methods was used due to the fact that internet use decreases with the increasing age and the age 50 was chosen as the top limit for best availability of respondents. Furthermore predetermined quotas regarding region, age and educational levels were all fulfilled for a balanced sample.

All data were subsequently treated using frequency tables and logistic regression analysis based on lifestyles frequency using the Stata V. 14 program. The study was approved by the First Medical Faculty of Charles University in Prague, all participants signed informed consent forms prior to partaking in the study.

2.2 STANDARDIZED TESTS AND LIFESTYLE QUESTIONNAIRE

The participants of this study were administered the ASRS V. 1.1 to assess ADHD symptomatology with scores from 0 to 6, with 0 being no ADHD symptoms and 6 being extremely severe symptoms. The range of 5-6 points is considered indicative of high symptomatology of adult ADHD ie, that the individual is diagnosable as ADHD. The result of 4 points suggests that the clinician must further investigate whether the patient is suffering from the disorder. Scores of 0-3 indicate no symptoms or weak symptoms. A score of 0 is indicative of low amounts of symptoms and low probabilities of the person being diagnosable due to no levels of impulsivity or inattentiveness. The ASRS V. 1.1 questionnaire is standardized and considered a very reliable method of assessing ADHD symptomatology within the adult population (Adler et al., 2006). The table is attached below.

Following the demographic information and ASRS, the participants filled out the self-report questionnaire which focused on their lifestyles in regards to behaviors generally seen in adults with ADHD. The questions were in this order: healthy lifestyles such as their diet and exercise routines, cigarette and tobacco usage, use of illegal substances, physical activity and sports, hours watching TV per day, how many meals they consume per day, sweets and sugar consumption, daytime tiredness and sleepiness, and sleeping habits. The questions were both open and closed, for example “do you smoke cigarettes: Yes or no” and “how many do you smoke?”. Some were put into ranges such as “how many hours of television do you watch per day?” with ranges including 0-1 hrs up to 12 hrs or more. Furthermore, certain questions regarding drug use were rated 0-4 with 0 being a protective factor (eg, do you use cocaine? No = 0). Within the logistic regression calculations, we only included the more prominent risky lifestyles associated with high ADHD symptomatology from our sample. The questionnaire was built on previous research from the authors.

Following the administration of the ASRS v. 1.1 and having filled out all their demographic information the participants took part in the lifestyles questionnaire. The questionnaire first asked about a previous ADHD diagnosis, and whether the individual had ever been treated for the disorder. Section C then is looking at lifestyles or the core of the study these include things such as smoking cigarettes, dietary habits and use of drugs (both prescription and illicit). The questions are based on literature reviews and trying to understand how much the lifestyles are a core aspect of adult-onset ADHD.

3.0 RESULTS

In this section the results of will be presented in the form of tables. We look at various factors such as the ASRS scores and the differences among genders, age. We also have various statistical calculations like ordered logistic regression of the particular lifestyles that are associated with ADHD symptomatology in adults.

Table 1

ASRS Scores, Frequencies and Percentages Among the Sample

ASRS SCORE	FREQUENCIES	PERCENT
0	369	36,46
1	254	25,10
2	166	16,40
3	116	11,46
4	73	7,21
5	23	2,27
6	11	1,09
TOTAL	1012	100

Table 1 shows the frequencies of results in the ASRS v. 1.1. The range of scores goes from 0-6 with 0 being no symptoms and 6 being very strong symptoms.

The results were close to our expectations, as the highest category was the 0 and the lowest the 6. The combined scores of categories 4-6 were 10.57% which was somewhat surprising as these categories are those associated with mild to high symptoms, in terms of childhood ADHD 10.57% would be expected but from the literature we would have expected lower incidence of mild to high ADHD symptoms.

Table 2*ASRS Scores Among the Genders*

ASRS Score	MALES		FEMALES	
	N	%	N	%
0	187	36,88	182	36,04
1	121	23,87	133	26,34
2	85	16,77	81	16,04
3	56	11,05	60	11,88
4	37	7,30	36	7,13
5	15	2,96	8	1,58
6	6	1,18	5	0,99
Total	507	100	505	100

Pearson $\chi^2(6) = 3.1001$ $P = 0.796$

In Table 2 the gender differences and ASRS scores are investigated, they are not statistically significant.

As we expected more males scored in the highest ASRS scores with N=15 scoring in the 5 and N=6 in the 6 or highest categories, in women it was N=8 and N=5, respectively. Approximately 37% of males and 36% of females had no symptoms whatsoever.

Table 3*Mean ASRS Scores Among the Genders*

ASRS SCORE	MEAN ASRS SCORE
Males	1,42
Females	1,36
Total	1,39

In Table 3 we can see no statistically significant difference among the genders and a mean score that is well within the low levels of symptomatology. Furthermore the scores are within our expectations indicating very low ADHD symptoms in the average of our adult sample.

Table 4*Mean ASRS Scores Among the Age Ranges*

AGE	MEAN ASRS SCORE
<=20 &	2,31
>20 & <=25	1,91
>25 & <=30	1,52
>30 & <=35	1,65
>35 & <=40	1,11
>40 & <=45	1,11
>45 & <=50	1,15
>50 & <=55	1,06
>55 & <=60	1,05
TOTAL	1,39

In Table 4 the mean ASRS scores are calculated among the age categories. Those of the youngest category scored had the highest mean score which was consistent with our expectations and the literature on the subject.

Table 5*Gender Differences, Educational Levels and ASRS Scores*

	Males	Females
Primary school	2,33	1,69
Secondary school drop	1,19	1,26
Secondary school	1,39	1,35
University	1,31	1,39

In Table 5 we can clearly see that the highest mean scores were in the lowest educational level and among males. Paradoxically those who had dropped out of primary school had lower ASRS scores than the individuals with a university degree both in the male and female category.

Table 6*Ordered Logistic regression of ASRS scores and lifestyle variables*

Question	Odds Ratio	Std. Err.	Z	P>z	[95% Confidence Interval]
Do you adhere to principles of a healthy lifestyle? (regular diet, healthy drinking regime, regular sleep) (Yes 1, Sometimes 2, Rarely 3, No 4, I don't know what they are 5)	1,21	0,11	2,22	0,027	1,02 -1,42
Do you smoke cigarettes? (Yes 1, No 2)	1,47	0,19	2,91	0,004	1,13-1,92
Use of illegal substances – marijuana (Yes, I use it regularly 1, I used it regularly in past 2, I tried it 3, No 4)	0,59	0,06	-4,91	0	0,48-0,73
Use of illegal substances - volatile substances (Yes, I use them regularly 1, I used them regularly in past 2, I tried them 3, No 4)	0,34	0,14	-2,59	0,010	0,15-0,77
Are you regularly involved in physical activity / sport? (No 1, Yes 2)	1,35	0,17	2,39	0,020	1,05-1,74
During a typical day - how much time do you spend: - watching TV: hours	0,95	0,02	-2,02	0,044	0,89 -0,99
How many main meals do you consume a day? (4 mains meals daily, 2-3 main meals daily, ½ main meals a day)	0,84	0,07	-1,91	0,057	0,71 -1,00
How many portions of fruits / vegetables do you eat? (>4 portions a day, 2-3 portions a day, 1 or none)	1,29	0,15	2,27	0,023	1,03 -1,60
How often do you eat sweets? (3x a week or less, 4-5x a week, every day)	1,37	0,11	4,11	0,000	1,17 -1,59
Are you extremely sleepy or tired during the day? (Yes 1, No 2)	0,46	0,06	-5,90	0,000	0,36 -0,59
Do you have troubles with sleep at night? (Yes 1, No 2)	0,73	0,09	-2,46	0,014	0,59 -0,97

In Table 6 we have the ordered logistic regressions calculated in regards to lifestyle questions. It is important to note that some questions may be negatively coded, with a positive OR indicating a protective effect. For instance in the question regarding adherence to a healthy lifestyle the OR=1.21 in regards to responding that the participants do not have

a healthy lifestyle in general. One of the most surprising finding was the low level of cocaine abuse among those with high symptoms, this is something that we expected to be much higher. They are connected to the scores of those with high ADHD symptomatology, meaning that the OR are looking at those who scored between 5-6 on the ASRS v. 1.1.

4.0 DISCUSSION OF RESULTS

The results of our study generally confirm that high ADHD symptoms such as impulsivity and inattentiveness as measured by the ASRS v. 1.1 are associated with specific lifestyles. We also found some surprising and unexpected behavioral tendencies in the subject. We hope these findings will prove useful for clinicians to get a better picture of what an individual with high ADHD symptoms look like as well as what can be helpful for them. The findings, clinical implications as well as limitations of the study will all be mentioned in this section.

When looking at the results of our questionnaire, those with ADHD symptoms were significantly more prone to *an overall unhealthy lifestyle*—assessed by a question regarding abiding to a regular diet, non-excessive drinking regime, and regular sleep (OR = 1,21). As we also had expected, in respondents with increased ADHD symptoms we found a 41% higher rate of cannabis use (OR = 0.59) and an increased tendency to abuse other substances (OR = 0.34); but very surprisingly, very high ADHD symptoms score were *negatively* correlated to cigarette smoking (OR = 1.41). Please note that the some questions were reverse coded and thus lower than 1 could mean higher rates.

With respect to meals, participants with higher ADHD symptoms reported more frequent eating and snacking (OR = 0.84) but, in concord with expectations, less frequent consumption of portions of fruits and vegetables (OR = 1.29) and more frequent snacking on sweets (OR = 1.37). Our sample confirms that ADHD symptoms correlate with sleep issues, both with sleep disorders (OR = 0.73) and sleepiness during the day (OR = 0.46). During their free time, respondents with high ADHD symptomatology appear to spend only slightly less time in front of the TV than their counterparts (OR = 0.95) and to our surprise report higher engagement in physical activity and sports (OR = 1.35).

We were surprised to find that in drug use, cocaine and heroin were not found to be used in any significance among neither the low ASRS scorers nor the high symptom group. This was contrary to most of the findings on the subject as cocaine addiction is very common among those with ADHD, often with a very early onset (Vonmoos et al., 2013).

The study is the first in the Czech Republic surveying adult ADHD in terms of symptoms and their intensity along with associated lifestyles of the individuals, regardless of diagnosis. A total of 3.36% of the total sample displayed increased ADHD symptomatology, we believe that investigating the lifestyles is of crucial importance for studying and for learning more about what could constitute key aspects of the disorder in terms of Adult ADHD. Many of the lifestyles that we uncovered in the study are consistent with previous research regarding the negative health outcomes of ADHD such as poor diets and generally poorer overall health as was shown by Nigg (2013).

We decided to use a standardized test to assess symptoms rather than focus on diagnosis. The ASRS v. 1.1 is one of the most reliable tools for assessing ADHD symptoms and is used in the clinical realm to assist clinicians in diagnosing individuals (Adler et al., 2006). Nonetheless, it is very important to note that high symptoms score such as 5-6 is not enough to draw a definite ADHD diagnosis and is only indicative of strong symptomatology which can then be further investigated by a clinician.

When looking at questions regarding lifestyle we found that most subjects with high ADHD symptomatology (ASRS scores of 5-6) rated their lifestyles as unhealthy (OR = 1.24). This was a surprising and unexpected result. It showed a high level of awareness and a finding that could be quite beneficial for those seeking psychotherapy and for clinicians to focus on. More research on this could certainly assist in clinical interviews as individuals with high ADHD symptoms seem to not be attempting to make themselves look better than they are in terms of how they assess their lifestyles. It could be that individuals with the symptoms are bothered by their impulsivity and the feeling of loss of control and this may be something that can be a telling sign of needing help as well as possible ADHD. Clinicians could ask clients more about assessment of lifestyles to get a better look if it is someone who has ADHD that is in front of them and how to proceed with treatment plans. Indeed it has been stated that it is often worthwhile to investigate for possible ADHD in the case of an obese client and/or a food addict. We found this reviewing literature on the comorbidities and lifestyles seen in those with the disorder (Weissenberger et al., 2017).

The literature on the dietary habits and nutrition of children and adolescents diagnosed with ADHD is quite abundant. It was often found that those diagnosed with the disorder tend to have iron deficiency, omega 3 and 6 imbalances, consume high amounts of fast food and sweets resulting in an overall imbalanced diet consisting of high fat/sugar or high fat/salt as shown by Millichap & Yee (2013). Obesity and hypertension are also prevalent in this population, something which was investigated extensively by Nigg (2013) as an example of an adverse health outcome associated with the disorder. The outcome can very well be an indirect and secondary one that is attributable to the lifestyles that constitute a constellation of the clinical presentation of the disorder. These phenomena can also be the result of possible self-medication with unhealthy food, binge eating and food addiction to problematic food (e.g. sugar). This would especially be the case when the poor diet is combined with a sedentary lifestyle. Surprisingly, those with high ADHD symptoms from our sample reported more physical activity and less TV watching than we expected, as well as less computer gaming. We did not ask about other games such as console systems or games on their cell phones which may be a limitation into looking at the electronic gaming factor in this day and age. The rate of consumption of sugary food was very high when compared with the groups without symptoms or low symptoms which was something that we had expected.

Insomnia and daytime fatigue were both statistically relevant results found in the high symptoms group. This is consistent with previous research on the subject. For instance, a study conducted by Rogers et al. (2017) looked at diagnosed adults with ADHD and found that within the group 62% suffered from fatigue or daytime sleepiness, often in connection to insomnia. For the purpose of this study we did not take into account psychiatric drugs or sleep medication but this could have an effect on the result. In a previous study on ADHD and insomnia it was found that approximately 67% of the ADHD group suffered from insomnia compared to 20% of the non-ADHD control group. Paradoxically, those taking stimulant prescription drugs for ADHD had lower rates of insomnia than the un-medicated individuals with the disorder (Brevik et al., 2017).

In a recent study by Heijer et al. (2017) sports and physical exercise have been consistently found to improve the outcome of the disorder in both children and adults. This was rated in terms of lowering symptoms and overall better health and quality of life. In our study, those that reported regular physical activity also had higher rates of ADHD symptoms which is something that needs to be further investigated. As this is a cross-sectional study we might conclude that people with stronger ADHD symptoms or ADHD traits tend to exercise more but we do not know if they took the questionnaire prior to or after exercising. An extensive literature review found that cardiovascular exercise such as running or team sports have the most benefit for those with ADHD, other types of exercise such as weight lifting had a protective and beneficial effect in terms of symptoms as well (Halperin, 2011).

One of the most surprising results of our study were the lower rates of nicotine use such as cigarette smoking among those with higher ASRS scores. It should be noted that most of the research and literature on ADHD and nicotine focuses on individuals diagnosed with the disorder and their smoking/nicotine intake rates (i.e. Nigg, 2013). Researchers have found nicotine to have a beneficial effect in those with ADHD. Examples of the benefits include reducing ADHD symptoms such as inattentiveness and higher rates of concentration (Poltavski, 2004). This is a finding that could possibly explain the lower correlation with nicotine use and high symptoms in our study. Nicotine could be helpful in reducing the symptoms and be used as a form of self-medication in those with the condition. A study looking at nicotine and its implications in lowering symptoms of ADHD found that it lowered ADHD symptoms by up to 9% in both nicotine naive individuals and regular smokers (Gehricke et al., 2009). This association is surely to be controversial and one that needs further investigation as it could play an important role in the neurological factors associated with ADHD. The finding also has implications in the clinical realm. Harm reduction approaches for clinicians could be a valid option when dealing with individuals with ADHD who use nicotine and describe improvement in their symptoms from it. This harm reduction approach can be as simple as advising patients to switch from cigarettes to other forms of nicotine containing products such as nicotine gums or electronic cigarettes.

When we look at the section regarding the consumption of illicit substances, we found high levels of cannabis use and surprisingly higher levels of experimentation with solvents in those with high rates of symptoms. The high rates of cannabis use was not surprising and has been very well known with the ADHD population. It was more surprising to find lower levels cocaine use among the high symptom group in our sample. Cocaine addiction along with nicotinism are the most common dependencies seen in those with ADHD (Estevez et al., 2013. Nigg, 2013. Vonmoos et al., 2016). It is possible that the reason for the lower rates of cocaine use and addiction in our sample is due to the lower availability of the drug in the Czech Republic and its high prices compared to Western European countries or the United States.

Overall, we believe the negative lifestyle habits associated with high intensity symptoms should be well noted among clinicians to get a better holistic picture of the patients they have in front of them. Questions regarding these lifestyles may prove useful along with other screeners and assessments especially when there are strong issues in the patient with classical symptoms of ADHD like inattentiveness and/or hyperactive impulsiveness. This can also have the strong advantage of preventing misdiagnosis, especially in cases of issues like substance abuse or problems in self-control. Due to Adult ADHD being a recognized condition in the DSM 5 it is very important that physicians and psychologists be aware of what a presentation of adult ADHD can look like in real life. In terms of questioning the client/patient the implications of the study could help veer the questions in a helpful direction for instance, asking about impulsive eating and bingeing to appease an impulsive need or self medicate may be a red flag, certainly not enough to entail ADHD but one to further investigate. Furthermore focusing on lifestyles within the clinical setting could also help veer the therapeutic in a more productive direction. For instance if a client is complaining about inattentiveness and has an impulse to constantly check his/her phone or eat sweets it could be helpful to use cognitive-behavioral therapy (CBT) along with drug therapy to improve the person's quality of life. For instance Coelho et al. (2017) found that in Brazilian teenagers with ADHD the best outcomes for treatment were methylphenidate administration along with group CBT sessions. The group therapy helped the people adhere to their therapy and discuss issues where they had the most difficulties in, these often included impulse control and other issues regardig behavior in public. The researchers referred to these issues as “peripheral” symptoms, they were often related to lifestyles and social settings. Other examples of reinforcing certain behaviors in lifestyles can be to encourage the patients to exercise on a weekly schedule, this could be done through CBT or other types of psychotherapy.

It must be noted that for the e purpose of this study we did not take into account ADHD diagnosis, nor did we use the Wender Utah Report Scale (WURS) on childhood ADHD symptoms for this study. We tried to be impartial and only focus on adult ADHD smyptoms. The questions of connecting child and adult ADHD symptoms were asked and will be used in the future for research regarding the incidence of ADHD in the country as

well as comparative studies regarding the comparing of intensity of symptoms versus diagnosis. One of the limitations of our study the influence of ADHD drugs and their effect on symptom intensity and possibly on lifestyles. The drugs tend to have protective factors both in neurological effects as well as in abstaining from addictive substances such as cocaine and nicotine. The major point of the study though of investigating and correlating lifestyles and ADHD symptom intensity within the general population has been a very interesting one, and one that we hope will inspire more studies and add to the knowledge of adult-onset ADHD and how to best address this condition.

There were some limitations regarding the methodology of the study that must be noted. First and foremost this was a study that used a cross-sectional design to assess the lifestyles and symptoms of the participants. We don't have the possibility of knowing whether they were very different from the past or what the outcome of these conditions will be. We also have to take into account that this was done through a questionnaire and we cannot be sure of the honesty of the participants in their responses. Since our age range was quite wide (ages 18-60) STEM/MARK had to use a different methodology on the older adults who are less likely to have Internet access. Those answering via phone interview had the risk of possibly trying to sound better than they actually are. It must be noted that those doing the survey online had more of a sense of anonymity than those speaking on the phone, despite the absolute guarantee of privacy in both cases. On the other hand those doing the questionnaire online do not have the advantage of asking for clarifications on the questions and may answer them incorrectly due to not understanding them. Overall we believe that the limitations did not have a major impact on the study and that clinicians and those in the field will find the contents of the study valuable to their practice.

It is very important to note that within the clinical field in Europe ADHD is vastly seen as a childhood condition and that at times clinicians are bound by rules to not diagnose adult ADHD in the absence of a previous diagnosis in childhood. This can create very big problems for those with the condition as they may be misdiagnosed and/or not able to get the medication nor receive treatment (Ginsberg et al., 2014). With the study we hope to raise attention to the fact that there are adults with ADHD symptoms who are not diagnosed and are not benefiting from the treatments they should be able to receive.

5.0 CONCLUSION

Overall we believe that the research we have conducted will prove valuable in mapping what is currently known as adult ADHD. Many clinicians still hold the misconception as ADHD as a disorder that is only present in childhood and are hesitant to prescribe drugs or diagnose in adulthood. This is unfortunate as it greatly limits and keeps many adults suffering from the condition without care. We hope that this information regarding adult ADHD and the lifestyles, which can very well be key aspects of the condition be taken into account by clinicians as clues into adult ADHD. We also hope that this study will stimulate the interest of other researchers to further look into adult ADHD and issues such as incidence and differences with the childhood version of it. We also believe that the disorder is more widespread than it is thought to be and hope this research will raise the awareness of the condition. We recommend an holistic approach to the disorder and as was mentioned in the theoretical section we looked at the social and environmental influences along with other more biologically based findings in order to paint a clearer picture and note that all three are interconnected and all play their part in making the disorder what it is. It is also important to note that the disorder should be looked at not only in the realms of pathology but also of potential in fulfilling a happy and productive life.

CONCLUSIONS

ADHD is now considered a lifelong neurodevelopmental disorder that can affect all age groups. It is divided in childhood and adult ADHD with its various presentations such as Inattentive, Hyperactive Impulsive and Combined. The symptoms of the disorder include difficulty paying attention to tasks that require it, sustaining it for long and many impulsive behaviors (American Psychiatric Association, 2013). The disorder can lead to a substantially lower quality of life in those who have it and has many direct and indirect poor health outcomes. Examples of these include obesity from impulsive eating and poor diet, substance abuse (i.e. Nicotinism, cocaine addiction), higher proness to accidents and many more incidents related to comorbidities and lifestyles (Nigg, 2013). Although it is far more common in childhood than adulthood (Agnew-Blais et al., 2016. Barkley, 2016), there are many questions that need to be answered regarding its adult form also due to the fact that it has only recently become an acknowledged diagnosis (APA, 2013). Overall ADHD tends to be seen far more in males than in females ADHD, it disproportionately affects males at the rate of 2.4 males diagnosed per 1 female (Polanczyk et al., 2007). This could be also the result of misdiagnosis and the fact that females tend to mask ADHD with other symptoms and comorbidities such as eating disorders (Ptacek et al., 2016). In the case of adult ADHD there needs to be far more research conducted as it is often seen separate and not connected to childhood ADHD. The rates of children carrying the disorder onto adulthood are as low as 16% (Caye et al., 2016).

In terms of adult ADHD we leave the question open as to how much the lifestyles constitute the core aspects of the disorder. In reviewing the literature we found that the disorder is associated with a wide variety of lifestyles that many would categorize as hedonic and focused on presentism. To elucidate, many individuals with the disorder are seeking pleasure and self medicating with food, drugs or other addictive behavior (Weissenberger et al., 2016).

In our study we found correlations with self-reported unhealthy lifestyles as well as higher rates of cannabis use and experimentation with other drugs. Many of the reports were in line with the poor health outcomes noted by Nigg (2013) with our expectations. Frequent snacking on sugary foods and fast food were seen in those with higher symptoms also in line with a vast amount of research on the subject. Others including lower cigarette and tobacco usage among high symptom individuals were surprising and need further investigation.

As we did not use diagnosis but only symptoms assessed by the standardized test ASRS v. 1.1 we cannot be certain that those who scored high in symptoms are certain to have the disorder. We can assess that the symptoms we recorded were in line with the percentages of expected individuals with the disorder among the general population.

We are confident that our study will be of use to clinicians dealing with individuals with

these symptoms, and that studying this through lifestyles can be of use for further investigation. We also hope that our study will help to change the perception of ADHD being only present in childhood and that mental health experts in Europe will be able to give adequate treatment to adults in need.

6.0 APPENDIX

Part A of ASRS v 1.1.

1. How often do you have trouble wrapping up the final details of a project, once the challenging parts have been done?	Never	Rarely	Sometimes	Often	Very often
2. How often do you have difficulties getting things in order for a task that requires organization?	Never	Rarely	Sometimes	Often	Very often
3. How often do you have problems remembering appointments or obligations?	Never	Rarely	Sometimes	Often	Very often
4. When you have a task that requires a lot of thought, how often do you delay or avoid getting started?	Never	Rarely	Sometimes	Often	Very often
5. How often do you fidget and squirm with your hands or feet when you have to sit down for a long time?	Never	Rarely	Sometimes	Often	Very often
6. How often do you feel overly active and compelled to do things, like you were driven by a motor?	Never	Rarely	Sometimes	Often	Very often

Part B of ASRS v. 1.1

7. How often do you make careless mistakes when you have to work on a boring or difficult project?	Never	Rarely	Sometimes	Often	Very often
8. How often do you have difficulty keeping your attention when you are doing boring or repetitive work?	Never	Rarely	Sometimes	Often	Very often
9. How often do you have difficulty concentrating on what people say to you, even if they are speaking to you directly?	Never	Rarely	Sometimes	Often	Very often
10. How often do you misplace or have difficulty finding things at home or at work?	Never	Rarely	Sometimes	Often	Very often
11. How often are you distracted by activity or noise around you?	Never	Rarely	Sometimes	Often	Very often
12. How often do you leave your seat in meetings or other situations in which you are expected to remain seated?	Never	Rarely	Sometimes	Often	Very often
13. How often do you feel restless or fidgety?	Never	Rarely	Sometimes	Often	Very often
14. How often do you have difficulty unwinding and relaxing when you have time for yourself?	Never	Rarely	Sometimes	Often	Very often
15. How often do you find yourself talking too much when you are in social situations?	Never	Rarely	Sometimes	Often	Very often
16. When you are in a conversation how often do you find yourself finishing the sentences of the people you are talking to, before they can finish them themselves?	Never	Rarely	Sometimes	Often	Very often
17. How often do you have difficulties waiting for your turn in situations where turn taking is	Never	Rarely	Sometimes	Often	Very often

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required?					
18. How often do you interrupt others when they are busy?	Never	Rarely	Sometimes	Often	Very often

Lifestyle Questionnaire

1. Do you follow the principles of healthy lifestyle? (regular diet, adherence to drinking regimen, regular sleep)

- a. Yes
- b. Mostly
- c. Minimally
- d. No
- e. I do not know what the principles of healthy lifestyle are

2. Do you smoke cigarettes?

- f. Yes
- g. No

4. Do you drink alcohol?

- a. Not at all
- b. Once a month or less often
- c. Twice to four times a month
- d. Twice to three times a week
- e. Four or more times a week
- f. Daily

6. Do you use any illicit drugs regularly?

- a. I enjoy it regularly
- b. I have been enjoying regularly
- c. I tried
- d. No

Cannabis

MDMA (Ecstasy)

Pervitin

Cocaine

Heroin

LSD

Hallucinogenic mushrooms

Volatile substances

Other (please specify)

7. Are you regularly involved in physical activity for at least 30 minutes?
- Yes
 - no
8. How many main meals do you consume a day?
- 4 meals a day
 - 3 meals a day
 - 1 - 2 meals a day
9. How many fruits / vegetables do you eat? (1 serving = 1 fruit / vegetables, ½ cup vegetable juice, ½ cup frozen vegetables)
- 4 servings a day
 - 2 or 3 servings a day
 - 1 or none
10. How often do you eat sweets? (chocolate, candy ...)
- 3 times a week or less
 - 4-5 times a week
 - Daily
11. Drinking sweetened drinks? (juices, ice tea, coca-cola ...)
- 250 ml a day or less
 - 250 - 500 ml. daily
 - 500ml. daily and more
12. Sleep (yes / no):
- Are you going to sleep at regular times?
 - Are you sleeping at least 6 hours a day?
 - Do you suffer from excessive sleepiness and fatigue during the day?
 - Do you have sleep problems in the night?

Publications

Attention deficit hyperactivity disorder and disordered eating behaviors: links, risks, and challenges faced

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Abstract: Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder that often persists in adulthood. It is defined by inattention and/or hyperactivity-impulsivity. ADHD is associated with many comorbidities, including eating disorders (EDs). In the last decade, studies have reported that ADHD is linked with binge EDs, bulimia nervosa, and anorexia nervosa. Many postulates have been proposed to explain the association: 1) impulsive behavior in ADHD patients leads to disordered eating behavior; 2) other psychologic comorbidities present in ADHD patients account for eating behavior; 3) poor eating habits and resulting nutritional deficiencies contribute to ADHD symptoms; and 4) other risk factors common to both ADHD and EDs contribute to the coincidence of both diseases. Additionally, sex differences become a significant issue in the discussion of EDs and ADHD because of the higher incidence of bulimia nervosa and anorexia nervosa in females and the ability of females to mask the symptoms of ADHD. Interestingly, both EDs and ADHD rely on a common neural substrate, namely, dopaminergic signaling. Dopaminergic signaling is critical for motor activity and emotion, the latter enabling the former into a combined motivated movement like eating. This linkage aids in explaining the many comorbidities associated with ADHD. The interconnection of ADHD and EDs is discussed from both a historical perspective and the one based on the revealing nature of its comorbidities.

Keywords: ADHD, eating disorders, obesity, disordered eating, dopamine, motivation

Introduction

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterized by an age inappropriate level of attention, impulsivity, and hyperactivity.¹ The prevalence of ADHD is ~5.3% in the pediatric population and 3.4% in the adult population.^{2,3} Treatment for ADHD includes cognitive behavioral therapy and pharmacologic treatment. The drug of choice is methylphenidate, a psychostimulant. Other drugs include amphetamine and nonpsychostimulant drugs, such as atomoxetine and guanfacine.⁴

Interestingly, ADHD is rarely present as an isolated disorder. Previous studies have reported that ~70% of ADHD patients display at least one other comorbid disorder or specific neurological problems.⁵⁻⁷ In the last decade, researchers report a significant coincidence of ADHD and eating disorders (EDs).^{5,8,9} The EDs mostly associated with ADHD are binge eating disorder (BED) and bulimia nervosa (BN). BED is characterized by recurrent binge eating episodes and associated feelings of guilt and lack of control. BN is characterized by recurrent binge eating episodes followed by self-induced vomiting or other compensatory behavior. Anorexia nervosa (AN) is characterized by

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distorted body image and excessive dieting.¹ Although the link between AN and ADHD is more controversial, some studies suggest an association between the two.¹⁰

Other psychiatric comorbidities of ADHD include conduct disorders, oppositional defiant disorders (ODDs), mood disorders, anxiety disorders, learning disabilities, mental retardation, Tourette's syndrome, borderline personality disorders, etc.¹¹ In this extensive literature review, Biederman et al proposed that ADHD patients with different comorbidities represent unique subgroups with different clinical courses and require different treatment strategies. Since 1991, many researchers have echoed this belief.¹¹

In addition to psychiatric comorbidities, ADHD is associated with devastating health outcomes: substance abuse, suicide, physical injuries, risky sexual behavior, obesity, diabetes type 2, hypertension, higher health care visits, and early mortality.^{12,13} Although the reason behind these associations is not clear, impairment of executive function in patients with ADHD is hypothesized to be the most simple explanation.¹⁴ Thus, they are unable to plan and execute healthy behaviors, including caring for their own hygiene and health. The adverse health outcome mostly related to disordered eating is obesity. Besides this, it is unclear whether ADHD may be connected with specific changes in somatic growth.¹⁵⁻¹⁷

The topic of sex differences in ADHD also becomes significant. In pediatric populations, ADHD is estimated to be three times more common in boys than in girls. In adults, the incidence of ADHD is similar in both sexes.¹⁸ Males with ADHD are more likely to externalize their symptoms, and females are more likely to internalize their symptoms.^{19,20} Compounding these observations some believe that, in reality, the prevalence of ADHD in girls is higher than reported, because of their ability to better "mask" their symptoms during childhood.²¹ BN and AN are disorders that mainly affect females. The phenomena that ADHD is underdiagnosed in girls and EDs are more prevalent have clinical implications.

Eating patterns and nutrition for subjects with ADHD

Recent studies have found a significant link between the ADHD and an abnormal dietary pattern, ie, the consumption of "junk food" and nonadherence to a "traditional" three-meal daily diet. The first of such studies was the Raine study, which analyzed the eating patterns of 1,799 adolescents.²² Of the participants, 115 adolescents were found to have ADHD. Subjects were classified as "western" or "traditional" at the 14-year follow-up after birth. The western diet pattern was

linked with higher intake of fat, sugar, and sodium and lower intake of omega-3 fatty acids, fiber, and folate. The study found that the subjects with ADHD symptoms were more likely to have a western style diet than a traditional healthy diet (odds ratio [OR] =2.21), potentially suggesting dietary problems, which may be associated with processed foods.

Similar to the Raine study, a Korean group studied the dietary patterns of children with ADHD.²³ The four dietary patterns discovered were "seaweed-egg", "traditional-healthy", "traditional", and "snack". The seaweed-egg pattern was characterized with high intakes of fats and sweets. The study found a significant association between the ADHD and the seaweed-egg dietary pattern. Another Korean study of 12,350 participants reports a significant association between ADHD and unhealthy foods, such as soft drinks, westernized fast food, and instant noodles.²⁴ Our group studied the eating behaviors of premedicated newly diagnosed ADHD boys using structured interviews of parents. We found that patients with ADHD are more likely to skip breakfast and dinner and have more than five meals throughout the day. We also found that these disruptive dietary patterns were accompanied by diminished consumption of fruits and vegetables and increased consumption of sweetened beverages.²⁵ Even prior to the Raine trial, many nutritional deficiencies had been associated with ADHD.²⁶ Iron deficiency and low serum ferritin levels have been linked to ADHD and impaired cognitive behavioral development.²⁷⁻²⁹ Zinc deficiency, especially in the Middle East, has also been associated with ADHD. Zinc is an important cofactor implicated in the metabolism of dopamine, a neurotransmitter involved in ADHD pathophysiology. Arnold et al reported that zinc supplementation decreased the optimal dose of amphetamine treatment.^{30,31} Consumption of food additives and artificial sweeteners has been reported to contribute to abnormal levels of hyperactivity in developing children.³² Considerable research has been devoted to the omega-3 and -6 polyunsaturated fatty acid (PUFA) supplementation. Similar to zinc, polyunsaturated fatty acids are also involved in neuronal development and have protective effects against ADHD symptoms.³³⁻³⁵ As a result of the previous findings, there has been an interest for dietary interventions with hopes of improvement in symptoms or prevention of ADHD in children.³⁶

Coupling of obesity and ADHD

The link between ADHD and disordered eating behavior is evident by the observation that obesity is more prevalent in individuals with ADHD compared to the general population. Altfas was the first to describe the comorbidity of the two

disorders.³⁷ Altfas found an unusual prevalence of ADHD (27.4%) among obese adults. After treatment of symptoms, weight loss was greater in the treated ADHD obese adults compared to non-ADHD obese adults.³⁷ Shortly after, two other groups reported similar finding in hospitalized obese children and obese women. Further studies reported that obese patients with ADHD had predominantly inattentive symptoms.^{38,39}

The comorbidity was later supported by massive community surveys, smaller clinical cross-sectional studies, and some longitudinal studies. A large cross-sectional study of 43,297 US adolescents revealed a statistically significant adjusted OR of 1.5.¹³ Similar results were found in adolescent population of 9,619 adolescents aged.⁴⁰ A study with 1,633 adult German participants found that the prevalence of ADHD was 9.3% in individuals who are obese. This abnormally high prevalence was not observed in overweight (3.8%) and normal weight individuals (4.3%). Conversely, the study reported that participants with ADHD were twice as likely to be obese than the general population (22.1% vs 10.2%).⁴¹ Furthermore, Cortese et al found that obese adults were more likely to have had a diagnosis of childhood ADHD in the past. Notably, their study consisted of 34,653 face-to-face interviews of young adults and also found that impulsive and inattentive symptoms, but not hyperactive symptoms, mediated the association.⁴² Also notable was a 33-year longitudinal study of 207 participants, by the same author, which found that men who had childhood ADHD had higher BMI and obesity rates.⁴³

Other smaller cross-sectional studies of children and adolescents seeking treatment for ADHD suggest a comorbidity between higher BMI and ADHD. A cross-sectional study by a group in Poland examined boys aged 6–18 years who were diagnosed with ADHD and demonstrated that overweight status but not obesity was statistically significant in the ADHD group.⁴⁴ Another study of 158 children with ADHD aged 6–16 years found that patients with ADHD had a higher prevalence of obesity. The study also found that the patients with combined subtype of ADHD were significantly more likely to be obese and overweight compared to those with only inattentive or only hyperactive symptoms.⁴⁵

A possible explanation for the comorbidity between the two disorders is a common genetic and neurobiological pathway. Obesity genes in the pathways of dopaminergic circuitry, such as FTO (fat mass–and obesity-associated variant) and melanocortin 4 receptor, have been associated with ADHD.^{46–48} A case study reported that a 13-year-old obese boy with ADHD (BMI =47.2) and a melanocortin 4 receptor mutation showed a dramatic decrease in BMI after

atomoxetine treatment.⁴⁹ Co-occurrence of ADHD and obesity has also been attributed to common immune and inflammatory processes, common fetal programming mechanisms, and common perinatal risk factors.^{12,50}

Coupling of BEDs and ADHD

Various investigators propose that the link between obesity and ADHD lies in the common symptom of impulsivity. Here, it is surmised that ADHD predisposes an individual to BED, again due to common impulsivity symptoms. Impulsivity is defined as a predisposition toward rapid, unplanned reactions to internal or external stimuli without regard to the negative consequences of these reactions.⁵¹ Inhibition, working memory, planning, and sustained attention are necessary for executive function or the ability to perform a sequence of goal-oriented tasks.^{52,53} Cortese et al argue that the impulsivity of ADHD patients causes executive dysfunction, which prevents the patient from executing the goal of controlling eating behavior or losing weight.¹⁴

Clinically, impulsivity in ADHD patients can be found with the Barratt Impulsiveness Scale (BIS). It is a 30-item self-reporting questionnaire.⁵⁴ Impulsiveness can also be demonstrated using the go–no-go paradigm. ADHD patients with predominantly impulsive symptoms have more commitment errors in the go–no-go task. For example, when receiving a cue for a string of consecutive “go” responses, the subject is more likely to commit to go even after presented with a cue for “no-go”. Commitment errors represent a lack of response inhibition, an essential ingredient of executive functioning.⁵⁵ Because of impulsiveness, patients with ADHD and BED are not able to “inhibit” their impulse to eat food, even when faced the task of dieting and losing weight.⁵⁶ This hypothesis is corroborated by many cross-sectional studies of BED patients in weight loss or prebariatric surgery clinics. It is found that symptoms of impulsiveness and inattention correlate with severity of BED symptoms.^{57,58} For example, Docet et al found that obese patients with ADHD were more likely to have binge eating episodes, to eat snacks between meals, to eat large amounts of food, and to eat in secret.⁵⁹ In another study, methylphenidate treatment in obese individuals with ADHD resulted in significant weight loss in obese patients with ADHD.⁶⁰

The link between impulsivity and BED was also demonstrated using a combination of magnetoencephalography, the go–no-go task, and the BIS.^{61,62} The study used food stimuli or toys as the go–no-go cues and a population of subjects with and without BED. It was found that, in BED, impulsiveness according to BIS scores correlated with decreased

food-specific response inhibition in the prefrontal control network during the go–no-go task.⁶³ This is consistent with other studies on response inhibition to food cues in BED using functional magnetic resonance imaging.^{64,65}

Often young children may not have BED at the time of diagnosis of ADHD; however, some have a similar condition called “loss of control eating” (LOC).⁶⁶ It is defined by subjective feelings of binge eating or subjective loss of control while consuming a normal or small amount of food. Thus, a subject who may not have an official diagnosis of BED may still be considered to have LOC. Reinblatt et al reported that LOC was much higher in children with ADHD (adjusted OR = 12.68).⁶⁷ LOC eating in childhood may be a predictor of disordered eating behavior in adolescence.⁶⁸ Although promising and educational, it is still not known whether a combination of LOC and ADHD in childhood longitudinally translate into objective BED. Food addiction, or eating behavior that involves overconsumption of specific foods that are highly palatable in an addiction-like manner, has also been associated with inattentive impulsive symptoms. It is thought that ADHD consists of dopamine and norepinephrine circuits in the brain, which are involved in reward processing. This accounts for the high prevalence of substance abuse disorders in ADHD subjects. Thus, food addiction, like substance abuse, is also comorbid with ADHD.^{69,70}

Although executive dysfunction has been shown to play a role in BED, it does not encompass the entire picture. Steadman and Knouse found that although impulsivity in ADHD correlates with BED symptoms, impulsivity alone does not mediate the association.⁷¹ Other comorbidities in ADHD patients are thought to contribute to binge eating behavior. Affective diseases, mainly depression, have been associated with higher incidence of BED. Many studies found that the presence of depressive symptoms in obese adults with ADHD correlated with severity of BED symptoms.^{72–75} The other comorbidity that may mediate the association between BED and ADHD is ODD. Pauli-Pott et al reported that ODD symptoms, not ADHD symptoms alone, were associated with disordered eating behaviors.^{76,77} This suggests that patients with ADHD and another psychiatric comorbidity are necessary for the development of BED. Expectedly, in the same study, participants with symptoms of anxiety and depression showed emotional and binge eating.

ADHD symptomatology in women with BN

BN, as noted for the other disorders, is associated with eating and has also been linked to ADHD. In the case of BN, sex

differences become significant and apparent from the literature. The prevalence of ADHD is three times higher in boys than girls.⁴² This may be due to the phenomena that girls are more likely to internalize and “mask” their symptoms, while boys externalize them. There is also a higher level of clinical suspicion of the disorder in boys, which may contribute to underdiagnosis in girls.^{18,21} On the other hand, BN is nearly 12 times more common in girls than boys.⁷⁸

Owing to underdiagnosis of ADHD in girls, by the time a female realizes she has a psychiatric disorder, she may already be in late adolescence or adulthood. This phenomenon is evident in a series of case studies, which were the first presentations of the association between BN and ADHD. These studies paint a common picture of a young adult female who had a seemingly normal childhood. Her attention was sufficient to perform her school duties and manage her family and social life during childhood and early adolescence.⁷⁹ When faced with greater challenges, such as attending university, managing her time, having a relationship, and making her own life decisions, her deficits in executive functions became apparent. Symptoms of depression and/or anxiety were present, and bulimic symptoms of bingeing and purging were out of control. Pharmacologic therapy for ADHD symptoms in this patient improved her executive functions and, interestingly, decreased her purging behaviors.^{79–84} A number of studies support the initial findings of the previously mentioned case studies. In a study of 20 women with BN and 20 age-matched controls, symptoms of impulsivity measured with the BIS were significantly higher in the BN group.⁸⁵ In a larger study of 89 women with ED, Yates et al found that inattentive symptoms of ADHD were common among women with BN. Furthermore, Yates et al also confirmed that inattentive symptoms correlated with bulimic behavior and depressive symptoms.⁸⁶ A number of other studies reported similar findings.^{87,88} In addition to depression, the presence of anxiety and disruptive disorders was reported. Impulsivity alone does not account for the link between ADHD and BN. Other comorbidities, such as depression, anxiety, and disruptive behavior, were also found to mediate the association between BN and ADHD.¹¹ Girls with ADHD and depressive symptoms were found to be at the highest risk of BN.¹¹ Notably, among studies of BN, there are two longitudinal studies by Mikami et al in a 5-year prospective longitudinal study of ADHD girls aged 6–12 years.⁸⁹ Mikami et al found that baseline impulsivity symptoms predicted adolescent pathology. Interestingly, the group found that baseline peer rejection and parent–child relationship predicted eating pathology. Punitive parenting

in childhood also predicted pathological eating behaviors.⁸⁹ In an 8-year follow-up, the Eating Disorder Inventory-II was used to collect data about body image dissatisfaction and personality characteristics associated with EDs. It was found that boys and girls with ADHD were at risk with symptoms of BN in mid-adolescence. The association was stronger in girls than in boys.⁹⁰ Similar studies have the same results.^{84,85} In summary, girls with ADHD and symptoms of depressive, anxiety, and disruptive disorders are at risk of developing BN. In adolescents with BN, there is a high prevalence of suicide attempts, alcohol consumption, and illegal drug use.⁹¹

Evidences from modern neurobiology methods corroborate the abovementioned findings. For example, the Catechol-O-methyltransferase gene, involved in the dopaminergic pathways of ADHD, was also implicated in BN.⁹² From a neuroimaging perspective, ADHD and BN share many neural pathways. Abnormalities in these pathways in the frontostriatal circuit may account for the coincidences in these two disorders.⁹³ Much is not known about the effect of puberty on ADHD and BN. It is thought that sex differences may be accounted for by different hormones in boys and girls during puberty.⁹⁴⁻⁹⁶ Biederman et al found that girls with ADHD tend to have an earlier onset of menarche; however, the reason behind this finding is currently not understood.⁹⁵ The link between AN and ADHD is not clear despite the hypothesis of a common neural substrate.⁹⁷⁻¹⁰⁰ The number of studies is small, and the studies that do exist have a small number of subjects.^{10,101,102} Thirty-two female patients diagnosed with ED had no correlation between severity of ADHD and severity of ED symptoms; however, there was an association between impulsivity and avoidance of fattening food.¹⁰¹ A larger study of 191 patients reports that girls with AN had a higher correlation with ADHD symptomatology than girls with BN.¹⁰ The symptoms with the highest correlation included novelty seeking, impaired self-directedness, and impaired cooperativeness. Similarly, Wentz et al found that in a small study of individuals with EDs, there was a high prevalence of ADHD.¹⁰²

Hazards and challenges

The literature suggests that it may be beneficial to interview and counsel patients and parents regarding eating behaviors. We surmise, from the data analysis, that special attention should be given to females since they are more likely to internalize their symptoms and display depressive behaviors, thus masking symptoms of ADHD. This may account for the observation that the ratio of ADHD children who seek treatment is ~3:1 (girls to boys).² This was especially evident in

the series of case studies on BN. These case studies paint the picture of a young adult female who was able to mask her ADHD symptoms throughout childhood. During adulthood, when faced with tasks that required higher executive function (for example, time management in university), the symptoms of ADHD caused havoc in her life. This is compounded by the problem that it is a challenge to diagnose ADHD early, regardless of the population. The solution for this problem may be in educating the general population, which will allow people to seek early advice if symptoms of ADHD are present. However, this may lead to an overdiagnosis of ADHD but is better than underdiagnosing this debilitating condition. Moreover, the solution for early detection is in the hands of neonatologists or pediatricians. In this regard, many risks factors for ADHD are perinatal, for example, prematurity.¹⁰³ Furthermore, research should be focused on identifying babies who are more likely to have ADHD.

In addition to early diagnosis, it is also important to monitor affective symptoms of ADHD. Most of the literature on BN and AN suggest that depression may mediate bulimic and anorexic symptoms. Monitoring depressive symptoms in addition to eating behaviors in girls, especially, appears to be critical. In addition to depressive symptoms, these patients have a distorted body image.^{89,90} Importantly, regarding dietary contributing factors, care must be taken when counseling girls about diet.⁸ Impulsive behavior is related to avoidance of food in anorexic girls.¹⁰¹ Anorexic and bulimic girls are already obsessed and guilty due to their eating behaviors. Counseling eating behavior should be done in a positive manner, which rehabilitates self-confidence, not in a manner that makes the girls feel even more “guilty”.

A challenge in the study of EDs and ADHD is the cyclical nature of the symptoms of both diseases. Investigators have found that predominant symptoms of ADHD may change, persist, or remit throughout the lifetime.^{104,105} The general trend is that inattentive symptoms are more persisting.¹⁰³ Patients with EDs have been found to cycle through symptoms of BN, AN, and EDs not otherwise specified.^{106,107} No study to our knowledge has longitudinally examined the complex interaction that may arise due to cyclical shifting between different subtypes of EDs and ADHD. One can only imagine that it is very complex, and more research and understanding about the relationship between the two is needed.

Conclusion

ADHD and eating behavior are strongly tied together and correlated throughout age groups.^{5,8,9} Furthermore, unhealthy eating habits as well as food-associated additives, in general,

are directly correlated with ADHD and healthier diets have been associated with improved symptomatology.²² ADHD is also correlated with pathological eating behaviors that are characterized as mental illnesses, such as, BN, AN as well as abnormal BMI ranges known as obesity.^{1,13,18} It is important to note that catecholamines, eg, dopamine, are heavily involved in both motor regulation and emotions, working together to provide the motivation for motor activity, using few chemical messengers in both invertebrates and vertebrates, especially humans.¹⁰⁸ Thus, it is not a surprise that ADHD comorbidities involve EDs, which may result from altered cognitive and emotional neural substrates.^{5,11} Furthermore, it is not a surprise that ADHD comorbidities involve EDs, which may result from altered cognitive and emotional neural substrates given their dependencies.¹⁰⁹ This is also somewhat evident from the COMT data, which involve ADHD behavioral states and EDs.^{110,111} Taken together, although ADHD is complex and multifaceted as are EDs, it appears that they may represent a logical comorbidity. Hence, early diagnostic indicators for ADHD may be at hand in the form of novel discoveries in gene expression patterns.

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The authors report no conflicts of interest in this work.

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ADHD and Present Hedonism: time perspective as a potential diagnostic and therapeutic tool

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Abstract: The article draws primarily from the behavioral findings (mainly psychiatric and psychological observations) and points out the important relationships between attention-deficit/hyperactivity disorder (ADHD) symptoms and time orientation. Specifically, the authors argue that there is a significant overlap between the symptoms of ADHD and Present Hedonism. Present Hedonism is defined by Zimbardo's time perspective theory and assessed by Zimbardo Time Perspective Inventory. Developmental data on Present Hedonism of males and females in the Czech population sample (N=2201) are also presented. The hypothesis of relationship between ADHD and Present Hedonism is mainly derived from the prevalence of addictive behavior (mainly excessive Internet use, alcohol abuse, craving for sweets, fatty foods, and fast foods), deficits in social learning, and increased aggressiveness both in ADHD and in the population scoring high on Present Hedonism in the Zimbardo Time Perspective Inventory. We conclude that Zimbardo's time perspective offers both: 1) a potential diagnostic tool – the Zimbardo Time Perspective Inventory, particularly its Present Hedonism scale, and 2) a promising preventive and/or therapeutic approach by the Time Perspective Therapy. Time Perspective Therapy has so far been used mainly to treat past negative trauma (most notably, posttraumatic stress disorder); however, it also has value as a potential therapeutic tool for possible behavioral compensation of ADHD.

Keywords: ADHD, time perspective, ZTPI, Zimbardo, addiction, alcoholism, delinquency, video games, problematic Internet use

Introduction

Attention-deficit/hyperactivity disorder (ADHD) is a widespread neurodevelopmental disorder, the prevalence and significance of which is rapidly growing. Increasing numbers of people suffer from the ADHD syndrome. The symptoms include a wide array of manifestations and experiences. In modern times, the ever-increasing life's tempo, ever-growing stress, and last but not least, the onset of the ubiquitous electronic technology environment also tend to exacerbate ADHD. The connection between ADHD and time perception specifically using the methods laid out by Zimbardo and Sword and the Zimbardo Time Perception Inventory can bring a new and helpful tool in diagnosis and therapy of ADHD.^{1,2}

The incidence, characteristics, comorbidities, and categories of ADHD

ADHD is a disorder which is widely known and classically recognized in children but that is only recently getting studied in the adult population.³ Simon et al report that prevalence of adult ADHD is 2%–3%.³ Other sources state that ADHD affects between 5%⁴ and 11%⁵ of the population aged 4–17 years in the US. Fayyad et al report that the prevalence of ADHD is around 5.3% in the pediatric population and

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3.4% in the adult population.⁶ However, recent data suggest even more dramatic occurrence of ADHD: “almost 1 in 5 teenage boys and 11% of all school-aged children have been diagnosed with ADHD”.⁷ ADHD is a neurodevelopmental disorder. However, rather than by its neurological substance and causes, it tends to be described by observable behavioral manifestations. The marked symptoms of ADHD include general inattention, hyperactivity, impulsivity, and difficulty with self-control.

ADHD used to be classified as a childhood syndrome, but it has recently become a chronic, lifelong disorder with “ADHD”, “childhood ADHD”, and “adult ADHD” defined as three different categories under *Diagnostic and Statistical Manual of Mental Disorders*, fifth edition (DSM-V).⁴ In the DSM system, the child or teenager can be labeled with the diagnosis of “predominantly inattentive”, “predominantly hyperactive impulsive”, or a mix of the two categories (DSM); the symptoms can later be carried on to adulthood. Failure to observe a linear progression from childhood to adult ADHD leads many to believe that with time, there is a “catch up” in development and the symptoms may remit into adulthood.⁸ The variety of causes and triggers is emphasized by the fact that the disorder can be managed to some extent by drug therapy and/or psychotherapy.⁹

The literature is abound with reports on the neurological and hormonal peculiarities of children with ADHD.^{10–12} Furthermore, neuroimaging studies have shown developmental differences in children with ADHD, especially disparity in the maturation of the cortex and the cerebellum.^{13,14} Children and adults with ADHD also seem to differ from non-ADHD individuals in that various deficiencies in the striatum have been observed. This is specifically related to the dopaminergic system, the reward system and dopamine.¹⁵ Dopamine is directly related to reward-seeking behavior, impulsivity, and addictions. However, to what degree dopamine–serotonin interactions are at the source of ADHD still remains a continuing debate.^{16,17}

ADHD was also found to have a genetic component.^{18,19} Specific genetic differences have been reported which link ADHD, impulsive behavior, delinquency, and also hedonism.²⁰ It is also hypothesized that ADHD may be connected with specific changes in physical growth.^{21,22}

There is no single clinical picture of ADHD. There are marked differences between the impulsive and inattentive types that have been isolated and described.²³ Although both the inattentive and hyperactive subtypes share the same diagnostic definition, they often manifest very different symptoms and comorbidities. According to Grizenko et al, the two subtypes appear as almost separate diagnoses.²⁴ While

looking at comorbidities, these authors found that the hyperactive group displayed symptoms such as conduct disorder, while the inattentive group manifested different ones (mainly depression). Another example of a difference in comorbidities is that the inattentive group often shows comorbid obesity, whereas the hyperactive group does not.²⁵ Other comorbidities associated with the hyperactive/impulsive subtypes are drug abuse and addictive behavior.²⁶

Correspondence in lifestyles of ADHD and Present Hedonistic individuals

The literature from various sources (neurological, genetic, and behavioral disciplines) seems to concur that there is a close link between ADHD and present-oriented behavioral patterns both in children and adults. This present-oriented behavior includes a wide array of behaviors which are hedonistically oriented: alcohol and drug abuse, compulsive gambling, dependence on electronic media, poor eating habits, higher rates of obesity and overall body weight in people, nicotinism, and others.^{27,28}

Analyses of populations of “alcohol abusers and alcoholics” indicate that up to 71% of the population have ADHD and in the case of other drug abusers, the number is up to 25%.^{29,30} Similarly, predominantly present hedonistically minded individuals were found to suffer from higher rates of drug and alcohol abuse.³¹ Interestingly, one genetic expression – the dopamine receptor genes (DRD2, DRD4) associated with ADHD and impulsivity³² – was also associated with alcoholism.³³ In a prospective study, higher rates of alcohol consumption were found among Present Hedonistic and Past Negative individuals.³⁴ Impulsive drinking and drug abuse were directly correlated with ADHD diagnosis in various studies.^{35,36} Individuals with a diagnosis of childhood ADHD and conduct disorder were found to be at much higher risk than controls for becoming “drug abusers” in adolescence.³⁷

Patients suffering from ADHD as well as Present Hedonists often manifest very “poor dietary choices”. These include high consumption and often dependence on fatty foods, sweets, and fast food.³⁸ A prospective study carried out in Australia on 2868 children found a correlation between ADHD and a “Western” type diet that included fast food; this was compared with a “healthy” diet that included adequate amounts of fruits and vegetables. Howard et al noted that impulsive eating can also become an addictive behavioral pattern³⁹ often seen in ADHD.²² One major predictor of binge eating in adolescence was found to be childhood ADHD.⁴⁰ Furthermore, a study by Wilhelm et al analyzed the difference between overweight

and ADHD individuals and found more impulsiveness within the ADHD group, especially at the beginning of the meal.⁴¹ Binge eating itself may be addictive or it is conjointly linked with other addictions, nutritional or behavioral.²⁴ A high correlation between binge eating/food addiction and cocaine abuse has been found, specifically for high fatty food intake.⁴² Swanson et al⁴³ and Nigg²⁶ attest that both binge eating and bulimia nervosa are connected with ADHD, and the common comorbidity of eating disorders in adolescence is substance abuse. A great amount of research has been done on ADHD and dietary habits, whereas the literature on Present Hedonism and lifestyle is just starting to emerge.

Current information technology has led to a whole new area of addictions. Most generally, they are labeled as problematic Internet use (PIU). PIU has been a topic of interest in psychiatric and clinical settings since the late 90s; this diagnosis had been proposed, but was later rejected by the DSM. The impulsive and addictive use of the Internet has been deemed problematic for certain individuals and indeed clinically significant. The disorder met all the criteria for being identified as an impulse control disorder, which is marked by impulsive behavior.⁴⁴

ADHD is often associated with PIU.⁴⁵ A correlation was found between PIU and alcohol abuse/dependence among adolescent populations in Germany and Korea.⁴⁶ Although Internet use can well serve educational and recreational purposes, increasing evidence shows its excessive and addictive abuse. The incidence of PIU has been estimated at 2%–20% among young people and has been increasing.⁴⁷ Zimbardo and Coloumbe highlight a wide range of negative consequences among boys and young men from excessive, socially isolated video gaming coupled with Internet pornography viewing.⁴⁸

In a Korean study, ADHD and depression turned out to be the biggest risk factors for developing online gaming addictions.⁴⁹ In a Turkish study, individuals with ADHD were also more likely to use the Internet impulsively.⁵⁰ Both Chinese and Korean research on Internet addiction among adolescents found boys to be more likely to suffer from the condition than girls; risk factors for developing such dependence were ADHD and impulsivity.^{51,52} This is congruent with the previous studies on the classical forms of addictions (ie, alcohol and other drugs). One possible shortcoming of the study was that there was no distinction between the subtypes of ADHD. The authors of the study did not attempt to discover the differences between the ADHD and depressed groups to see what the reasons for impulsive gaming were (such as for lowering depression or quenching the impulsivity).

An American cross-sectional study on nearly 70,000 children has indicated the “protective factors” against ADHD, which are: watching less than 1 hour of television/gaming a day, being active in sports teams, and a solid family structure.⁵³ The unhealthy lifestyles learned from parents, especially from lower socioeconomic status households, should not be underestimated when looking at ADHD and impulsiveness. It is very likely that the impulsive behaviors such as PIU and excessive gaming are directly related to parenting styles and also inadequate care by school teachers.

“Deficits in social learning” as a direct effect of “parenting styles” seem to play a very significant role in development of late-onset ADHD. High emotional expression in parenting (particularly negative-reactive instead of positive parenting strategies) was associated with ADHD⁵⁴ as well as higher rates of aggressive behavior, fighting, and later impulsivity.⁵⁵ Similarly, research has found a direct correlation with the behaviors and parenting roles in time perspective studies. Specifically, when teenagers perceived their parents as psychologically controlling, the result was that they displayed predominantly Present Hedonistic behaviors. On the other hand, future-oriented teenagers perceived their parents as adequately responsive and giving ample autonomy.⁵⁶ Worrel et al reported the Present Hedonistic mindset to be closely associated with authoritarian and permissive parenting.⁵⁷ Furthermore, authoritarian parenting styles were correlated with disorders such as anxiety⁵⁸ and drug abuse/addiction.⁵⁹ Incidentally, both are major, well-documented comorbidities associated with ADHD.^{60,61} However, deeper analysis of these phenomena is methodologically challenging. Correlational studies tend to describe the vicious circle within the family instead of providing a deeper insight into the causality. In contrast to authoritarian and permissive parenting styles, authoritarian parenting, which is associated with clear roles and boundaries as well as healthy levels of communication, was found to have positive effects. Authoritative parenting styles were found to be the most advisable in managing ADHD in family setting. Maintaining the communication and clear borders were also found to be essential along with medication in managing the symptoms and having healthy family relationships among those suffering from ADHD.⁶²

Parenting styles, besides neurological and genetic disorders, are often related to “aggressiveness” among ADHD patients as well as among present-oriented hedonists. In a 2016 study, Stolarski et al administered the Zimbardo Time Perspective Inventory (ZTPI) as well as the Aggression Questionnaire to 300 individuals and found that individuals with Present Hedonistic perspective were more likely to show aggressive and impulsive tendencies.⁶³ The study did

not assess for ADHD symptoms, but it would most likely yield similar results with ADHD being linked to both Present Hedonism and aggression. Likewise, during a neurological mapping study, adolescents with ADHD have been observed to show low inhibition along with high levels of aggression and impulsivity. The study included 18 ADHD diagnosed children and 18 controls, individuals from both groups had their brains scanned by fMRI machines while playing a game specifically designed to elicit aggressive responses to fictitious opponents. The ADHD group displayed significantly more aggressive responses. The comorbidities in the ADHD group included disruptive behavior disorder and conduct disorder.⁶⁴ The study did not inquire about drug usage or any other lifestyle habits of the participants. Again, there was no differentiation between hyperactive impulsive individuals and generally inattentive subjects in this study. We can assume from the comorbidities and aggressiveness that this was most likely the hyperactive/impulsive group that we are associating with Present Hedonism.

Generally, the respective behaviors tend to be related. Both in ADHD and in Present Hedonists, overconsumption of fast food, alcohol as well as unhealthy media habits and Internet use are not only signs of possible disorders but of poor discipline and inadequate parenting. Impulsivity and hedonism are often tied together by various behavioral addictions (ie, gambling, video games, nicotine). Presently, we see new forms of addictions emerge, which both the ADHD group as well as Present Hedonists are likely to suffer from.

Zimbardo time perspective

Zimbardo developed a time perspective theory with a corresponding standardized questionnaire known as the ZTPI. In this, subjects answer how much of their thoughts are spent in the past, present, and future and whether their time perspective tends to have a positive or negative accent. ZTPI provides five dimensions which are as follows. Past Positive dimension relates to positive reminiscence, for example, certain stimuli bring forward pleasant memories of the past. Past Negative dimension assesses the degree to which unpleasant and possibly traumatic past experiences are influencing the current life of the individual. Present Hedonism focuses on living in the moment, seeking thrill and pleasure. Present Fatalism expresses conviction that rather than by free will, individual lives are influenced by unexpected and uncontrollable forces, fate, luck, and so on. Future dimension assesses to what degree individuals are goal oriented, focusing on accomplishments and responsibilities to other people, and

display what is known as a traditional Protestant work ethic.³⁰ These dimensions can be assessed individually or in their mutual relationship and balance. Various types of disorders can be attributed to imbalances of time perspective. Examples include anxiety or posttraumatic stress when Past Negative orientation takes over, or risky behaviors and risk-taking in Present Hedonistic orientation.³¹

ADHD and Present Hedonism

From the above-mentioned literature review of risky lifestyle habits and ADHD comorbidities, we hypothesize a clear and definite correlation between ADHD and Present Hedonistic time orientation. We hypothesize that ADHD sufferers, especially from the hyperactive impulsive subtype, are most likely to be overwhelmingly anchored in the Present Hedonistic mindset. They will more likely engage in behaviors representative of Present Hedonistic time perspective which often leads to substance abuse, poor eating habits, and currently most popular modern addictions, especially PIU, and overall dependence on the electronic media.

As follows from the Zimbardo theory, people with a prevalence of Present Hedonistic orientation are generally very focused on enjoying the present, feeling excited in their lives, and are therefore driven by what Freud called the pleasure principle. Although healthy and well-adapted individuals may enjoy the present moments as well, the Present Hedonism in their case tends to be balanced with a realistic level of future orientation and reminiscence of the past. If Present Hedonism becomes the guiding principle, individuals may be more likely to engage in risky behaviors in order to seek strong sensations; this can possibly put the person at risk of developing addictions, whether classical (ie, alcoholism, overeating, nicotinism) or the newer, electronic versions, such as gaming or Internet addiction.^{65,48}

High levels of Present Hedonistic orientation are usual, especially among young males. Empirical data show that Present Hedonism sharply declines with age and it is lower in women. These phenomena are illustrated by the Present Hedonism ZTPI scores of a national survey which we conducted in the Czech Republic. The target population included Czech-speaking residents, almost exclusively Czechs, seldom Slovaks, and rarely other nationalities. The fieldwork was executed by the Sociological Institute of the Czech Academy of Sciences (Center for Public Opinion Research). The sample involved N=2,201 respondents, consisting of 48.8% males and 51.2% females, aged 15–89 years (44 years on average). The sample was proportional to the population

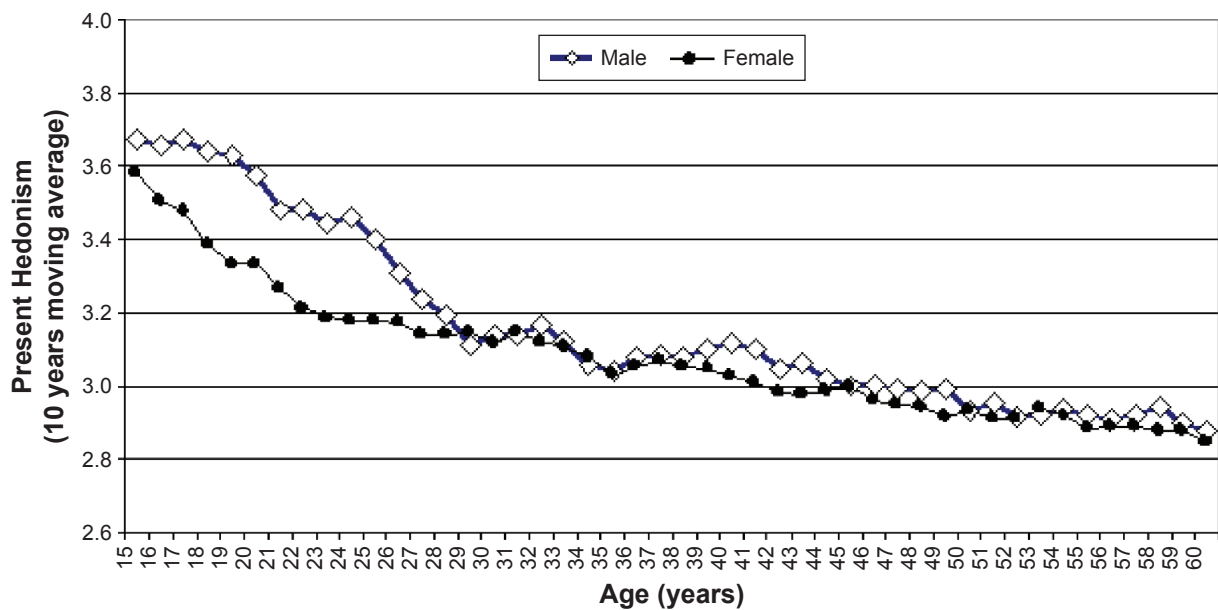


Figure 1 ZTPI Present Hedonism moving average score: gender difference and the overall decline with age. Values of respondents >60 years of age were excluded due to low frequency counts.

Abbreviation: ZTPI, Zimbardo Time Perspective Inventory.

regions and urban–rural areas of the country. The ZTPI data were collected by face-to-face (pen and paper) interview using quota-sampling methodology in two subsequent waves in 2003 and 2008. The relationship between age and the Hedonism scale was calculated from $n=2,118$ valid responses to the Hedonism scale (ie, 96.2% of the total sample); almost all ($n=2,199$) respondents were included in the latent class analysis (LCA). This study focused on ZTPI and its 56 items and did not include any ADHD indices at that point.

The overall decline with age was statistically significant (high Eta 0.367 for interval and Cramer's $V=0.248$ for categorized age: Beta= -208 in multivariate regression). There were significant differences among all age groups, except the middle-age category of 35–44 years; in the age group of 35–44 years, the decline in Present Hedonism was not apparent.

The gender difference proved significant as well. Higher Present Hedonism in men was confirmed by two-tailed non parametric statistics: both median and Kolmogorov–Smirnov test of independent samples confirmed the difference on asymptotic significance level of 0.023 and 0.008, respectively. The results are illustrated in Figure 1.

LCA used on the same Czech sample yielded an even more dramatic depiction of the decline of Present Hedonism with age. LCA is able to identify subgroups of really existing respondents of ZTPI who share similar patterns of time perspective. The distinctly Present Hedonistic pattern/class characterized 28% of respondents. The age composition

of this pattern/class is interesting: half of this group was represented by the youngest respondents aged 15–24 years; older ages contributed to this group with radically declining frequency. Figure 2 shows the percentage of respondents from various age categories who constituted a latent class of Present Hedonists.

Men predominated in the Present Hedonists LCA class, as it consisted of 60% men and only 40% women. This corresponds to the gender difference observed in Present Hedonism illustrated in Figure 1 and in other studies that find men more Present Hedonistic than women.

As mentioned earlier, ADHD symptoms, as well as Present Hedonism, are also most pronounced in the young age group.⁶⁶ Likewise, gender is a major variable to take into account for addictions, as males are more likely to show addictive behavior such as alcoholism. For example, 58% of men reported binge drinking on a monthly basis.⁵ Binge drinking is an example of a Present Hedonistic behavior.

Time perspective paradigm as a potential diagnostic and therapeutic tool

Our article introduces both indicators and pieces of evidence showing that there is a substantial overlap between ADHD and Present Hedonistic orientation. This leads us to hypothesize that Present Hedonism itself in all its various forms may well serve as a telling indicator of ADHD or proneness to ADHD. Furthermore, psychometric methods devised for

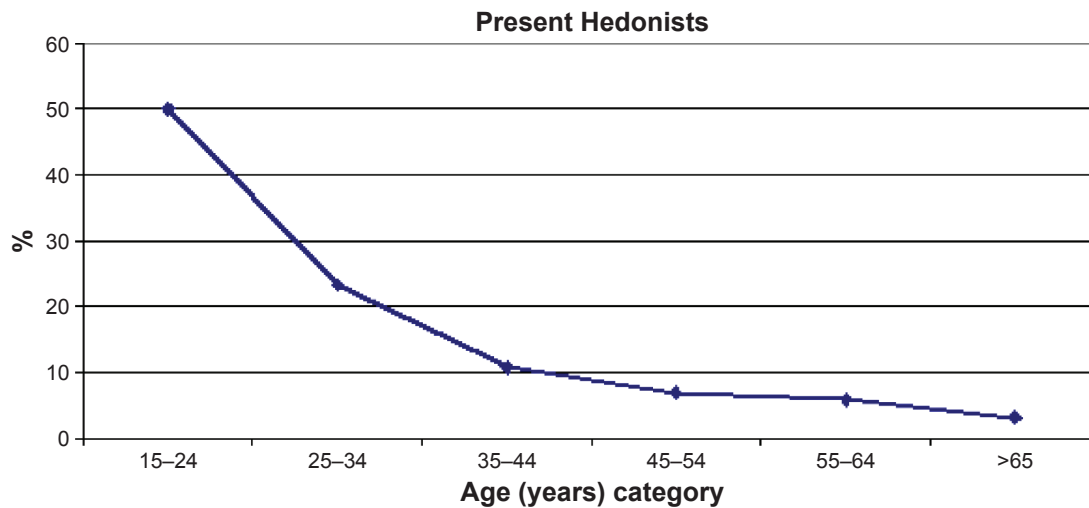


Figure 2 Percentage of respondents of various age categories constituting a class defined by Present Hedonism.

assessment of Present Hedonism, such as ZTPI by Zimbardo, may prove particularly useful for this purpose.

Even more importantly, Zimbardo's temporal theory was elaborated into a systematic therapeutic approach – Time Perspective Therapy (TPT). So far, this approach has been used mainly to treat clients who are pathologically focused on their Past Negative experiences due to their traumatic past. These include especially war veterans who suffer from posttraumatic stress disorder, but also include survivors of abuse, accidents, assault, and neglect. In their case, TPT is being used to restore the temporal balance, to switch negativity to positivity, and to shift from the past to present and to future. Zimbardo et al² provide a detailed description of the procedure in *The Time Cure: Overcoming PTSD with the New Psychology of Time Perspective Therapy*, which is praised as a “landmark book”. Similar time perspective principles that take into account the ratio of the past, present, and future have been traditionally used in gerontology and geriatrics.^{67,68} Similarly, patients suffering from depression and dwelling in negative past may profit from reframing their time perspective, which is an observation by Bitsko et al who worked with depressive adolescent cancer patients.⁶⁹

In contrast to the above-mentioned groups, most of which consist of patients “stuck to the past”, the ADHD patients seem to suffer from being “stuck in the present”. Coincidentally, this is the core of the title that Gruber et al used for their article about mania and its association with the present oriented time perspective.⁷⁰ Refugees are another group of clients who have been known to “focus on the present to the relative exclusion of past and future”⁷¹ or to suffer from “atomism” of a single time orientation.⁷² Also, prisoners may suffer from a similar exclusive focus.⁷³

And then, of course, intense orientation in the present time has been observed in a wide array of people who suffer from dependencies that are very often linked to ADHD and that have been described above. Only sporadic reports mention the usefulness of time perspective as a useful framework or even as a possible direction of treatment. For example, Henik and Domino published an article entitled, “alterations in future time perspective in heroin addicts.”⁷⁴ “Excessive players” and pathological gamblers’ time perspective and the possible therapeutic uses thereof are mentioned in the reports of Hodgins and Engel⁷⁵ and Lukavska.⁷⁶ Finally, irrespective of diagnoses, Stolarski et al⁶³ point out the significance of balanced time perspective for a general satisfaction with life.

Overall, it is surprising that although ADHD tends to be viewed as a disorder which generally responds well to behavioral therapy,⁷⁷ TPT in general – or, specifically, the TPT approach by Zimbardo and Sword² – is not discussed and utilized more. We hope that this article will help to correct this blind spot.

Discussion

This article reviews significant relationships between ADHD and various factors – from genetic and neurological to developmental and social. Attention is also paid to a range of manifestations of typical ADHD lifestyle and comorbidities. It is concluded that Zimbardo's time perspective approach suggests an important relationship between ADHD and Present Hedonism.

Although literature is available both on ADHD and, to a lesser degree, on time perspective, many of the studies are methodologically limited. Many are based mostly on correlations, without a deeper concern for the direction of

causality. Furthermore, the ADHD studies typically do not differentiate between the two main types of ADHD disorder. Although our focus is mostly on the hyperactive subtype of ADHD, the differentiation between inattentive and hyperactive is not always properly recorded by clinicians and, as such, can create some confusion in the findings.

Some studies arrived at counterintuitive results. Carelli and Wiberg compared 30 ADHD participants and 30 controls in a Swedish study and found that ADHD was associated with predominantly future positive time perspective.⁷⁸ However, a major confounding factor was that the patients were already being pharmacologically treated for ADHD. Perhaps, they had measured the effects of treatment rather than ADHD itself.

In any case, our hypothesis is that ADHD individuals seem to live in a different time perspective than the general population. In *Principles of Psychology*, William James argued that time is a sensation.⁷⁹ It appears that ADHD individuals spend their waking state (possibly dream states as well) more often in Present Hedonism than other individuals to the detriment of their future. The modern era poses a particular challenge for ADHD-prone individuals by the new electronic environment that is both widespread and intensive.

At the same time, it is pointed out that modern psychology, namely, Zimbardo's time perspective theory, provides a new paradigm which is useful as a new insight into the substance of ADHD, the methodology of assessment of proneness to ADHD, and finally, the possible therapeutic interventions based on the concept of balanced time perspective. It is surprising that all of the relevant literature only seldom mentions about the therapeutic use of time perspective. We hope this article will contribute to the eventual implementation of temporal interventions in therapy. Still, we realize that although the relationship between ADHD and excessive focus on Present Hedonism seems to be straightforward, the relationship itself and the therapeutic interventions may not be that simple. Let us take an example from Lukavska.⁷⁶ She found in her study of online game players among others that "present fatalistic TP [time perspective] was demonstrated to be a stronger predictor of extensive playing than present hedonistic TP". Such finding calls for replacing of simple correlational studies by more complex models which take into account mediating roles of multiple variables.

The stressors leading to ADHD are increasing, along with the enticing incentives of the brave new electronic world (even electronic schools) and with fast food, cigarette, pornography, and other industries. These industries are particularly focused on targeting ever-younger consumers.⁸⁰

The instant gratification principle is facilitated by advertising to young people, appealing to adults not to deprive their loved ones, seducing young consumers by credit cards, and so on. The peer pressure is increased by use of electronic social media such as Facebook and others.

All this poses a grave threat to the public health not just in the developed countries but also in the developing countries. Thus, while ADHD is one of the most diagnosed disorders, it is also one of the most misdiagnosed disorders. After all, the ADHD lifestyle may often be just a symptom of novelty seeking, an expression of conforming social mimicry, or a defense mechanism to the overstimulated electronic state of consciousness in children and young adults. The search for new effective approaches to assessment and treatment of ADHD in the current era is particularly topical. Zimbardo's time perspective perception approach seems to provide both a welcome theoretical basis as well as a practical tool. It becomes not only a medical and educational issue, but also a philosophical question as to how to utilize the current technology and at the same time promote sanity, harmony, and freedom, both individual and collective.

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ADHD, Lifestyles and Comorbidities: A Call for an Holistic Perspective – from Medical to Societal Intervening Factors

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The review examines Attention Deficit Hyperactivity Disorder (ADHD in its Child and Adult form) and its various presentations (Hyperactive Impulsive, Inattentive, and Combined) with a particular focus on environmental (incl. social factors), lifestyles and comorbidities. It is argued that ADHD is best understood in a holistic and interactive context and a vast empirical literature is presented to illustrate the point: Environmental factors include stress in general as well as exposure to toxins (phthalates, bisphenol A). Social factors are illustrated by effects of social deprivation and seduction to unhealthy lifestyles. Maternal lifestyle during pregnancy is pointed out (particularly her exposure to nicotine, alcohol, caffeine, and drugs, even seemingly benign medications like acetaminophen), which all tend to be related to ADHD. Family environment is discussed with respect to protective effect of (mainly authoritative and autocratic) parenting styles. Societal factors include mainly economic and political issues: income inequality and poverty (low SES is an ADHD risk factor) and a growing moral dilemma between a humanistic effort to globally spread the knowledge of ADHD and the medicalization and commercialization of the disorder. The second part of the review is devoted to ADHD related lifestyles and resulting comorbidities (e.g., food addiction and obesity, substance abuse, electronic media dependencies and conduct and personality disorders). Although ADHD is a neurodevelopmental disorder, its assessment and treatment are also linked to environmental, behavioral and social factors and their interactions.

Keywords: ADHD, childhood, obesity, substance abuse, pollution, smoking, alcohol, comorbidities

ADHD AND ITS INCIDENCE

Attention Deficit Hyperactivity Disorder (ADHD) is a lifelong neurodevelopmental disorder marked by its observable behavioral manifestations. The continuum of the symptoms is not always clear and ADHD may or may not continue into adulthood. The disorder presents itself as ‘childhood ADHD’ and ‘adult ADHD,’ with childhood ADHD being more common (Polanczyk et al., 2007). The disorder carries into adulthood approximately 50% of the time (Moreno-Alcázar et al., 2016) but the processes of remission still remain unclear. As of 2013, with the introduction of DSM-5, it is no longer classified as a childhood disorder but as a chronic lifelong disorder.

The marked symptoms of ADHD include general inattention, hyperactivity, impulsivity, and difficulty in self-control. These are seen in the various presentations of the disorder and they are divided in what was once called subtypes of the disorder but are currently referred to as presentations; they are 'Hyperactive Impulsive' (ADHD-HI) 'Inattentive' (ADHD-I), and 'Combined' (ADHD-C) (American Psychiatric Association, 2000). Importantly, the categories are not necessarily permanent as the disorder progresses: for example, a child with combined hyperactive and inattentive ADHD may later become less hyperactive and more inattentive with age if the disorder persists (Larsson et al., 2011).

There is a general agreement that the disorder disproportionately affects males compared to females but the gender proportion greatly differs among different studies; e.g., Polanczyk et al. (2007) assess the rate at 2.4–1.

Data from 2007 relevant to ADHD worldwide found childhood ADHD to be around 5.3% with lower rates in lower income nations and 3.4% incidence for Adult ADHD. The authors emphasized the importance of studying Adult ADHD to a greater extent, as this was before the DSM-5 classification (Fayyad et al., 2007). The progression of the disorder is often non-linear with remission of symptoms from childhood to adolescence occurring at times. From early childhood ADHD is associated with certain comorbidities such as Oppositional Defiant Disorder (ODD) and executive dysfunction, in a longitudinal study it was found that high oppositional traits and more severe clinical presentations along with family factors such as having a father with anxiety and internalizing disorders was a strong predictor for ADHD persisting into adolescence. Interestingly these factors were a better predictors than childhood adversity or cognitive functioning (McAuley et al., 2014).

Attention Deficit Hyperactivity Disorder is considered the most genetically anchored mental disorder (Ptacek et al., 2011b) with probabilities of up to 77% for both childhood and adult ADHD and around 30–40% in case of Adult ADHD only. In the case of Adult ADHD it is considered one of the most devastating disorders which in the long term may affect all areas of one's life (Franke et al., 2012). Along with new neurological findings differentiating ADHD individuals from normally developing children and adolescents, the disorder is mostly recognized and diagnosed by its distinctive behavioral appearance. That leads to a wide variety of distinct documented behavioral traits or even lifestyles which are often attributable to a variety of comorbidities.

We focus specifically on *lifestyles*, a concept which is familiar to medical experts (cf. widely publicized lifestyles of cardiovascular or diabetic patients) and at the same time comprehensible to the general public. We perceive lifestyles as key in the presentation of ADHD, its management and to a great degree also significant in the instigation of ADHD. We define lifestyle in terms of *distinct behavioral patterns*. Curiously, one of the best fitting definitions of lifestyle can be found in the Business Dictionary (2017): "A way of living of individuals, families (households), and societies, which they manifest in coping with their physical, psychological, social, and economic environments

on a day-to-day basis." Furthermore, we focus on comorbidities which are directly associated with respective lifestyles, i.e., obesity and food addiction, impulsive gaming, and other behaviors.

Modern science tends to consider phenomena in larger micro or macro contexts. In case of ADHD it became quite logical to focus at the microlevel of the phenomenon and a great progress is being made, e.g., in microanatomy. However, the larger social and environmental contexts of ADHD tend to be underestimated or ignored. The venture of this review is to reveal the lesser known ADHD contexts.

ENVIRONMENTAL, SOCIAL, AND SOCIETAL FACTORS RELEVANT TO ADHD

A growing body of literature indicates a relationship between ADHD and environmental, social, and societal factors. The three types of factors differ by their nature and links to ADHD but they cannot be viewed separately as they are naturally intertwined with each other. For example, all of these factors can become a source of stress and exposure to stress hormones (i.e., cortisol) and thus causally related to later ADHD (Chu et al., 2012; Samiei et al., 2015). The intertwining of micro- and macro-processes of environmental, social, and societal factors is obvious: e.g., environmental exposure to toxins is prevalent among populations with lower socioeconomic status (SES) and also among children whose mothers are less educated and less interested in healthy lifestyles. Countries which have higher rates of income inequality are also more negligent about ecological rules and environmental risks to their populations, etc. We begin by introducing the environmental factors that influence the early stages of human existence from fetal exposure to substances ingested by the mother, or environmental influences to the neonatal period.

ENVIRONMENTAL FACTORS

Exposure to environmental toxins and industrial additives have a potential negative influence on the development of the nervous system. Malefic chemical agents and pollutants can affect the developing fetus in the maternal womb; babies are later further affected by contaminated nursing bottles, pacifiers and toys and other plastic products for daily use.

Phthalates

Phthalates are very common as they make plastic more flexible, thus they are found in children toys, medical devices as well as in cosmetics. In animal studies exposure to these chemicals has been found to induce hormonal disturbances and developmental symptoms of hyperactivity very similar to human ADHD (Ghisari and Bonefeld-Jorgensen, 2009; Huang et al., 2009). Animal studies have found a direct correlation between prenatal exposure to industrial chemicals such as phthalates and the development of neurodevelopmental disorders as ADHD and autism (Masuo et al., 2004). A Korean study looking at the

amounts of phthalate metabolites in the urine of school aged children found a significant positive correlation between higher concentrations of these chemicals and ADHD symptoms, thus confirming earlier animal studies in human samples (Kim et al., 2014). Similarly, in a study focusing on children diagnosed with ADHD, higher levels of phthalates were found in the urine of ADHD Combined and ADHD Hyperactive Impulsive children compared to normally developing children. Various neurological and behavioral differences were also noted, such as brain cortical thickness abnormalities and higher rates of externalizing disorders. Interestingly, the higher levels of phthalate metabolites were associated with the ADHD Combined and Hyperactive Impulsive children but not with the Inattentive group (Park et al., 2015).

Bisphenol A

Similarly to phthalates, *Bisphenol A* (BPA) is ubiquitous in food packaging and other plastic products. This chemical has received media attention due to its correlation with insulin dysfunction and its mild oestrogenic effects that can influence development—especially intrauterine and fetal development. Most recently, the discovery that BPA directly influences the dopaminergic system during early development is especially relevant to ADHD and other disorders marked by impulsivity (Huang et al., 2016). As with phthalates, studies on pregnant rats exposed to BPA found increased mutations and abnormalities in their offspring; specifically, lower synaptic plasticity and disinhibition of the GABAergic system leading to a higher dopaminergic response. Symptomatically this means much higher rates of hyperactive behaviors in the rats. A particularly alarming factor of this study is that even exposure to minute doses of BPA was associated with later ADHD-like symptoms (Zhou et al., 2011). Similarly, it was found that children aged three with higher concentration of BPA in their urine displayed symptoms of hyperactivity and restlessness. The chemical was present in varying concentrations in the urine of as many as 97% of the children tested (Braun et al., 2011). A systematic review on 834 studies looking at BPA, phthalates and other endocrine disrupting chemicals (EDC) found a significant positive correlation of the exposure to these substances with both autism spectrum disorders and ADHD. It was consistently found that these chemicals cause hormonal and neurological changes that result in hyperactivity and symptoms later associated with ADHD-HI and ADHD-C (De-Cock et al., 2016). As mentioned earlier, these contaminants often play a key role in mutations related to the dopaminergic and GABAergic systems. Sagvolden et al. (2005) point to these same systems in explaining various symptoms with the dynamic developmental behavioral theory. They emphasize the special needs of these children and affirm the importance of parental training to teach them how to accomplish improvements.

There are further environmental factors involved in the development of ADHD such as nicotine, alcohol, drug, and pharmacological dependence. However, they tend to be more closely associated to social environment and behavioral lifestyles, and thus we discuss them in more details in the next segment.

SOCIAL FACTORS

Many indicators suggest that ADHD is not just solely a biological phenomenon, it is also linked in numerous ways to factors of social nature. Also, exposure to many noxious stimuli is mediated socially, by friends, the lifestyles of the closest family, in particular the mother, or by their absence, i.e., by social deprivation.

Social deprivation or *early life stress*, which is its accompaniment, appears to be a perilous factor for the development of ADHD. Internationally adopted babies and children had higher rates of ADHD as well as lower IQ when they spent long periods of time institutionalized and separated from the biological parents. Time spent in the adoptive family had a positive effect on the IQ which had a tendency to rise to average or above average levels but curiously, the rates of ADHD persisted even after the extended length of adoption. This indicates a possible association between ADHD and the immediate environment of neonates and the effect of early life stress. However, this study did not consider prenatal exposure to drugs or other toxins from the mother (Doom et al., 2015), these will be discussed in the following paragraphs. Importantly, besides the stress of a child there is also maternal stress. Maternal stress has been found to be more associated with ADHD Hyperactive Impulsive and Combined than with the Inattentive presentation of the disorder; the study also reconfirmed the association between prenatal nicotine exposure and ADHD with comorbid Conduct Disorder (Grizenko et al., 2010).

Maternal Lifestyles as a Gateway for ADHD Related Substances

The noxious substances which influence early child development start affecting the nervous system before the child is born. Prospective mothers may be exposed to medication, drugs, and alcohol even before they know they are pregnant, some continue in the harmful exposure also in their advanced pregnancy either because they are not fully aware of the risk involved for their child or because they are unwilling to change their lifestyles.

The toxicity of *nicotine* and *alcohol* exposure to developing fetuses is very well known. Multiple studies have linked prenatal lifestyles and addictions of pregnant mothers to the occurrence of ADHD in their children. Early nicotine exposure was found to pose a higher risk for later ADHD than alcohol and *caffeine* during pregnancy. An extensive Canadian study found that *smoking during pregnancy* was associated with ADHD and specifically a more severe presentation of ADHD with comorbid Conduct Disorder resulting in a particularly disturbed child; the study took into account both genetic and lifestyle factors and found that while the influence of genetics was significant, the lifestyle and environment had an equal influence on the development of the disorder (Sengupta et al., 2015).

The effect of alcohol yielded inconclusive and contradictory results whereas exposure to caffeine had too many other confounds (Linnet et al., 2003). In contrast to Linnet, Davis et al. (2011) found in a recent medical literature review that alcohol exposure was a major risk factor for ADHD, but even more surprisingly, they found that exposure to *junk food* including

high fat and sugary food also had negative effects on the fetus. Ultimately, alcohol is transformed into sugar and therefore a diet which is high in refined sugar could also have a result similar to alcohol exposure. An American longitudinal study found that nicotine exposure in the womb was associated with ADHD Hyperactive Impulsive to a far greater degree than to the Inattentive presentation of the disorder (Gard et al., 2016). Similarly, in a Scandinavian study over 12,000 children and their mothers were observed and it was found that higher rates of obesity in the mothers were directly associated with ADHD-I in their children (Rodriguez et al., 2008). A possible explanation is presented by Davis et al. (2011) who point out similarities of high sugar consumption to alcohol intake and/or some genetic link to the disorder. Coincidentally, and as will be later described in more detail, obesity is one of the most common comorbidity of ADHD along with food addiction, with obesity starting in childhood and food addiction, respectively, at adolescence and early adulthood (Davis et al., 2011; Nigg, 2013; Cortese et al., 2016; Karaca et al., 2016).

Reviews of longitudinal data from studies on adopted babies that were brought to Scandinavia from ex-Soviet countries indicate a wide range of problems derived from prenatal alcohol exposure such as fetal alcohol syndrome and neurodevelopmental disorders. ADHD was present in approximately 51% of the children who had been exposed to alcohol prenatally (Landgren et al., 2010). Premature and very premature born babies are also at a much greater risk for ADHD, and nicotine use is very often associated with premature births (O'Shea et al., 2013).

Acetaminophen is one of the most common over the counter drugs administered for fever reduction and for its mild analgesic properties. A direct correlation between acetaminophen taken by mothers during their pregnancy and higher rates of hyperkinetic disorders and ADHD in their children was found in a Danish study. The researchers reviewed the records of as many as 64,322 children born between 1996 and 2002 and found consistent positive correlations with acetaminophen exposure and ADHD. Acetaminophen was unsurprisingly also found to have endocrine disrupting properties (Liew et al., 2014). One of the most recent studies on the topic found that prenatal exposure to acetaminophen is associated with adverse effects on neurodevelopment and raised the risk of autism as well as ADHD. This study was based on parental interviews and frequency of administration of the drug by the mother, a positive correlation between exposure and various adverse effects was found (Avella-Garcia et al., 2016). Others have criticized the designs of similar studies, arguing there is too much space for confounding factors as they are based on parents' self-reports, yet they acknowledge animal studies that have shown neurological effects in regards to acetaminophen exposure but argue that these mutations may not apply to human subjects (Fays et al., 2015).

Parenting Styles and ADHD

The way parents raise their offspring is crucial to understanding most aspects of mental health as well as later lifestyles. It can be argued that each type of comorbidity and lifestyle can be at least to some degree influenced by parenting. From very

early on, individuals who later develop ADHD show an irritable temperament. Ineffective, inconsistent, and especially negligent parenting were found to exacerbate ADHD symptoms and be predictive of later disruptive behavior disorders such as Conduct Disorder; furthermore, children who had more positive and involved parenting manifested an improvement of symptoms (Ullsperger et al., 2016). ADHD in its childhood presentations is not only directly influenced by parenting styles but also by parental perception.

Generally speaking, there are predictive and protective factors linking substance abuse and parenting. One of the most widely recommended parenting style with respect to ADHD is authoritative parenting. This parenting style includes warmth, communication, and clear boundaries for the child. This style of parenting is compared with authoritarian which is less warm, with strict boundaries, low communication, and strict rules. Permissive parenting consists of low boundaries and varying levels of communication where the parental role is not clearly defined; finally, there is negligent parenting (*laissez-faire*), where the child is not being properly taken care of and the parents are often missing from the households (Briesmeister and Schaefer, 2007; Schaefer, 2007). A systematic review of parenting styles and drug abuse consistently found a clear correlation with authoritative parenting and lower rates of drug abuse and addiction (Becoña et al., 2012). In a South African study, authoritative mothers in families with children with ADHD had much better communicating styles and better educational outcomes for their children (Tancred and Greeff, 2015). Similarly, severity of symptoms as well as academic and social well-being of children aged 7–11 years with ADHD Inattentive presentation, were directly correlated with parenting: negative parenting such as harshness and/or neglect was associated with worse outcomes (Haack et al., 2016).

One of the most classically acclaimed examples is the Baumrind (2013) study that found that children raised with an authoritative parenting style in the United States not only had lower drug and alcohol abuse incidences but were more competitive and successful in their academic careers. In the United States, authoritative parenting is consistently advised and considered ideal for healthy outcomes in psychological development as well as a good preventive measure for substance abuse and addiction. Interestingly, European scholars favor a contrasting attitude: indulgent (permissive) parenting turned out equally effective.

Strict authoritarian parenting as well as negligent parenting were the most widely implicated parenting styles associated with drug and alcohol abuse (Calafat et al., 2014). A Canadian study focusing on the families of children with ADHD found that not only were ADHD cases most likely among mothers with children with ADHD but that a major component was family dysfunction. Hostility and parental conflicts were correlated with ADHD as well as single parent households (Williamson and Johnston, 2016). However, correlational studies usually cannot exclude a reverse causality, i.e., the disruptive child might have severed the bonds of a stressed family.

Studies looking into the parenting behaviors of adults with ADHD found significant differences in self-reports and

observations about their own relationship and parental style with their children. ADHD Inattentive parents were most likely to self-report negative parenting, as they were consistently ignoring their children and getting easily annoyed with them. In the Hyperactive Impulsive group much more positive interactions were observed, in the self-report ADHD parents had a tendency to conflate their positive parenting to higher self-esteem or a result of exaggeration due to other comorbid mental illnesses often seen in ADHD-HI like Antisocial Personality Disorder (Lui et al., 2013).

The family is the most influential environment where children's behavior is influenced and habits are formed (Vandewater and Lansford, 1998; Day, 2010; Ptacek et al., 2014a). A functional and supportive family can help to prevent ADHD onset and in case ADHD cannot be prevented, family members may mitigate the severity of symptoms.

SOCIETAL FACTORS – SOCIOECONOMIC, CULTURAL AND POLITICAL ASPECTS

While suffering from ADHD appears as a highly individualized private matter, the intervening factors may be of a general societal nature. Poverty and lack of access to resources are at the forefront of societal phenomena quoted in the literature.

Lower SES and trends toward non-traditional single parent households (Klein et al., 2012; Russell et al., 2016) have been linked to an increased ADHD incidence. Lower SES has also been associated with other ADHD-prone conditions, such as higher risk of disease and higher exposure to pollution (Woolf et al., 2015), higher smoking and drinking rates (Bader et al., 2011; Woolf et al., 2015), i.e., lower SES is generally linked to unfavorable prenatal conditions, unhealthy lifestyles and nuclear family problems discussed in the previous section on social factors. Individuals with lower SES have less access to resources, including proper food, lack of economic means to pay for decent education. Poverty is stressful and stress, as mentioned in the beginning of this section, is a general ADHD risk factor. While particularly noxious during the early stages of development, stress has been associated consistently with a later onset of ADHD as well as comorbid asthma (Grizenko et al., 2015). Lower SES is often associated with poor family cohesiveness and frequent family conflicts (Conger et al., 2010; Santiago et al., 2011). This creates an unhealthy environment for children to grow up in and puts them at risk of a variety of problems including ADHD. A study comparing 100 children aged 6–18 years who had ADHD Inattentive presentation (ADHD-I) to a control group of 100 children indicated that family problems and conflicts are one of the most common risk factors for ADHD-I. The researchers used both the Family Adversity Scale (FAS) and the Family Environment Scale (FES) to determine family cohesiveness and problematic interpersonal relationships in the household. Children who scored high on the FAS and low on the FES were consistently from the ADHD-I group, showing that family adversity situations and conflicts are a risk factor. These are associated with low SES and lack of resources which the study

showed are predictive factors, too (Pheula et al., 2011). A meta-analysis found a significant correlation between ADHD and lower SES. When compared to children from middle income families, those from poor families were 1.85–2.3 times more likely to suffer from ADHD.

Still, the issue of poverty, status and ADHD is not without controversy. While ADHD does typically correlate with low SES, some perceive an opposite tendency: ADHD appears to be almost a fashionable, trendy label in advanced societies. It is most prevalent in the USA and Western Europe, much less so in developing countries. The rest of the world is trying to catch up with the United States; e.g., a noted sociologist, P. Conrad—was quoted by the Huffington Post article by Gregoire (2014): “With millions more kids (and adults) likely to be diagnosed with and treated for ADHD in the next decades we see the export of American behavioral norms worldwide. This may be more insidious than the globalization of American fast food or pop music, in that it comes in the name of proper mental health and behavior.” The Huffington Post stressed that the ADHD disorder “has become a cultural and economic phenomenon—but it may not be a medical one...” with a significant presence of the pharmaceutical companies and their lobbyists. We are facing a moral dilemma: a growing conflict between the humanistic effort to help to diagnose and manage ADHD problems and medicalization of the disorder around the world (Conrad and Bergey, 2014).

ENVIRONMENTAL, SOCIAL AND SOCIETAL FACTORS IN INTERACTION

The question still remains to what degree the poor economic status is the result of societal factors (the economic system, structural racism, structural violence, lack of resources, etc.) or the result of parents' mental health, genetic factors and others. A consensus tends to be in a conclusion that multiple factors are important at the same time (Russell et al., 2016). Extensive reviews confirm this assumption by finding consistent correlations between socioeconomic factors and ADHD both in children and their families (Bernfort et al., 2008).

Lifestyles related to ADHD are easily acquired within the family as social learning would entail. A longitudinal study on ADHD found low SES to be one of the greatest risk factors for ADHD. Furthermore, this was associated with parental behaviors that are easily learned such as higher rates of smoking and eating junk food as a normal staple food (Russell et al., 2016). In a cross national review focusing on a smoking cessation program in Europe, it was found that higher rates of smoking were much more frequent in individuals from a lower socioeconomic background (Bosdriesz et al., 2016). It is therefore clear that the associations between class and social factors have a strong implication in ADHD development and its associated lifestyles. Higher rates of smoking, drug abuse, and poor diet are all included as lifestyles and at times comorbidities associated with ADHD (Nigg, 2013).

In summary, it is important to keep a holistic point of view and not to underestimate the extrinsic factors influencing this

disorder such as SES and the effect of certain lifestyles mothers had before the individual was born.

The above mentioned effects are all significant and at times preventable but it is important to keep in mind that these lifestyles and higher exposure to toxic chemicals and pollution are also generally associated with lower SES and the social problems that are associated with poverty (Duncan and Brooks-Gunn, 2000; Woolf et al., 2015) which will be discussed later in more detail.

LIFESTYLES AND COMORBIDITIES ASSOCIATED WITH ADHD

Attention Deficit Hyperactivity Disorder is associated with various peculiarities in lifestyle and resulting comorbidities which vary with the different manifestations of the disorder and present themselves in various developmental stages of life. The comorbidities are both somatic and/or behavioral, we will focus primarily on those that are related to certain behavioral manifestations associated with the disorder such as addictive gaming and impulsive eating leading to obesity and addiction.

From the neonatal stage there is an association between certain particularly irritable temperaments and later negative emotive expression in pre-school. Many of these children are later diagnosed with ADHD (Rabinovitz et al., 2016).

COMORBIDITIES IN VARIOUS PRESENTATIONS OF ADHD

Attention Deficit Hyperactivity Disorder is not a uniform disorder, it consists of three clinical presentations; Hyperactive Impulsive (HI), Inattentive (I), and Combined Hyperactive Inattentive (CHI). The various presentations of ADHD differ in comorbidities (Wilens et al., 2009; Grizenko et al., 2010). This is particularly confounding and problematic as clinicians don't often properly differentiate among the various types of ADHD. The genetic and behavioral differences between Inattentive, Hyperactive and Combined ADHD patients were so vast to lead some researchers to see them as separate diagnoses with differences even in reactions to methylphenidate which is universally prescribed for all presentations of the disorder (Grizenko et al., 2010, 2015). Others have differentiated the dopaminergic functions and GABAergic effects on the different symptoms such as impulsivity and hyperactivity (Sagvolden et al., 2005). In the Hyperactive Impulsive presentation of ADHD, comorbidities such as conduct disorder in childhood and antisocial personality traits in late adolescence were more common.

The Inattentive presentation of the disorder showed different comorbidities like depression and anxiety. Furthermore, the individuals showing higher inattentive presentation of the disorder manifested more frequent social isolation and lack of intimate relationships (Halfon et al., 2013; Barkley, 2016). Obesity, another major comorbidity was prevalent among the inattentive group but not among the Hyperactive Impulsive group (Halfon et al., 2013).

Nicotinism, alcohol abuse, and drug abuse were all noted pathological lifestyles and comorbidities in the ADHD Hyperactive Impulsive "subtype" as it was defined in the Diagnostic and Statistical Manual of Mental Disorders IV-TR. Nigg (2013) among others points out that the comorbidities of ADHD are extremely important for the clinician to know as they constitute most of the health issues and dangers associated with the disorder. Gillberg et al. (2004) urge that clinicians working with ADHD should have ample knowledge of neurology as well as the vast arrays of comorbidities associated with the disorder, as it is almost impossible to work with the disorder as a single cause as the lifestyles are often the main symptoms.

Conduct and Personality Disorders

Perhaps the most serious aspect of ADHD lies in its tendency to be associated with disorders, some of which impact not just behavior but personality. This endangers not just the well-being and life of the ADHD sufferers but also of their social environment. These comorbidities are seen in children and if not resolved by late adolescence can then become personality disorders such as antisocial PD or continue as externalizing disorders into adulthood.

In a sample of 358 Australian children diagnosed with ADHD, 92% had other comorbid health conditions along with parents suffering from some disorder (Silva et al., 2015). As was previously mentioned, in the earliest stages of human existence, maternal stress (and resulting premature birth) and/or exposure to nicotine are factors that have been consistently associated with ADHD (Chu et al., 2012; Nosarti et al., 2012; Grizenko et al., 2015; Samiei et al., 2015) along with other mental disorders (Glaslova et al., 2004). The study by Samiei et al. (2015) closely analyzed the social aspects (see also SES factors above) of the disorder and left the question open about whether or not it was the stress of the mother that caused ADHD or whether a vicious cycle has developed, in which the child's disorder and behavioral symptoms were responsible for the increased stress of the parents. In practical terms, the authors argue that psychological care and adequate doctor-to-patient communication is equally important for the parents of children affected with the disorder in addition to the children's treatment (Samiei et al., 2015).

Attention Deficit Hyperactivity Disorder is commonly associated with other externalizing disorders (Gillberg et al., 2004; Silva et al., 2015). These are mental disorders that have clear and often problematic behavioral implications due to socially unacceptable and/or antisocial behavior that constitutes them. These disorders include ODD and Conduct Disorder in children. They also include personality disorders in adults including Antisocial Personality Disorder and Borderline Personality Disorder, as well as substance abuse disorders and other disorders or behaviors such as kleptomania that can lead to criminal charges. Externalizing disorders are currently not listed in the DSM-5 but were proposed as the description is very useful to identify certain disorders with problematic behavioral traits (Krueger et al., 2005).

Sleep Disorders

Sleep disorders are another comorbidity that affect children with ADHD at a much higher level than normally developing children. A meta-analysis review evaluating studies from 1987 to 2008 found consistent differences such as bedtime resistance (defiance to parents), sleep onset difficulties, night awakenings and at times low sleep duration (Cortese et al., 2009). Other studies have pointed out some subtle differences in relation to the circadian rhythm and melatonin in children with ADHD, thus explaining the often-noted sleep onset difficulties (Nováková et al., 2011). Furthermore, these sleep disturbances can further aggravate the symptoms of ADHD such as inattention and motor skill dysfunction (Schneider et al., 2016). Kirov and Brand (2014) argue that the influence of sleep in the symptomatology of ADHD is one that needs much further research and is an area often neglected. Owens et al. (2013) similarly report on a multidisciplinary approach of various physicians to investigating the many aspects of sleep and ADHD to develop new therapies related to sleep in order to manage ADHD indirectly. Indeed, in an Iranian study on sleep interventions in children with ADHD it was found that the children whose parents were trained to implement better sleeping routines for their children had significant improvement in their physical, emotional, and mental well-being; and interestingly had improved interpersonal relationships among peers (Keshavarzi et al., 2014).

Obesity

Obesity has been linked with ADHD both in childhood and adulthood in several major longitudinal studies and meta analyses, making it one of the most common comorbidities of ADHD with males being more afflicted with the condition (Cortese et al., 2013; Ptacek et al., 2014b; Cortese et al., 2016). Incidentally, the DRD 4 genetic pathway, is correlated both with ADHD (Ptacek et al., 2011a; Choudhry et al., 2013) and other impulsive disorders like alcoholism and drug addiction, a genetic link and shared genes for ADHD and obesity have also been isolated. ADHD is often associated with motor skill dysfunction from an early age. In a cross-sectional study, it was found that motor dysfunction was very often associated with childhood obesity, but children with just ADHD were most likely to be underweight, which was paradoxical for the researchers. This has led to the conclusion that when studying this condition, it is extremely important to differentiate and assess the conditions separately (Goulardins et al., 2016).

A longitudinal study found very strong links between childhood ADHD with both Hyperactive Impulsive and Inattentive showing greater risk for being overweight or obese, respectively. The study found a stronger correlation in the Hyperactive Impulsive group with later hypertension than with obesity, possibly due to lifestyles associated with this presentation such as higher consumption of nicotine and other drugs (Fuemmeler et al., 2011). The extremely high rate of comorbid ADHD among the obese was noted in a study in Israel where the researchers strongly advise physicians to check for or refer obese patients to clinical psychologists to assess ADHD and other mental health disorders, as curing lifestyles may improve both conditions (Agranat-Megedger et al., 2005).

In contrast, a large cross-sectional study with a sample of 45,987 individuals aged 10–17 years in the United States found that the individuals with comorbid ADHD and a learning disorder, along with the youth with learning disorder alone were more likely to be obese than their peers (OR = 1.464 and OR = 2.094, $p = 0.01$). However, the study did not find an association between children with only ADHD and obesity (OR = 0.870). Those with ADHD and not obesity were found to have lower levels of physical activity, furthermore, the study did not differentiate among the clinical presentation of the disorder (i.e., inattentive, combined, etc.). After accounting for demographic factors (e.g., gender, age, ethnicity, and SES), ADHD patients with comorbid learning disability that were medicated had lower obesity rates than non-medicated patients (OR = 1.393 and OR = 2.516, respectively). This study suggests that ADHD symptoms alone are not associated with obesity, and points toward a different possibility: the presence of other comorbid psychiatric disorders and/or social factors. The study supports the lower incidence of obesity in medicated patients, but the length of time of drug treatment or the type of drug used (i.e., methylphenidate or a non-stimulant) was not reported (Cook et al., 2015). We hypothesize that in many of the obesity and ADHD correlation studies, medication could be a confounding factor in getting correct results and correlations. This is due to the fact that most drugs used to manage ADHD are of the stimulant class such as methylphenidate and amphetamine, both have the effect of speeding up the metabolic rate. Reviewing the literature, we found a great amount of studies failed to register the duration and at times whether drugs were being administered while analyzing the correlations between obesity and ADHD. At other times, comorbidities in childhood such as ODD or Conduct Disorder were not taken into account. The long term metabolic effects of ADHD drugs need to be studied to a greater extent in relationship to metabolic rate and long term changes, rebound effects and tolerance (Weissenberger and Akotia, 2015). In fact, some researchers are even calling for stimulants such as methylphenidate and amphetamine to be used both for the management of ADHD symptoms and subsequent obesity and food addiction improvements (Poulton et al., 2016). It is crucial to note that some studies have also mentioned a much higher prevalence of obesity among the predominantly inattentive presentation of ADHD but not so much in the Hyperactive Impulsive group (Fuemmeler et al., 2011; Khalife et al., 2014).

A clinical study in Turkey found that children and teenagers with ADHD have a much lower tolerance to stress and frustration than normally developing children and thus may binge on junk food possibly as a form of self-medicating. In addition to this, ADHD was correlated with both malnutrition as well as being overweight and obese. The researchers state that this shows ADHD to be a major risk factor not only for obesity but also for eating disorders in general (Güngör et al., 2016). The lower threshold for stress as well as emotional dysregulation and behaviors associated with this have also been noted in a meta-analysis by Barkley (2016). A Korean study further linked bulimia, higher body mass index and obesity with ADHD as well as lower SES (Kim et al., 2014). ADHD has been disparagingly studied among males but among females it is often associated

with eating disorders like bulimia nervosa and binge eating (Ptacek et al., 2016). There is also a separate question of the possible effect of ADHD on physical growth and development (Ptacek et al., 2009a,b, 2014b) and may be contributing to above mentioned questions.

Food Addiction

Just as in drug addiction or gambling, an unhealthy preoccupation with food along with compulsivity to eat is often associated with ADHD. This begins in childhood and continues into adulthood if the disorder persists often leading to comorbid obesity (Cortese et al., 2013). Generally, individuals and animals will binge on high fat and salty food or high fat and sugary food, this has a dopaminergic effect that is similar to a drug of abuse (i.e., nicotine, cocaine). Food addiction is now a recognized mental health condition and there are standardized scales to measure it such as the Yale Food Addiction Scale. Davis (2011) pointed out that in an obese population the food addicts were most likely to have comorbid ADHD and those found with these behaviors had higher emotional instability and were displaying the classic behavior noted in other addictions such as using the food to soothe unpleasant states of mind as seen in traditional drug users; the food was also being used to self-medicate certain unpleasant states of consciousness such as anxiety and sadness. The study confirmed a new type of obese patient or subtype that was not previously officially recognized by the medical field aside from anecdotal accounts, the food addict. It must be noted though, that due to the high-risk factor associated, those with ADHD both in childhood and adulthood are most likely to abuse drugs, food, and electronic media (Nigg, 2013; Karaca et al., 2016; Yen et al., 2016). A Canadian research team pointed out in detail how ADHD may not only be one of the most important risk factors for developing obesity but also one of the driving forces behind the impulsive eating previously mentioned. In concord with Davis et al. (2011), they argue that the treatment and improvement of ADHD symptoms will directly reduce obesity and result in weight loss. They recommend tools such as the Yale Food Addiction Scale along with the classical self-assessment scales administered for ADHD as the two are often intrinsically connected. Behavioral modifications are recommended in treating ADHD and its subsequent comorbidities such as food addiction (Yang, 2010). Pharmacological interventions have also been successful in managing hedonic and impulsive eating habits in those affected with the disorder, ideally together with psychotherapy (Hanan, 2016). Throughout the literature, there is a pervasive common emphasis on immediate gratification, poor discipline and self-control with the individuals suffering from ADHD. Addictive behaviors are among the most prominent behavioral tendencies associated with the disorder which can lead to pathological comorbidities such as various types of addictions and dependencies (Karaca et al., 2016).

Parenting is also directly involved in comorbid obesity of ADHD children. It was found that harsh parenting in adolescence or, more specifically, an authoritarian style as well as food insecurity due to lower SES (again connected to ADHD) correlate strongly with later obesity (Lohman et al., 2016). A longitudinal

study that took place in Canada from 1994 to 2008 and focused on parenting similarly found that authoritarian and negligent parenting were directly associated with obesity. When compared to the children raised in authoritative and traditional homes, the children from authoritarian homes were 35% more likely to be obese and the children from negligent homes 44% more. The authors clarify that the correlation is certainly there but that the effects of poverty (SES) should not be underestimated, specifically when looking at children from negligent homes (Kakinami et al., 2015). In contrast, behavioral modification therapy for obese children found that warm and authoritative parenting had a very positive effect in reducing the body mass index and raising the quality of life of obese children in recovery (Rhee et al., 2016). The entire body of studies show the great importance of family cohesiveness in this disorder and point to often ignored extrinsic social factors, that we argue are equally if not more important than the genetic factors involved.

Substance Abuse

Attention Deficit Hyperactivity Disorder is often associated with substance abuse and addiction. It has been estimated that almost one quarter of those suffering from Substance Use Disorder (SUD) have comorbid ADHD and they furthermore have a much worse prognosis in treatment compared to non-ADHD substance abusers (Van Emmerik-van Oortmerssen et al., 2015). Differentiating the presentation of the disorder is crucial; in a study on cocaine addicted and nicotine addicted adults with ADHD compared to other non-addicted individuals diagnosed with ADHD, both the cocaine and nicotine addicted patients scored very high in the hyperactive/impulsive presentation scale and very low in the inattentive both in adulthood and in a self-report childhood scale (Saules et al., 2003). Similarly, in one of the best known longitudinal study on ADHD conducted in a 33-year period, higher rates of nicotine addiction and substance abuse were noted in the adults who showed what we now classify as Combined Presentation of the disorder in childhood (Klein et al., 2012). Childhood ADHD was found to be associated with higher levels of later sensation seeking.

A Swiss study found that young adults (mean age of 20) with ADHD and comorbid Antisocial Personality Disorder had been experimenting with legal and illegal drugs from an early age. The study found higher rates of cocaine and nicotine use/addiction, but not as much alcoholism compared to controls (Estévez et al., 2016).

In a Danish longitudinal study looking at gender and its influence on SUD found that unlike in the general population, the rate of individuals with SUD and ADHD was at times higher in females. Different comorbidities were also reported in the female population such as higher rates of depression, pointing out that although ADHD is more common in males than in females, the disorder is just as disruptive in females although it may have a different and more masked presentation (Ottosen et al., 2016). In contrast to this study, more anomalous findings were observed; specifically Davis et al. (2015) found much higher rates of drug and alcohol abuse among those with ADHD compared to the general population but no gender differences in contrast with what is seen in non-ADHD populations.

TABLE 1 | Examples of the environmental agents (chemical, social, and societal) relevant to the onset of Attention Deficit Hyperactivity Disorder (ADHD).

	Prenatal stage (maternal exposure)	Nursing stage	Childhood	Adolescence	Adulthood
Chemical agents	Nicotinism and other substance abuse; exposure to EDC (endocrine disrupting chemicals), acetaminophen, unhealthy diet	Second hand smoke; EDC contaminated bottles and toys	Second hand smoke; EDC contaminated toys; unhealthy diet	Substance abuse; unhealthy diet	Substance abuse; unhealthy diet
Social agents	Maternal stress Extreme stress (stress hormone exposure)	Early life stress, social deprivation; inconsistent care	Family dysfunction, harmful parenting styles (authoritarianism, negligence), negative role models	Negative peer influence and authorities condoning harmful addictive lifestyles	Social mediation of noxious stimuli and harmful lifestyles
Societal agents	Poverty – higher exposure to toxins, inadequate healthcare and education, higher stress from family and immediate environment				

Substance abuse and alcoholism are widely known to be running in families, and research shows both environmental and genetic causes (Thapar, 2015; Kendler et al., 2016). A meta-analysis in Sweden reviewing substance abuse and addiction among ADHD populations and their relatives, found a strong correlation among the two. The researchers argue that this is due to genetics, as the genetic pathways responsible for ADHD are the same as those involved with proneness to addiction (Skoglund et al., 2015). The dopamine receptor gene DRD2 that is associated with ADHD Hyperactive Impulsive presentation was also found to be associated with alcoholism and drug addiction (Jones et al., 2015). A study at a rehabilitation facility for problematic gamblers found that one third of the inpatients came out positive during assessment for ADHD and the majority of those with ADHD had Cluster B personality disorders as a comorbidity with no major differences among sexes (Waluk et al., 2016). Another factor related to drug abuse and other addictions is time perspective. It has been hypothesized that individuals with ADHD Hyperactive Impulsive have a present hedonistic time orientation as defined by Philip Zimbardo (Weissenberger et al., 2016).

New Addictions – Electronic Media Dependencies

Similarly to drug addiction, currently we see more cases of compulsive internet use, social media addiction and video game addiction; we refer to these as the new addictions. A French study tested almost 1000 college students with five assessment inventories including the Wender-Utah, ASRS-V1, UPPS, Rosenberg Scale and CPPG to assess both ADHD in childhood and in adulthood. It revealed that the Adult ADHD Hyperactive Impulsive presentation is highly correlated with problematic gambling and had the highest rates of video game addiction (Romo et al., 2015).

As with the other lifestyles and comorbidities, there are gender differences in problematic computer use and psychiatric disorders. In some cases, even paradoxical ones, for instance a study in Taiwan looking at which type of ADHD presentation and gender is more likely to show higher rates of internet addiction, found that those with higher inattentive symptoms and females with ADHD were most likely to be addicted to

TABLE 2 | The dual role of harmful lifestyles, precursors and symptoms.

Precursors: Lifestyles contributing to ADHD	Lifestyles related to ADHD presentation
Unhealthy maternal lifestyles causing exposure to noxious agents and stress; harmful parenting styles; parents and peers involved in harmful lifestyles (addictive behaviors, models of lack of self-control).	Lack of self-control, tendency to succumb to addictions; substance addictions; food addictions (addictions to high volume and low quality food – mainly easily accessible fast food); social isolation and dependency on electronic media, impulsive gaming (prevalently in males); oppositional behavior and aggressiveness; passive lifestyle (mostly in inattentive ADHD); depressed passive lifestyle (often in females); vicarious social life on social media networks (often in females)

the internet (Yen et al., 2009). Subsequent analyses showed that females suffering from ADHD and/or other disorders such as Borderline Personality Disorders were most likely to be addicted to social media use. Males with higher impulsivity symptoms on the other hand were found more likely to fall for the addictive game usage. The male group who came out as highest on the ASRS scale for ADHD had one of the strongest correlation for impulsive gaming. The gender difference was emphasized by the researchers to also point out the fallacy of the previously proposed Problematic Internet Use (PIU) diagnosis as too broad and encompassing as the behaviors are varied with this type of addiction (Andreassen et al., 2016). The PIU description/diagnosis was proposed as an affective disorder in the early 2000s to be added to the DSM consisting of an unhealthy preoccupation with the Internet as well as impulsive and addictive use of the internet not specifying exactly for which purposes (i.e., social media or gambling) but eventually was not added (Shapira et al., 2000). Regardless of the nomenclature, the link with unhealthy technological habits in people with ADHD is prevalent. ADHD was one of the most common risk factors for impulsive internet use and Internet Gaming Disorder (IGD), with neurochemical alterations noted in one ADHD study comparing compulsive gamers with diagnosed ADHD and without the diagnosis (Hyun et al., 2015; Karaca et al., 2016; Bae et al., 2016).

Similarly, Yen et al. (2016) found a significant correlation between impulsive gaming disorder and ADHD, the researchers also assessed impulsivity and aggressiveness and found a strong correlation with it in individuals diagnosed with ADHD but not in those who were only impulsive gamers. High impulsivity was most common among males as was previously mentioned. In terms of time perspective, the majority of those with a Facebook addiction tended to score high in Past Negative and Present Fatalism in the Zimbardo Time Perspective Inventory. Present hedonism was associated with addictive video game use and pornography usage, but not necessarily social media or Facebook addiction. Gender was also a factor, with females being more attracted to social media use (Przepiorka and Blachnio, 2016).

DISCUSSION AND CONCLUSION

Attention Deficit Hyperactivity Disorder is a common neurodevelopmental disorder. Our article is devoted to a variety of factors which are involved in its onset and presentations; we paid particular attention to factors of an environmental nature spanning from chemical to societal agents which are often neglected – see (Table 1).

Accompanied by behavioral manifestations, lifestyles and comorbidities make the life of the patients and their families difficult. The lifestyles appear both in the role of precursors and symptoms – see (Table 2).

Lifestyles are often perpetuated in families and sometimes directly cause vicious cycles; e.g., mothers are exposing their unborn children to nicotine and raising the risk of the disorder in their child. We emphasize the significance of lifestyles associated with the disorder and we suggest for clinicians to treat these with equal attention as the disorder itself. With the fairly recent advent of Adult ADHD as a new recognized diagnosis in the DSM-V, some researchers are going so far as to say that childhood and adult ADHD are at times not related (Faraone and Biederman, 2016). This view may seem very controversial, but an emphasis on the lifestyles of these adults could be crucial to be understanding ADHD that starts in adulthood. Much more research will be needed on this topic as the disorder was long considered a “childhood disorder.” As pointed out in the article, the disorder only carries out into adulthood approximately 50% of the times (Moreno-Alcázar et al., 2016). That view is not consistent with a notion which classifies the disorder as “lifelong.” Due to its behavioral implications with lifestyles burdened by substance abuse and impulsive game disorder, the possibility that the lifestyles can be a later factor in developing the disorder is a controversial topic that we suggest more research be devoted to in the psychiatric field.

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Our analyses lead us to a growing conviction that with respect to all ages of ADHD patients, both diagnostics and treatment should encompass a wide, holistic approach. This approach should not neglect social and economic factors. Low SES and high stress (and related exposure to noxious substances and lifestyles) have been consistently shown to greatly contribute to the disorder from the prenatal period on. Adequate communication by clinicians and an awareness of these factors is very important. Pediatricians and General Practitioners should be well aware of the environmental risks to the developing fetus and warn the prospective mothers about preventable hazards.

We strongly recommend that new research includes healthy lifestyle, enhancement of family communication, as well as sound societal policies besides inevitable focus on the neurological substance of the disorder. One positive change for educators and schools is to have longer outdoor time for children and emphasize the importance of physical education as this has been very helpful for hyperactive and ADHD children (Pontifex et al., 2013). Additional research on the environmental pollutants and their effect on the disorder and publication of the findings may in the long run also pressure citizens to demand companies to pursue more responsible practices, as was seen in the public backlash against products with BPA. Open minded physicians and clinicians with a holistic perspective will better understand and more effectively improve the quality of life of their patients and of those around them.

AUTHOR CONTRIBUTIONS

SW: Contributed to ideating the review, designed and literature review. RP: Supervised the work contributed to literature review. MK-B: Contributed to literature review. AE and KS: Contributed to literature review and formatting. JR and MG: Contributed to supervision and literature review.

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ADHD and lifestyle habits in Czech adults, a national sample

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Background: Adult attention-deficit/hyperactivity disorder (ADHD) has been added as a diagnosis to the *Diagnostic and Statistical Manual of Mental Disorders* version 5 (DSM5) in 2013, thus making ADHD, which has been classically known as a childhood disorder, a life-long disorder. Those suffering from the condition show very specific behavioral traits, which manifest as lifestyle habits; they also show comorbidities that can be the symptoms and/or consequences of certain lifestyles.

Materials and methods: The targeted population was adults aged 18–65 years. The total sample was 1,012 (507 males and 505 females). The Adult ADHD Self-Report Scale (ASRS V. 1.1) was administered to evaluate the current symptoms of ADHD and a questionnaire regarding lifestyles that are pertinent to ADHD, exercise, drug use, and diet.

Results: An ASRS score of 4–6 points was found in 11.4% of the male population and 9.7% of the female population (5–6 points indicate very high-intensity symptoms). A score of 6, the highest intensity of symptomatology, was found in 1.18% of males and 0.99% of females. Gender differences in scores were not statistically significant. In terms of self-reported lifestyles, we calculated an ordered logistic regression and the odds ratios of those with ASRS scores >4. Those with higher ASRS scores had higher rates of self-reported unhealthy lifestyles and poor diets with high consumption of sweets. We also ascertained a paradoxical finding that is not in line with the current literature on the disorder – lower rates of cigarette smoking among people with higher ADHD symptomatology.

Conclusion: Several specific lifestyles were found to be associated with higher ADHD symptoms such as poor diet and cannabis use. Other factors classically associated with the disorder such as cocaine addiction and nicotine use were either insignificant or surprisingly less prominent among the Czech sample. However, ADHD-prone respondents reported to be more physically active, which fits the clinical picture of hyperactivity but contrasts with literature that reports sedentary ADHD lifestyle.

Keywords: ADHD, lifestyle, diet, adulthood, ASRS, obesity

Introduction

Attention-deficit/hyperactivity disorder (ADHD) is a lifelong neurodevelopmental disorder that is marked by various symptoms and behavioral manifestations. The core symptoms include impulsivity, inattention, and hyperactivity. Categorically speaking, it is these symptoms that are listed in diagnostic criteria such as the *Diagnostic and Statistical Manual of Mental Disorders* version 5 (DSM5). The disorder is most frequently seen among children with ~50% of those affected carrying ADHD symptomatology into adulthood.¹ It should also be noted that ADHD may be viewed as a continuum of symptoms and not only as a categorical construct. Twin studies have shown the importance of using the idea of the disorder as a dimensional construct that

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includes genetic influences and environment as risk factors, thus making the picture of the disorder very complex and not black and white.³⁵ Furthermore, ADHD has been linked to a wide range of structural and functional brain abnormalities that are presently documented by neuroimaging studies in both children and adults.²⁻⁴

There is a probable gender discrepancy in the disorder with more males diagnosed than females, this can be explained by a possible gender bias and/or error in diagnostic criteria.⁵ There is also a strong genetic link associated with the disorder.⁶ In the case of adult ADHD, it has been associated with perilous lifestyles such as drug abuse, smoking, poor dietary habits, in particular compulsive eating, as well as a general preference for sedentary living.^{7,8}

Most of these lifestyles are likely associated with hedonism and impulsive behavior.⁹ The majority of these lifestyles can result in serious health issues (obesity, hypertension, heart disease, and risky behaviors, such as reckless driving and suicidal ideation).^{9,10} ADHD is often connected with sleep problems, and it is not clear whether it is a real comorbidity or a result of specific sleeping habits. This is especially noted in children.^{11,12}

Poor diet is a significant lifestyle issue associated with ADHD; it is common both in children and in adults with some light differences seen between the genders, with binge eating being more common among men and eating disorders, such as bulimia nervosa, more seen among women. These comorbidities can mask ADHD and can lead to misdiagnosis especially in girls; furthermore, women with the disorder tend to express less externalizing behaviors, and the disorder is often unnoticed and not diagnosed leading to an apparent gender disparity.^{13,14}

Children with the disorder are often stigmatized within the school setting. This is especially common among males and in schools which provide less recreational time and physical exercise for the students.¹⁵

Good parenting styles seem to be a protective factor for certain ADHD-related lifestyles and behaviors, this is consistent with previous research on the benefits of authoritative parenting in managing children and adolescents with the disorder. The protective effects extend to lower rates of externalizing disorders and notable improvement in the quality of life for the individuals.¹⁶ Recently the benefits and protective effects of parenting have also been noted in adults with ADHD. An American study exploring this factor followed a sample of 92 undergraduate students; it was found that the students with ADHD were at a higher risk of sexually transmitted diseases/infections compared with healthy controls, and that previous closeness with their mothers in

childhood had a protective effect, compared with those with ADHD, but with neglectful mothers.¹⁷

Nicotinism and substance abuse are very also associated with ADHD—one explanation may be a genetic predisposition.¹⁸ ADHD and substance abuse tend to share genetic liabilities; one of the risk factors is an abnormality in the *DRD-4* gene that is partially responsible for dopamine regulation. The genetic factor should be looked at from an epigenetic perspective; it is a risk factor that is raised substantially with a poor environment, such as with low socioeconomic status and neglectful parenting and family conflicts.¹⁹ From an epidemiological perspective, adults with ADHD tend to have higher rates of nicotinism and cannabis use as well as a tendency to abuse other illegal drugs, to a higher extent than non-diagnosed individuals and individuals without ADHD symptoms. Those with ADHD also report that they begin to experiment with drugs at a much earlier age than other drug users. Paradoxically, compared with other types of drug addictions such as cocaine addiction and nicotinism, ADHD was found to be negatively correlated with problem drinking and/or alcoholism. Furthermore, other common comorbidities associated with adult ADHD are antisocial personality disorder, substance abuse and binge eating, especially among males.²⁰

The recent research on ADHD and cerebellar dysfunction and abnormalities helps to shed light on ADHD and the associated neural mechanisms of substance abuse. For example, cigarette smoking is generally associated with cognitive and structural dysfunction in the general population but was found to have positive effects on ADHD symptoms. The positive effects of smoking on ADHD symptoms can be directly attributed to nicotine, which was found to increase attentiveness and alertness in those with the disorder; this could be one of the reasons for higher rates of nicotinism among those affected with the disorder and could be a possible form of self-medication.²¹⁻²³

As was previously mentioned, those with the disorder tend to experiment with drugs at a very early age. In a study conducted in patients inside a major addiction clinic in Brazil, over 60% of those with cocaine addiction had ADHD; they were also likely to have initiated their drug use at a much earlier age than the other individuals not diagnosed with ADHD.²⁴ Interestingly, some medications for ADHD tend to have a protective factor against later addiction and drug abuse. For example, those prescribed D-amphetamine were much less likely to use either cannabis and/or cocaine.²⁵ The same was noted in long-term animal studies, especially in rodents where mixed amphetamine salts had a protective effect and resulted in later abstinence

from cocaine use in the laboratory setting. However, methylphenidate when administered in adolescence was suspected to be a risk factor for later cocaine abuse and addiction.²⁶

In a similar way to substance abuse and chemical dependencies, those affected with ADHD are often more prone to electronic addictions such as pathological internet use, which includes impulsive gaming and addictive behaviors associated with social media.²⁷ An especially dangerous correlation found in those with high ADHD symptomatology was an urge to use the social network sites while driving. It was noted that those with ADHD symptoms had higher stress levels and felt a much more impulsive need to use the sites/applications even while behind the wheel of a car, thus raising the risk of automobile accidents, endangering themselves and others. Males showed higher impulsivity and addictive behaviors with social media sites, often logging in and checking “updates” as a way to relieve the discomfort of not being connected.¹⁰

To our knowledge, there is currently no study focusing on lifestyles and general ADHD symptoms in the Czech population. We believe that the lifestyles associated with adult ADHD are one of the core elements of the disorder and can give insight into treatment and management of the disorder.

Materials and methods

Study population

A sample of adults aged 18–60 years from the Czech Republic was recruited by a professional polling and statistics agency (STEM/MARK, a.s.). The subjects were randomly chosen from a Czech National Panel and the questioning was done through computer-assisted web interviewing method. Participants aged 18–49 years (N=756) were recruited online and participants aged ≥50 years (N=256) via direct phone interview. This distinction was made due to easier accessibility of participants in each age category. Because of the use of this method, the dropout rate remains unknown. The sample consisted of 1,012 participants, of whom 507 were males and 505 were females. There were no statistical differences between the two types of data collections.

All data were analyzed through frequency tables and a logistic regression model which was build for ADHD Self-Report Scale (ASRS V. 1.1) score and lifestyle questionnaire using the Stata V. 14 program. The study was approved by the Ethical Committee of the First Medical Faculty of Charles University in Prague. All participants signed written informed consent forms prior to taking part in the study.

Standardized tests and a lifestyle questionnaire

The participants of this study were administered using ASRS V. 1.1 to assess ADHD symptomatology with scores from 0 to 6, with 0 being no ADHD symptoms and 6 being extremely severe symptoms. The range of 5–6 points is considered indicative of high symptomatology of adult ADHD, that is, the individual is diagnosable as having ADHD. The result of 4 points suggests that the clinician must further investigate whether the patient is suffering from the disorder. Scores of 0–3 indicate none or weak symptoms (0) to a low number of symptoms and low probabilities of ADHD. The ASRS V. 1.1 questionnaire is standardized and considered a very reliable method of assessing ADHD symptomatology within the adult population.²⁸ Following the demographic information and ASRS, the participants filled out self-report questions regarding their lifestyles in this order: healthy lifestyles such as their diet and exercise routines, cigarette and tobacco usage, use of illegal substances, physical activity and sports, hours watching TV per day, how many meals they consume per day, sweets and sugar consumption, daytime tiredness and sleepiness, and sleeping habits. The questions were both open and closed, for example, “Do you smoke cigarettes?” Yes or No, and “How many do you smoke?” Some were put into ranges such as, “How many hours of television do you watch per day?” with ranges including 0–1 hours up to 12 hours or more. Furthermore, certain questions regarding drug use were rated 0–4 with 0 being a protective factor (eg, Do you use cocaine? No =0). For the regression model, we included only certain lifestyle behaviours and observed their association with higher ADHD symptomatology. The questionnaire was built on previous research from the authors.

Results

ADHD and gender

The ASRS results for men and women are presented in Table 1. We found no statistically significant gender differences in ASRS scores. In total, 449 males and 456 females (77.52% of males and 78.42% of females) scored below the threshold of high ADHD symptomatology with 0–3 ASRS score. In the mild symptom category of ASRS 4, there were 37 males and 36 females (7.3% and 7.13% of the sample, respectively). The high symptomatology of 5 or 6 ASRS score was observed in 21 males (4.14% of the male sample) and 13 females (2.57% of the female sample).

ADHD and lifestyles

Table 2 provides information on the results of ordered logistic regression of ASRS scores and significant variables

Table 1 ASRS score and gender

ASRS score	Males		Females	
	N	%	N	%
0	187	36.88	182	36.04
1	121	23.87	133	26.34
2	85	16.77	81	16.04
3	56	11.05	60	11.88
4	37	7.30	36	7.13
5	15	2.96	8	1.58
6	6	1.18	5	0.99
Total	507	100	505	100

Note: Pearson $\chi^2(6) = 3.1001$, probability = 0.796.

Abbreviation: ASRS, Adult Attention-Deficit/Hyperactivity Disorder Self-Report Scale.

inquiring about various lifestyles of the respondents. While some results confirmed our expectations, others conveyed unexpected results.

The results generally confirm that high ADHD symptoms such as impulsivity and inattentiveness as measured by the ASRS V. 1.1 are associated with specific lifestyles. We also found some surprising behavioral tendencies. As expected, those respondents with higher ADHD tendencies/symptoms were significantly more prone to an overall unhealthy lifestyle – assessed by a general question regarding regular diet, healthy drinking regime, and regular sleep (OR = 1.21). Also, as we expected, respondents with increased ADHD symptoms admitted a 41% higher tendency to higher use of marijuana

(OR = 0.59) and an increased tendency to abuse other substances (OR = 0.34); but very surprisingly, high ADHD symptoms score was negatively related to smoking (OR = 1.41).

With respect to meals, participants with higher ADHD symptoms reported more frequent eating of main meals (OR = 0.84) but, in concordance with expectations, less frequent consumption of portions of fruits and vegetables (OR = 1.29) and more frequent snacking on sweets (OR = 1.37). Our sample confirms that ADHD symptoms correlate with sleep issues, both with sleep disorders (OR = 0.73) and sleepiness during the day (OR = 0.46). During their free time, respondents with high ADHD symptomatology appear to spend only slightly less time watching TV than their counterparts with lower ASRS scores (OR = 0.95) but they report higher engagement in physical activity and sports (OR = 1.35).

Surprisingly, other drugs of abuse such as cocaine and heroin were not found to have significance among either the non-diagnosable low ASRS scorers or the ADHD high symptoms group.

Discussion

This study is the first in the Czech Republic reviewing adult symptoms of ADHD in terms of their intensity and the associated lifestyles, regardless of diagnosis. With an average of 3.36% of the individuals sample displaying increased ADHD symptomatology, the lifestyles are of the

Table 2 Ordered logistic regression of ASRS scores and lifestyle variables

Ordered logistic regression						
Number of obs = 1,012						
Question	Odds ratio	SE	Z	P > z	95% CI	
Do you adhere to principles of a healthy lifestyle? (regular diet, healthy drinking regime, regular sleep) (Yes 1, Sometimes 2, Rarely 3, No 4, I don't know what they are 5)	1.21	0.11	2.22	0.027	1.02	1.42
Do you smoke cigarettes? (Yes 1, No 2)	1.47	0.19	2.91	0.004	1.13	1.92
Use of illegal substances – marijuana (Yes, I use them regularly 1, I used them regularly in the past 2, I tried them 3, No 4)	0.59	0.06	-4.91	0.000	0.48	0.73
Use of illegal substances – volatile substances (Yes, I use them regularly 1, I used them regularly in the past 2, I tried them 3, No 4)	0.34	0.14	-2.59	0.010	0.15	0.77
Are you regularly involved in physical activity/sport? (No 1, Yes 2)	1.35	0.17	2.39	0.020	1.05	1.74
During a typical day, how much time do you spend watching TV: hours	0.95	0.02	-2.02	0.044	0.89	0.99
How many main meals do you consume a day? (four main meals daily, two to three main meals daily, one or two main meals daily)	0.84	0.07	-1.91	0.057	0.71	1.00
How many portions of fruits/vegetables do you eat? (more than four portions a day, two to three portions a day, one or none)	1.29	0.15	2.27	0.023	1.03	1.60
How often do you eat sweets? (three times a week or less, four to five times a week, every day)	1.37	0.11	4.11	0.000	1.17	1.59
Are you extremely sleepy or tired during the day? (Yes 1, No 2)	0.46	0.06	-5.90	0.000	0.36	0.59
Do you have trouble with sleep at night? (Yes 1, No 2)	0.73	0.09	-2.46	0.014	0.59	0.97

Abbreviations: ASRS, Adult Attention-Deficit/Hyperactivity Disorder Self-Report Scale; LR, likelihood ratio; obs, observations; SE, standard error.

utmost importance for the study and for learning more about what could constitute key aspects of the disorder. Many of the lifestyles that we explored are consistent with previous research regarding the negative health outcomes of ADHD, such as poor diets, obesity, and poorer overall health.⁹

In terms of standardized tests we opted for the ASRS V. 1.1 which is one of the most reliable tests for assessing ADHD symptoms and is used in the clinical realm to assist clinicians in diagnosing individuals.²⁸ Nonetheless, it is very important to note that a high symptoms score, such as 5–6, is not enough to draw a definite ADHD diagnosis and is only indicative of strong symptomatology, according to this instrument. Therefore, further exploration into association between ADHD diagnosis and lifestyle would be advised.

In the self report questions about lifestyle, we found that most subjects with high ADHD symptomatology (ASRS scores of 5–6) rated their lifestyles as unhealthy (OR=1.24). This showed a high level of awareness and a finding that could be quite beneficial for those seeking psychotherapy, and for clinicians to focus on.

The literature on dietary habits and certain deficits seen in children diagnosed with ADHD is quite abundant, often reporting that those with the disorder tend to have iron deficiency, omega 3 and 6 imbalances, consume high amounts of fast food and sweets, resulting in an overall imbalanced diet,²⁹ as well as obesity and hypertension.^{7,9} This can be the result of a possible form of self-medicating with unhealthy food, binge eating, and addiction to problematic food (ie, sugary food). This would especially be the case when the poor diet is combined with a sedentary lifestyle. Surprisingly, ADHD-prone respondents from our sample reported more physical activity and less TV watching and computer gaming than we expected. We did not ask about other games such as console systems or games on their cell phones, which may be a limitation for looking into the electronic gaming factor.

Insomnia and daytime fatigue were both statistically relevant results found in the high symptom group. This was consistent with both research in the field and our hypothesis. For instance, a previous study observing adults diagnosed with ADHD found that within the group, 62% suffered from fatigue or daytime sleepiness, often in connection with insomnia.³⁰ We did not take into account the information on the individuals taking ADHD drugs or other psychiatric drugs in relation to sleep. This may be seen as a confound when looking at insomnia, especially since most drugs used for ADHD are stimulants. In a previous study on ADHD and insomnia, it was found that ~67% of the ADHD group suffered from insomnia compared with 20% of the healthy

control group. Paradoxically, those taking stimulant prescription drugs for ADHD had lower rates of insomnia than the unmedicated individuals with the disorder.³¹

Sports and/or physical exercise have been consistently found to improve the outcome of the disorder in both children and adults.³² Paradoxically in our study, those who reported regular physical activity also had higher odds of ADHD symptomatology, which is something that needs to be further investigated. The study was cross-sectional a design and thus we might conclude that people with higher ADHD symptoms may exercise more. An extensive literature review found that cardiovascular exercise such as running or team sports have the most benefit for ADHD patients but non-cardio exercise such as weight lifting also had a protective effect.³³

One of the most surprising results of our study was the lower rates of nicotine use and cigarette smoking among those with higher ASRS scores. This was unexpected due to the fact that most of the literature on ADHD and nicotine focuses on those already diagnosed with the disorder and their smoking rates. Some indications show nicotine as reducing ADHD symptoms such as inattentiveness and helping those with the disorder in concentrating.²² This is a finding that could possibly explain the fact that lower rates of smoking are seen in our study in terms of higher symptoms. Nicotine could be helpful in reducing the symptoms and can be used as a form of self-medication, thus those with more intense symptoms may be self-medicating less with nicotine.^{34,35} A study examining nicotine and its implications in lowering symptoms of ADHD found that it lowered ADHD symptoms by up to 9% in both nicotine-naïve individuals and regular smokers.²³ This association needs further investigation as it could play an important role in the neurological factors associated with ADHD.

In terms of drug use, cannabis and experimentation with solvents were found among the ADHD population at an increased level. The higher rates of cannabis use/abuse was consistent with our hypothesis and predictions as well as with a vast amount of literature on the subject. One very surprising finding was the lower use of cocaine among those in our sample. This is surprising as generally cocaine addiction along with nicotine are the most common dependencies seen in those with ADHD.^{8,18,20} The low use of cocaine in our sample may be due to lower availability of the drug or high price in the Czech Republic and/or other factors.

Overall, we believe that the negative lifestyle habits associated with high-intensity symptoms should be well noted by clinicians in order to help those suffering from

the disorder. These lifestyles could possibly constitute one of the core manifestations of the disorder in its adult form, and we hope our research will inspire more investigation into this topic.

Conclusion

In our study, several lifestyle habits that were noted in previous ADHD literature were found to be associated with higher intensity of ADHD symptoms, such as cannabis use and poor diet (including higher consumption of sweets). Other factors usually associated with the disorder such as cocaine addiction were less prominent among the Czech sample. Nicotine use and smoking were less associated with high-intensity ADHD symptoms possibly due to self-medication phenomena and lowering of symptoms. In other words, as we looked only at symptoms and not diagnosis, it could mean that nicotine is improving symptomatology in these individuals. However, we did not observe the same effect in physical activity: we observed increased levels of exercise in those with high ASRS scores. We believe that studying the lifestyles associated with adult ADHD is very important to help those suffering from it, as they could represent core aspects of the clinical presentation of the disorder. From the finding that those in our sample showed high awareness of their poor lifestyle habits and choices, we believe that this gives clinicians a further tool for inquiry and investigation of whether ADHD is present. We recommend that clinicians take a holistic approach and not neglect lifestyles along with social and environmental influences when dealing with adults who may be suffering from the adult form of ADHD.

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Disclosure

The authors report no conflicts of interest in this work.

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SUMMARY

ADHD is a lifelong neurodevelopmental disorder that is mostly seen in childhood and that can also manifest or carry on into adulthood. It is of crucial importance for clinicians to be aware of the adult version of ADHD so that they can adequately recognize and treat those who are ailed by the condition. It is also important to raise awareness of the condition to clinicians in Czech Republic, as our study clearly shows that there are a fair amount of adults who are living with strong symptoms. We conducted our study on ADHD symptomatology among Czech adults and the correlated lifestyles to get a better picture of the condition and how it presents itself, to give a clear idea of questions that could be asked by clinicians to adults regarding their lifestyles and ADHD. We also decided to only stick to symptomatology rather than previous diagnosis to further refine our research and get a clear picture.

Our study was the first to assess ADHD symptoms and investigate lifestyles in the Czech adult population. The study was cross-sectional as this allowed us to assess the symptoms and lifestyles in “real time”. The cross-sectional design was a strength as well as a limitation in the sense that we cannot see what the individuals will do in the future, whether symptoms have improved or worsened, or likewise if they have changed their lifestyles. Our results were mostly in line with previous studies that looked at the lifestyles and health of individuals that are diagnosed with the disorder with some exceptions. Unlike other studies we found less associations with ADHD symptoms, in terms of intensity (i.e. 5-6 score on ASRS) and nicotine use. We also found higher scorers to be associated with higher rates of physical exercise. Further investigation would be of high importance to the field in order to understand whether lifestyles such as nicotine use and physical exercise, help with ADHD symptoms and how to help patients from an holistic perspective. The study has vast implications for the field in that clinicians may see individuals who are, for example, obese and/or suffering from substance abuse disorders may want to dig deeper and screen or test for ADHD, investigating the patient's lifestyles could give hints into the patient possibly suffering from the disorder. We are confident that adult ADHD should receive more attention in the field and that when treated with drug therapy and counseling it can substantially improve the person's life both professionally and in terms of overall health.

ADHD je celoživotní neurovývojová porucha, která je typická pro dětství, ale která se může manifestovat či přetrvávat i v dospělosti. Pro kliniky je velmi důležité být o ADHD u dospělých informováni, protože jen tak jsou schopni poskytnout adekvátní léčbu. Je také důležité zvýšit povědomí kliniků v České republice o tomto onemocnění, protože naše studie jasně ukazuje, že existuje velké množství dospělých, u kterých můžeme pozorovat silné příznaky. Naše studie je zaměřena na symptomatologii ADHD v České republice a

její korelaci s životním stylem. To nám umožní získat lepší představu o tom, jak se onemocnění manifestuje, a pokládat konkrétní otázky, které přispějí k diagnostice ADHD v dospělosti. S ohledem na sjednocení kritérií jsme se rozhodli využít symptomatologii onemocnění místo předchozí diagnózy.

Naše studie je první studií, která hodnotí symptomy ADHD a zkoumá je v souvislosti s životním stylem dospělé populace v České republice. Rozhodli jsme zvolit průřezový design, který umožňuje zhodnotit příznaky a životní styl v „reálném čase“. Jsme si vědomi také omezeních, které s sebou průřezový design přináší, mezi které patří například nemožnost hodnotit změnu symptomů v souvislosti se změnou životního stylu participantů. Naše výsledky byly většinou v souladu s předchozími studiemi, které se zabývaly životním stylem dospělých s ADHD. Na rozdíl od jiných studií jsme shledali menší korelaci intenzity příznaků ADHD (tj. 5-6 skóre na ASRS) a užíváním nikotinu. Také jsme zjistili, že větší intenzita příznaků je spojena s častější cílenou fyzickou aktivitou. Pro zjištění zda má fyzické cvičení a užívání nikotinu pozitivní vliv na redukci příznaků ADHD a pro zajištění holistické péče je potřeba dalšího výzkumu v této oblasti. Naše studie má široký dopad na praxi, protože lékaři mají možnost zjistit, zda za obezitou či zneužíváním návykových látek pacientů nestojí ADHD, jehož závažnost může být zjištěna screenigovým dotazníkem. Jsme přesvědčeni, že by se dospělým lidem s ADHD měla z odborného hlediska věnovat větší pozornost. Věříme také, že farmakologická či psychoterapeutická léčba může zásadně zlepšit kvalitu života těchto pacientů.