

AKADÉMIAI KIADÓ

Prevalence and clinical phenotypes of adult patients with attention deficit hyperactivity disorder and comorbid behavioral addictions

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GIACOMO GRASSI* , CORINNA MORADEI  and CHIARA CECHELLI 

Brain Center Firenze, Florence, Italy

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FULL-LENGTH REPORT



ABSTRACT

Background: Although the correlation between substance use disorder and attention deficit hyperactivity disorder (ADHD) has been largely studied, less is known about the correlation between behavioral addictions and ADHD. Thus, the aim of the present study was to investigate the prevalence of behavioral addictions in a large sample of adult patients with a primary diagnosis of ADHD and to compare the clinical profile of ADHD patients with and without behavioral addictions comorbidity. **Methods:** 248 consecutive adults newly diagnosed as ADHD patients were assessed through a series of validated scales for gambling disorder, internet, sex, shopping and food addictions. ADHD patients with at least one comorbid behavioral addiction were compared to non-comorbid patients on ADHD symptoms, impulsivity, mood and anxiety symptoms and functional impairment. **Results:** 58.9% of patients had at least one behavioral addiction comorbidity. Of the whole sample, 31.9% of the patients had a comorbidity with one behavioral addiction while the 27% showed a comorbidity with two or more behavioral addictions. Internet addiction was the most common comorbidity (33.9%) followed by food addiction (28.6%), shopping addiction (19%), sex addiction (12.9%) and gambling disorder (3.6%). ADHD patients with comorbid behavioral addictions showed higher ADHD current and childhood symptoms, higher cognitive and motor impulsivity, higher mood and anxiety symptoms and higher functional impairment. **Conclusions:** Behavioral addictions are highly frequent in adult ADHD patients. Comorbid patients seem to have a more complex phenotype characterized by more severe ADHD, mood and anxiety symptoms, higher impulsivity levels and greater functional impairment.

KEYWORDS

ADHD, internet addiction, gambling disorder, shopping addiction, food addiction, sex addiction, impulsivity, mood and anxiety symptoms

INTRODUCTION

In a Research Domain Criteria (RDoC) perspective, attention deficit hyperactivity disorder (ADHD) and addictions share several common neural dysfunctions. They are both characterized by reward processing dysfunctions, response inhibition deficits and executive function deficits (Faraone et al., 2021). Indeed, the correlation between substance use disorder and ADHD has been largely studied. Several meta-analyses found a clear association between ADHD and substance use disorders in both adolescents and adults and a Swedish study of over half a million people found a more than threefold association between ADHD and subsequent drug use disorders (Faraone et al., 2021; Sundquist, Ohlsson, Sundquist, & Kendler, 2015). The prevalence of substance use disorders across ADHD patients is largely variable across studies but it reach a peak of more than 40% in the general population and more than 80% in clinical populations (Choi, Woo, Wang, Lim, & Bahk, 2022).

*Corresponding author.

E-mail: giacomograssimd@gmail.com



In the last decade's literature, a series of excessive behaviors (such as gambling, internet use, sex, shopping and food consumption) have been suggested as potentially addictive disorders and they have been commonly described under the umbrella term "behavioral addictions". This term usually indicates a pattern of excessive behaviors characterized by the core symptoms of substance use disorders (e.g. impaired control over the behavior, increasing priority given to the behavior, escalation of the behavior despite negative consequences). However, only a few of the proposed behavioral addictions reached a consensus on diagnostic criteria and have been included in the current international nosography. The ICD-11 listed gambling disorder and gaming disorder in the "Disorders due to addictive behaviors" while compulsive sexual behavior disorder is listed in the "Impulse control disorders". Differently, the DSM-5 included only gambling disorder (in the "Substance-related and addictive disorder" section) and internet gaming disorder (in the "Condition for further study" section). The lack of a reliable conceptualization of the other putative forms of behavioral addictions (such as internet, shopping and food addictions) has generated methodological inconsistencies across studies and limited their investigation in other disorder such as ADHD (Fineberg et al., 2022). Indeed, in comparison to substance use disorder, the correlation between non-substance-related disorders (or behavioral addictions) and ADHD has been significantly less investigated. Existing studies mainly focused on patients with a primary diagnosis of behavioral addictions (mainly gambling disorder and internet addiction). Most of these studies showed an increased prevalence respect to the general populations of ADHD symptoms in subjects with gambling disorder (GD) (or problem gambling) and subjects with internet addiction (and/or internet gaming disorder) and a significant association between ADHD and the behavioral addiction symptoms (Bielefeld et al., 2017; Brandt & Fischer, 2019; El Archi et al., 2023; Jacob, Haro, & Koyanagi, 2018; Karaca, Saleh, Canan, & Potenza, 2017; Ko et al., 2023; Koncz et al., 2023; Retz, Ringling, Retz-Junginger, Vogelgesang, & Rösler, 2016; Theule, Hurl, Cheung, Ward, & Henrikson, 2019; Wang, Yao, Zhou, Liu, & Lv, 2017). Only a few studies examined the co-occurrence of other putative behavioral addictions such as sex addiction, compulsive buying and food addiction (despite some studies suggested at least an association between sex addiction and both food addiction and binge eating disorder and ADHD) (Brunault et al., 2019; Davis, Cohen, Davids, & Rabindranath, 2015; Karaca et al., 2017; Korchia et al., 2022).

In the current literature there is a lack of studies investigating the presence of behavioral addictions in adult clinical samples of subjects with a primary diagnosis of ADHD. Also, the impact of the presence of a behavioral addiction comorbidity in ADHD patients on their clinical phenotype is still unknown. Thus, the aim of the present study was to investigate the prevalence of behavioral addictions in a sample of adult patients with a primary diagnosis of ADHD and to compare the clinical profile of ADHD patients with and without behavioral addictions comorbidity.

METHODS

Participants

All the patients were recruited at the Brain Center Firenze, a specialized clinic for adult ADHD. We enrolled 248 consecutive adult outpatients with a primary diagnosis of ADHD. The ADHD diagnosis was established by one of two psychiatrists expert in the field (GG or CC) and confirmed through the structured clinical interview for adults ADHD, DIVA 5.0 (Hong et al., 2020). All the included patients were newly diagnosed as adult ADHD at the time of the assessment. All the patients were comprehensively assessed through a clinical interview (assessing lifetime comorbidities) and a series of psychometric test (see below).

Measures

Clinical assessment. All the patients underwent a clinical interview assessing demographic and clinical characteristics (see Table 1).

ADHD assessment. ADHD symptoms were assessed through the Barkley Adult ADHD Rating Scale-IV (BAARS-IV), a widely used scale for screening ADHD in adult patients. The BAARS-IV is a self-report scale, based on the DSM-IV-TR criteria for the diagnosis of ADHD, meant to assess current and childhood ADHD symptoms in adults (Barkley, 2011a). The self-report version of current symptoms scale includes 30 items and 4 subscales (attention, impulsivity, hyperactivity, sluggish cognitive tempo). Twenty seven of the 30 items are rated on a 4-point Likert scale: (1) never or rarely, (2) sometimes, (3) often, and (4) very often. Each scale of current symptom has three extra questions (assessing functional impairment of ADHD symptoms). The sluggish cognitive tempo (SCT) subscale includes symptoms such as daydreaming, staring, mental fogginess, confusion, hypoactivity, sluggishness, slow movement, lethargy, apathy, and sleepiness (Barkley, 2012). The self-report version of childhood symptoms scale (referring to symptoms between 5 and 12 years) includes 18 items rated on a 4-point Likert scale and is divided in two subscales (inattention, impulsivity/hyperactivity).

Impulsivity assessment. Impulsivity traits were assessed using the Barratt Impulsiveness Scale, version 11 (BIS-11). This scale consists of 30 self-descriptive items, with responses in a four-point Likert-type scale ranging from "Rarely/Never" to "Almost Always/Always." (Patton, Stanford, & Barratt, 1995). It measures the total score (range: 30–120) of impulsivity and three factors: Attentional Impulsiveness (AI), Motor Impulsiveness (MI), and Non-planning Impulsiveness (NPI) with higher scores indicating higher impulsivity. BIS-11 was used in its Italian translation (Fossati, Di Ceglie, Acquarini, & Barratt, 2001).

Mood and anxiety symptoms assessment. Mood and anxiety symptoms were assessed using the Symptoms of Depression Questionnaire (SDQ). The SDQ is a 44-item,



Table 1. Demographic and clinical characteristics of patients with ADHD with BAs and ADHD without BAs

	ADHD+BAs (n:146)	ADHD (n:102)	U	p
Age	27 (23; 34)	28.5 (23; 35)	6,967.5	0.389
Gender (M:F) (F%)	56:90 (61.6)	47:55 (53.9)	$\chi^2 = 1,475$	0.225
Years of Educations	14 (13; 17.5)	13 (13; 18)	7,642	0.644
ADHD current symptoms (BAARS-IV Total)	52 (45; 57)	45 (38.75; 52)	9,650.5	<0.001
Inattention (BAARS-IV)	27 (25; 31)	26 (22; 29)	8,934.5	0.005
Hyperactivity (BAARS-IV)	13 (10; 15)	10 (8; 14)	9,119.5	0.002
Impulsivity (BAARS-IV)	11 (8; 13)	9 (7; 12)	8,777	0.012
Sluggish Cognitive Time (BAARS-IV)	26 (23; 30)	24 (20; 27)	9,592.5	<0.001
ADHD childhood symptoms (BAARS-IV Total)	50 (42; 56)	45 (35; 54)	8,863	0.008
Inattention (BAARS-IV)	27 (23; 31)	26 (20; 30)	8,458.5	0.054
Hyperactivity/Impulsivity (BAARS-IV)	22 (17.5; 27)	20 (13; 26)	8,652	0.023
Impulsiveness (BIS-11 Total)	74 (69; 80.5)	69 (63; 75.5)	9,853.5	<0.001
Attention (BIS-11)	23 (21; 25)	21 (18; 24)	9,553.5	<0.001
Motor (BIS-11)	26 (22; 29)	22 (19; 26)	9,776.5	<0.001
Non Planning (BIS-11)	25 (23; 29)	25 (23; 28)	7,478	0.776
SDQ Total	143.5 (120; 162.75)	120 (104.5; 145.75)	9,259.5	<0.001
Mood (SDQ)	60 (48; 69)	51.5 (42.25; 60)	8,983	0.001
Anxiety (SDQ)	44 (38.25; 52)	37 (33; 47)	9,291.5	<0.001
Suicidal Ideation (SDQ)	17 (13; 22)	15 (12.25; 19)	8,227.5	0.058
Sleep Quality (SDQ)	9 (6; 12)	8 (6; 10)	8,530.5	0.013
Appetite and Weight (SDQ)	10 (9; 11)	9 (8; 10)	8,990.5	0.001
Barkley Functional Impairment Scale (BFIS)	5.83 (4.66; 6.68)	4.51 (3.42; 5.65)	10,333	<0.001
BFIS (% of impaired domains)	75 (60; 90)	55.5 (36; 75.25)	10,289	<0.001

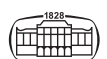
Note. Data are expressed as median (interquartile range) for all variables. ADHD = Attention-Deficit Hyperactivity Disorder; BAs: Behavioral Addictions; BAARS-IV = Barkley Adult ADHD Rating Scale-IV; BIS-11 = Barratt Impulsiveness Scale, version 11; SDQ = Symptoms of Depression Questionnaire; BFIS: Barkley Functional Impairment Scale.

self-report scale designed to measure the severity of symptoms across several subtypes of depression. The items are rated on a 6-point scale. Each item is rated based on a subject's perception of what is normal for the individual (score = 2), what is better than normal (score = 1), and what is worse than normal (scores = 3–6). The SDQ encloses five subscales, investigating the following dimensions: lassitude, mood, cognitive/social functioning (in this study summarized as “mood” subscale); anxiety, agitation, anger and irritability (in this study summarized as “anxiety” subscale); desire to be dead; disruptions in sleep quality; changes in appetite and weight (Pedrelli et al., 2014). For this study, we used the validated Italian version of this scale (Salerno, Burian, & Pallanti, 2017).

Internet addiction. Internet addiction symptoms were assessed using the Internet Addiction Test (IAT), a widely used screening test consisting of 20 questions, all measured on a 5-point likert scale. The questions are scored from 1 to 5, with a score of 1 for the answer “rarely” and 5 for the answer “always.” Summative scores ranging from 20 to 49 are considered “average” online users. Scores ranging from 50 to 79 are considered to be internet users with problematic internet use. Scores ranging from 80 to 100 are considered to be users suffering from severe problems due to their Internet usage. In the results section of this study all subjects scoring above 50 are considered as having internet addiction (Young K, 1998).

Gambling disorder. Gambling disorder (GD) symptoms were assessed using The South Oaks Gambling Screen (SOGS), a 20-item questionnaire originally based on DSM-III criteria for pathological gambling and widely used across clinical and epidemiological studies for the screening of gambling behaviors (Lesieur & Blume, 1987). SOGS assess gambling symptoms over the past 6 months and positive responses to 5 or more items result in a designation of “probable pathological gambler”. However, recent studies assessing the sensitivity and specificity of the SOGS according to gambling disorder's DSM-5 criteria argued in favor of increasing the cut-off score in order to reduce false positive rates (Goodie et al., 2013). Thus, in this study, we used the suggested cut-off of 8 to classify patients with probable GD according to DMS-5 criteria (Goodie et al., 2013).

Food addiction. Food addiction symptoms were assessed using the Yale Food Addiction Scale (YFAS) version 2.0, a self-report scale designed to reflect the assessment of addictive-like eating behavior based upon the substance-related and addictive disorders (SRADs) diagnostic criteria in the DSM-5. In the YFAS each of the 11 DSM-5 diagnostic criteria for SRADs is considered to be met if one or more of the relevant questions for each criterion meet the threshold. Two different summary scores are reported: a symptom count (0–11) and a diagnosis with severity level (mild, moderate, severe). The symptom count scoring option for



the YFAS 2.0 is computed by summing the 11 diagnostic criteria (scores ranging from 0 to 11). Based on the DSM–5 diagnosis for SRADs, mild food addiction is indicated by meeting two to three criteria, moderate food addiction reflects presence of four to five criteria, and severe food addiction is defined as meeting six or more criteria (Gearhardt, Corbin, & Brownell, 2016). In our study patients scoring 3 or more on the YFAS 2.0 were classified as having food addiction.

Sex addiction. Sex addiction symptoms were assessed using the Sex Addiction Screening Test – revised (SAST-R), a 45-item self-report screener for distinguishing possible cases of sexual addiction. The SAST-R is composed of a 20-item core scale, measuring the general construct of sexual addiction. In addition, the SAST-R contains 4 specific scales measuring vital characteristics of sexual addiction: preoccupation (4 items), loss of control (4 items), relationship disturbance (4 items), affective disturbance (5 items), and an internet scale (6 items) that comprises internet-related sexual activity. Finally, there are 3 scales (6 items) measuring behaviors intended to be more relevant to specific groups—heterosexual men, homosexual men, and women (both hetero- and homosexual). The SAST-R's total score range from 0 to 20 with scores equal or above 6 indicating the presence of significant compulsive sexual behaviors (Carnes, Green, & Carnes, 2010).

Shopping addiction. Shopping addiction symptoms were assessed using the Bergen Shopping Addiction Scale (BSAS), a self-report screening scale consisting of 28 questions covering seven addiction criteria (salience, mood modification, conflict, tolerance, withdrawal, relapse, and problems) (Andreassen et al., 2015). This scale is still lacking of well established cut-off score for the diagnosis of shopping addiction. Therefore, according to what suggested by the authors who developed the scale, score above the 50% of the maximum score were considered as indicative of the presence of a probable shopping addiction.

Functional impairment assessment. Functional impairment was assessed through the Barkley Functional Impairment Scale (BFIS) for adults (Barkley, 2011b). The BFIS is a 15-item self-report measure of psychosocial impairment which assesses difficulties completing various activities in daily life. Respondents answer on a scale from 0 (not impaired) to 9 (severely impaired). The BFIS outcome is expressed both as the percentage of compromised daily life domains or the mean score of daily life dysfunction.

Statistical analysis

Normality of all variables was evaluated using the Shapiro–Wilk test. Since all the included variables were non-normally distributed, non-parametric tests were used. A Mann–Whitney U test was performed to compare clinical scales scores (BAARS-IV total and subscales scores, SDQ total and subscale scores, BFIS percentage of compromised domain and total dysfunction scores) of ADHD subjects with and without

a behavioral addiction continuous, while chi-square test was used for categorical variables. Spearman's correlation coefficient was calculated to evaluate the correlation between behavioral addiction scores (IAT, SAST-R, SOGS, YFAS, BSAS) and ADHD, impulsivity and mood scales (BAARS-IV, SDQ and BIS-11 total and subscales scores) in the group of patients with behavioral addictions comorbidity. Level of significance was set at $p = 0.05$. All analyses were carried out using the Statistical Package for the Social Sciences v25 (SPSS) (IBM Corp., 2017).

Ethics

The study procedures were carried out in accordance with the Declaration of Helsinki. The study was approved by the Florence's Institutional Review Board (protocol number #18762). All subjects were informed about the study and all provided informed consent.

RESULTS

Prevalence of behavioral addictions

In the study sample, 146 out of 248 patients (58.9%) had at least one behavioral addiction comorbidity. Of the whole sample, 31.9% of the patients had a comorbidity with one behavioral addiction while the 27% showed a comorbidity with two or more behavioral addictions (16.9% two BAs, 8.1% three BAs and 2% four BAs comorbidities). Internet addiction was the most common comorbidity (33.9%) followed by food addiction (28.6%), shopping addiction (19%), sex addiction (12.9%) and gambling disorder (3.6%) (see Fig. 1).

Comparisons between ADHD patients with and without BAs. Demographic and clinical characteristics of patients with comorbid behavioral addictions (here named as ADHD+BAs) and without behavioral addictions comorbidity

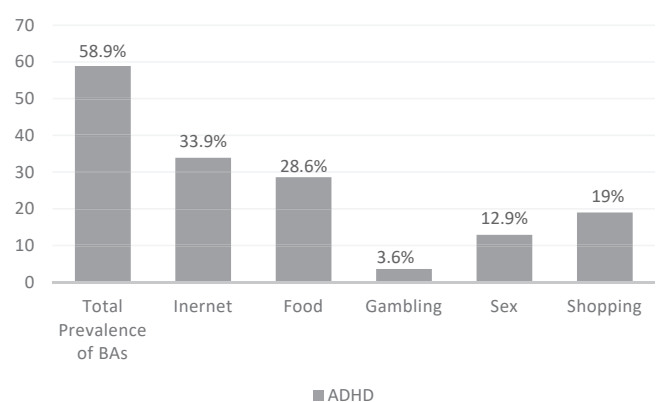


Fig. 1. Prevalence of behavioral addictions comorbidity in the whole adult ADHD sample

Note. Data are expressed as mean for all variables. BAs (behavioral addictions).



(here simply named as ADHD) are displayed in Table 1. The two groups did not differ on age, gender and years of education (see Table 1). Also, the two groups did not differ on rates of lifetime psychiatric comorbidities (65.9% for the ADHD+BAs group vs 70.1% for the ADHD group) ($\chi^2 = 0.450$; $p = 0.502$) and on rates of lifetime substance use disorders (38.2% for the ADHD+BAs group vs 32.4% for the ADHD group) ($\chi^2 = 0.887$; $p = 0.346$). Interestingly, the ADHD+BAs group showed significant higher prevalence for hoarding disorder (32.2% for the ADHD+BAs group vs 9.8% for the ADHD group) ($\chi^2 = 17.003$; $p = 0.000$) and for alcohol abuse (13.1% for the ADHD+BAs group vs 3.9% for the ADHD group) ($\chi^2 = 5.978$; $p = 0.014$) than ADHD group (see Table 2 for details). Considering the whole sample, mood and anxiety disorders were the most common lifetime comorbidities (35.9 and 29.8% respectively) followed by eating disorders and obsessive-compulsive disorder (13 and 6% respectively considering the whole sample). Binge eating disorder (BED) was the most common comorbidity among eating disorders (8.1% considering the whole sample) and interestingly only 14.1% of patients with comorbid BED scored over the cutoff for food addiction at the Y-FAS 2.0. The two groups did not differ on rates of medicated patients ($\chi^2 = 0.816$; $p = 0.366$) (33.9% of the whole sample were on current pharmacological medications, 22.1% under serotonergic

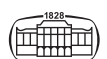
medications, 14.5% under anti-anxiety medications and 4.4% under mood stabilizers).

Patients in the ADHD+BAs group showed significantly higher scores of current and childhood ADHD symptoms in comparison to the ADHD group. The total score and all the subscale scores of the BAARS-IV current and childhood symptoms were significantly higher in the ADHD+BAs vs the ADHD group except for the childhood inattentive subscale that did not reach a statistically significant difference between the two groups ($U = 8,458.5$; $p = 0.054$) (see Table 1). Also, patients in the ADHD+BAs group showed significantly higher impulsivity symptoms. The total score and the attentional and motor subscales of the BIS-11 were significantly higher in the ADHD+BAs vs the ADHD group ($p \leq 0.001$ for all the three scores), while the non-planning subscale did not differ between the two groups ($U = 7,478$; $p = 0.776$) (see Table 1). Concerning mood and anxiety symptoms, again, patients in the ADHD+BAs group vs patients in the ADHD groups showed higher SDQ total scores and higher scores at all the SDQ subscales (mood, anxiety, sleep and appetite/weight subscales) except for the suicidal ideation subscale ($U = 8,227.5$; $p = 0.058$) (see Table 1). Finally, patients with ADHD and comorbid behavioral addictions showed higher levels of functional impairment (median of 5.83 (4.66; 6.68) vs median of

Table 2. Psychiatric comorbidities of patients with ADHD with BAs comorbidity (ADHD+BAs) and ADHD without BAs comorbidity (ADHD)

	ADHD+BAs (n:146)	ADHD (n:102)	χ^2	p
Mood Disorders	52/146 (35.9%)	37/102 (36.2%)	0.004	0.947
Major Depressive Disorder	53/146 (36.6%)	32/102 (21.4%)	0.712	0.399
Bipolar Spectrum Disorder	2/146 (1.4%)	4/102 (3.9%)	1.633	0.201
Anxiety Disorders	44/146 (30.3%)	30/102 (29.4%)	0.025	0.875
Phobia Disorder	1/146 (0.7%)	1/102 (1%)	0.063	0.802
Panic Disorder	15/146 (10.3%)	10/102 (9.8%)	0.019	0.890
Separation Anxiety Disorder	5/146 (3.4%)	4/102 (3.9%)	0.038	0.845
Generalized Anxiety Disorder	21/146 (14.5%)	12/102 (11.8%)	0.382	0.536
Social Anxiety Disorder	7/146 (4.8%)	3/102 (2.9%)	0.549	0.459
Health Anxiety Disorder	4/146 (2.8%)	5/102 (4.9%)	0.783	0.376
OCD and Related Disorders	58/146 (40%)	17 (16.7%)	15.418	0.000
Obsessive-Compulsive Disorder	8/146 (5.5%)	7/102 (6.9%)	0.190	0.663
Hair Pulling Disorder	4/146 (2.8%)	9/102 (0%)	2.869	0.091
Excoriation Disorder	5/146 (3.4%)	4/102 (3.9%)	0.038	0.845
Body Dysmorphic Disorder	0/146 (0%)	1/102 (1%)	1.427	0.232
Hoarding Disorder	47/146 (32.2%)	10/102 (9.8%)	17.003	0.000
Eating Disorders	22/146 (15.2%)	10/102 (9.8%)	1.530	0.216
Anorexia Nervosa	9/146 (6.2%)	4/102 (3.9%)	0.627	0.428
Bulimia Nervosa	4/146 (2.8%)	3/102 (2.9%)	0.007	0.932
Binge Eating Disorder	13/146 (9%)	7/102 (6.9%)	0.356	0.551
Substance Use Disorders	55/146 (38.2%)	33/102 (32.4%)	0.887	0.346
Cannabis	43/146 (29.7%)	26/102 (25.7%)	0.452	0.502
Cocaine	12/146 (8.3%)	11/102 (10.8%)	0.446	0.504
Stimulants	7/146 (4.8%)	8/102 (7.8%)	0.955	0.329
Opioids	3/146 (2.1%)	3/102 (2.9%)	0.192	0.661
Psychedelics	0/146 (0%)	2/102 (2%)	2.866	0.090
Alcohol	19/146 (13.1%)	4/102 (3.9%)	5.978	0.014

Note. Data are expressed as percentage. ADHD = Attention-Deficit Hyperactivity Disorder; BAs: Behavioral Addictions.



4.51 (3.42; 5.65); $p \leq 0.001$) and higher percentages of impaired domains ($p \leq 0.001$) (see Table 1).

Correlation analyses in the ADHD+BAs group. Internet addiction scores showed a moderate positive correlation with ADHD symptoms (BAARS-IV total scores, attentional and sluggish cognitive tempo subscale, $r(144) = 233$, $p = 0.005$, $r(144) = 350$, $p < 0.001$ and $r(144) = 273$, $p = 0.001$ respectively) and impulsivity symptoms (BIS-11 total score and attentional subscale, $r(144) = 262$, $p = 0.001$ and $r(144) = 436$, $p < 0.001$ respectively) and a weak positive correlation with mood and anxiety symptoms (SDQ total score, mood and anxiety subscale, $r(144) = 197$, $p = 0.018$, $r(144) = 192$, $p = 0.021$ and $r(144) = 169$, $p = 0.043$ respectively). Shopping addiction scores showed a moderate positive correlation with ADHD symptoms (BAARS-IV total scores and hyperactivity subscale, $r(144) = 219$, $p = 0.008$, $r(144) = 199$, $p = 0.017$ respectively) and impulsivity symptoms (BIS-11 total score, attentional and motor subscale, $r(144) = 357$, $p < 0.001$, $r(144) = 184$, $p = 0.028$ and $r(144) = 540$, $p < 0.001$ respectively). Sex addiction scores showed a moderate positive correlation with ADHD hyperactivity subscale ($r(144) = 222$, $p = 0.008$). Food addiction scores and gambling disorder scores did not show significant correlation with ADHD, impulsivity, mood and anxiety symptoms.

DISCUSSION

This is one of the first study investigating the prevalence and the clinical correlates of behavioral addictions in a large sample of adults with a primary diagnosis of ADHD. Our study showed that more than half of adult ADHD patients have a behavioral addiction comorbidity. While 31.9% of the patients had a comorbidity with one behavioral addiction, the 27% showed a comorbidity with two or more behavioral addictions. Internet addiction is the most common comorbidity followed by food addiction (28.6%), shopping addiction (19%), sex addiction (12.9%) and gambling disorder (3.6%). ADHD patients with a behavioral addiction comorbidity showed a more complex clinical phenotype in respect to ADHD patients without behavioral addictions comorbidity. Indeed, they showed more severe ADHD symptoms, higher impulsivity levels (both cognitive and motor impulsivity), higher mood and anxiety symptoms and greater functional impairment. Several behavioral addiction symptoms (internet, shopping and sex symptoms) showed a moderate positive correlation with ADHD and impulsivity symptoms in the ADHD group with comorbid behavioral addictions.

The current literature is relatively lacking of studies investigating behavioral addictions prevalence and clinical features in patients with a primary diagnosis of ADHD and the available studies are limited to children or adolescent populations. The high prevalence of behavioral addictions in our sample seems in line with the prevalence of substance use

disorder reported in adult ADHD populations. The prevalence of internet addiction in our sample is significantly higher (33.9%) than that reported across epidemiological studies using the same assessment tool (pooled prevalence of 8.51% according to a recent meta-analysis) (Pan, Chiu, & Lin, 2020), while the prevalence of gambling disorder in our sample is substantially in line with the prevalence reported in the European general population (Calado & Griffiths, 2016; Gabellini, Lucchini, & Gattoni, 2023). Both food and shopping addiction prevalence in our sample were slightly higher than the pooled prevalence rates reported in a recent meta-analysis (28.6% vs 21% for food addiction using the same assessment tools and 19% vs 10% for shopping addiction using different assessment tools) (Alimoradi, Lotfi, Lin, Griffiths, & Pakpour, 2022). On the other hand, our rate of sex addiction comorbidity seems significantly lower in respect to that reported in recent meta-analyses (12.9 vs 34%) (Alimoradi et al., 2022). Concerning the clinical phenotype, our results highlight the relevance of recognizing behavioral addictions comorbidity in adult ADHD patients since these patients may represent a more complex and functionally impaired population of ADHD patients. The moderate correlation found between some of these addictions (mainly internet and shopping addiction) and ADHD and impulsivity symptoms also highlight the importance of treating ADHD symptoms in adult populations as it has been recommended by several international guidelines for ADHD comorbid with substance use disorders (Brynte et al., 2022; Crunelle et al., 2018; Özgen et al., 2020).

The high prevalence of addictive disorders in ADHD should be viewed taking into-account the common neural dysfunctions involved in both disorders. Indeed, reward processing dysfunctions, response inhibition deficits and executive function deficits have been largely documented both in subjects with ADHD and behavioral addictions (Yau et al., 2015). Moreover, the relation between ADHD symptoms and addictive behaviors seem to be mediated by these core dimensions (Davis et al., 2015). Also, childhood ADHD has been consistently recognized as a risk factor for the development of substance use disorders (Crunelle et al., 2018; Ozgen et al., 2020).

Up to date, the literature lacks of controlled study investigating the treatment of comorbid ADHD and behavioral addictions (especially in adults). Thus, is still unclear if treating one of the two conditions could potentially affect the other. Interestingly, two open trials on children and adolescents with ADHD and internet gaming disorder showed some effectiveness on the behavioral addiction symptoms of the anti-ADHD medications methylphenidate and atomoxetine (Han et al., 2009; Park, Lee, Sohn, & Han, 2016). However, the effects of anti-ADHD interventions on other behavioral addictions and in other ADHD populations (e.g. adults) are still missing.

Several limitations are worth mentioning. First of all, the behavioral addictions investigated in this study (except for gambling disorder) lack of reliable and recognized diagnostic criteria. Thus, the presented results should be considered in



the light of this main limitation. Also, the estimate of the prevalence of behavioral addictions in the ADHD sample was not based on a clinical diagnosis (e.g. based on the ICD-11 criteria for Other Specified Disorders Due to Addictive Behaviours) but was based on the IAT, BSAS, SAST-R, SOGS and YFAS scale scores. These assessment tools are based on operational symptoms criteria that could be slightly different across other existing tools. Therefore, the prevalence reported in our study could be substantially different using different instruments. Moreover, using self-report tools such as those just mentioned could potentially imply an over diagnosis (excessive self-estimation of behavioral addictions) as well as an under diagnosis (e.g. patients with low insight in their addictive behaviors). However, our results showed an estimated prevalence of behavioral addictions substantially in line with current literature on lifetime substance use disorders in ADHD populations. Also, despite the large number of patients included in our study, our sample cover a specific ADHD population (adults with high mean level of education). Thus, the results are not generalizable to a broader ADHD population and further studies should expand the investigation to a broader adult ADHD audience (e.g. ADHD patients with low levels of educations and different comorbidity patterns). Finally, the BIS-11 scale has been criticized as a reliable measure of subjective impulsivity and alternative models has been suggested (Kapitány-Fövényi et al., 2020). Therefore, future studies should include more reliable subjective and objective measures of impulsivity.

In conclusion, our study showed that behavioral addictions are highly frequent in adult ADHD patients and that comorbid patients have a more complex phenotype characterized by more severe ADHD, mood and anxiety symptoms, higher impulsivity levels and greater functional impairment. Thus, clinicians should screen adult ADHD patients for the presence of behavioral addictions and future studies should elucidate the impact of ADHD treatment these addictive conditions.

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