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# Examination of Changes in Levels of Empathy and Narcissistic Pathology After Treatment of Adult with Attention-Deficit/Hyperactivity Disorder

## ABSTRACT

**Objective:** The purpose of this study was to investigate changes in narcissistic personality traits and empathy deficits in adults with attention-deficit hyperactivity disorder (ADHD) after pharmacotherapy, focusing on psychostimulant treatment. Understanding these comorbidities is crucial for optimizing treatment and improving therapeutic outcomes.

**Methods:** This cross-sectional cohort study consisted of 75 randomly selected ADHD patients. The patients were started on methylphenidate or atomoxetine as per the indications for treatment. A Sociodemographic Data Form, Adult ADHD Self-Report Scale (ASRS), Pathological Narcissism Inventory (PNI), and Empathy Quotient (EQ) were applied. Based on the study design, Adult ASRS, PNI and EQ were re-administered to the patients at the end of 3 months of treatment. The levels of pathological narcissism and empathy in patients were assessed before and after treatment.

**Results:** The median and minimum–maximum in PNI grandiosity score decreased significantly from 67.00 (30-108) before treatment to 60.00 (24-102) after treatment ($P < .001$). The mean ± Standard Deviation (SD) PNI Vulnerability score decreased statistically significantly from 63.83 ± 26.02 before treatment to 60.06 ± 24.64 after treatment ($P = .003$). The median and minimum–maximum in PNI total score was 134.50 (64-208) pre-treatment, which showed a statistically significant decrease after treatment ($P < .001$). The mean ± SD EQ score decreased statistically significantly from 33.86 ± 7.03 before treatment to 36.53 ± 7.55 after treatment ($P = .001$).

**Conclusion:** Psychostimulant treatment in adult ADHD patients can ameliorate narcissistic traits and enhance empathy, thereby improving social functioning and interpersonal relationships. These findings suggest that psychostimulants may positively modulate neural circuits involved in narcissism and empathy, potentially leading to better treatment outcomes.

**Keywords:** Adult ADHD, personality disorders, empathy, narcissism, psychostimulant treatment

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## Introduction

Attention-deficit hyperactivity disorder (ADHD) is a neurodevelopmental condition that typically emerges in childhood and is characterized by symptoms of inattention, hyperactivity, and impulsivity.[1] Numerous studies have suggested that ADHD is primarily a neurodevelopmental disorder. Nonetheless, ADHD can manifest in various ways, including personality traits, such as neuroticism and impulsivity.[2,3] The rate of prevalence of ADHD in adults is approximately 5%,[4] and individuals with ADHD are at a higher risk of developing psychiatric comorbidities compared to the general population.[5] Attention-deficit hyperactivity disorder can impair multiple areas of functioning and reduce the quality of life, manifesting in pathological personality traits such as difficulties in emotion regulation, distractibility, irresponsibility, risk-taking, and impulsivity.[6] However, there are significant limitations in the existing

literature on the connections between ADHD and personality disorders within the Diagnostic and Statistical Manual of Mental Illnesses (DSM-5) model.[7]

Personality disorders are reported to be more prevalent among adults with ADHD.[8] The prevalence of personality disorder diagnoses in adults with ADHD was reported to range from 10% to 75%.[9] Additionally, approximately 25% of these individuals may have 2 or more personality disorders.[10] It is plausible that ADHD and personality disorders share a common etiology; however, the developmental processes involved remain challenging to elucidate.[9]

Highly compelling and unusual insights within the field of psychiatry have underscored the link between narcissistic personality disorder and ADHD. Narcissistic personality disorder is associated with various negative outcomes, including behavioral issues in individuals with ADHD.[11] Both personality disorders and ADHD may originate from shared developmental pathways and disrupted emotional processes.[11,12] This observed connection supports the identification of narcissistic personality disorder as the most prevalent personality disorder in males with ADHD, while histrionic personality disorder is more common in females.[11,13] Nonetheless, it is important to acknowledge that the body of research in this area remains limited.

Empathy, a vital aspect of social cognition, is essential for a fulfilling social life. Research has identified challenges in facial emotion processing and recognition among adults with ADHD.[14,15] Furthermore, a deficiency in empathy may exacerbate the negative effects experienced by individuals with narcissistic personality disorder, as empathy deficit is a core characteristic of narcissism. The intersection of social cognition and empathy has received considerable attention in ADHD research. Additionally, studies have revealed that autism spectrum disorders and ADHD share commonalities in social dysfunctions, particularly concerning the empathizing–systemizing cognitive style.[16]

Methylphenidate, the gold standard pharmacological treatment for ADHD, has been shown to improve interpersonal relationships and enhance empathy.[15,17] However, individuals with ADHD and comorbid personality disorders may exhibit lower response rates to methylphenidate treatment compared to those with ADHD alone; such patients may also demonstrate reduced compliance with the treatment. This highlights the complexity and variability of treatment outcomes in this population.

It remains unclear whether comorbid personality traits, such as narcissistic personality traits and lack of empathy, which are thought to negatively affect the course of ADHD, can be altered after ADHD treatment and how the treatment contributes to such an alteration.

## MAIN POINTS

- *This study found that pharmacotherapy with psychostimulants significantly reduced narcissistic pathology and increased empathy levels in adult ADHD patients.*
- *Psychostimulant treatment was effective in improving ADHD symptoms and comorbid personality traits.*
- *A comprehensive treatment approach that considers personality traits and empathy levels is crucial for better treatment adherence and long-term outcomes in ADHD patients.*

We hypothesized that adult ADHD patients may have high narcissistic personality traits and low levels of empathy and therefore evaluated these parameters in ADHD patients before and after pharmacotherapy. We also aimed to contribute to the literature by determining treatment approaches that are appropriate for these comorbid personality traits.

## Methods

### Participants and Procedures

This cross-sectional cohort study consisted of 75 randomly selected patients who applied to the psychiatry outpatient unit of Bağcılar Training and Research Hospital between September 2020 and March 2021. The diagnostic status of all patients was evaluated by a specialist psychiatrist through the Structured Clinical Interview for DSM-5 Disorders, Clinician Version (SCID-5-CV). Only adult patients diagnosed according to the ADHD criteria were included in the study. Other inclusion criteria for the study were as follows: being over 18 years of age, literacy, having a Body Mass Index (BMI) of 18.5-25, absence of comorbid psychiatric and neurological disorders, and providing verbal and written informed consent to participate in the study. The height and weight of the patients were determined. The patients were then started on methylphenidate or atomoxetine according to the disease indications by a specialist psychiatrist. In addition, a Semi-Structured Sociodemographic and Clinical Data Form, Adult ADHD Self-Report Scale (ASRS), Pathological Narcissism Inventory (PNI), and Empathy Quotient (EQ) were applied to the participants. Routine psychiatric assessments were carried out by a specialist psychiatrist in the first, second, and third months of receiving pharmacological treatment for adult ADHD. The final study cohort at the end of the third month consisted of 30 patients who received regular pharmacological treatment, had no change in treatment protocol, and came for routine follow-up. As per the study design, the adult ASRS, PNI, and EQ were re-administered to the patients at the end of the third month. Fifteen patients were excluded from the study because they did not continue with the treatment and 10 patients underwent changes in their treatment plans in the last 3 months (Figure 1).

This study was approved by the Ethics Committee of University of Health Sciences Bagcilar Research and Education Hospital (Approval Number: 2020.10.1.11.137.r1.157; Date: Oct 9, 2020).

### Data Collection

**A Semi-Structured Sociodemographic and Clinical Data Form:** Demographic characteristics such as age, height, weight, gender, and clinical features of the disease were evaluated using the sociodemographic data form.

**Adult Attention-Deficit Hyperactivity Disorder Self-Report Scale:** The Adult ASRS Symptom Checklist is a self-reported questionnaire developed by the World Health Organization to screen for the presence of ADHD symptoms in adults according to the DSM-IV ADHD diagnostic criteria. The patient- as well as the rater-administered versions demonstrated high internal consistency, with Cronbach's alpha values of 0.88 and 0.89, respectively. Additionally, the intraclass correlation coefficient (ICC) between the scales for total scores was notably high at 0.84, with ICCs for subset symptom scores also indicating strong agreement, both at 0.83 for the original version.[18] The ASRS is a 5-point Likert-type scale and consists of a

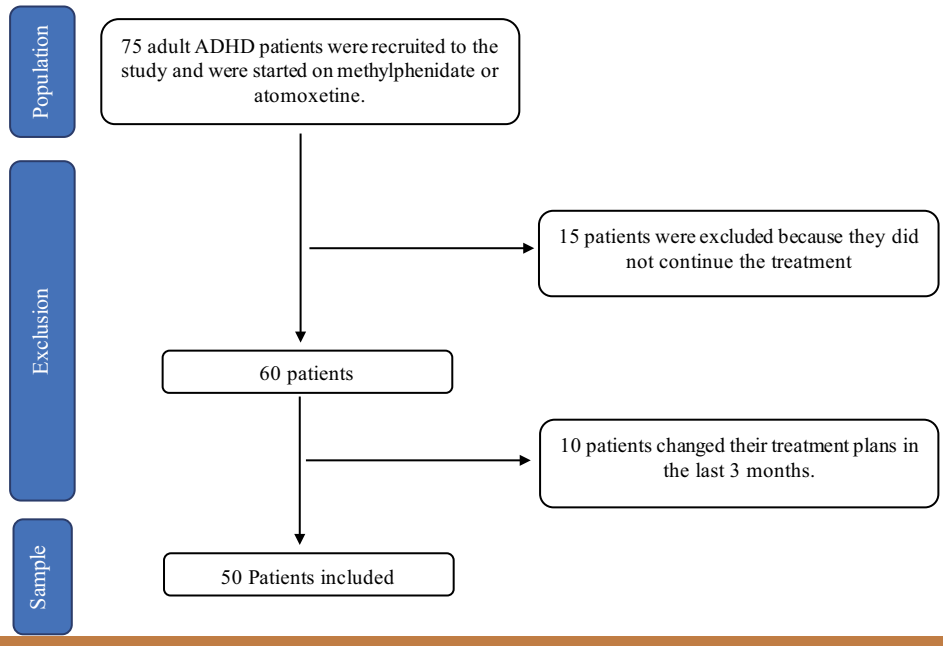


**Figure 1. Flowchart of the patients' inclusion process.**

total of 18 items where each item is scored between 0 and 4 points. Part A contains 6 items; these questions were found to best predict ADHD and were therefore used as a screening tool. Part B includes 12 questions based on DSM criteria that provide additional clues for further investigations into the patient's symptoms. The Cronbach's alpha values for the subscales were also notably high, determined as 0.82 for "attention deficit" and 0.78 for "hyperactivity/impulsivity" of the Turkish version. The Turkish validity and reliability study for this scale has been reported.[19]

**Pathological Narcissism Inventory:** The PNI was designed to distinguish between pathological and normal narcissism. This scale measures narcissism via 2 main factors: grandiose and fragile. The PNI consists of 52 items and is scored in a 6-point Likert style (0: does not describe me at all, 5: describes me completely). The total score exhibited a high level of internal consistency with a Cronbach's alpha of 0.91 in the original version.[20] The Turkish standardization and validity and reliability studies of the PNI were carried out, and the Cronbach Alpha consistency coefficient was found to be 0.93.[21]

**Empathy Quotient (EQ-60) for Adults:** The EQ, developed by Lawrence et al, consists of 60 items, 20 of which are distractors.[22] The EQ demonstrates good reliability with a test–retest reliability coefficient of 0.835 over 12 months for the original version.[22] Kaya and Colakoglu reported the Turkish validity and reliability study of the scale in 2015. The exploratory factor analysis value of the Turkish version, which explains the reliability levels, was found to be 0.78, and the confirmatory factor analysis value was 0.86.[23] The EQ is a Likert-type self-report scale that is scored from 0 (lowest possible empathy) to 80 (highest possible empathy).

### Statistical Analysis

Clinical characteristics and demographics of the participants were presented with descriptive statistical analyses such as n (%), median (minimum–maximum), and mean ± standard deviation (SD). The Kolmogorov–Smirnov test was used to test for the normal distribution of the variables. Variables with a normal distribution were evaluated with the paired *t*-test, and variables that had a non-normal distribution were evaluated with the Wilcoxon signed-rank test. The reliability coefficients of the scales used in this study are based on these scales' Turkish validity and reliability study values. These values are determined as 0.82 for "attention deficit" and 0.78 for "hyperacti vity/impulsivity" for the adult ASRS. It is 0.93 for the PNI and 0.86 for the EQ. The significance level for all analyses was determined as $P < .05$. IBM SPSS v25.0 software (IBM Corp., Armonk, New York, United States) was used for all statistical analyses.

## Results

### Sociodemographic Characteristics of the Study Population

The general characteristics of the 50 participants in the current study diagnosed with adult ADHD are shown in Table 1. The mean ± SD and median (minimum–maximum) age of the participants were 22.20 ± 0.72 and 21.50 (18-32) years, respectively. The mean duration of formal education was 12.13 ± 0.30 years. About 54.00% (n = 27) of the patients were male, and 46.00% (n = 23) were female. The mean ± SD daily dose of methylphenidate was 30.70 ± 2.73 mg, and the mean ± SD daily dose of atomoxetine was 73.33 ± 30.55 mg. About 20.00% (n = 10) of the patients were either not working at all or were not working regularly; 84% (n = 42) of the patients were not married; and 50.00% were smokers. About 36.00% of the patients had used alcohol or substances at least once in their lifetime. About 14.00% of the patients described adverse childhood experiences. About 24.00% (n = 12) of the patients had a history of ADHD in a first-degree relative, while 24.00% of the patients had a history of suicide. Among the patients, 44.00% (n = 22) were treated with extended-release methylphenidate, 50.00% (n = 25) with immediate-release methylphenidate, and 6.00% (n = 3) with atomoxetine.

### Comparison of Clinical Variables Before and After Treatment

Pre- and post-treatment comparisons of the variables related to the ASRS, PNI, and EQ are shown in Table 2. The mean ± SD ASRS

**Table 1.** Characteristics of Participants with Adult Attention-Deficit/Hyperactivity Disorder (ADHD)

| Variables | N (%) / Mean ± SD |
|---|---|
| Age | 22.20 ± 0.72 |
| Education (years) | 12.13 ± 0.30 |
| Methylphenidate dosage (mg) per day | 30.70 ± 2.73 |
| Atomoxetine dosage (mg) per day | 73.33 ± 30.55 |
| Gender | |
| Male | 27 (54. 00) |
| Female | 23 (46. 00) |
| Employment | |
| No/Irregular | 10 (20. 00) |
| Regular | 40 (80.00) |
| Marital status | |
| Unmarried | 42 (84. 00) |
| Married | 8 (16.00) |
| Smoker | |
| Yes | 25 (50. 00) |
| No | 25 (50. 00) |
| Lifetime history of alcohol/substance use | |
| Yes | 18 (36. 00) |
| No | 32 (64.00) |
| Adverse childhood experience | |
| Yes | 7 (14. 00) |
| No | 43 (86.00) |
| Family history of ADHD | |
| Yes | 12 (24. 00) |
| No | 38 (76.00) |
| History of suicide | |
| Yes | 12 (24. 00) |
| No | 38 (76.00) |
| Drug type | |
| Extended-release methylphenidate | 22 (44. 00) |
| Immediate-release methylphenidate | 25 (50. 00) |
| Atomoxetine | 3 (6.00) |

SD, Standard Deviation.

part A score was 15.96 ± 3.50 before treatment and statistically significantly decreased to 9.96 ± 3.88 after treatment ($P < .001$). The median (minimum–maximum) ASRS part B score was 31.00 (13-43) before treatment, which statistically significantly reduced to 15.50 (6-43) after treatment ($P < .001$). There was a statistically significant decrease in the mean ± SD ASRS total score after treatment (28.86 ± 12.05) compared to the pre-treatment score (44.60 ± 10.25) ($P < .001$).

**Table 2.** Pre- and Post-Treatment Comparison of Adult Attention-Deficit Hyperactivity Disorder Self-Report Scale (ASRS), Pathological Narcissism Inventory (PNI), and Empathy Quotient Dependent Variables

| | Pre-Treatment Mean ± SD /Median (Minimmum–Maximum) | Post-Treatment Mean ± SD /Median (Minimum–=Maximum) | *P* |
|---|---|---|---|
| ASRS | | | |
| Part A | 15.96 ± 3.50 | 9.96 ± 3.88 | <.001 |
| Part B | 31.00 (13-43) | 15.50 (6-43) | <.001 |
| Total | 44.60 ± 10.25 | 28.86 ± 12.05 | <.001 |
| PNI | | | |
| Grandiosity | 67.00 (30-108) | 60.00 (24-102) | <.001 |
| Vulnerability | 63.83 ± 26.02 | 60.06 ± 24.64 | .003 |
| Total | 134.50 (64-208) | 119.50 (54-190) | <.001 |
| Empathy quotient | 33.86 ± 7.03 | 36.53 ± 7.55 | .001 |

The median (minimum–maximum) PNI grandiosity score decreased significantly from 67.00 (30-108) before treatment to 60.00 (24-102) after treatment ($P < .001$). The mean ± SD PNI Vulnerability score decreased statistically significantly from 63.83 ± 26.02 before treatment to 60.06 ± 24.64 after treatment ($P = .003$). The median (minimum–maximum) PNI total score was 134.50 (64-208) pre-treatment, which showed a statistically significant decrease after treatment ($P < .001$).

The mean ± SD EQ score increased statistically significantly from 33.86 ± 7.03 before treatment to 36.53 ± 7.55 after treatment ($P = .001$).

## Discussion

To our knowledge, this is the first study to examine changes in the levels of narcissistic pathology and empathy in adult ADHD patients as a result of treatment. Our findings show a significant improvement in the levels of narcissistic pathology and empathy in patients undergoing ADHD treatment.

Individuals with ADHD have a heightened risk of developing comorbid psychiatric disorders throughout their lifetime. These include affective disorders, personality disorders, and substance use disorders, all of which are significantly more common in patients with ADHD compared to the general population.[24-26] One functional brain network that may link ADHD with these comorbid disorders is the reward system. A substantial body of research indicates that individuals with ADHD exhibit altered behaviors and neural activation patterns both in anticipation of and during the receipt of rewards,[27,28] particularly in the frontal-striatal brain regions traditionally associated with reward processing. The reward system, particularly in both humans and rodents, plays a crucial role in reward processing and represents a key node in the behaviors observed in ADHD.[29,30] Notably, each of the aforementioned comorbid disorders is also linked to altered reward processing, as described recently.[28]

Narcissism is also associated with a weakened frontostriatal pathway, and one theory posits that narcissism is caused by a neural disconnect between the self and reward circuits.[31] Narcissists have a larger disparity between their baseline and desired levels of self-reward connectivity compared to non-narcissists. However, an alternative explanation could be that narcissists possess a similar baseline of self-reward connectivity to others, but the amount or magnitude of stimulus necessary to reach their desired levels of self-esteem may be larger. Much like substance-dependent individuals requiring greater and greater doses to achieve their desired high, narcissists may require substantially more external affirmation than their non-narcissist counterparts because each instance is associated with less reward. Indeed, if narcissists do not possess an intrinsically robust frontostriatal connection, external affirmations are unlikely to hold a strong hedonic magnitude.[31]

We found that narcissistic personality traits in ADHD patients responded to pharmacotherapy with methylphenidate; moreover, both grandiose and fragile/covert narcissistic traits benefited from the treatment, showing significant improvement. This suggests that

psychostimulant treatment may be strongly linked to the ability to improve frontostriatal circuit-dependent cognition.[32] Increased regulation and strengthening of the connections in these regions may have ameliorated the pathological symptoms. The treatment of ADHD is complicated by various comorbid conditions, which can influence both treatment response and resistance. Individuals with ADHD and comorbid personality disorders tend to have lower response rates to methylphenidate and worse adherence to treatment compared to those with ADHD alone.[33,34] Therefore, new approaches are needed to mitigate comorbid personality traits in order to enhance treatment adherence and response rates. Hence, the main hypothesis of the current study was that narcissistic personality traits may be high and empathy levels may be low in adult ADHD patients. Results of the current study suggest that neural changes in the reward system due to psychostimulant treatment may mediate such a characteristic.

Individuals diagnosed with ADHD, aside from the core symptoms, commonly encounter significant challenges in establishing connections with peers, which can be further compounded by frequently observed deficits in cognitive and/or affective empathy. Groen et al studied cognitive and emotional empathy in adult ADHD patients and reported lower emotional empathy scores. These authors demonstrated that the traits of ADHD were related to the emotional aspect of empathy. However, the study did not report the more complex aspects of empathy in patients with adult ADHD.[16] Another study indicated that adults with ADHD found facial emotion/affect processing and recognition to be difficult.[15] Individuals with grandiose narcissism are known to show inadequacy in empathy, while individuals with fragile narcissism show socially introverted and avoidant characteristics. A deterioration in the normal coping abilities of individuals with pathological narcissism exacerbates the problems in social relations that the individual may face. Therefore, it is important to ameliorate the lack of empathy, which is considered to be a consequence of ADHD and its comorbidities.

Psychostimulants including methylphenidate and amphetamine are the gold standard for the treatment of ADHD.[35] The use of these drugs was reported to be associated with improvements in social reasoning and interpersonal relationships.[36,37] A recent study by Fantozz et al[38] found a significant improvement in emotional and cognitive empathy scores in ADHD patients after they were treated with methylphenidate. Consistent with the literature, we found that the empathy of ADHD patients benefited significantly with treatment and the empathy levels increased after treatment. We found that the empathy scores of ADHD patients improved significantly with treatment along with a post-treatment increase in empathy levels. A number of brain regions, including the amygdala, cingulate cortex, and some prefrontal regions, are involved in the capacity for empathy.[39,40] It is also suggested that the clinical efficacy of psychostimulants is strongly linked to their ability to improve cognition linked to the prefrontal cortex and extended frontostriatal circuitry.[32] We hypothesize that psychostimulant treatment may increase the ability to empathize by having a positive effect on these regions of the brain. Psychostimulants such as methylphenidate may modulate the prefrontal region, which is activated when an individual feels empathy. Thus, the activation of this neurobiological mechanism may have positively contributed towards increased empathy in personality traits observed in the current study.

There were various limitations that limited the generalizability of our study: small sample size, lack of longitudinal follow-up, lack of a healthy control group, inability to determine the effects of the results on the clinical course of the patients due to the study design, and ignoring potential confounding factors that may affect personality traits.

## Conclusion

In the current study, we found that psychostimulant treatment significantly decreased narcissistic traits and significantly increased empathy skills in patients with ADHD. The diagnosis of pathological narcissism and lack of empathy in ADHD patients is often overlooked. An omission in the consideration of these traits may be the reason for inadequate improvement in areas such as social interaction, social functioning, and interpretation of events. This, in turn, may lead to sub-optimal treatment of ADHD. However, these comorbid conditions should be further interrogated, and more research with large sample sizes should be conducted in order to identify the developmental and clinical aspects. Clinicians should carefully assess these comorbidities and consider the dimensions of both ADHD and comorbid personality disorders to ensure more effective patient management. This approach may facilitate preventive interventions as well as the treatment of comorbid conditions in adulthood.

***Availability of Data and Materials:*** *The data that support the findings of this study are available upon request from the corresponding author.*

***Ethics Committee Approval:*** *This study was approved by the Ethics Committee of University of Health Sciences Bagcilar Research and Education Hospital (Approval Number: 2020.10.1.11.137.r1.157; Date: Oct 9, 2020).*

***Informed Consent:*** *Informed consent was obtained from the patients who agreed to take part in the study.*

***Peer-review:*** *Externally peer-reviewed*

***Author Contributions:*** *Concept – U.T., H.B., H.G., H.K., H.A.A., A.Ç.; Design – U.T., H.B., H.G.; Supervision – U.T., H.B., H.G.; Resources – U.T., H.B., H.G., H.K., H.A.A., A.Ç.; Materials – U.T., H.B., H.G., H.K., H.A.A.; Data Collection and/or Processing – U.T., H.B., H.G., H.K., H.A.A., A.Ç.; Analysis and/or Interpretation – U.T., H.G., H.K., A.Ç.; Literature Search – U.T., H.B., H.G., H.K., H.A.A., A.Ç.; Writing Manuscript – U.T., H.B., H.G., H.K., H.A.A., A.Ç.; Critical Review – U.T., H.B., H.G.*

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## References

1. Torgersen T, Gjervan B, Rasmussen K. ADHD in adults: a study of clinical characteristics, impairment and comorbidity. *Nord J Psychiatry*. 2006;60(1):38-43. [CrossRef]
2. Costa PT, McCrae RR. Domains and facets: hierarchical personality assessment using the revised NEO Personality Inventory. *J Pers Assess*. 1995;64(1):21-50. [CrossRef]
3. Nigg JT, Karalunas SL, Feczko E, Fair DA. Toward a revised nosology for attention-deficit/hyperactivity disorder heterogeneity. *Biol Psychiatry Cogn Neurosci Neuroimaging*. 2020;5(8):726-737. [CrossRef]

4. Polanczyk G, de Lima MS, Horta BL, Biederman J, Rohde LA. The worldwide prevalence of ADHD: a systematic review and metaregression analysis. *Am J Psychiatry*. 2007;164(6):942-948. [CrossRef]
5. Lichtenstein P, Halldner L, Zetterqvist J, et al. Medication for attention deficit-hyperactivity disorder and criminality. *N Engl J Med*. 2012;367(21):2006-2014. [CrossRef]
6. Shaw M, Hodgkins P, Caci H, et al. A systematic review and analysis of long-term outcomes in attention deficit hyperactivity disorder: effects of treatment and non-treatment. *BMC Med*. 2012;10:99. [CrossRef]
7. Jacobsson P, Hopwood CJ, Söderpalm B, Nilsson T. Adult ADHD and emerging models of maladaptive personality: a meta-analytic review. *BMC Psychiatry*. 2021;21(1):282. [CrossRef]
8. Simon V, Czobor P, Bálint S, Mészáros A, Bitter I. Prevalence and correlates of adult attention-deficit hyperactivity disorder: meta-analysis. *Br J Psychiatry*. 2009;194(3):204-211. [CrossRef]
9. Matthies S, Philipsen A. Comorbidity of personality disorders and adult attention deficit hyperactivity disorder (ADHD)--review of recent findings. *Curr Psychiatry Rep*. 2016;18(4):33. [CrossRef]
10. Olsen JL, Reimherr FW, Marchant BK, Wender PH, Robison RJ. The effect of personality disorder symptoms on response to treatment with methylphenidate transdermal system in adults with attention-deficit/hyperactivity disorder. *Prim Care Companion CNS Disord*. 2012;14(5):26293. [CrossRef]
11. Anckarsäter H, Stahlberg O, Larson T, et al. The impact of ADHD and autism spectrum disorders on temperament, character, and personality development. *Am J Psychiatry*. 2006;163(7):1239-1244. [CrossRef]
12. Helgeland MI, Kjelsberg E, Torgersen S. Continuities between emotional and disruptive behavior disorders in adolescence and personality disorders in adulthood. *Am J Psychiatry*. 2005;162(10):1941-1947. [CrossRef]
13. Matthies SD, Philipsen A. Common ground in attention deficit hyperactivity disorder (ADHD) and Borderline Personality Disorder (BPD) - review of recent findings. *Borderline Pers Disord Emot Dysregulation*. 2014;1:3. [CrossRef]
14. Marsh PJ, Williams LM. ADHD and schizophrenia phenomenology: visual scanpaths to emotional faces as a potential psychophysiological marker? *Neurosci Biobehav Rev*. 2006;30(5):651-665. [CrossRef]
15. Miller M, Hanford RB, Fassbender C, Duke M, Schweitzer JB. Affect recognition in adults with ADHD. *J Atten Disord*. 2011;15(6):452-460. [CrossRef]
16. Groen Y, den Heijer AE, Fuermaier ABM, Althaus M, Tucha O. Reduced emotional empathy in adults with subclinical ADHD: evidence from the empathy and systemizing quotient. *Atten Deficit Hyperact Disord*. 2018;10(2):141-150. [CrossRef]
17. Ibáñez A, Petroni A, Urquina H, et al. Cortical deficits of emotional face processing in adults with ADHD: its relation to social cognition and executive function. *Soc Neurosci*. 2011;6(5-6):464-481. [CrossRef]
18. Kessler RC, Adler L, Ames M, et al. The World Health Organization Adult ADHD Self-Report Scale (ASRS): a short screening scale for use in the general population. *Psychol Med*. 2005;35(2):245-256. [CrossRef]
19. Doğan S, Öncü B, Varol Saraçoğlu G, et al. Erişkin dikkat eksikliği hiperaktivite bozukluğu kendi bildirim ölçeği (ASRS-v1.1): Türkçe formunun geçerlilik ve güvenilirliği. *Anadolu Psikiyatr Derg*. 2009;10:77-87.
20. Pincus AL, Ansell EB, Pimentel CA, Cain NM, Wright AGC, Levy KN. Initial construction and validation of the Pathological Narcissism Inventory. *Psychol Assess*. 2009;21(3):365-379. [CrossRef]
21. Şen G, Barışkın E. Patolojik narsisizm envanterinin Türkçe standardizasyonu, geçerlik ve güvenirliğinin sınanması. *Turk Psikiyatri Derg*. 2019;30(2):118-129.
22. Lawrence EJ, Shaw P, Baker D, Baron-Cohen S, David AS. Measuring empathy: reliability and validity of the Empathy Quotient. *Psychol Med*. 2004;34(5):911-919. [CrossRef]
23. Kaya B, Çolakoğlu Ö, Ölçeği EDB. Empati Düzeyi Belirleme Ölçeği (EDBÖ) Uyarlama Çalışması. *İnönü Univ Eğitim Fak Derg*. 2015;16:17-30.
24. Bernardi S, Faraone SV, Cortese S, et al. The lifetime impact of attention deficit hyperactivity disorder: results from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC). *Psychol Med*. 2012;42(4):875-887. [CrossRef]
25. Cortese S, Moreira-Maia CR, St Fleur DST, Morcillo-Peñalver C, Rohde LA, Faraone SV. Association between ADHD and obesity: a systematic review and meta-analysis. *Am J Psychiatry*. 2016;173(1):34-43. [CrossRef]
26. Hanć T, Cortese S. Attention deficit/hyperactivity-disorder and obesity: a review and model of current hypotheses explaining their comorbidity. *Neurosci Biobehav Rev*. 2018;92:16-28. [CrossRef]
27. Plichta MM, Scheres A. Ventral-striatal responsiveness during reward anticipation in ADHD and its relation to trait impulsivity in the healthy population: a meta-analytic review of the fMRI literature. *Neurosci Biobehav Rev*. 2014;38:125-134. [CrossRef]
28. Grimm O, van Rooij D, Hoogman M, et al. Transdiagnostic neuroimaging of reward system phenotypes in ADHD and comorbid disorders. *Neurosci Biobehav Rev*. 2021;128:165-181. [CrossRef]
29. Volkow ND, Wang G-J, Kollins SH, et al. Evaluating dopamine reward pathway in ADHD: clinical implications. *JAMA*. 2009;302(10):1084-1091. [CrossRef]
30. Costa Dias TG, Wilson VB, Bathula DR, et al. Reward circuit connectivity relates to delay discounting in children with attention-deficit/hyperactivity disorder. *Eur Neuropsychopharmacol*. 2013;23(1):33-45. [CrossRef]
31. Chester DS, Lynam DR, Powell DK, DeWall CN. Narcissism is associated with weakened frontostriatal connectivity: a DTI study. *Soc Cogn Affect Neurosci*. 2016;11(7):1036-1040. [CrossRef]
32. Spencer RC, Devilbiss DM, Berridge CW. The cognition-enhancing effects of psychostimulants involve direct action in the prefrontal cortex. *Biol Psychiatry*. 2015;77(11):940-950. [CrossRef]
33. Robison RJ, Reimherr FW, Gale PD, et al. Personality disorders in ADHD Part 2: The effect of symptoms of personality disorder on response to treatment with oros methylphenidate in adults with ADHD. *Ann Clin Psychiatry*. 2010;22(2):94-102.
34. Gift TE, Reimherr FW, Marchant BK, Steans TA, Wender PH. Personality disorder in adult attention-deficit/hyperactivity disorder: attrition and change during long-term treatment. *J Nerv Ment Dis*. 2016;204(5):355-363. [CrossRef]
35. Cortese S, Adamo N, Del Giovane C, et al. Comparative efficacy and tolerability of medications for attention-deficit hyperactivity disorder in children, adolescents, and adults: a systematic review and network meta-analysis. *Lancet Psychiatry*. 2018;5(9):727-738. [CrossRef]
36. Whalen CK, Henker B. Social impact of stimulant treatment for hyperactive children. *J Learn Disabil*. 1991;24(4):231-241. [CrossRef]
37. Whalen CK, Henker B, Granger DA. Social judgment processes in hyperactive boys: effects of methylphenidate and comparisons with normal peers. *J Abnorm Child Psychol*. 1990;18(3):297-316. [CrossRef]
38. Fantozzi P, Muratori P, Caponi MC, et al. Treatment with methylphenidate improves affective but not cognitive empathy in youths with attention-deficit/hyperactivity disorder. *Children (Basel, Switzerland)*. 2021;8(7):596. [CrossRef]
39. de Waal FBM, Preston SD. Mammalian empathy: behavioural manifestations and neural basis. *Nat Rev Neurosci*. 2017;18(8):498-509. [CrossRef]
40. Domínguez-Arriola ME, Olalde-Mathieu VE, Garza-Villarreal EA, Barrios FA. The dorsolateral prefrontal cortex presents structural variations associated with empathy and emotion regulation in psychotherapists. *Brain Topogr*. 2022;35(5-6):613-626. [CrossRef]