

# A Neuropsychological Comparison of Bipolar Disorder and Adult Attention Deficit Hyperactivity Disorder

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## SUMMARY

**Aim:** The present study aimed to compare cognitive signs of bipolar disorder patients with that of adult attention-deficit/hyperactivity disorder (ADHD) patients.

**Method:** The study comprised 66 bipolar disorder patients, 63 ADHD patients, and 58 healthy controls. Structured Clinical Interview for DSM-IV Axis-I Disorders (SCID-I), Wender Utah Rating Scale, and Adult Attention-Deficit/Hyperactivity Rating Scale were performed in all subjects, whereas bipolar disorder patients underwent additional Hamilton Depression Rating Scale and Young Mania Rating Scale. Subsequently, all participants underwent cognitive assessment including Digit Ordering Test, Verbal Memory Process Test, Wisconsin Card Sorting Test and Stroop Test.

**Results:** Bipolar disorder, ADHD and control groups did not differ significantly from each other with regard to age, sex and duration of education. Bipolar patients displayed poorer performance in Digit Span Test, Verbal Memory Process Test, Wisconsin Card Sorting Test and Stroop Test as compared to the control group. ADHD patients were worse than the control subjects in Stroop Test (subtest of difference in times). Bipolar disorder patients were poorer than ADHD patients in cognitive tests except for Stroop Test.

**Conclusion:** In general, bipolar disorder patients have much more severe cognitive impairment than ADHD patients in terms of verbal memory and executive functions. The results supports the idea of bipolar disorder and ADHD are different, at least in terms of cognitive performance.

**Key words:** Bipolar disorder, Attention deficit hiperactivity disorder, adult, neuropsychology

## INTRODUCTION

Bipolar disorder and attention deficit hyperactivity disorder (ADHD) are two common disorders encountered in society causing significant deterioration in functionality (West et al 1995). The presence of overlapping symptoms such as talkativeness, restlessness, distractibility, impulsivity, and affective lability in both bipolar disorder and patients ADHD increases the significance towards the relationship between these two disorders (2000, Nierenberg et al 2005). Bipolar Disorder comorbidity was detected in 11% of ADHD infants in an observation study lasting four years conducted by Biederman et al (1996). In addition, it was witnessed that more than 12% of the patients received bipolar disorder. In this study, it was concluded that ADHD individuals carried high risk of developing

bipolar disorder in adulthood but, this finding was not confirmed in another study (Roberts et al 2000). In the study conducted by Faraone et al (1997), it was determined that ADHD and bipolar disorder carried risk factors of common familial disorders and are quite possibly associated with one another. Conversely, detecting common dysfunctions in anatomical structures such as frontal lobe and striatum in monitoring studies highlights the necessity for better enlightenment of the relationship between these two disorders (Soaresve Mann 1997, Strakowski et al 2005, Casey et al 1997).

Despite all the similarities mentioned above, distinctive discrepancies exist between clinical bipolar disorder and ADHD. For example, bipolar disorder is associated with a course of affective attacks, while symptoms in ADHD show continuity.

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Interestingly, psychotic findings are seen during affective attacks in bipolar disorder, but these episodes are not expected in ADHD (Torralva et al 2011). Although dramatic changes in mood are evident in bipolar disorder, it is expected that light fluctuations may be seen in ADHD.

The debate of the similarities and differences between bipolar disorder and ADHD has resulted in three different views relating to the relationship between these disorders. The first view is that these two conditions are completely different from each other; the second is that these disorders are similar diseases with different developmental views; and the third view is that they have a complex relationship (Kent and Craddock, 2003). One of the ways to understand the neurological relationship between these two disorders is by assessment of the cognitive functions.

Studies independently investigating the cognitive characteristics of these two diseases suggest that bipolar patients and adult ADHD patients in the euthymic period carry verbal memory and executive dysfunctions (Bora et al 2009, Oncu and Olmez 2004, Rodriguez-Jiménez et al 2006). To the best of our knowledge, the sole study comparing the cognitive findings of adult ADHD and bipolar patients was conducted recently by Torralva et al. In this study, it was reported that bipolar patients perform worse in memory tests in comparison to ADHD patients. Nevertheless, there is no difference between two groups in terms of attention and executive functions. However, the authors reported that the study groups (bipolar disorder, p:15, ADHD, p:19, control, p:15) were small and noted this detail as a limitation that may contribute to statistical errors.

In our study, we aimed to compare and evaluate the cognitive functions in bipolar disorder and ADHD adult patients with an extensive control group sample. The findings of this study may contribute to the understanding of the overlapping and reserved views of these two disorders.

## METHOD

### Cases

The study was conducted among control groups consisting of 66 patients (35 females, 31 males) in remission for at least 2 months and 63 patients diagnosed as ADHD (38 females, 25 males) and 58 healthy individuals diagnosed as bipolar disorder defined by the DSM-IV diagnosis criteria. Patients between 18-60 ages that were consecutively being admitted to Pamukkale University, Faculty of Medicine, Psychiatry clinic were assessed. According to DSM-IV criteria, the inclusion criteria for Bipolar I group was as follows: (1) to be diagnosed with bipolar I disorder (remission), (2) remission for at least 2 months, (3) scored a 7 from The Hamilton Depression Rating Scale or a 5 or less from Young Mania Rating Scale. The inclusion criteria for a group of adult ADHD according to the

DSM-IV criteria was as follows: (1) must have received ADHD diagnosis, (2) must have a history of ADHD in childhood, (3) scored a 36 or more on the Wender Utah Rating Scale, and (4) must have scored a 2 or 3 (minimum) from 6 items out of the 9 questions in first and second parts in Adult Attention Deficit Hyperactivity Disorder. The exclusion criteria were co-existence of bipolar disorder and ADHD, mental retardation, psychotic disorders, electro-convulsive therapy within the last 6 months, and the presence of neurological and organic mental disorders. Due to co-existence of bipolar disorder and ADHD, 13 patients (2 patients with bipolar disorder due to mental retardation, 2 patients due to diagnosis of schizoaffective disorder, and 1 ADHD patient due to drug abuse) were excluded the study. Cases in the control group were selected from hospital personnel or acquaintances to match the patients groups in terms of age, gender, and education status.

These people included were informed about the study and their written consents were duly obtained. The study obtained the consent of Pamukkale University, Faculty of Medicine Ethics Committee and is in compliance with Helsinki Declaration.

### Procedure

All of the study participants were interviewed by a psychiatrist SCID I (Structured Clinical Interview for DSM-IV) (First et al 1997). Diagnoses of the clinical groups were authenticated and a control group without psychopathology was created. Forms prepared by us were used for recording the information relating to socio-demographic and clinical characteristics of patients. The Adult Attention Deficit Hyperactivity Disorder Rating Scale and the Wender-Utah Rating Scale were applied to all participants. These tests were used in the group of bipolar I disorder as well as the Hamilton Depression Rating Scale and the Young Mania Rating Scale. After conducting the Structured Clinic Interview for DSM-IV Axis-I Disorders (SCID-I/CV) and filling in clinic rating scales, the Letter-Number Sequencing Test, a subset of WAIS-R (Wechsler Adult Intelligence Scale-Revised) (Wechsler 1987; Karakas et al 1996), a Verbal Memory Processes Test (Öktem 1996), Wisconsin Card Sorting Test (Heaton et al 1993; Karakas et al 1996) and a Stroop Test Dotrill Form (Stroop 1935a, Stroop 1935, Karakas et al 1999) were all given to the participants in a different session by an experienced clinic psychologist.

### Measuring tools

#### Clinical rating scales

Structured Clinical Interview for DSM-IV Axis-I (SCID-I/CV)

According to the DSM-IV Axis-I is a structured interview tool developed by First et al (1997) for investigating diagnosis

of Axis-I mental disorders. Turkish adaptation and reliability studies were performed by Corapcioglu et al (1999).

### **Hamilton Depression Rating Scale**

A rating scale was applied by the interviewer and developed for the rating severity of depression symptoms (Hamilton 1967). Validity and reliability studies of the Turkish version were performed by Akdemir et al (1996). The scale consists of 17 items scored between 0-4 points. The total sum of the scores of all items gives information about the severity of depression.

### **Young Mania Rating Scale**

It is a scale consisting of 11 items used for measuring the severity of mania that is issued by an interviewer. Seven out of the eleven items are in the five Likert type and the remaining four items are in the nine Likert type for providing proper measurement (Young et al 1978). Validity and reliability studies of the Turkish version were performed by Karadag et al (2002).

### **Adult ADHD Rating Scale**

Adult ADHD rating scale was developed by Turgay (1995). It is a five-point Likert-type rating scale consisting of three sub-sections as characteristics and problems relating to Attention Deficit, Hyperactivity / Impulsivity and ADHD. Research on the validity and reliability of the Turkish version was conducted by Gunay et al (2006).

### **Wender Utah Rating Scale**

It is a scale consisting of 61 items developed for investigating childhood ADHD symptoms retrospectively and helping diagnosis of ADHD in adults (Ward et al 1993). Twenty five items identified to distinguish adult ADHD patients from healthy patients are scored. When a minimum threshold score of 36 or is considered, the sensitivity and specificity of the test is 82.5% and 90.8%, respectively (Lead et al 2005).

### **Neuropsychological tests**

#### **Rey Auditory Verbal Learning Test (RAVLT)**

It was developed by Oktem and Tanor (1992) and is similar to the word list learning test developed by Rey (1964). A list of 15 words is read 10 times to the subject in this test. By means of the test, variables such as total learning score, the highest learning score, long-term memory word recalling, and inconsistency in item recalling can be calculated (Oktem 1996). Learning scores measure the increase of words recalled when the list is read multiple times. The inconsistency score in item recall measures the case of failure in recalling the later words learned and recalled in previous repetitions. This type

of function is considered to reflect a verbal memory test temporal cortex (Floel et al 2004).

### **Digit Span Test**

Being a sub-scale of WAIS-R, it consists of two parts in a way of forward and backward sequencing of digits. Flat number count is based on what the subject can remember and repeat with mixed numbers and accuracy is used for scoring short term memory. Reverse number count determines the accuracy of the working memory by having the subject recite complex numbers given verbally from the last number given to the first (Wechsler, 1987, Lezak 1995). In this study, sub-test of reverse number counting was used. It was reported that performance of digit sequence tests would be associated with dysfunction of several areas in brain (Sun et al 2005). Standardization studies of WASI-R were carried out (Karakas et al 1996).

### **Wisconsin Card Sorting Test (WCST)**

WCST was developed by Heaton (1993) for rating the ability of mind flexibility and abstraction. Standardization studies in Turkey were conducted by Karakas et al (1996). It is used to assess the capabilities of executive functions, strategic planning, change category, mental control, and organizational skills. These functions evaluated by the Wisconsin Card Sorting test are considered in association with the dorsolateral prefrontal cortex (Karakas and Eski, 2004).

### **Stroop Test**

Stroop test was developed by Stroop (1935a, 1935b). Validity and reliability studies of the Turkish version were performed by Karadas et al (1999). It reveals the ability of suppressing habitual pattern of a behavior and the ability of changing one's perceptual set in parallel with the demands whose Stroop test is altered especially when under the influence of a disturbance (Karakas and Kafadar 1999). There are two stages of the test. In the first place, subjects are requested to say color names written in ink with a different color. In the second place, subjects are requested to say what color ink the names are written by ignoring color names. The period elapsed in the test for completing two phases by a subject, difference between these periods, correct and false answers are calculated. In particular, calculating period difference is considered to be an indicator of response suppression skills (1999). It is considered that the Stroop test measures the function of anterior cingulate cortex (Leung et al 2000).

### **Statistical Analyses**

Statistical analyses were conducted by making use of SPSS (Statistical Package for Social Sciences) 10.0 Package Program. The differences between the groups in terms of categorical

variable was investigated by  $\chi^2$  (Chi-square) test. A p-value of greater than 0.05 was determined as statistically significant. Differences in neuropsychological test scores were investigated by one-way ANOVA. Bilateral comparisons (post-hoc) were conducted by using Tukey correction for understanding from what group the scores having statistically significant differences arise. Significance values were adopted as  $p < 0.05$ .

## RESULTS

### Socio-demographic and clinical characteristics of the groups

Bipolar disorder, ADHD, and control groups were not significantly different from one another in terms of age (respectively  $34.07 \pm 8.58$ ,  $30.85 \pm 6.91$ ,  $32.98 \pm 8.23$ ,  $F=2.71$ ,  $df=184$ ,  $p=0.07$ ), gender ( $\chi^2=0.69$ ,  $df=2$ ,  $p=0.70$ ) and education time (year;  $9.77 \pm 3.97$ ,  $10.68 \pm 3.55$ ,  $10.56 \pm 3.88$ ,  $F=1.20$ ,  $df=184$ ,  $p=0.34$ ). Age of patients with bipolar illness onset was  $24.91 \pm 9.06$  and disease time was  $11.28 \pm 6.26$ . The number of total attack was  $5.46 \pm 4.90$ . Two of the patients (3.1%) with bipolar disorder were not using drugs. Out of other patients, 17 patients (26.5%) was using lithium, 7 patients valproic acid (10.9%), 6 patients (9.2%) an affective regulator, 2 patients

(3.1%) second generation anti-psychotic, 29 patients affective regulator and second generation antipsychotic (42.8%) and 3 patients were using 2 affective regulators and second generation antipsychotic (4.6%). Twenty of the ADHD patients (31.7%) were predominantly the inattentive type, 18 (28.6%) were predominantly hyperactivity-impulsivity and the remaining 25(39.7%) were combined type. Patients in ADHD groups received no diagnosis beforehand and thus, were not on any drugs other than those used in the group 2 patients (sertraline).

Both patients with bipolar disorder and ADHD had some co-diagnoses (Table 1). The group of these two patients was significantly different from one another in terms of Wender-Utah and Adult Attention Deficit Hyperactivity scale scores. (All  $p=0.000$ ; Table 2).

### Cognitive functions of the groups

Statistically significant differences were found in all sub-tests of all neuropsychological tests except for Wisconsin Card Sorting Test set-maintenance failure between the two group

#### Memory

Bipolar patients showed worse performance than control group in all sub-tests of WCST (the highest learning score  $p=0.000$ , long term memory automatic recall  $p=0.000$ , total learning score  $p=0.000$ , inconsistency  $p=0.000$ ). These patients were much worse when compared with patients with WCST in all sub-tests of the highest learning ( $p=0.000$ ), long term memory automatic recall ( $p=0.000$ ), and total learning ( $p=0.000$ ). However, patients with DEHB were worse when compared with controls in only inconsistency subtest ( $p=0.010$ ).

#### Executive functions

Bipolar patient group showed worse performance when compared with control group in sub-tests of the number of categories completed in Wisconsin Card Sorting test ( $p=0.010$ ), perseverative response rate ( $p=0.005$ ), preservative error count ( $p=0.003$ ), preservative percentage error ( $p=0.002$ ),

**Table 1.** Comorbidity of the groups

Comorbid Axis I Diagnoses	Adult ADHD group n=63		Bipolar disorder group n=66	
	Number	(%)	Number	(%)
Depressive Disorder	6	9.5	-	-
Generalized Anxiety Disorder	5	7.9	-	-
Panic Disorder	4	6.3	3	4.5
Obsessive Compulsive Disorder	5	7.9	5	7.5
Social anxiety disorder	1	1.5	1	1.5
Conversion disorder	-	-	5	7.5
Impulse control disorder	-	-	1	1.5
Premenstrual dysphoric syndrome	-	-	1	1.5
No additional diagnosis	42	66.9	16	76

ADHD: Attention Deficit Hyperactivity Disorder

**Table 2.** Scale scores of the groups (The table to inserted into the text) ADHD: Attention Deficit Hyperactivity Disorder

	Bipolar disorder	ADHD:	Checks	F	df	p*
	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD			
Wender Utah Scale	25.19 $\pm$ 17.03	51.79 $\pm$ 13.79	18.70 $\pm$ 10.28	95.20	184	0.00
Adult attention deficit hyperactivity Scale						
Attention deficit	8.27 $\pm$ 5.53	15.41 $\pm$ 4.93	6.12 $\pm$ 3.54	63.58	184	0.00
Hyperactivity	7.12 $\pm$ 5.81	16.28 $\pm$ 5.40	5.32 $\pm$ 4.12	79.11	184	0.00
ADHD symptom score	24.30 $\pm$ 17.42	43.98 $\pm$ 16.69	5.25 $\pm$ 4.83	108.75	184	0.00

ADHD: Attention-deficit hyperactivity disorder, \*One-way ANOVA.

**Table 3.** Comparison of neuropsychological test performances of the groups

	<b>Bipolar disorder Mean ± SD</b>	<b>ADHD: Mean ± SD</b>	<b>Control Mean ± SD</b>	<b>F</b>	<b>df</b>	<b>p*</b>	<b>Comparison</b>
<b>Auditory Verbal Learning Test</b>							
The highest learning points	12.79 ± 2.66	14.38 ± 1.21	14.72 ± 1.06	20.25	184	0.000	Bipolar> ADHD and control
Long-term memory automatic recall	10.91 ± 3.23	12.67 ± 1.60	12.67 ± 1.75	12.02	184	0.000	Bipolar> ADHD and control
Total learning score	100.67 ± 28.37	119.41 ± 16.14	127.14 ± 11.34	28.31	184	0.000	Bipolar> ADHD and control
Inconsistency	4.86 ± 3.56	3.65 ± 3.55	1.90 ± 2.18	12.75	184	0,000	Bipolar, ADHD > control
<b>Wisconsin Card Sorting Test</b>							
Number of categories completed	3.21 ± 2.22	4.56 ± 1.82	4.28 ± 2.00	7.92	184	0.000	Bipolar> ADHD and control
Number of perseverative response	29.85 ± 30.56	21.13 ± 25.11	16.33 ± 11.34	5.05	184	0.007	Bipolar> Control
Number of perseverative errors	28.00 ± 28.73	17.89 ± 20.20	15.11 ± 11.33	6.16	184	0.003	Bipolar> ADHD and control
Number of conceptual level response	44.53 ± 22.08	51.21 ± 19.11	55.10 ± 18.38	4.47	184	0.013	Bipolar> Control
Failure in maintaining set up	0.70 ± 0.93	0.56 ± 1.06	0.50 ± 0.82	0.72	184	0.48	
<b>Digit Span Test</b>							
Reverse number	4.88 ± 1.51	5.87 ± 2.03	6.12 ± 1.67	8.96	184	0.000	Bipolar> ADHD and control
<b>Stroop test</b>							
Wrong Number	2.20 ± 4.62	0.56 ± 1.33	1.10 ± 1.79	4.95	184	0.008	Bipolar> ADHD
Correction	1.67 ± 2.13	2.51 ± 2.21	1.50 ± 1.93	4.11	184	0.018	ADHD> control
Time difference	58.08 ± 29.46	50.59 ± 21.72	39.07 ± 10.67	11.21	184	0.000	Bipolar, ADHD > control

\* One-way ANOVA

ADHD: Attention Deficit Hyperactivity Disorder

number of conceptual level response ( $p=0.009$ ), percentage of conceptual level response ( $p=0.046$ ) subtests, time difference sub-test of Stroop Test ( $p=0.000$ ), Digit Span Test reverse number sub-test ( $p=0.000$ ). Bipolar patients were much worse when compared with ADHD patients in the number of categories completed ( $p=0.000$ ), preservative error count ( $p=0.022$ ), percentage of conceptual level response ( $p=0.013$ ) subtests in Wisconsin Card Sorting test, reverse number sub-test of Digit Span Test ( $p=0.004$ ), false number sub-test of Stroop Test ( $p=0.006$ ). Patients with ADHD ( $p=0.000$ ) were much worse than control group in reverse number sub-test of Test Digit Span ( $p=0.000$ ) and time difference ( $p=0.013$ ) and correction sub-tests ( $p=0.022$ ).

## DISCUSSION

In this study, it was aimed to compare cognitive findings of adult bipolar and ADHD patients among themselves and with control group. Our findings suggest that patients with bipolar disorder are much worse than both healthy persons and patients with ADHD in terms of memory and executive functions. Patients with ADHD showed corrupted performance in similar way to bipolar disorder in terms of response suppression function out of executive functions.

It is known that patients with bipolar disorder have dysfunctions in memory and several executive function fields (Bora et al 2009). In line with the findings, patients with bipolar

disorder were found to show verbal memory and executive dysfunctions in our study. On the other hand, the studies evaluating executive functions of adult ADHD patients reported frequent planning and response suppression disorders (Desjardins et al 2010, Seidman et al 2004). The results of our study showed that patients with ADHD had response suppression disorders. However, patients with ADHD did not show any disorder in countdown sub-test of Digit Span Test in which planning skill was shown. However, patients with ADHD showed inconsistency sub-test of WCST suggesting that learning styles are a lack of planning. Patients with ADHD show normal performance in Digit Span Test but organizational disorder during learning a verbal material might arise from the fact that these patients experience greater difficulty in learning verbal material when compared with digital material. It will be of the utmost importance to investigate this issue by more specific studies. While the data of our study shows a planning disorder during verbal material by patients with ADHD, it is suggested that they are not much different from controls in terms of recalling verbal memory materials. Despite the availability of the studies reporting reverse conditions such as our study (Torralva et al 2011), there are studies reporting verbal memory disorders in patients with ADHD (Woods et al 2002). The results conflicting with one another in this field might arise from methodological differences between the studies and are open to investigation conducted by other studies.

To our best knowledge, there has been only one study in the literature investigating cognitive differences between the patients with adult bipolar and ADHD (Torralva et al 2011). In this study, it was reported that patients with bipolar disorder had worse verbal and visual memory disorders, but there was no significant difference between two groups in terms of executive functions. Due to the small number of participants in this study, the authors stated that the statistical power was weak. The results of our study gain importance at this point. In this study, it was found that patients with bipolar disorder showed executive dysfunctions except for verbal memory disorders and response suppression when compared with patients with ADHD. These results suggest that bipolar disorder and ADHD showing clinic symptoms could demonstrate different characteristics in cognitive aspects. These two diseases could not be separated from one another and, under clinic cases, neuropsychological review could be of utmost use. By considering the studies suggesting that impaired cognitive functions are effective over life qualities of patients (Brissos et al 2008), the results of this study indirectly support that life quality orders of bipolar disorder patients in the euthymic period might be impaired when compared patients with ADHD. However, the results of the study could not prove accuracy of this notion. New studies that shall investigate life quality orders in both diseases might be useful in diagnosing this potential discrepancy.

Though several differences are present in terms of cognitive aspect among patients with bipolar disorder and patients with adult ADHD, the groups strikingly showed disorder to violence in a fashion similar to one another in terms of response suppression function. It is considered that response suppression function dysfunctions might be in association with impulsivity (Kaladjan et al 2011). From this perspective, the response suppression dysfunctions of the groups are similar and might reflect common impulsivity in both diseases.

In general, it is considered that verbal memory functions are the functions in relation with middle temporal area (Floel et al, 2004), dorsolateral prefrontal cortex of mental flexibility, (Karakas and Eski 2004) and anterior cingulate cortex of response suppression (Leung et al, 2000). From this perspective, our results suggest that patients with bipolar disorder have dysfunctions in each three brain areas and patients with ADHD showed dysfunctions in anterior cingulate cortex from these three areas. It was reported that patients with bipolar disorder showed dysfunctions in relation to dorsolateral prefrontal cortex (Hassel et al 2008, Frey et al 2007) and the anterior cingulate cortex. On the other hand, one of the brain areas where the most frequent dysfunction is shown in patients with adult ADHD is anterior cingulate cortex (Frodal and Skokauskas 2012). Our findings suggest that a wider brain area shows dysfunction in bipolar disorder when compared with ADHD. Only the studies which will compare

these two disease groups with functional monitoring methods will prove this notion.

Patients with bipolar disorder that use drugs can be considered as limitation of this study in terms of the possibility of affecting cognitive functions. Despite availability of the studies suggesting that cognitive disorders are a characteristic of this disease and are independent of effects of drugs (Mur et al 2007), comparison studies that will be conducted in patient groups not using drug are needed for reaching more reliable results. On the other hand, that patients with bipolar disorder and ADHD in this study have comorbidity is considered as limitation of the study when cognitive disorders are seen in other several diseases.

While disorders were witnessed in executive functions where response suppression ability and verbal memory are present in patients with bipolar disorder, response suppression disorder was witnessed in patients with ADHD. Overall, our findings suggest that patients with bipolar disorder show more severe cognitive dysfunctions than patients with ADHD in terms of verbal memory and executive functions. These findings at least support that bipolar disorder and ADHD are different disorders from one another in terms of a cognitive perspective.

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## REFERENCES

- Akdemir A, Örsel S, Dağ İ ve ark. (1996) Hamilton Depresyon Derecelendirme Ölçeği (HDDÖ)'nin geçerliği, güvenilirliği ve klinikte kullanımı. *Psikiyatri Psikoloji Psikiyatri Dergisi*, 4:251-59.
- Biederman J, Faraone S, Mick E et al (1996) Attention-deficit hyperactivity disorder and juvenile mania: an overlooked comorbidity? *J Am Acad Child Adolesc Psychiatry* 35: 997-1008.
- Bora E, Yucel M, Pantelis C (2009) Cognitive endophenotypes of bipolar disorder: a meta-analysis of neuropsychological deficits in euthymic patients and their first-degree relatives. *J Affect Disord* 113:1-20.
- Brissos S, Dias VV, Kapczinski F (2008) Cognitive performance and quality of life in bipolar disorder. *Can J Psychiatry* 53:517-24.
- Casey BJ, Castellanos FX, Giedd JN et al (1997) Implication of right frontostriatal circuitry in response inhibition and attention deficit/hyperactivity disorder. *J Am Acad Child Adolesc Psychiatry* 36: 374-83.
- Çorapçıoğlu A, Aydemir Ö, Yıldız M et al (1999) Reliability of clinic evaluation in Turkish version according to DSM-IV axis I mental disorders *Journal of Drug and Therapeutics* 12: 33-6.
- Desjardins C, Scherzer P, Braun CM et al (2010) A verbal planning impairment in adult ADHD indexed by script generation tasks. *J Atten Disord* 14:220-31.
- Faraone SV, Biederman J, Mennin D et al (1997) Attention-deficit hyperactivity disorder bipolar disorder: a familial subtype? *J Am Acad Child Adolesc Psychiatry* 36:1378-90.
- First MB, Spitzer RL, Gibbon M et al (1997) Structured Clinical Interview for DSM-IV Clinical Version (SCID-I/CV). Washington American psychiatric press s. 1-87.
- Floel A, Poeppel D, Buffalo EA et al (2004) Prefrontal Cortex Asymmetry for Memory Encoding of Words and Abstract Shapes *Cerebral Cortex*. *Cereb Cortex* 14:404-9.
- Frey BN, Stanley JA, Nery FG ve ark (2007) Abnormal cellular energy and phospholipid metabolism in the left dorsolateral prefrontal cortex of

- medication-free individuals with bipolar disorder: an in vivo 1H MRS study. *Bipolar Disord Suppl* 1:119-27.
- Frodl T, Skokauskas N (2012) Meta-analysis of structural MRI studies in children and adults with attention deficit hyperactivity disorder indicates treatment effects. *Acta Psychiatr Scand* 125:114-26.
- Günay Ş, Savran C, Aksoy UM et al (2006) Erişkin Dikkat Eksikliği Hiperaktivite ölçeğinin (Adult ADD/ ADHD DSM IV based diagnostic screening and rating Scale) dilsel eşdeğerlilik, geçerlik güvenilirlik ve norm çalışması. *Türkiye'de Psikiyatri* 8: 98-107.
- Hamilton M (1967) Development of a rating scale for primary depressive illness. *Br J Soc Clin Psychol* 6:278-96.
- Hassel S, Almeida JR, Kerr N et al (2008) Elevated striatal and decreased dorsolateral prefrontal cortical activity in response to emotional stimuli in euthymic bipolar disorder: no associations with psychotropic medication load. *Bipolar Disord* 10:916-27.
- Heaton RK, Chelune GJ, Talley JL et al (1993) Wisconsin card sorting test manual: Revised and expanded. *Florida Psychological Assessment Resources* s. 62-230.
- Kaladjian A, Jeanningros R, Azorin JM et al (2011) Impulsivity and neural correlates of response inhibition in schizophrenia. *Psychol Med* 41:291-9.
- Karadağ F, Oral ET, AranYalçın F et al (2002) Young Mani Derecelendirme Ölçeğinin Türkiye'de geçerlik ve güvenilirliği. *Türk Psikiyatri Derg* 13:107-14.
- Karakaş S, Eski R (2004) Nörokognitif testler için araştırma ve geliştirme çalışmaları. *Ankara Dizayn Ofset*.
- Karakaş S, Eski R, Başar E (1996) Türk kültürü için standardizasyonu yapılmış nöropsikolojik testler topluluğu: BİLNOT Bataryası. 32. Ulusal Nöroloji Kongresi Kitabı. İstanbul Ufuk Matbaası: 43-70.
- Karakaş S, Erdoğan E, Sak L et al (1999) StroopTesti TBAG Formu: Turkish Culture Standardization, Reliability, and Validity. *Clinical Psychiatry* 2:75-88.
- Karakaş S, Kafadar H (1999) Şizofrenideki bilişsel süreçlerin değerlendirilmesinde nöropsikolojik testler: bellek ve dikkatin ölçülmesi. *Şizofreni dizisi* 4:132-52.
- Kent L, Craddock N (2003) Is there a relationship between attention deficit hyperactivity disorder and bipolar disorder? *J Affect Disord* 73:211-21.
- Leung HC, Skudlarski P, Gatenby JC et al (2000) An event-related functional MRI study of the Stroop color word interference task. *Cereb Cortex* 10:552-60.
- Lezak MD (1995) *Neuropsychological assessment*. New York Oxford University Press s. 86.
- Mur M, Portella MJ, Martínez-Arán A et al (2007) Persistent neuropsychological deficit in euthymic bipolar patients: executive function as a core deficit. *J Clin Psychiatry* 68:1078-86.
- Nierenberg AA, Miyahara S, Spencer T et al (2005) Clinical and diagnostic implications of lifetime attention-deficit/hyperactivity disorder comorbidity in adults with bipolar disorder: data from the first 1000 STEP-BD participants. *Biol Psychiatry* 57:1467-73.
- Öktem, Ö. (1992) Auditory Verbal Learning Test (RAVLT) - A Preliminary Study. *Arch Neuropsych* 29:196-206
- Öktem Ö, Topraksever Y, Göregenli M (1996) A new verbal memory test. VIII. Scientific work of the National Congress of Psychology. Ankara: Turkish Psychological Association Publications: 45-57.
- Öncü B, Ölmez Ş (2004) Neuropsychological findings in adults with attention deficit hyperactivity disorder. *Türk Psikiyatri Derg* 15:41-6.
- Öncü B, Ölmez S, Şentürk V (2005) Validity and reliability of the Turkish version of the Wender Utah Rating Scale for attention-deficit/ hyperactivity disorders in adults. *Türk Psikiyatri Derg* 16:252-9.
- Rey A (1964). *L'examen Clinique en Psychologie*. Paris PresseUniversitaire de France.
- Roberts N, Parker KC, Woogh C et al (2000) Bipolar disorder in ADHD children grown up. *J Am Acad Child Adolesc Psychiatry* 39:678-9.
- Rodriguez-Jiménez R, Cubillo A, Jiménez-Arriero MA et al (2006) Executive dysfunctions in adults with attention deficit hyperactivity disorder. *Rev Neurol* 43:678-84.
- Sachs GS, Baldassano CF, Truman CJ et al (2000) Comorbidity of attention deficit hyperactivity disorder with early-and late-onset bipolar disorder. *Am J Psychiatry* 157: 466-8.
- Seidman LJ, Doyle A, Fried R et al (2004) Neuropsychological function in adults with attention-deficit/hyperactivity disorder. *Psychiatr Clin North Am* 27:261-82.
- Soares JC, Mann JJ (1997) The anatomy of mood disorders-review of structural neuroimaging studies. *Biol Psychiatry* 41:86-106.
- Stroop JR (1935a) Studies of interference in serial verbal reactions. *J Exp Psychol* 18:643-62.
- Stroop JR (1935b) The basis of ligons theory. *Am J Psychol* 47:499-504.
- Strakowski SM, DelBello MP, Adler CM (2005) The functional neuroanatomy of bipolar disorder: a review of neuroimaging findings. *Mol Psychiatry* 10:105-16.
- Sun X, Zhang X, Chen X et al (2005) Age-dependent brain activation during forward and backward digit recall revealed by fMRI. *Neuroimage* 26:36-47.
- Torrvalva T, Gleichgerrcht E, Torrente F et al (2011) Neuropsychological functioning in adult bipolar disorder and ADHD patients: a comparative study. *Psychiatry Res* 186:261-6.
- Turgay A. Diagnosis and review inventory integrated therapy institute (unpublished scale) of adult attention deficit hyperactivity disorder based on DSM-IV, Canada 1995
- West SA, McElroy SL, Strakowski SM et al (1995) Attention Deficit Hyperactivity Disorder in adolescent mania. *Am J Psychiatry* 152:271-3.
- Woods SP, Lovejoy DW, Ball JD (2002) Neuropsychological characteristics of adults with ADHD: a comprehensive review of initial studies. *Clin Neuropsychol* 16:12-34.
- Wechsler D (1987) *The Wechsler Memory Scale - Revised* (Psychological corporation). New York Harcourt Brace Jovanovich.
- Ward MF, Wender PH, Reimherr FW (1993) The Wender Utah Rating Scale: An aid in the retrospective diagnosis of childhood Attention Deficit Hyperactivity Disorder. *Am J Psychol* 50:885-90.
- Young RC, Biggs JT, Ziegler VE et al (1978) A rating scale for mania: reliability, validity and sensitivity. *Br J Psychiatry* 133:429-35.