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RESEARCH

Relationship between impulsivity, aggression and blood ghrelin, vitamin D, lipids levels in borderline personality disorder

Borderline kişilik bozukluğunda dürtüsellik ve saldırganlık ile kan ghrelin, D vitamini, lipit düzeyleri arasındaki ilişki

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Abstract

Purpose: This study aimed to investigate the correlations between impulsivity and aggression, and blood ghrelin, lipids, and vitamin D levels in Borderline Personality Disorder (BPD).

Materials and Methods: Thirty female patients with BPD and 30 healthy controls were included to the study. Sociodemographic Data Form, Beck Anxiety Inventory (BAI), Beck Depression Inventory (BDI), Barratt Impulsivity Scale Short Form (BIS-11-SF), Buss-Perry Aggression Questionnaire (BPAQ) were applied.

Results: Ghrelin, cholesterol, and triglyceride (TG) levels were higher in BPD patients (p=0.013, p=0.042, p=0.019, respectively); however, there was no significant difference between the groups based on vitamin D, High-density lipoprotein (HDL) and Low-density lipoprotein (LDL) levels. There was no correlation between ghrelin, and lipid and vitamin D levels. The BIS-11 and BPAQ scores were higher in BPD group. A positive correlation was determined between ghrelin and BIS-11 scores. A positive correlation was found between vitamin D and 'anger' subscale score of BPAQ. A negative correlation was identified between triglyceride and the 'verbal aggression' subscale score of BPAQ.

Conclusion: BPD is a disorder with several hospital admissions, frequent comorbid conditions, problematic social relationships, and functionality, and the treatment is quite difficult. Regulation of Ghrelin, vitamin D and lipid levels could assist clinicians in the treatment and clinical follow-up of the disease.

Keywords:. Borderline personality disorder, impulsive behavior, aggression, ghrelin, vitamin D, lipids

Öz

Amaç: Bu çalışmada Borderline Kişilik Bozukluğu (BKB)'da impulsivite ve agresyonun serum ghrelin, lipit ve D vitamini düzeyleriyle ilişkisinin araştırırılması planlandı.

Gereç ve Yöntem: Çalışmaya BKB tanılı 30 kadın hasta ve 30 sağlıklı kontrol dâhil edildi. Katılımcılara Sosyodemografik ve Klinik Bilgi Formu, Beck Anksiyete Envanteri, Beck Depresyon Envanteri, Barratt Dürtüsellik Ölçeği-Kısa Form (BIS-11-KF), Buss-Perry Saldırganlık Ölçeği (BPSÖ) uygulandı.

Bulgular: Ghrelin, kolesterol ve trigliserit seviyeleri BKB hastalarında daha yüksekti, D Vitamini, HDL ve LDL açısından anlamlı farklılık yoktu. Ghrelin ile lipitler ve D vitamini arasında ilişki tespit edilmedi. BIS-11 ve BPSÖ puanlarında, gruplar arasında anlamlı farklılık vardı. Ghrelin ile BIS-11 puanları arasında pozitif bir ilişki bulundu. D vitamini ile BPSÖ alt boyutu olan 'öfke' puanı arasında pozitif bir ilişki bulundu. Trigliserit ile BPSÖ alt boyutu olan 'sözel saldırganlık' puanı arasında negatif bir ilişki bulundu.

Sonuç: BKB, hastane başvurularının çok olduğu, komorbid durumların sık eşlik ettiği, sosyal ilişkileri ve işlevselliği bozan ve tedavisi güç olan bir bozukluktur. Ghrelin regülasyonu, Vitamin D ve lipit düzeylerinin düzenlenmesi hastalığın tedavisinde ve klinik takibinde klinisyenlere fayda sağlayabilir.

Anahtar kelimeler: Borderline kişilik bozukluğu, impulsif davranış, agresyon, ghrelin, vitamin D, lipitler

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INTRODUCTION

Borderline personality disorder (BPD) is a consistent pattern characterized by inconsistency in interpersonal relationships, self-perception, and affection accompanied by impulsivity and aggression[1]. It is twice more common in females[2]. Depression, anxiety, hypersensitivity to abandonment, hostility, and risky behavior are among the accompanying clinical findings[2]. The etiology of BPD has not been determined. Emotional dysregulation and impulsivity are thought to occur due to the interaction between genetic factors and childhood traumas[3]. Increased suicide risk, aggression and impulsivity are features that should be considered in the follow-up and treatment of BPD patients[4].

Impulsivity is described as impaired decision making or acting without thinking about the future. It was demonstrated that it was associated with attention-deficit and hyperactivity disorder, substance use disorders, eating disorders, and certain personality disorders[1, 5-7]. Aggression is defined as a behavior that aims to harm another person emotionally, socially or physically[8]. There is an increased risk of both direct and indirect aggression including physical assault, domestic violence, relational aggression and property damage in patients with BPD[8].

Ghrelin is a natural ligand of the growth hormone secretagogue receptor, secreted mainly by the stomach and duodenum, and regulates energy homeostasis[9]. Ghrelin is known to increase food intake, food reward and novelty seeking[10, 11]. It was also reported that impulsivity was also associated with food intake, food reward, and novelty seeking[12, 13]. Impulsivity and aggression have been associated with increased serum ghrelin[14, 15], lower serum cholesterol[5, 16-19] and lower plasma vitamin D levels[20, 21]. However, as seen in our literature review, no study investigating the relationship between impulsivity and aggression and ghrelin levels in BPD was found.

This study hypothesize that the blood ghrelin, lipids and vitamin D levels are associated with impulsivity and aggression in patients with borderline personality disorder and its aim is to investigate the relationship between impulsivity and aggression and ghrelin, lipids, and vitamin D levels in BPD.

MATERIALS AND METHODS

Local Ethics Committee (Fırat University Ethics Committee) approval was obtained for the study (Date: 08.05.2019; number: 327034) and the study was conducted in compliance with the Helsinki Declaration [22]. All participants signed the written informed consent form. A senior psychiatry resident (S.K.) conducted all interviews with the patients in the Fırat University Faculty of Medicine, outpatient clinic of Psychiatry. All the psychiatric diagnoses, treatment and rehabilitation procedures are performed in the outpatient and inpatient psychiatry clinics of the instutition.

Sample

Forty-eight patients who were consecutively admitted to our hospital's psychiatry outpatient clinic, diagnosed with BPD according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), SCID (The Structured Clinical Interview for DSM-IV) I and SCID II, and met the study criteria, were invited to participate in the study. Seven patients did not volunteer to study, and five did not attend the scheduled interviews. Since the male patients invited to the study did not accept, the study was conducted with 30 female patients.

The inclusion criteria for the study group were to be diagnosed with BPD, to be between 18-65 years of age, to be literate and to sign the written informed concent form. The exclusion criteria included the presence of a comorbid psychiatric diagnosis to BPD, an organic disease or significant physical pathology (metabolic disease, cardiovascular disease, respiratory disease, inflammatory disease, muscle joint disease etc) history of alcohol or substance use disorder during the last 6 months, and illiteracy based on DSM-5 [1]. Six patients diagnosed with BPD were excluded due to any organic diseases. Exclusion due to a comorbid diagnosis was based on the patient history, laboratory test findings and physical examination. Among the BPD patients who applied to the outpatient clinic, all underwent drug treatment. To minimize the impact of drug administration, patients who were only on selective serotonin reuptake inhibitors (SSRI) medication were included in the study. Patients were not receiving add-on therapy or augmentation therapy.

The control group included 30 healthy female who matched the patient group based on age, who were not diagnosed with any psychiatric, organic and

physical disease and were not on any medicine. The controls signed written informed concent form.

Measures

Sociodemographic and Clinical Data Form, Beck Anxiety Inventory (BAI), Beck Depression Inventory (BDI), Barratt Impulsivity Scale Short Form (BIS-11-SF), Buss-Perry Aggression Questionnaire (BPAQ), SCID I and SCID II were applied to the participants.

Beck Anxiety Inventory (BAI)

Beck Anxiety Inventory was developed by Beck et al.[23]. It is used to determine the frequency of anxiety symptoms in individuals. The inventory is composed of 21 items and has a 3-point Likert type scale, scored between 0 and 3. Its validity and reliability in Turkish was conducted by Ulusoy et al[24].

Beck Depression Inventory (BDI)

BDI is a self-report scale developed by Beck for measuring emotional, cognitive, somatic and motivational components[25]. BDI is the most common tool used in clinics and studies for self-recognition purposes. The scale consists of 21 items and the cut off point of the scale is 17. Turkish validity and reliability was done by Hisli [26].

Barratt Impulsivity Scale Short Form (BIS-11-SF)

The BIS-11 is a patient-filled scale used to assess impulsivity. It is evaluated including three factors: motor, attentional and non-planning[23]. The higher the total BIS-11 score, the higher the person's impulsivity level. Cronbach's alpha value is 0.82 for the total scale, it is between 0.64-0.80 for the subscales[16]. Turkish validity and reliability study was conducted by Güleç et al.[28.]

Buss-Perry Aggression Questionnaire (BPAQ)

The BPAQ was developed to be used for assessing the scale of anger and aggression. It consists of 5 subscales including physical aggression, verbal aggression, anger, hostility and total score [29].

The scale was designed in a 5-point Likert type, as I strongly disagree (1 point) and I strongly agree (5 points). Participants can get a minimum of 29 and a maximum of 145 points from the scale, which consists of four subsections and a total of 29 questions. High scores were evaluated as increased angry and aggressive behavior. Turkish validity and reliability study was conducted by Madran in 2012 [30]. The internal consistency (Cronbach's alpha) reliability coefficient for the total scale was .85, and .78 for the physical aggression, .71 for the hostility, .76 for the anger, and .48 for the verbal aggression subscales [30].

Structured Clinical Interview for DSM-IV Axis 1 Disorders (SCID-I)

SCID-I was developed for DSM-IV in 1997 by Spitzer et al. [31]. It is a structured interview form for the first axis diagnosing. Çorapçıoğlu et al. translated it into Turkish [32]. The validity and reliability study was completed in Turkey [33].

The Structured Clinical Interview for DSM-III-R Personality Disorders (SCID-II)

SCID-II is a clinical interview method developed by Spitzer et al. [34]. It is applied individually and it evaluates individuals in terms of 12 personality disorders. An adaptation and reliability study was carried out for Turkey[35].

Serum ghrelin, serum lipids and plasma vitamin D levels

Venous blood samples were taken from the patient and control groups and studied at Hospital's laboratories. About 5 ml venous blood samples were taken from the antecubital area on 08:00 am, after overnight fasting and were centrifuged to obtain plasma and serum. Samples were stored for at -80°C until the analyses. From these samples, ghrelin, lipid panel and vitamin D were analyzed. Lipid panel were analyzed with the spectrophotometric method using the Siemens ADVIA 2400 autoanalyzer, plasma vitamin D levels were measured by HPLC (High-Performance Liquid Chromatography, Shimadzu RF-10AxL) and serum levels of ghrelin were measured using the commercial enzyme-linked immunosorbent assay (Human GHRL ELISA) kit (Catalog number: AD10642Hu).

Statistical analysis

SPSS program (Statistical Package for the Social Sciences, version 22, IBM Inc., Chicago, IL, USA) was used to analyze the data. The values obtained in the study were given as mean ± standard deviation (SD). Since the data show normal distribution according to Kolmogorov Smirnov Test, Student t

test was used to compare the data of the groups. Pearson correlation analysis was made. p <0.05 was accepted as statistical significance.

RESULTS

The patient group mean age was 28.93 ± 8.84 and the control group mean age was 25.20 ± 5.79. There was no significant difference between the two groups based on age and Body Mass Index (BMI) (respectively, p=0.058, p=0.519).

There was a significant difference between the groups based on ghrelin, cholesterol and triglyceride (TG) levels (p=0.013, p=0.042, p=0.019, respectively), and the levels were higher in the patient group. There was no significant difference between the groups based on vitamin D, High-density lipoprotein (HDL) and Low-density lipoprotein (LDL) levels (p=0.396, p=0.127, p=0.150, respectively) (Table 1).

Table 1. Comparison of Ghrelin lipid and vitamin D values of patient and control groups.

	Patients (Mean±SD)	Controls (Mean±SD)	p*
Ghrelin (ng/L)	7.39±3.10	5.54±2.43	**0.013**
Vitamin D (µg/L)	22.42±11.29	20.15±9.25	0.396
Cholesterol (mg/dL)	171.53±45.76	152.10±23.03	**0.042**
HDL (mg/dL)	51.55±16.51	57.02±10.08	0.127
LDL (mg/dL)	96.83±39.28	84.92±21.24	0.150
Triglycerides (mg/dL)	110.57±66.63	78.37±29.42	**0.019**

*Student t test, SD: Standard deviation, HDL: High-density lipoprotein, LDL: Low-density lipoprotein

There was a significant difference between the groups based on the BIS-11 and BPAQ total and subscale scores, which were higher in the patient group. The comparison of the group BIS-11 and BPAQ scores is presented in Tables 2 and 3.

Table 2. Comparison of BIS-11 scores of the patient and control groups.

	Patients (Mean±SD)	Controls (Mean±SD)	p*
Attentional Motor	19.80±3.77	12.53±2.13	<0.001
Attention	12.77±2.81	7.83±1.76	<0.001
Cognitive Instability	7.03±1.38	4.70±0.99	<0.001
Motor	25.87±4.27	16.03±2.17	<0.001
Motor	18.33±3.51	10.37±1.73	<0.001
Perseverance	7.53±1.43	5.67±1.09	<0.001
Nonplanning	31.60±5.17	21.90±3.53	<0.001
Self-Control	16.77±3.37	10.63±2.33	<0.001
Cognitive Complexity	14.83±2.52	11.27±1.95	<0.001
Total score	77.27±11.79	50.47±6.76	<0.001

*Student t test, BIS-11: Barratt Impulsivity Scale Short Form

Table 3. Comparison of the BPAQ scores of the patient and control groups

	Patients (Mean±SD)	Controls (Mean±SD)	p*
Physical Aggression	11.07±5.98	3.63±3.54	<0.001
Verbal Aggression	11.27±4.63	6.17±3.35	<0.001
Anger	16.33±6.65	6.40±4.56	<0.001
Hostility	16.83±7.44	5.77±4.93	<0.001
Total score	55.50±21.82	21.97±13.50	<0.001

*Student t test, BPAQ: Buss-Perry Aggression Questionnaire; SD: Standard deviation

There was a significant difference between the groups based on BAI and BDI scores, which were higher in the patient group ($p<0.001$, $p<0.001$, respectively). The comparison of the group BAI and BDI scores is presented in Table 4.

Table 4. Comparison of the BAI and BDI scores of the groups.

	Patients (Mean±SD)	Controls (Mean±SD)	p*
BAI	24.43±14.68	5.53±4.98	**<0.001**
BDI	25.50±11.93	5.07±3.07	**<0.001**

*Student t test. BAI: Beck Anxiety Inventory; BDI: Beck Depression Inventory; SD: Standard deviation

In the correlation analysis conducted to determine the correlations between ghrelin, lipid, and vitamin D levels, and aggression and impulsivity in the patient group: There was no correlation between ghrelin, lipids and vitamin D levels and a positive significant correlation was found between ghrelin and total BIS-11 and subscales (attentional, motor, non-planning) scores. A significant positive correlation was determined between vitamin D level and anger score, a BPAQ subscale. A significant negative correlation was determined between triglyceride level and the 'verbal aggression' score, a BPAQ subscale. The correlations between blood parameters of patients and BSI-11 and BPAQ scores are presented in Table 5.

Post Hoc Power analysis was found to be 100%.

Table 5. The relationship between blood values of patients and BSI-11 and BPAQ scores.

n (30)	Pearson Correlation	Attention	Cognitive Instability	Attentional	Motor	Perseverance	Motor	Self-Control	Cognitive Complexity	Non-planning	Total score	Physical Aggression	Verbal Aggression	Anger	Hostility	Total score
Ghrelin (ng/L)	r	**0.530**	0.129	**0.442**	**0.441**	0.281	**0.456**	0.331	**0.474**	**0.446**	**0.502**	0.067	0.033	0.020	-0.175	-0.028
	p	**0.003**	0.498	**0.015**	**0.015**	0.133	**0.011**	0.074	**0.008**	**0.013**	**0.005**	0.727	0.862	0.916	0.355	0.882
Vitamin D (µg/L)	r	0.312	0.159	0.290	0.277	0.260	0.314	0.301	0.254	0.320	0.347	0.280	0.254	**0.374**	0.338	0.360
	p	0.094	0.400	0.119	0.139	0.165	0.091	0.106	0.176	0.085	0.060	0.134	0.176	**0.042**	0.068	0.051
Cholesterol (mg/dL)	r	-0.038	-0.020	-0.036	-0.046	-0.036	-0.050	-0.027	-0.028	-0.032	-0.043	0.118	-0.125	-0.077	0.141	0.030
	p	0.841	0.916	0.851	0.811	0.850	0.795	0.886	0.882	0.868	0.821	0.536	0.511	0.685	0.457	0.873
HDL (mg/dL)	r	-0.260	-0.245	-0.283	-0.185	-0.345	-0.267	-0.222	-0.041	-0.165	-0.260	0.141	0.286	0.089	0.314	0.234
	p	0.166	0.192	0.130	0.328	0.062	0.153	0.238	0.829	0.384	0.166	0.457	0.126	0.642	0.091	0.214
LDL (mg/dL)	r	0.013	0.095	0.044	0.007	0.152	0.057	0.043	0.051	0.053	0.058	0.220	-0.042	0.088	0.263	0.168
	p	0.947	0.619	0.818	0.970	0.424	0.766	0.823	0.787	0.781	0.762	0.242	0.825	0.643	0.160	0.375
Triglycerides (mg/dL)	r	-0.004	-0.185	-0.071	-0.153	-0.048	-0.141	-0.013	-0.163	-0.088	-0.112	-0.236	**-0.416**	-0.317	-0.187	-0.313
	p	0.982	0.328	0.711	0.421	0.801	0.456	0.945	0.390	0.644	0.554	0.209	**0.022**	0.088	0.322	0.092

BIS-11: Barratt Impulsivity Scale Short Form, BPAQ: Buss-Perry Aggression Questionnaire; HDL: High-density lipoprotein, LDL: Low-density lipoprotein

DISCUSSION

In the present study, it was determined that impulsivity scores of patients with BPD were significantly higher than the controls. The neurobiological mechanism underlying impulsivity is unknown, but it was suggested that dopamine and serotonin regulate impulsive behavior[36]. It is known that the decrease in dopamine signal through the dopamine 1 receptor in the dorsal striatum reduces impulsivity and the decrease through the dopamine 2 receptor increases impulsivity[37]. It was demonstrated in previous studies that the decrease in serotonin level is associated with high impulsivity and aggression[38, 39]. Both neurotransmitters are modulated by ghrelin[40, 41]. The effect of ghrelin on neurotransmitters associated with impulsive behavior led to the idea that it regulated impulsive behavior. Ghrelin exerts these effects through the receptors in the ventral tegmental area (VTA). It is possible for ghrelin and impulsivity to have a common neural substrate that converges on VTA dopamine neurons[15]. In the present study, the patient group serum ghrelin levels were significantly higher than the control serum ghrelin levels consistent with the above-mentioned information.

In the present study, it was determined that the aggression scores of BPD patients were significantly higher than those of the controls. However, there was no correlation between the patient serum ghrelin and lipid levels, and their BPAQ scores. A significant negative correlation was determined only between TG and aggression, a BPAQ subscale. Suicide is a specific behavior associated with aggression [28]. The suicide attempt frequency in BPD is 76%. In studies that investigated the correlation between suicide and BPD, it was reported that serum ghrelin levels were higher in BPD patients when compared to controls[4, 14,19]. Furthermore, it was reported that the increase in ghrelin level was associated with high aggression and impulsivity[14]. Consistent with the above-mentioned findings, it was found that ghrelin levels were higher in the BPD group in the current study, but no correlation was found between the patient serum ghrelin and lipid levels, and their BPAQ scores, unlike previous studies those found association between ghrelin levels, cholesterol levels and aggression and impulsivity[14, 42]. However, a study by Stewart and Stewart found no association between cholesterol and aggressive behavior, consistent with the results of our study [43]. They pointed to the low number of the patient group in their study. Our study group was small too as we stated in the limitations. The relatively small sample size may have caused the results of the studies to differ from the results of previous studies. In the study a positive significant correlation was found between ghrelin and total BIS-11 and subscales (attentional, motor, non-planning) scores. Higher ghrelin levels are related to impulsivity such as decreased self-control and increased likelihood of acting without thinking[44]. In line with our study findings it was showed that ghrelin was positively correlated with traits of impulsivity in not only animals but also humans in many studies in the literature[45-47]. We found a negative correlation between triglyceride level and the 'verbal aggression' score, a BPAQ subscale in this study. The results of the studies investigating the relation between serum triglyceride levels and aggression is contradictory. Fawkes at all indicated that triglyceride concentration was significantly associated with score for hostile acts and domineering attitude in men, but not in women[48]. Very high serum triglyceride concentrations were associated with mental confusion and dementia. In one report it was suggested that high triglyceride concentrations may affect the central nervous system by producing disorganization of myelin lamellae[49]. The relatively small sample size of our study may have affected the results of the study. The relation between serum triglyceride concentration and aggression needs further investigation.

It is known that serotonergic system dysfunction is observed in BPD[50]. Studies on the correlation between cholesterol levels and serotonin demonstrated that serotonin levels were also low in individuals with low cholesterol[51, 52]. Studies demonstrated that low cholesterol levels decreased serotonin receptor sensitivity by reducing membrane fluidity, and low cholesterol levels reduced 5-HT neurotransmission in presynaptic and postsynaptic regions[53]. In a study conducted by Atmaca et al, it was found that serum cholesterol and leptin levels were lower in patients with BPD when compared to healthy controls, and it was reported that low leptin and cholesterol levels were negatively associated with the impulsivity, aggression and suicidal ideation dimensions of the disorder [31]. In the present study, serum lipid levels of BPD patients were investigated, and while the cholesterol and TG levels were significantly higher in the patient group, there was no difference between the groups based on HDL and LDL levels.

Vitamin D is effective in the differentiation of developing brain cells and axonal growth, and plays a protective role against oxidative stress by producing antioxidants such as glutathione[21]. In a study conducted by Rhonda et al, correlations between low vitamin D levels and schizophrenia, depression and Alzheimer's were demonstrated[54]. In the brain, serotonin is synthesized from tryptophan by the enzyme tryptophan hydroxylase. Vitamin D is a tryptophan hydroxylase cofactor and it was suggested that brain serotonin is not optimal in vitamin D deficiency (observed in about 70% of the population)[21]. As mentioned above, the decrease in serotonin level in the brain is associated with high impulsivity and aggression[38, 39]. Reduction in serotonin levels in healthy individuals leads to reduction in impulsivity control and an immediate small reward would be preferred to a long-term but significant reward[55]. Polymorphism in the serotonin transporter gene was associated with aggression, impulsivity, anxiety, psychopathology, and personality disorders[56]. Furthermore, it was demonstrated that vitamin D deficiency, like serotonin deficiency[27, 28], was associated with suicidal ideation, which was associated with impulsivity and aggression[20]. While there was no significant difference between the groups based on vitamin D levels in the present study, similar to the above-mentioned data, a positive and significant correlation was determined between vitamin D level and the anger score, a BPAQ subscale, in the patient group.

In the study, BAI and BDI scores were found higher in the patient group. Clinical observers stated that depressed mood, anxiety and aggression tend to coexist[57]. For example, panic disorder and OCD are often accompanied by major depression, and panic attacks, generalized anxiety, and obsessive-compulsive symptoms are also common in depressed patients. Again, the link between depression and aggression has been shown. Depressed patients not only show increased suicidality, but also have very high degrees of hostility and aggression[58]. Results from studies have shown that 5HT dysfunction is associated with anxiety, impulsivity, depressed mood, suicide, and violence which are often determined in patients with BPD[59].

The present study had certain limitations. The relatively low number of patients and inclusion of only female participants could be an obstacle to the generalization of the findings. The different nutritional characteristics of the study group may be a confounding factor which could not be prevented. The fact that ghrelin, which exhibits a diurnal secretion pattern, was measured once a day due to financial limitations could have weakened the study findings. However, due to the lack of a study on the correlations between impulsivity and aggression, and serum ghrelin, lipid and vitamin D levels in BPD patients in the literature, the present study may inspire similar future studies. Further studies with a larger sample including treatment-free patients with both sexes and minimizing other confounding factors, would contribute to the literature.

In the present study, it was determined that impulsivity and aggression scores and serum ghrelin, cholesterol, and triglyceride levels of BPD patients were significantly higher than impulsivity and aggression scores, and ghrelin, cholesterol and TG levels of healthy controls. It was demonstrated that increased patient serum ghrelin level was associated with high impulsivity. Although there was no difference between the groups based on vitamin D levels, there was a positive correlation between vitamin D level and the aggression subscale anger in the patient group. It was determined that there was a negative correlation between TG and 'verbal aggression', a subscale of aggression. BPD is a disorder that leads to several hospital admissions, frequent comorbid conditions, disrupted social relationships and functionality, and is difficult to treat. Correctable conditions such as ghrelin dysregulation, vitamin D deficiency and control of lipid levels could assist clinicians in the treatment and clinical follow-up of the disease. The fndings of the current study may lead to the future studies investigating the relationship between clinical manifestations and blood parameters in BPD.

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REFERENCES

1. APA. Diagnostic and Statistical Manual Of Mental Disorders (DSM-5®). 5th ed. ed. Arlington, VA: American Psychiatric Publishing; 2013.
2. Widiger TA, Weissman MM. Epidemiology of borderline personality disorder. Hosp. Community Psychiatry. 1991;42:1015-21.
3. Siever LJ, Torgersen S, Gunderson JG, Livesley WJ, Kendler KS. The borderline diagnosis III: identifying endophenotypes for genetic studies. Biol Psychiatry. 2002;51:964-8.
4. Kurt E, Güler Ö, Ozbulut O, Altınbaş K, Işingör M, Serteser M et al. Evaluation of serum ghrelin and leptin levels in suicide attempters. J Psychophysiol. 2008;22:76-80.
5. Virkkunen M. Serum cholesterol in antisocial personality. Neuropsychobiology. 1979;5:27-30.
6. Dawe S, Loxton NJ. The role of impulsivity in the development of substance use and eating disorders. Neurosci Biobehav Rev. 2004;28:343-51.
7. Schag K, Schonleber J, Teufel M, Zipfel S, Giel KE. Food-related impulsivity in obesity and binge eating disorder--a systematic review. Obes Rev. 2013;14:477-95.
8. Asakawa A, Inui A, Kaga T, Yuzuriha H, Nagata T, Fujimiya M et al. A role of ghrelin in neuroendocrine and behavioral responses to stress in mice. Neuroendocrinology. 2001;74:143-7.
9. Kojima M, Hosoda H, Date Y, Nakazato M, Matsuo H, Kangawa K. Ghrelin is a growth-hormone-releasing acylated peptide from stomach. Nature. 1999;402:656-60.9.
10. Hansson C, Shirazi RH, Näslund J, Vogel H, Neuber C, Holm G et al. Ghrelin influences novelty seeking behavior in rodents and men. PloS One. 2012;7:e50409.
11. Skibicka KP, Dickson SL. Ghrelin and food reward: the story of potential underlying substrates. Peptides. 2011;32:2265-73.
12. van den Akker K, Jansen A, Frentz F, Havermans RC. Impulsivity makes more susceptible to overeating after contextual appetitive conditioning. Appetite. 2013;70:73-80.
13. Velazquez-Sanchez C, Ferragud A, Moore CF, Everitt BJ, Sabino V, Cottone P. High trait impulsivity predicts food addiction-like behavior in the rat. Neuropsychopharmacology. 2014;39:2463-72.
14. Atmaca M, Tezcan E, Parmaksiz S, Saribas M, Ozler S, Ustundag B. Serum ghrelin and cholesterol values in suicide attempters. Neuropsychobiology. 2006;54:59-63.
15. Anderberg RH, Hansson C, Fenander M, Richard JE, Dickson SL, Nissbrandt H et al. The Stomach-Derived Hormone Ghrelin Increases Impulsive Behavior. Neuropsychopharmacol. 2016;41:1199-209.
16. Muldoon MF, Manuck SB, Matthews KA. Lowering cholesterol concentrations and mortality: a quantitative review of primary prevention trials. BMJ. 1990;301:309-14.
17. New AS, Sevin EM, Mitropoulou V, Reynolds D, Novotny SL, Callahan A et al. Serum cholesterol and impulsivity in personality disorders. Psychiatry Res. 1999;85:145-50.
18. Marcinko D, Bilic V, Pivac N, Tentor B, Franic T, Loncar M et al. Serum cholesterol concentration and structured individual psychoanalytic psychotherapy in suicidal and non-suicidal male patients suffering from borderline personality disorder. Coll Antropol. 2011;35 Suppl 1:219-23.
19. Atmaca M, Kuloglu M, Tezcan E, Ustundag B, Gecici O, Firidin B. Serum leptin and cholesterol values in suicide attempters. Neuropsychobiology. 2002;45:124-7.
20. Umhau JC, George DT, Heaney RP, Lewis MD, Ursano RJ, Heilig M et al. Low vitamin D status and suicide: a case-control study of active duty military service members. PLoS One. 2013;8:e51543.
21. Patrick RP, Ames BN. Vitamin D and the omega-3 fatty acids control serotonin synthesis and action, part 2: relevance for ADHD, bipolar disorder, schizophrenia, and impulsive behavior. FASEB J. 2015;29:2207-22.
22. Riis P. Perspectives on the Fifth Revision of the Declaration of Helsinki. JAMA. 2000;284:3045-6.
23. Beck AT, Epstein N, Brown G, Steer RA, 1988. An inventory for measuring clinical anxiety: psychometric properties. J Consult Clin Psychol. 56, 893-97.
24. Ulusoy M. Turkish version of the Beck Anxiety Inventory: psychometric properties. J Cognit Psychother Internat Quart. 1998;12:2.
25. Beck AT, Steer RA. Internal consistencies of the original and revised Beck Depression Inventory. J Clin Psychol. 1984;40,1365-67.
26. Hisli, N. Beck Depresyon Envanterinin üniversite öğrencileri için geçerliği, güvenirliği. Psikoloji Dergisi. 1989;7, 3-13.
27. Patton JH, Stanford MS, Barratt ES. Factor structure of the Barratt impulsiveness scale. J Clin Psychol. 1995;51:768-74.
28. Tamam L, Güleç H, Karatas G. (2013). Barratt Dürtüsellik Ölçegi Kisa Formu (BIS-11-KF) Türkçe Uyarlama Çalismasi/Short Form of Barratt Impulsiveness Scale (BIS-11-SF) Turkish Adaptation Study. Noro-Psikyatri Arsivi. 50, 130.
29. Buss AH, Perry M. The aggression questionnaire. J Pers Soc Psychol. 1992;63:452.
30. Madran, HAD. Buss-Perrı saldırganlık Ölçeği'nin Türkçe formunun geçerlik ve güvenirlik çalışması. Türk Psikoloji Dergisi. 2012;24:1-6.
31. Spitzer RL, First MB, Gibbon M, Williams JB. Structured clinical interview for DSM-III-R: American Psychiatric Press; 1990.

32. Çorapçıoğlu A, Aydemir Ö, Yıldız M, Danacı A, Köroğlu E. DSM-IV Eksen I bozuklukları için yapılandırılmış klinik görüşmenin Türkçeye uyarlanması ve güvenilirlik çalışması. İlaç ve Tedavi Dergisi. 1999;12:33-6.
33. Özkürkçügil A, Aydemir Ö, Yıldız M, Esen Danacı A, Köroğlu IV E. DSM-IV Eksen I bozuklukları için yapılandırılmış klinik görüşmenin Türkçe'ye uyarlanması ve güvenilirlik çalışması. İlaç ve Tedavi Dergisi. 1999;12:233-6.
34. First MB, Spitzer RL, Gibbon M, Williams JB. The structured clinical interview for DSM-III-R personality disorders (SCID-II). Part I: Description. J Pers Disord. 1995; 9, 83-91.
35. Coşkunol H, Bağdiken İ, Sorias S, Saygılı R. SCID-II Türkçe versiyonu görüşmesinin kişilik bozukluklarındaki güvenirliği. Türk Psikoloji Derg. 1994; 9: 26-9.
36. Eagle DM, Lehmann O, Theobald DE, Pena Y, Zakaria R, Ghosh R et al. Serotonin depletion impairs waiting but not stop-signal reaction time in rats: implications for theories of the role of 5-HT in behavioral inhibition. Neuropsychopharmacology. 2009;34:1311-21.
37. Eagle DM, Wong JC, Allan ME, Mar AC, Theobald DE, Robbins TW. Contrasting roles for dopamine D1 and D2 receptor subtypes in the dorsomedial striatum but not the nucleus accumbens core during behavioral inhibition in the stop-signal task in rats. J Neurosci. 2011;31:7349-56.
38. Miyazaki KW, Miyazaki K, Tanaka KF, Yamanaka A, Takahashi A, Tabuchi S et al. Optogenetic activation of dorsal raphe serotonin neurons enhances patience for future rewards. Curr Biol. 2014;24:2033-40.
39. Brown GL, Ebert MH, Goyer PF, Jimerson DC, Klein WJ, Bunney WE et al. Aggression, suicide, and serotonin: relationships to CSF amine metabolites. Am J Psychiatry. 1982;139:741-6.
40. Hansson C, Alvarez-Crespo M, Taube M, Skibicka KP, Schmidt L, Karlsson-Lindahl L et al. Influence of ghrelin on the central serotonergic signaling system in mice. Neuropharmacology. 2014;79:498-505.
41. Skibicka KP, Shirazi RH, Rabasa-Papio C, Alvarez-Crespo M, Neuber C, Vogel H et al. Divergent circuitry underlying food reward and intake effects of ghrelin: dopaminergic VTA-accumbens projection mediates ghrelin's effect on food reward but not food intake. Neuropharmacology. 2013;73:274-83.
42. Atmaca M, Kuloglu M, Tezcan E, Gecici O, Ustundag B. Serum cholesterol and leptin levels in patients with borderline personality disorder. Neuropsychobiology. 2002;45:167-71.
43. Stewart MA, Stewart SG. Serum cholesterol in antisocial personality. A failure to replicate earlier findings. Neuropsychobiology. 1981;7:9-11.
44. Ralevski E, Shanabrough M, Newcomb J, Gandelman E, Hayden R, Horvath TL et al. Ghrelin is related to personality differences in reward sensitivity and impulsivity. Alcohol Alcohol. 2018;53:52-6.
45. Menzies JR, Skibicka KP, Leng G, Dickson SL. Ghrelin, reward and motivation. Endocr Dev. 2013;25:101-11.
46. Galanti K, Gluck ME, Geliebter A. Test meal intake in obese binge eaters in relation to impulsivity and compulsivity. Int J Eat Disord. 2007;40:727-32.
47. Engel SG, Corneliussen SJ, Wonderlich SA, Crosby RD, le Grange D, Crow S et al. Impulsivity and compulsivity in bulimia nervosa. Int J Eat Disord. 2005;38:244-51.
48. Fowkes FG, Leng GC, Donnan PT, Deary IJ, Riemersma RA, Housley E. Serum cholesterol, triglycerides, and aggression in the general population. Lancet. 1992;340:995-8.
49. Mathew NT, Meyer JS, Achari AN, Dodson RF. Hyperlipidemic neuropathy and dementia. Eur Neurol. 1976;14:370-82.
50. Silva H, Iturra P, Solari A, Villarroel J, Jerez S, Vielma W et al. Serotonin transporter polymorphism and fluoxetine effect on impulsiveness and aggression in borderline personality disorder. Actas Esp Psiquiatr. 2007;35:387-92.
51. Steegmans PH, Fekkes D, Hoes AW, Bak AA, van der Does E, Grobbee DE. Low serum cholesterol concentration and serotonin metabolism in men. BMJ. 1996;312:221.
52. Alvarez JC, Cremniter D, Lesieur P, Gregoire A, Gilton A, Macquin-Mavier I et al. Low blood cholesterol and low platelet serotonin levels in violent suicide attempters. Biol Psychiatry. 1999;45:1066-9.
53. Korkmaz S, Ustundag B, Ozer O, Tasc G, Kaya S, Atescelik M et al. Copeptin levels and blood lipid profile in borderline patients with or without self-mutilation. S Afr J Psychiatry. 2016;22:976.
54. Virkkunen M, De Jong J, Bartko J, Goodwin FK, Linnoila M. Relationship of psychobiological variables to recidivism in violent offenders and impulsive fire setters. A follow-up study. Arch Gen Psychiatry. 1989;46:600-3.
55. Robbins TW, Crockett MJ. Role of central serotonin in impulsivity and compulsivity: comparative studies in experimental animals and humans. Handbook of Behavioral Neuroscience: Elsevier; 2010. p. 415-27.
56. Greenberg BD, Li Q, Lucas FR, Hu S, Sirota LA, Benjamin J et al. Association between the serotonin transporter promoter polymorphism and personality traits in a primarily female population sample. Am J Med Genet. 2000;96:202-16.
57. Kahn RS, van Praag HM, Wetzler S, Asnis GM, Barr G. Serotonin and anxiety revisited. Biological Psychiatry. 1988;23:189-208.
58. Farmer R. Hostility and deliberate self-poisoning: the role of depression. Br J Psychiatry. 1987;150:609-14.

59. Brown GL, Goodwin FK, Bunney WE, Jr. Human aggression and suicide: their relationship to neuropsychiatric diagnoses and serotonin metabolism. Adv Biochem Psychopharmacol. 1982;34:287-307.