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The Correlations Between Serum Thyroid Hormone Levels, Crime, Impulsivity and Aggression in High-Security Forensic Psychiatry Service Patients

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ABSTRACT

Objective: High security forensic psychiatry services (HSFP) are increasingly popular institutions in Turkey, since they play a key role in the follow-up and treatment of patients. Thyroid hormone is known to be associated with certain psychiatric diseases. There are limited number of studies on thyroid level and delinquency. We investigated the correlations between serum thyroid hormone levels, criminality, impulsivity and aggression in criminal patients who received treatment in HSFP.

Material and method: The study was conducted with 115 patients who presented in HSFP and met the study criteria and 115 healthy controls. Sociodemographic and Clinical Data Forms, Barratt Impulsivity Scale Short Form (BrIS-SF-11), Buss-Perry Aggression Scale (BPAS) were applied to all participants. Furthermore, serum TSH, serum free T3 and T4 levels were determined in the patient and control groups.

Results: The sT3 and sT4 levels were significantly higher in the patient group when compared to the control group ($p<0.001$). A negative significant correlation was determined between TSH and sT4 in the patient group ($r=-.197$, $p= .035$). There was no significant difference between the criminality based on the serum TSH levels ($p>0.001$). There was no significant difference between the TSH levels in the two groups ($p>0.001$). Furthermore, it was determined that BrIS-SF-11 sub-dimension scores and the total score, BPRS sub-dimension scores and the total score were significantly higher in the patient group when compared to the healthy controls ($p<0.001$).

Conclusion: It was observed that the impulsivity and aggression levels of the criminal patients who were followed up and treated in HSFP were higher. The present study demonstrated that serum thyroid hormone levels of individuals who committed criminal offenses could be associated with impulsivity and aggression; however, further studies are required for clarification.

Key Words: High security forensic psychiatry, thyroid hormone, impulsivity, aggression.

1. INTRODUCTION

Violence is described as the intentional physical coercion, use of force or threat that could cause bodily or mental harm to oneself or another individual. Aggression is a physical act or behavior that intends to cause absolute harm to another individual (1). Crime encompasses any behavior that is contrary to social rules (2). It is known that personality traits such as impulsivity, aggression and introversion play a key role in crime (3, 4). It was demonstrated that individuals with a psychological disorder could engage in violent behavior 2-4 times more than others (5). In Turkey, the number of high-security forensic psychiatry (HSFP) services that provide observation, treatment and rehabilitation services for patients with a psychiatric diagnosis who committed crimes has been gradually increasing (6, 7). Impulsivity entails unintentional behavior that lead to dangerous and often unpleasant consequences, and could result in crime (8). Impulsivity is also among the reasons for uncontrollable aggressive behavior (9). Impulsivity is common not only in crime but also in several mental disorders. It was determined that impulsivity is prominent in several psychiatric diseases such as schizophrenia, bipolar disorder, and borderline personality disorder (10-13). It is known that patients with bipolar disorder and

schizophrenia exhibit high levels of aggressive behavior (14,15). It was reported that the aggression levels of delinquent schizophrenic patients were higher than that of non-criminal schizophrenic patients (16). Several studies are conducted to determine novel physiological biomarkers that could be employed to clarify the etiopathogenesis of impulsivity and aggression (17, 18). Thyroid hormones have been promising. The thyroid gland regulates cellular activities by secreting significant amounts of L-thyroxine (T4) and a small amount of 3,5,3'-triiodo-L-thyronine (T3). TSH regulates the thyroid gland functions. Thyroid hormones play a role in certain metabolic activities and regulate various systems (19). These hormones also play a role in several psychiatric diseases that entail impulsivity and aggression (20). Certain studies investigated the correlations between serum thyroid hormone levels and aggression, impulsivity and delinquency. It was observed that criminal individuals that exhibited aggressive behavior had high free serum T3 and T4 levels (21, 22). Thus, it was considered that thyroid hormone levels of the psychiatric patients who committed crimes could be higher when compared to the healthy control group. The present study aimed to investigate the correlations between criminality, impulsivity and aggression and serum thyroid hormones of patients who were treated in HSFP due to a forensic crime.

2. MATERIALS AND METHODS

Fırat University Faculty of Medicine ethics committee approved on 01.09.2022 (Approval no: 2022/10-17). This study was conducted in accordance with the ethical standards set forth in the Declaration of Helsinki, 1983 revision. The study was conducted with 125 male patients who met the study criteria and with a psychiatric disorder diagnosed based on the Diagnostic and Statistical Manual for Mental Disorders, 5th edition (DSM-5), and presented in the Fethi Sekin Urban Hospital Psychological Health and Disorders High Security Forensic Psychiatry Clinic after committing a crime and 126 healthy male control individuals without any mental disorder. Since the female section of the HSFP service was not operational, the sample group included only male individuals. 10 patients and 11 controls subsequently left the study voluntarily. All participants with a history or significant current systemic disease, hormonal drug therapy, use of drugs that may affect the thyroid level thyroid disorder, carcinoid syndrome, endocrinological disease, parathyroid gland dysfunction, and drug use in the last 6 months were excluded from the study.

2.1. Data Collection Instruments

2.1.1. Sociodemographic and Clinical Data Form: Participant demographics and clinical status were determined with a sociodemographic and clinical data form developed by the authors. The form was a semi-structured interview form that included sociodemographic data such as age, marital status, education level, family structure, and clinical data such as disease duration and diagnosis.

2.1.2. Barratt Impulsivity Scale (BrIS-SF-11): The scale was developed by Barratt in 1959, and the final version, the 11th edition of the Barratt Impulsivity Scale (BrIS-11) was developed in 1995 (23). It includes 30 items in 3 sub-factors: planning, attention and motor. The scale score varies between 0 and 120 points. Turkish validity and reliability of the scale was determined by Güleç et al. (24).

2.1.3. Buss-Perry Aggression Scale (BPAS): The scale includes thirty-four items. The items describe five aggression sub-dimensions (physical aggression, verbal aggression, anger, hostility and indirect aggression). The validity and reliability of the Turkish version of the scale was determined by Can (25, 26).

2.2. Application A structured interview was conducted by a psychiatrist with the cases in the interview room based on DSM-5 procedures. In the interview, sociodemographic data form, BrIS-SF-11 and BPAS were applied. Then, following an overnight fast, venous blood was drawn by the psychiatric nurse between 07.00 and 09.00 hours. TSH, free T3, free T4 levels were determined in the blood samples. Thyroid hormone levels were determined with an autoanalyzer (Beckman Coulter AU5800, Beckman Coulter, Brea, ABD).

2.3. Statistical Analysis

The study data were analyzed with SPSS software version 22 (SPSS Inc., Chicago, IL). The categorical descriptive data are presented in n and %, and continuous data are presented in mean±standard deviation (mean±SD) and median interquartile range (25-75 percentile values). Chi-square analysis (Pearson Chi-square) was employed to compare categorical variables between the groups. The normal distribution of continuous variables was determined with the Kolmogorov-Smirnov test. Mann Whitney U-test was employed to compare paired groups. The Kruskal Wallis test was employed to compare multiple variables. Spearman

Table 1. Comparison of the patient and control group parameters

		Patient		Control		p*
		n	%	n	%	
Age. median (IQR)		39.0 (32.0-46.0)		40.0 (28.0-56.0)		0.712**
Marital status	Single	74	64.3	49	42.6	**0.001**
	Married	41	35.7	66	57.4	
Education level	Primary	78	67.8	79	68.7	0.887
	Secondary or higher	37	32.2	36	31.3	
Residence	Village/town	45	39.1	43	37.4	0.786
	Urban	70	60.9	72	62.6	
Income level	Low	63	54.8	52	45.2	0.278
	Medium	44	38.3	56	48.7	
	High	8	7.0	7	6.1	
Employment	Yes	48	41.7	59	51.3	0.146
	No	67	58.3	56	48.7	
Concomitant organic disease	Yes	19	16.5	13	11.3	0.253
	No	96	83.5	102	88.7	
Current psychiatric drug use	Yes	81	70.4	3	2.6	**<0.001**
	No	34	29.6	112	97.4	
Previous psychiatric therapy	Yes	102	88.7	3	2.6	**<0.001**
	No	13	11.3	112	97.4	
Self-mutilation	Yes	34	29.6	3	2.6	**<0.001**
	No	81	70.4	112	97.4	
Suicide	Yes	33	28.7	0	.0	**<0.001**
	No	82	71.3	115	100.0	
Smoking	Yes	75	65.2	21	18.3	**<0.001**
	No	40	34.8	94	81.7	
Alchohol/substance use	Yes	27	23.5	0	.0	**<0.001**
	No	88	76.5	115	100.0	
Tattooing	Yes	18	15.7	6	5.2	**0.01**
	No	97	84.3	109	94.8	
Psychiatric diagnosis	Bipolar	25	21.7	-		-
	Schizophrenia	30	26.1			
	BTA psychosis	23	20.0			
	BTA mood disorder	18	15.7			
	MR	14	12.2			
	Delusional disorder	5	4.3			
Psychiatric disorder duration	Less than 5 years	26	22.6	-		-
	5-10 years	23	20.0			
	More than 10 years	66	57.4			
Reason for incarceration in the HSFP	Observation	25	21.7	-		-
	Protection	90	78.3			
Crime	Simple assault	44	38.3	-		-
	Murder	12	10.4			
	Multiple	21	18.3			
	Other	38	33.0			
Number of treatments in HSFP	One	76	66.1	-		-
	Two	19	16.5			
	Three or more	20	17.4			
Inpatient treatment other than HSFP	Yes	78	67.8	-		-
	No	37	32.2			

*Chi-square analysis. **Mann Whitney U test. IQR: Interquartile Range

correlation test was employed to determine the correlations between continuous variables. The statistical significance level was accepted as p<0.05.

3. RESULT

The study was conducted with 230 participants, 115 of whom were HSFP inpatients and 115 were healthy controls. The mean age of the patient group was 40.4±11.4, and the mean age of the control group was 41.8±15.0. There was no significant difference between the mean age of the study groups (p=0.712). The percentage of singles (64.3%) was significantly higher in the patient group when compared to the control group (42.6%) (p=0.001). The percentage of psychiatric drug users was significantly higher in the patient group (70.4%) when compared to the control group (2.6%) (p<0.001). The rate of previous psychiatric treatment was significantly higher in the patient group (88.7%) when compared to the control group (2.6%) (p<0.001). The rate of self-mutilation was significantly higher in the patient group (29.6%) when compared to the control group (2.6%) (p<0.001). The suicide rate was significantly higher in the patient group (28.7%) when compared to the control group (0%) (p<0.001). The smoking rate was significantly higher in the patient group (65.2%) when compared to the control group (18.3%) (p<0.001). Alcohol/substance abuse was significantly higher in the patient group (23.5%) when compared to the control group (0%) (p<0.001). Tattooing incidence was significantly higher in the patient group (15.7%) when compared to the control group (5.2%) (p<0.001). The analysis of the psychiatric diagnoses of the patients revealed that 21.7% had bipolar disorder, 26.1% had schizophrenia, 20% had unspecified psychosis (CTA), 15.7% had CTA mood disorder, 12.2% had mental retardation, and 4.3% had delusional disorder. The duration of the disease was less than 5 years in 22.6% of the patients, 5-10 years in 20% and more than 10 years in 57.4%. 21.7% of the patients were in HSPF for observation and 78.3% were in the service protection. The analysis of the crimes of the patients revealed that 38.3% committed simple injury, 10.4% committed murder, 18.3% committed multiple crimes, and 33% committed other crimes. 66.1% of the patients received a single treatment, 16.5% twice, and 17.4% for three or more times in the HSPF. 67.8% of the patients received inpatient treatment in a psychiatry ward other than HSPF (Table 1). The s T3, sT4, impulsivity scale total and sub-dimension scores, BPAS total and sub-dimension scores of the patients were significantly higher than those of the control group (p<0.001). There was no significant difference between the groups based on TSH (p=0.912) (Table 2).

Table 2. Comparison of thyroid hormone levels and scale scores of the patient and control groups

	Patient	**Control**	**p***
	Median (IQR)	Median (IQR)	
TSH	1.5 (.9-2.1)	1.5 (1.0-2.4)	0.912
T3	3.4 (3.1-3.8)	3.3 (2.9-3.5)	**<0.001**
T4	.9 (.8-1.1)	.8 (.7-.9)	**<0.001**
Attention	22.0 (19.0-27.0)	16.0 (14.0-19.0)	**<0.001**
Motor	25.0 (20.0-28.0)	19.0 (18.0-21.0)	**<0.001**
Lack of planning	29.0 (23.0-32.0)	18.0 (15.0-21.0)	**<0.001**
Barrat-total	76.0 (64.0-87.0)	54.0 (51.0-57.0)	**<0.001**
Physical aggression	26.0 (19.0-30.0)	16.0 (14.0-18.0)	**<0.001**
Verbal aggression	18.0 (15.0-20.0)	12.0 (10.0-14.0)	**<0.001**
Anger	24.0 (18.0-28.0)	19.0 (15.0-22.0)	**<0.001**
Hostility	23.0 (17.0-27.0)	17.0 (14.0-21.0)	**<0.001**
BPAS-total	90.0 (69.0-104.0)	65.0 (62.0-70.0)	**<0.001**

*Mann Whitney U test. IQR: Interquartile Range

There was a negative significant correlation between TSH and sT4 in the patient group (Table 3). There was no significant difference between the crimes based on TSH level (p=0.296) (Table 4).

4. DISCUSSION

It was observed that the impulsivity and aggressive behavior of criminal psychiatric patients were higher when compared to the control group, and the sT3, aT4 levels of the patient group were significantly higher than the healthy control group. TSH levels were similar in both groups. Furthermore, no correlation was observed between the type of the crime and TSH levels. It has been considered that thyroid dysfunction could be an early indicator of impulse control disorder (27). It is known that impaired maternal and neonatal thyroid hormone levels lead to certain neurodevelopmental disorders indicated by impulsivity (28, 29). High s T3 and low s T4 levels were associated with type B personality disorder and psychopathy indicated by impulsivity

Table 3. Correlation between thyroid hormones and other parameters in the patient group

		TSH	T3	T4
T3	r	.009		
	p	.922		
T4	r	**-.197**	.042	
	p	**.035**	.652	
Attention	r	.114	.034	.125
	p	.224	.721	.184
Motor	r	.094	-.043	.028
	p	.319	.648	.764
Lack of planning	r	.147	-.107	.053
	p	.117	.257	.575
Barrat-total	r	.120	-.040	.069
	p	.202	.673	.465
Physical aggression	r	.132	-.067	.014
	p	.161	.478	.881
Verbal aggression	r	.092	-.070	.132
	p	.329	.459	.158
Anger	r	.103	-.127	.020
	p	.276	.175	.834
Hostility	r	.036	-.093	-.005
	p	.705	.324	.954
BPAS-total	r	.098	-.103	.025
	p	.300	.276	.789

Table 4. Comparison of TSH levels by crime

	TSH	**p***
	Median (IQR)	
Simple assault	1.7 (1.0-2.4)	0.296
Murder	2.0 (1.4-2.2)	
Other	1.4 (.9-2.0)	
Multiple	1.3 (1.0-1.9)	

*Kruskal Wallis test. IQR: Interquartile Range

(30). A high T3/T4 ratio was observed in patients who attempted suicide and those with high aggression scores (31). It was demonstrated that juvenile delinquents with consistent delinquent behavior had higher mean T3 levels when compared to non-delinquents. This was interpreted as the individuals with consistent criminal behavior had higher T3 levels to compensate for their low social adaptability (32). Thyroid hormone levels were associated with impulsivity in patients with attention deficit and hyperactivity disorder, but not with attention deficit. Furthermore, it was reported that certain behavioral symptoms improved with thyroid hormone replacement therapy (33). In a study conducted with 208 prisoners, it was determined that their T3 and T4 levels were significantly higher when compared to the healthy controls, and significantly higher T3 and T4 levels were associated with aggressive crimes (34). Also, in an empirical study conducted with animals, it was reported that thyroid hormone replacement therapy reduced aggression (35). However, Özsoy et al. argued that low free thyroid hormone levels could be the result of a heavy alcohol marker that could progress with aggression (36). In the current study, it was determined that s T3 and s T4 levels, impulsivity and aggression scale scores were higher in criminal psychiatric patients. Thus, the study findings were consistent with previous reports in the literature.

We did not establish a difference between the THS hormone levels of the patient and healthy control groups, similar to the study by Evrensel et al. (20), where the correlation between aggression and serum thyroid hormone levels was investigated in male individuals diagnosed with antisocial personality disorder. This suggested that thyroid hormones were associated with aggressive behavior, however, TSH level was not effective on aggressive behavior. Also, no correlation was determined between sT3 and TSH in the patient group, we found a negative correlation between sT4 and TSH. Further studies are required to explain this finding.

In the current study, no significant difference was determined between the crimes committed based on the TSH level. In other words, we did not observe any difference in TSH hormone levels between the individuals who committed simple injuries and murder. In a study conducted in Ankara Sincan Prison, those who committed aggressive crimes and the prisoners convicted of other crimes were categorized in two groups, no correlation was determined between the type of crime and thyroid stimulating hormone (TSH) levels in individuals who committed aggressive crimes (34), similar to the present study. It is known that individuals who attempted suicide are impulsive (37). Self-mutilation behavior is frequently observed in impulsive individuals (38). However, in the current study, the number of people who attempted suicide and exhibited self-mutilation behavior was lower, although the total and subscale scores of the patients were higher when compared to the control group. It could be suggested that highly impulsive individuals who committed criminal offenses tend to harm others rather than themselves. It is also known that most impulsive individuals smoke and burn themselves more frequently (39). In the present study, we observed that criminal psychiatric patients did not exhibit tattooing even though most were smokers. Although alcohol-substance use is usually high in impulsive and aggressive individuals (40), we observed that alcohol and substance use was lower in the patient group.

It was a strength of the present study that thyroid hormone levels were not controlled in criminal forensic psychiatry patients before and all participants were male. However, the cross-sectional nature of the current study and the small sample size were the limitations of the study.

5. CONCLUSION

Although there were no differences in the TSH levels of criminal psychiatric patients and the controls, the serum T3 and serum T4 levels were higher in the patient group. It could be suggested that the current study would assist further research that would be conducted with larger groups to determine whether psychiatric conditions with a tendency to commit crimes could be predicted with

thyroid hormone levels, an inexpensive and easy method.

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Conflicts of Interest: The authors declared that there is no conflict of interest.

Ethical Statement: The study protocol was approved by The Ethics Committee of Fırat University Faculty of Medicine (Approval Date: September 01, 2022; Approval Number: 2022/10-17.)

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