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Research Article

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The Relationship between Aggression and Serum Thyroid Hormone Level in Individuals Diagnosed with Antisocial Personality Disorder

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ABSTRACT

Introduction: Aggression is one of the leading clinical characteristics of antisocial personality disorder (APD). Studies aiming to clarify and control the biological basis of aggression are ongoing. Thyroid hormones have been indicated to play a role in the development of aggression. The aim of this study was to examine the level of aggression and serum thyroid hormone in a sample of APD and to make contributions to this field with the current findings.

Methods: The sample consisted of 96 subjects with a diagnosis of APD and 97 subjects as a control group. Structured Clinical Interview for DSM-IV Axis (SCID) I and 2 were used for the diagnosis, and the Buss–Perry Aggression Questionnaire was administered. Based on criminal patterns, the APD group was then divided into two subgroups: "criminal" and "noncriminal" APD groups. The day after the interview, after one night of fasting, blood was collected from the subjects between 7:00 a.m. and 9:00 a.m.. Thyroid function tests and other biochemical analyses related to the confounding variables were also administered. The study group and the control group were compared in terms of their aggression scores and thyroid hormone levels.

Results: The mean score of free T3 level in the criminal APD group was found to be significantly higher than that in the noncriminal APD group. APD subjects with higher free T3 levels also had higher aggression scores. In the noncriminal APD group, as serum free T3 and T4 levels increased, there was also an increment in the aggression scores. However, in the criminal APD group, there was no significant correlation between thyroid hormone levels and aggression.

Conclusion: The findings of this study indicated that criminal and noncriminal APD groups actually show different properties.

Keywords: Antisocial personality disorder, criminality, aggression, thyroid hormones

INTRODUCTION

Aggression is one of the diagnostic criteria of antisocial personality disorder (APD) (1). It is also among the symptoms of hyperthyroidism (2,3). There are few studies that indicate a correlation between serum thyroid hormone levels and aggression and tendency to commit a crime. The incidence of crime in individuals with high serum T3 levels is 3.8 times greater than that in those with normal serum T3 levels (4,5). The free T3 level of individuals with high aggression scores is more closer to the upper limit (6,7,8,9). After the application of high doses of anabolic androgenic steroids (AAS), an increase in serum free T4 and TSH levels and aggression was determined (10). Testosterone, cortisol, and T4 levels were found to be significantly high in individuals exhibiting antisocial behavior (11).

Because of methodological problems, the results of some previous studies are controversial. There are no large-scaled and methodological studies examining the relationship between aggression and serum thyroid hormone levels in samples with antisocial personality disorder. In APD, two subgroups were identified as aggression at the forefront and aggression not at the forefront. Perpetrators of violent crimes (murder, mutilation, rape, arson, pugnacity, etc.) have been called "aggressive type (criminal)." Perpetrators of nonviolent crimes (theft, fraud, deceit, etc.) have been called "passive type (noncriminal)" (12).

The aim of this study was to investigate the relationship between aggression and serum thyroid hormone levels in patients with APD. Additionally, two sub-groups, "criminal" and "non-criminal," were defined according to crime history in the APD sample to compare this relationship between subgroups.

METHODS

Subjects

The sample group included APD patients who were admitted to the psychiatry polyclinic of a university hospital and who received inpatient or outpatient treatment in sequential order. The inclusion criteria were as follows: being diagnosed with APD according to the DSM-IV-TR criteria, being between the ages of 20 and 30 years, having the necessary level of education to take the tests and participate in a structured

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interview (at least primary school graduates), and giving consent for the study. The exclusion criteria were as follows: not giving consent for the study and having comorbid mental-physical illnesses. The control group consisted of healthy volunteers who met the inclusion criteria. Only men were included in the study to ensure the homogeneity of the group and avoid the hormonal effect of the menstrual cycle.

While defining the subgroups of APD, a classification was made based on the nature of the crime pattern. To distinguish between "criminal" and "noncriminal," the rough criteria were committing life-threatening crimes and felonies (armed attacks, grievous bodily harm, murder, arson, serious sexual assaults).

Gulhane Military Medical Academy Ethics Committee approval was received, and the study is in accordance with the Helsinki Declaration. The participants were given information about the study, and their written consents were obtained. The study included a total of 100 APD patients and 100 healthy controls. Four APD patients and three healthy controls were excluded because it was found that they did not mark the test in accordance with the instructions. Impaired liver and renal function, autoimmune thyroid disease, and hormone levels outside the normal range were the exclusion criteria; however, no participants were excluded because of these reasons. The study was completed with 96 APD patients and 97 healthy controls.

Instruments

Case Report Form: Questions were asked regarding sociodemographic information, alcohol/substance abuse, suicidal attempts, tattoos, self-mutilation, and criminal history. Subjects who committed life-threatening crimes were defined by the "criminal" (n=49) subgroup; those who did not have a history of crime or who committed other crimes were defined by the "noncriminal" (n=47) subgroup.

Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-1): This is a structured clinical interview form developed to accommodate the DSM-IV Axis I diagnosis. The Turkish translation of SCID-I was used. The reliability and validity study of the Turkish translation was performed by Çorapçıoğlu et al. (13)

Structured Clinical Interview for DSM-III-R Axis 2 Disorders (SCID-2): This is a structured clinical interview form developed to accommodate the DSM-III-R Axis 2 diagnosis. The reliability and validity study of the Turkish translation has been performed by Sorias et al. (14)

Buss–Perry Aggression Questionnaire (BPAQ): This consists of 34 items. The conditions described in the items question five sub-forms of aggression (physical aggression, verbal aggression, anger, hostility, and indirect aggression). It is a five-point Likert-type self-assessment scale. The validity and reliability study of this scale in our country has been performed by Can (15).

Procedure

Individual interviews were conducted with the patients. During this interview, SCID 1-2 and the Buss–Perry Aggression Questionnaire were applied. After overnight fasting, blood samples were taken between 7:00 and 9:00 a.m. TSH, free T3, free T4, AntiTPO, and AntiTG levels were tested. Additionally, tests for evaluating the steps known to have an effect on production, emissions, and the destruction processes of hormones were also performed to exclude confounding factors that may affect thyroid hormone metabolism (GH, ACTH, free testosterone, total testosterone, DHEA-S, cortisol, albumin, AST, ALT, GGT, creatinine).

Statistical Analysis

Frequency distributions were calculated for descriptive statistics, and mean and standard deviation were calculated for continuous variables. The results were presented as mean±standard deviation. Relationships between qualitative data were evaluated by chi-square test. While investigating the differences between the two groups, the t-test was used for data that conformed to a normal distribution, and the Mann–Whitney U test was used for data that did not conform to a normal distribution. α=0.05 was chosen as the error level, and p values less than or equal to this value were interpreted as "statistically significant differences."

RESULTS

Forty-nine of the APD patients (51%) were defined as "criminal" and 47 (49%) as "noncriminal." When the sociodemographic characteristics of the APD and control groups were assessed, significant differences were found in terms of age, education, substance-alcohol abuse, self-mutilation, tattoos, and suicide attempts. The number of single men among the controls was significantly higher than that in the APD group. Substance-alcohol abuse, self-mutilation, tattoos, and suicide attempts were not found in the control group (Table 1). When the sociodemographic characteristics of criminal and noncriminal APD patients were assessed, significant differences were not found in terms of age, education, and suicide attempts. Although no significant difference was detected, it was notable that the likelihood of being a criminal decreased with increasing education levels. The number of single men in the noncriminal APD group was significantly higher than that in the criminal APD group. In the criminal APD group, substance-alcohol usage, self-mutilation, and tattoos were more common than in the noncriminal APD group (Table 2).

When the aggression scores of APD and control groups were examined according to the BPAQ, total and subscale scores were significantly higher in the case group (Table 3). BPAQ, total, and subscale scores were found to be significantly higher in the criminal group than in the noncriminal group (Table 4).

While the free T4 and cortisol levels of the case group were significantly higher than those of the control group, the free T3 level of the case group was lower than that of the control group. There were no differences between the case group and the control group in terms of TSH, free testosterone, and total testosterone levels (Table 5). Serum free T3 levels were significantly higher in the criminal APD group than in the noncriminal APD group. There were no differences between the case group and the control group in terms of free T4, TSH, cortisol, free testosterone, and total testosterone levels (Table 6).

When the relationships between aggression and hormone levels were analyzed by two-tailed Pearson correlation test in the APD group, it was found that BPAQ total (r=0.363, p<0.001) and subscale scores [(physical aggression: r=0.347, p=0.001), (verbal aggression: r=0.227, p=0.026), (anger: r=0.398, p<0.001), (hostility: r=0.403, p<0.001), (indirect aggression: r=0.324, p=0.001)] increased with increasing serum free T3 level.

When the same analysis was performed with the control group, it was found that as TSH levels increased, BPAQ total (r=-0.204, p=0.045) and verbal subscale scores (r=-0.358, p<0.001) decreased. Another finding was that BPAQ total (r=-0.218, p=0.032), physical aggression subscale (r=-0.221, p=0.030), and verbal aggression subscale scores (r=-0.332, p=0.001) decreased as free testosterone levels increased.

In the noncriminal APD group, although serum free T3 levels increased, BPAQ total (r=0.507, p<0.001) scores decreased. Similarly, it was found that five subscale scores also increased [(physical aggression: r=0.505

Table 1. Sociodemographic characteristics of APD patients and control group

Sociodemographic characteristics	APD n=96		Control group n=97		Total n=193		Statistical analysis	
	n	%	n	%	n	%	χ^2	p
Marital status								
Married	36	85.7	6	14.3	42	21.8	27.788	<0.001*
Single	60	39.7	91	60.3	151	78.2		
Education level								
University	2	8.3	22	91.7	24	12.4	37.519	<0.001*
High School	24	38.1	39	61.9	63	32.6		
Secondary	16	48.5	17	51.5	33	17.1		
Primary	39	69.6	17	30.4	56	29.0		
Early school leaving	15	88.2	2	11.8	17	8.8		
Alcohol abuse								
Yes	51	100	0	0	51	26.4	70.039	<0.001*
No	45	31.7	97	68.3	142	73.6		
Substance abuse								
Yes	71	100	0	0	71	36.8	113.490	<0.001*
No	25	20.5	97	79.5	122	63.2		
Self harm								
Yes	58	100	0	0	58	30.1	83.782	<0.001*
No	38	28.1	97	71.9	135	69.9		
Tattoo								
Yes	36	100	0	0	36	18.7	44.716	<0.001*
No	60	38.2	97	61.8	157	81.3		
Suicide attempt								
Yes	56	100	0	0	56	29.0	79.712	<0.001*
No	40	29.2	97	70.8	137	71.0		
Age								
23 years and under	48	39.0	75	61.0	123	63.7	15.579	<0.001*
Over 23 years	48	68.6	22	31.4	70	36.3		

*p<0.05. APD: antisocial personality disorder

p<0.001), (verbal aggression: r=0.293, p=0.045), (anger: r=0.571, p<0.001), (hostility: r=0.524, p<0.001), (indirect aggression: r=0.509, p=0.001)]. In the same group, it was found that participants with high serum free T4 levels had higher BPAQ total scores (r=0.371, p=0.010). It was found that BPAQ subscale scores increased with increasing free T4 levels [(physical aggression: r=0.355, p=0.014), (verbal aggression: r=0.389, p=0.007), (anger: r=0.349, p=0.016), (hostility: r=0.426, p=0.003)]. There was no significant relationship between BPAQ indirect aggression score and free T4 level.

It was notable that there was no significant correlation between hormone levels and BPAQ total aggression scores in the noncriminal group. However, there was an opposite correlation, but it was not statistically significant.

DISCUSSION

Significantly more frequent substance-alcohol abuse, self-mutilation, tattoos, and suicide attempts as well as significantly more married cases and significantly lower levels of education were found in the APD group; these are expected findings that are consistent with the general characteristics of APD (16). The high mean age in the APD group was thought to stem from imprisonment.

The lack of a significant difference between the criminal and noncriminal groups in terms of age, education, and suicide attempts has been interpreted as an indication of intragroup homogeneity. The free T4 and cortisol levels of the case group were found to be significantly higher than those of the control group, whereas the free T3 level was lower. This finding was compatible with some study results but not with some others.

The reasons for these discrepancies may include the following: Some of the studies have very small sample sizes (5,6,7,8,9). A diagnostic distinction has not been made in some of the studies (4,9). The reliability of the data obtained from studies not using a healthy control group is controversial (9). The results obtained from studies with samples of psychotic prisoners (5),

Table 2. Sociodemographic characteristics of criminal and noncriminal APD patients

Sociodemographic characteristics	Criminal n=49		Noncriminal n=47		Total n=96		Statistical analysis	
	n	%	n	%	n	%	χ^2	p
Marital status								
Married	25	69.4	11	30.6	36	37.5	7.806	0.005*
Single	24	40.0	36	60.0	60	62.5		
Education level								
University	0	0	2	100	2	2.1	2.872	0.090
High School	10	41.7	14	58.3	24	25.0		
Secondary	9	56.3	7	43.8	16	16.7		
Primary	20	51.3	19	48.7	39	40.6		
Early school leaving	10	66.7	5	33.3	15	15.6		
Alcohol abuse								
Yes	32	62.7	19	37.3	51	53.1	5.964	0.015*
No	17	37.8	28	62.2	45	46.9		
Substance abuse								
Yes	46	64.8	25	35.2	71	74.0	20.619	0.001*
No	3	12.0	22	88.0	25	26.0		
Self harm								
Yes	43	74.1	15	25.9	58	60.4	31.279	0.001*
No	6	15.8	32	84.2	38	39.6		
Tattoo								
Yes	28	77.8	8	22.2	36	37.5	16.477	0.001*
No	21	35.0	39	65.0	60	62.5		
Suicide attempt								
Yes	33	58.9	23	41.1	56	58.3	3.345	0.067
No	16	40.0	24	60.0	40	41.7		
Age								
23 years and under	22	45.8	26	54.2	48	50	1.042	0.307
Over 23 years	27	56.3	21	43.8	48	50		

*p<0.05. APD: antisocial personality disorder

Table 3. Total and subscale scores of the Buss–Perry Aggression Questionnaire of APD patients and control group

Buss–Perry aggression questionnaire	APD (Mean±SD) n=96	Control group (Mean±SD) n=97	Statistical analysis	
			t/z	p*
Total score	109.07±38.76	72.02±15.98	8.69t	<0.001*
Physical Aggression Subscale	27.32±11.48	16.10±6.04	-6.68z	<0.001*
Verbal Aggression Subscale	16.28±6.01	12.15±3.06	-4.66z	<0.001*
Anger Subscale	22.54±7.68	14.97±4.77	-6.75z	<0.001*
Hostility Subscale	26.46±9.16	18.27±5.06	7.69t	<0.001*
Indirect Aggression Subscale	16.67±6.73	10.53±2.51	-5.81z	<0.001*

*p<0.05, t: t test, z: Mann–Whitney U test. APD: antisocial personality disorder; SD: standard deviation

Table 4. Total and subscale scores of the Buss–Perry Aggression Questionnaire of criminal and noncriminal APD patients

Buss-Perry aggression questionnaire	Criminal (Mean±SD) n=49	Noncriminal (Mean±SD) n=47	Statistical analysis	
			t/z	p*
Total score	125.76±29.61	91.68±39.77	4.77t	0.03*
Physical Aggression Subscale	32.80±8.94	21.62±11.12	-4.01z	<0.001*
Verbal Aggression Subscale	18.78±5.18	13.68±5.75	-4.27z	<0.001*
Anger Subscale	25.39±6.62	19.57±7.65	-3.83z	<0.001*
Hostility Subscale	29.86±6.52	22.91±10.19	3.99t	<0.001*
Indirect Aggression Subscale	19.49±5.86	13.53±6.26	-4.40z	<0.001*

*p<0.05, t: t test, z: Mann–Whitney U test. APD: antisocial personality disorder; SD: standard deviation

Table 5. Hormone levels of APD patients and control groups

Hormones	APD (Mean±SD) n=96	Control group (Ort±SS) n=97	Statistical analysis	
			t/z	p*
Free T3	3.52±0.47	3.86±0.36	-5.63[t]	0.004*
Free T4	1.28±0.21	1.23±0.14	2.10[t]	0.044*
TSH	1.72±0.94	1.97±1.17	-1.78[z]	0.074
Cortisol	13.73±3.03	10.28±4.02	6.72[t]	0.003*
Free testosterone	27.05±8.20	22.95±8.26	3.46[t]	0.848
Total testosterone	631.52±146.66	525.23±130.08	5.32[t]	0.541

*p<0.05, t: t test, z: Mann–Whitney U test. APD: antisocial personality disorder; SD: standard deviation

Table 6. Hormone levels of criminal and noncriminal APD patients

Hormones	Criminal (Mean±SD) n=49	Noncriminal (Mean±SD n=47	Statistical analysis	
			t/z	p*
Free T3	3.60±0.37	3.44±0.55	1.62[t]	0.002*
Free T4	1.31±0.26	1.25±0.13	1.44[t]	0.112
TSH	1.72±0.79	1.72±1.08	-0.51[z]	0.610
Cortisol	13.94±3.21	13.52±2.85	0.67[t]	0.368
Free testosterone	26.41±8.81	27.71±7.56	-0.77[t]	0.296
Total testosterone	628.97±174.12	634.18±113.01	-0.17[t]	0.132

*p<0.05, t: t test, z: Mann–Whitney U test. APD: antisocial personality disorder; SD: standard deviation

non-psychotic prisoners (6,7,8), and veterans (11) do not reflect the conditions in the APD sample. Different scales were used in some of the studies. Different findings may have arisen in studies conducted in different societies because of differences in culture-specific characteristics and judgments of society. Our study is important because it is the first study that examines thyroid functions in APD samples.

The mean free and total testosterone levels of the APD group were found to be higher than those of the control group. The testosterone-aggression relationship has been investigated and demonstrated by numerous studies (17). Aggressiveness increases with the use of testosterone analogs. It is not clearly known whether anabolic androgenic steroids increase aggressiveness directly by testosteronergic effects or by raising thyroid hormone levels (10). Significant differences in terms of free and total testosterone were not found between the criminal and noncriminal groups. In the criminal group, it was remarkable that the mean values of the hormones mentioned above were lower. No data are available to compare this finding. In APD patients and other people with cluster B personality traits, novelty seeking, impulsivity, and aggression are high. High levels of novelty seeking have been associated with mesolimbic and mesocortical dopaminergic hyperactivity (16). Our finding suggests that aggression does not only occur due to testosterone but also other mechanisms such as dopaminergic mechanisms play a role in the formation of aggression.

When the correlation between hormone levels and aggression scores was examined in the case group, it was found that the aggression scale scores increased with increasing free T3 levels. Many previous studies focused on the differences between the mean values. A correlation analysis that questions the causal relationship between the two variables was not performed in these studies (6,7,8,9). The positive correlation found in our study suggests that free T3 levels play an important role in the formation of aggression. Even if free T3 levels do not indicate hyperthyroidism and remains within the normal range, it seems to be effective in causing aggression. Lithium is effective in the treatment of aggression (18). The effect of lithium may be to either directly or indirectly slow thyroid function. This finding needs to be replicated by other studies investigating the drugs used in the treatment of hyperthyroidism, such as propylthiouracil and methimazole, on aggressive people.

In the control group, a negative relationship between testosterone and aggression was found; however, it is noteworthy that this relationship was not generally found in antisocial patients and their subgroups. This finding is consistent with some research results (19,20) and not with others (7,10,21). Our finding suggests that neurobiological processes other than testosterone play a role in the formation of aggression. In both healthy individuals and individuals with APD, the effect of testosterone on aggression may develop through different pathways.

In the noncriminal APD subgroup, aggression scores were found to increase with increasing serum free T3 and free T4 levels. Although aggression increases with increasing serum thyroid hormone levels, a lack of violent behavior may be associated with high reward dependence. High reward dependence is associated with serotonergic pathways in the median raphe nucleus and noradrenergic pathways in the ceruleus (16). In addition to thyroid hormones, serotonergic and noradrenergic transmission is effective in the formation and type of aggression. In the criminal APD subgroup, a significant correlation was not detected between hormone levels and BPAQ aggression scores. Although it is not statistically significant, a negative correlation is a significant finding. It is noteworthy that although the criminal subgroup has higher mean T3 levels than the noncriminal subgroup, there was no significant correlation with aggression scores. This finding is important because it indicates that factors other than thyroid hormones may play a role in the aggression of criminals, and there may be many determinants of aggression and violent behavior (22).

In conclusion, these data gave the impression that the criminal and noncriminal groups represent two different groups sociodemographically and biologically. In the literature, although there are studies comparing APD cases with healthy individuals, these studies do not include detailed comparisons in terms of sociodemographic, clinical, and hormonal characteristics of the cases by defining subgroups. This condition prevents further comments; however, in the present study, it shall be considered that the data may have been interpreted differently. Detailed studies on this topic are needed. The findings suggest a relationship between thyroid hormone levels and aggression in the APD sample. Because of the lack of objective criteria defined by the International Classification System in the discrimination of criminal and non-criminal subgroups of APD, the study sample may not be sufficiently large to reflect the subgroups properly. In terms of the distinction criteria used in this study, a participant who was not a criminal during the study might become a criminal if he committed a felony later. Therefore, generalization cannot be made with these findings. Studies with larger samples, questioning personality traits with psychometric tests, and using more objective criteria to distinguish the criminality of APD cases are needed. These studies will not only shed light on this subject but will also contribute to the control of aggression.

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