

The Effect of Adult Attention Deficit/Hyperactivity Symptoms on Quality of Life in People with Epilepsy

Hacer Akgül Ceyhun¹ , Esat Fahri Aydın¹ , Nilifer Gürbüz² 

¹Department of Psychiatry, Atatürk University, Medical Faculty, Erzurum, Turkey

²Department of Psychiatry, University of Health Sciences, Regional Training and Research Hospital, Erzurum, Turkey



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Corresponding author: Hacer Akgül Ceyhun, e-mail: hacer.cejhun@atauni.edu.tr

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Abstract

Objective: The aim of this study is to investigate the relationship between the diagnosis and symptoms of adult attention deficit/hyperactivity disorder and quality of life in people with epilepsy.

Methods: In this study, 50 idiopathic/cryptogenic epilepsy patients aged 18-65 years, followed by University Hospital Neurology outpatient clinic, and 50 healthy controls were included. Adult-Attention Deficit/Hyperactivity Disorder (A-ADD/ADHD), Symptom Checklist 90-Revised, Barratt Impulsivity Scale, and World Health Organization Quality of Life Short Form (WHOQoL-Bref) were completed by the participants. The diagnosis of adult attention deficit/hyperactivity disorder was made according to the Diagnostic and Statistical Manual (DSM)-5 diagnostic criteria.

Results: The positive screening rate for adult attention deficit/hyperactivity disorder was 22% in people with epilepsy. Totally 6 (12%) people in the people with epilepsy and 2 (4%) people in the control group were diagnosed with adult attention deficit/hyperactivity disorder ($P = .204$). Significant differences were found in WHOQoL-Bref General, Physical, and Mental sub-parameters, A-ADD/ADHD-total and attention-deficit and related characteristics scores, Barratt Impulsivity Scale-11 total and all subgroups, and Symptom Checklist general and all subscales between people with epilepsy and control groups. A moderate negative correlation was found between WHOQoL-Bref scores and A-ADD/ADHD-attention deficit, Barratt Impulsivity Scale-11 total, Symptom Checklist General scores. Barratt Impulsivity Scale-11 total, and adult attention deficit/hyperactivity disorder-attention-deficit scores; there was a moderate positive correlation between each of the number of hospitalization and outpatient treatments. A multivariate linear regression analysis was performed to predict the dependent variable as WHOQoL-Bref General using the independent variables of epilepsy age of onset, Barratt Impulsivity Scale-11 total, A-ADD/ADHD-attention-deficit, and Symptom Checklist general score. Accordingly, from the independent variables, the impulsivity total score predicts the dependent variable as negative and significant.

Discussion: Impulsivity predicts general quality of life scores reported by people with epilepsy and reveals the importance of the attention deficit/hyperactivity disorder clinic for people with epilepsy and its visible impact on daily functioning. It is important to evaluate attention deficit/hyperactivity disorder in these patients, as attention deficit/hyperactivity disorder comorbidity will create a serious burden for epilepsy.

Keywords: Adult with epilepsy, attention deficit, comorbidity, impulsivity, quality of life

INTRODUCTION

Epilepsy is the second most common neurological disorder known to affect more than 70 million people of all ages worldwide.¹ Health-related quality of life (QoL) is one of the priorities of a common disease like epilepsy, and so factors affecting QoL are important. It is now well established that the biopsychosocial perspective should be incorporated into the understanding of the QoL.² People with epilepsy (PWE) are affected by medical and psychiatric comorbidities, cognitive difficulties, stigma, decreased family functions and social support, greater difficulty in employment, lower annual income, and physical limitations.³ It is important to understand and work to improve the QoL of PWE. Current treatment guidelines for epilepsy aim to prevent seizures, as well as improve patients' quality of life.⁴ Compared to individuals with and without PWE, a higher lifetime prevalence of depression, more neuropsychological, psychiatric, and social disorders, and significantly lower QoL have been reported.⁵ While investigating factors that contribute to perceived QoL, age at onset of epilepsy in adults has been shown to affect QoL scores.⁶ However, there is increasing evidence that psychosocial factors and mental health rather than clinical variables (e.g., age of onset, seizure frequency, and side effects of antiepileptic drugs) affect QoL in PWE.⁷

Psychiatric comorbidities are seen more frequently in epileptic patients compared to both the general population and individuals with other neurological diseases and negatively affect the QoL in epilepsy patients.⁸ Identifying current medical diagnoses prior to a diagnosis of epilepsy can inform clinicians in managing and guiding associated comorbid conditions and is an important step in increasing our understanding of how PWE may respond to treatment and even determine the QoL.⁹ While the most common comorbid psychiatric disorder in PWE is depression, it is attention deficit/hyperactivity disorder (ADHD) in children with epilepsy (31% in epilepsy, 6% in healthy individuals).¹⁰ Attention deficit/hyperactivity

disorder is frequently overlooked in PWE. At the same time, the risk of developing epilepsy in ADHD cases was reported 2.7 times higher than in the healthy population,¹¹ suggesting a 2-way relationship between epilepsy and ADHD. Epilepsy and ADHD share common risk factors. Environmental factors, tissue-specific expression of mutated genes during and after embryonic development in the presence or absence of genetic modifiers, differences in tissue sensitivity, metabolic activity and neuronal discharges, and neurodevelopmental phenotypes are likely to affect the development of both epilepsy and ADHD.

There is a growing consensus that ADHD in adult life continues with a range of clinical and psychosocial disorders in approximately two-thirds.^{12,13} The persistence of ADHD symptoms in adult life is more common in individuals with comorbid conditions such as epilepsy. In 2 separate population-based studies, ADHD comorbidities were found to be 13.2% and 15.4% in PWE.^{14,15} Quality of life assessment can be considered as a measure of its long-term outcomes, encompassing the impact of both executive and emotional dysfunctions associated with ADHD.¹⁶ An underestimation of psychiatric comorbid disorders may be the case in patients admitted to a referral center for epilepsy.¹⁷

Attention deficit/hyperactivity disorder is an important disorder associated with pathological impulsivity, as well as attention-deficit and hyperactivity. It has been reported that impulsivity in adult ADHD may be associated with various behavioral problems such as a sensation-seeking tendency in daily life, lack of planning, and hasty behavior.¹⁸ It is thought that impulsivity makes life difficult in risky behaviors such as suicide and cannot choose the appropriate social adaptation against different negativities.^{19,20} The relationship between attention-deficit/hyperactivity and impulsivity and QoL in PWE is a gap that needs to be investigated. Given the far-reaching biopsychosocial consequences of PWE, knowledge of ADHD and related problems in PWE is valuable and crucial in helping those with epilepsy to a positive adjustment to their chronic medical condition and a better QoL. To close this gap, it is important to conduct new research on PWE.

In this study, we aimed to better understand the relationship between ADHD and QoL in PWE. Secondly, we aimed to evaluate the relationship between clinical and sociodemographic characteristics of PWE and ADHD symptoms. Our hypotheses were that the diagnosis and symptoms of ADHD were detected more frequently in PWE than in healthy controls, and this would negatively affect the patients' QoL. To the best of our knowledge, we have not come across any study in

the literature evaluating the QoL with diagnosing ADHD through an interview in PWE.

METHODS

Participants

The study included 50 idiopathic/cryptogenic epilepsy patients between the ages of 18 and 65 years and 50 healthy controls followed by University Hospital Neurology Outpatient Clinic. Inclusion criteria were as follows: those between the ages of 18 and 65, those with complex partial or generalized seizure type, those followed for at least 1 year with a confirmed diagnosis of epilepsy, those who have had at least 1 seizure in the last 6 months, and those who do not have a history of using any psychiatric medication. Those patients with psychiatric comorbidity were applied to the Clinical Global Impression–Severity Scale and participants with a score of 2 and below “borderline mentally ill” were accepted for the study. Exclusion criteria were as follows: those whose seizures are directly related to causes such as tumors, metabolic disorders, or acute infection, history of the static or non-static central nervous system associated with the risk of epilepsy and those who have another serious medical problem and/or neurological disease that has acquired a chronic feature that may affect their QoL. The medical records of the patients were reviewed by the researchers and 7 patients with a history of using any psychiatric medication, diabetes mellitus, hypertension, and severe head injury were excluded. Fifty patients who met the inclusion criteria were included. None of the control subjects were alcohol drinkers, heavy smokers, or had ever taken psychotropic drugs. They had no history or family history of psychiatric disorder. The control group consisted of 50 subjects, who were age- and sex-matched non-medical workers from our hospital and their relatives.

The study was approved by Atatürk University Clinical Research Ethics Committee (Date: October 01, 2020, Decision No: B.30 .2.AT A.0.0 1.00/ 503). All subjects gave their written informed consent which had been approved by the local ethics committee by the Declaration of Helsinki.

All participants filled out sociodemographic and clinical information forms. Participants were asked to complete the Adult-Attention Deficit/Hyperactivity Disorder (A-ADD/ADHD), Symptom Checklist 90-Revised (SCL-90-R), Barratt Impulsivity Scale-11(BIS-11), and QoL Scale (WHOQoL-Bref). Interviews with PWE were made in the interictal period. The diagnosis of adult ADHD was investigated by conducting a diagnostic interview based on DSM-5 criteria by the same psychiatrist with high-risk participants (11 epilepsy patients and 5 controls) who scored above 60 in the adult ADD/ADHD Diagnosis and Evaluation Inventory.

Data Collection Tools

Sociodemographic and Clinical Information Form

Generalized seizures included generalized tonic, clonic, tonic-clonic, atonic, absence, or myoclonic seizures. Partial seizures included simple or complex partial seizures (including partial seizures with secondary generalization).

World Health Organization Quality of Life Scale Short Form

Turkish Version: This scale, developed by the World Health Organization, includes 26 questions selected from the WHOQoL-100 and 4 areas: physical health, psychological health, social relations, and environment. The validity and reliability study of the Turkish version of the WHOQoL-Bref was conducted.²¹ In both patients and healthy individuals, the highest internal consistency was found in the somatic

MAIN POINTS

- Positive screening and diagnosis rates for adult attention deficit/hyperactivity disorder (ADHD) in people with epilepsy were 22% and 12%, respectively.
- People with epilepsy (PWE) had worse quality of life (QoL), higher psychiatric symptom burden, and higher attention-deficit and impulsivity levels compared to healthy controls.
- As attention deficit, impulsivity, and general psychiatric symptom severity of PWE were increased, their QoL was decreased.
- The increase in hospitalization and outpatient visits of PWE was correlated with the increase in attention-deficit and impulsivity levels reported by the patients.
- When the predictors of QoL (epilepsy onset age, impulsivity, attention deficit, and general psychiatric symptom severity) were examined, it was found that only impulsivity predicted a lower QoL.

domain (Cronbach's $\alpha = 0.83$ and 0.79) and the lowest internal consistency in the social domain (Cronbach's $\alpha = 0.53$ in both).²¹

Turgay's Turkish version of Adult ADD/Attention Deficit/Hyperactivity Disorder DSM IV-Based Diagnostic Screening and Rating Scale: It was developed by A. Turgay in 1995 and translated into Turkish by himself. The scale is a 5-point Likert-type rating scale and consists of 3 sub-sections: Attention-deficit section (AD) contains 9 items, hyperactivity/impulsivity section (HA) contains 9 items, and ADHD-related problems (Problem) section contains 30 items. In general, those who score below 20 show low ADHD, those who score between 20 and 59 show moderate ADHD, and those who score above 59 show high ADHD symptoms. The internal consistency coefficient calculated to test the grand total reliability of the A-ADHD scale was determined as Cronbach's $\alpha = 0.96$.²²

Symptom Checklist 90-Revised: It is a 90-item multidimensional questionnaire designed to screen for a broad range of psychological problems. Each of the 90 items is rated on a 5-point Likert scale of distress, ranging from "not at all" (0) to "extremely" (4). The SCL-90-R items are as follows: anxiety, hostility, somatization, obsessive-compulsive, depression, paranoid ideation, interpersonal sensitivity, psychoticism, phobic anxiety, and supplement subscale.²³

Barratt Impulsivity Scale-11: It is a patient-filled scale used to evaluate impulsivity. It consists of 30 items and has 3 subscales; attention (inattention), motor, and lack of planning, and total score. The higher the total BIS-11 score, the higher the person's level of impulsivity. The Turkish validity and reliability study of BIS-11 was conducted by Güleç et al (Cronbach's alphas for internal consistency were 0.78 (students) and 0.81 (patients)).²⁴

Data Analysis

Data were presented as mean, standard deviation, median, minimum, maximum, percentage, and number. For the comparisons between 2 independent groups, the independent samples *t*-test was used when the normal distribution condition was met, and the Mann-Whitney *U* test was used if the normal distribution condition was not met. Chi-square test was used to evaluate the relationships between categorical variables and Student's *t*-test was used to compare group means. Pearson and Spearman correlation tests and multivariate linear regression analysis were used. Data were analyzed using Statistical Package for the Social Sciences software, Version 20.0 (IBM SPSS Corp.; Armonk, NY, USA). Significance was evaluated at $P < .01$ and $P < .05$ levels.

RESULTS

Demographic and life event characteristics of PWE and the control group included in the study are shown in Table 1.

Clinical Characteristics of People with Epilepsy

In the epilepsy group included in the study, the mean age was 27.9 years, the mean age of onset of epilepsy was 16.6, and the mean duration of epilepsy was 11.2 years. The clinical features of PWE are shown in Table 2.

Comparison of World Health Organization Quality of Life Short Form, Adult Attention Deficit/Hyperactivity Disorder, Barratt Impulsivity Scale-11, and Symptom Checklist 90-Revised Scales of the Groups

When the patient and control groups included in the study were compared, statistically significant differences were found between all SCL

Table 1. Demographic and Life Events Characteristics of PWE and the Control Groups

	Epilepsy (n = 50)		Control (n = 50)		P
	n	%	n	%	
Male	23	46	25	50	.689
Female	27	56	25	50	
Single	21	42	29	58	.110
Married	29	58	21	42	
Primary school	27	57	13	26	.012*
Middle school	19	38	27	54	
High school	4	8	10	20	
Unemployed	30	60	18	36	.014*
Officer	3	6	14	28	
Workman	13	26	16	32	
Craftsman	2	4	0	0	
Farmer	2	4	2	4	
Suicide attempt	2	6	0	0	.153
Psychiatric illness in the family	5	10	6	12	.749
Smoking	6	12	21	42	.010*
Alcohol use	1	2	2	4	.558
Substance use	0	0	0	0	1.000
Grade repetition	7	14	0	0	.006**
Disciplinary punishment	1	2	1	2	1.000
Judicial event	2	4	3	6	.646
Traffic penalty	6	12	9	18	.401
Traffic accident	7	14	7	14	1.000
Job change	9	18	6	12	.401
Physical trauma	13	26	2	4	.002**

PWE, people with epilepsy.

subscale scores (somatization, anxiety, obsession, depression, interpersonal sensitivity, psychotic symptom, paranoid, anger, phobic, complementary, and SCL general). ($P < .05$ for each, see Table 3). A significant difference was found between the BIS-11 total score and plan, motor, and attention sub-scores of the groups ($P < .05$ for each, see Table 3). While there was statistical significance between the groups in the adult ADHD total score, attention-deficit and related characteristics scores (each $P < .05$ for 1, see Table 3); The hyperactivity and impulsivity section scores were similar ($P > .05$ for each, see Table 3). In the evaluation made with WHOQoL-Bref, there was a significant difference between the groups in the QoL general and physical, and mental sub-parameters ($P < .05$ for each, see Table 3), while the groups were similar for the social and environment sub-parameters ($P > .05$ for each, see Table 3).

Comparison of scale scores of patients with electroencephalography (EEG) abnormality (n = 18) and EEG within normal limits (n = 32) in the epilepsy group and SCL general psychopathology scores ($t = -2.094$, $df = 48$, $P = .042$) differed. There were no statistically significant differences between the groups' WHOQoL-Bref general, BIS total, ADHD attention-deficit, hyperactivity, impulsivity, associated characteristics, and ADHD total scale scores ($P > .005$ for each).

According to the number of antiepileptic drugs used in epilepsy receiving monotherapy (n = 28) and polytherapy (n = 22) groups SCL overall, WHOQoL-Bref overall, BIS total, ADHD attention-deficit, hyperactivity, impulsivity, related features, and ADHD total score averages were compared. No statistically significant difference was found in the comparison of scores ($P > .005$ for each).

Table 2. Clinical Features of PWE (n = 50) Group

Epilepsy age of onset	Mean: 16.6 ± 10.1 SD	1-51
Epilepsy duration (years)	Mean: 11.2 ± 8.5 SD	1-33 years
Hand dominance	Right	45 (90%)
	Left	5 (10%)
Seizure type	Complex partial seizures	14 (28%)
	Generalized tonic-clonic seizures	36 (72%)
Seizure frequency	1 seizure in 6 months	6 (6%)
	1 seizure in 2 months	19 (38%)
	Monthly seizures	16 (32%)
	Weekly shifts	6 (12%)
	Daily seizures	3(6%)
AED treatment	Monotherapy	28 (56%)
	Polytherapy	22 (44%)
History of hospitalization		22
Outpatient compliance	Compatible	43
	Irregular	7
Number of outpatient applications in 1 year	More than 6	11 (22%)
	Between 3 and 6	34 (68%)
	2 and less	5 (10%)
Status presence		7 (14%)
Last seizure time	Last week	18 (36%)
	Last month	14 (28%)
	Last 6 months	18 (36%)
Family history of epilepsy		2 (6.6%)
Chronicity	Diagnosed 0-3 years ago	11 (22%)
	Diagnosis > 3 years ago	39 (78%)
History of first epileptic pre-seizure psychiatric application		2 (4%)
History of psychiatric application after diagnosis of epilepsy	Mean: 16.6 ± 10.1 SD)	48 (96%)

PWE, people with epilepsy; SD, standard deviation, AED, antiepileptic drug.

In the comparison of the scale scores of the patients whose first seizure started before the age of 12 (n = 19) in the epilepsy group with the patients who started after the age of 12 (n = 31), SCL general, WHOQoL-Bref general, BIS total, ADHD attention-deficit, hyperactivity, impulsivity, associated characteristics, and ADHD total scale scores of the groups were similar ($P > .005$ for each). When the effect of seizure type in the epilepsy group was evaluated and when patients with complex partial seizures (n = 14) and generalized tonic-clonic seizures (n = 36) were compared, WHOQoL-Bref general scores were found to be statistically significant ($t = 2.044$, $df = 45$, $P = .047$), while no statistically significant difference was found in the comparison of SCL general, BIS total, ADHD attention-deficit, hyperactivity, impulsivity, associated characteristics, and ADHD total each scale scores ($P > .005$ for each).

Diagnosis of Adult Attention Deficit/Hyperactivity Disorder

High-risk participants who scored above 60 in the A-ADHD Diagnosis and Evaluation Inventory were diagnosed by the same psychiatrist through a diagnostic interview based on DSM-5 criteria. In the study, 6 (12%) people in the epilepsy group and 2 people (4%) in the control group were diagnosed with adult ADHD, and the difference was not statistically significant ($P = .204$). Of 6 patients diagnosed with ADHD in the epilepsy group, 2 (33%) were diagnosed as “predominantly inattentive presentation,” 4 (67%) as “combined presentation,” and no patient with the predominantly

hyperactive-impulsive presentation was found. In the control group, 2 patients diagnosed with adult ADHD were diagnosed with “combined presentation.”

Correlations of Clinical Markers and Scale Scores of People with Epilepsy

Age of onset of epilepsy, number of hospitalizations due to epilepsy, number of outpatient visits per year, education level, QoL general parameters of SCL general, QoL mental, BIS total, ADHD total, and subsections correlations between section scores were evaluated (Table 4).

A multivariate linear regression analysis was performed to predict the dependent variable as the quality of life-general using the independent variables of epilepsy age of onset, Barrat Impulsivity Scale total, Attention deficit, and SCL general score. It was found that with a significant regression model; $F(4,45) = 5.78$, $P = .01$, and it was found that the independent variables explained 34% (R^2 adjusted = 0.339) of the variance in the dependent variable. Accordingly, from the independent variables, the impulsivity total score predicts the dependent variable as negative and significant $\beta = -0.53$, $t(45) = -2.98$, $P = -0.005$, $pr^2 = 0.16$. It was observed that the total score variables of age of onset of epilepsy, attention deficit, and SCL general did not achieve statistical significance in predicting dependent variable the quality of life-general $P = .659$, .068, .245, respectively) (Table 5).

DISCUSSION

In this study, symptoms of impulsivity and attention-deficit, which is a condition that affects the QoL of PWE, were investigated. We hypothesized that adult epilepsy patients had more severe ADHD symptoms than healthy controls. Our results showed that PWE had higher overall psychopathology, attention-deficit, and impulsivity scores compared to controls. Impulsivity level was a negative and significant predictor of general-QoL.

In our study, while the positive screening rate for ADHD in the epilepsy group was 22%, ADHD was diagnosed at a rate of 12% according to DSM-5 diagnostic criteria. Our results are consistent with the results of previous studies.^{14,17} The prevalence of ADHD in PWE has been reported as the most common accompanying psychiatric comorbidity after any anxiety or depressive disorder.¹⁴ We could not find any study in the literature reporting ADHD diagnosis rates with structured psychiatric interviews in adult epilepsy patients. Adult attention deficit/hyperactivity disorder comorbidity is reported to occur in approximately one-third of children with epilepsy in childhood.¹⁴ While the co-occurrence of ADHD and epilepsy implicated shared genetic factors, other conditions showed evidence that suggests unique environmental or directional effects.²⁵ Although two-thirds achieve partial remission, one-third with persistent symptoms are expected to continue to meet diagnostic criteria for ADHD into adulthood.¹² However, the epilepsy population in our study did not include only childhood-onset cases, and there may be cases where childhood symptoms are not clearly remembered. In these situations, too, authorities recommend considering ADHD when the typical symptoms that define ADHD are present and there is evidence of lifelong persistence.¹² Concerning this, although it has been suggested that they share pathophysiology that is part of the diagnosis of both disorders in the context of brain development, it is unknown whether they occur with similar pathophysiological mechanisms.^{4,26} Neuroimaging studies of people with ADHD typically show altered functional connectivity in the prefrontal, striatal, and various temporal brain regions.²⁷ Evidence of frontal lobe dysfunction also emerges in focal-onset and generalized-onset epilepsy types.¹¹ Identification of neurobiological

Table 3. Comparison of Scale Scores of PWE and Control Groups; WHOQoL-Bref, A-ADHD, BIS-11, and SCL-90-R

	Epilepsy (X ± SD)	Control (X ± SD)	<i>t</i>	<i>df</i>	<i>P</i>
Age	27.92 ± 9.378	30.16 ± 9.020	-1.217	98	.226
Monthly income	2166 ± 1142	3086 ± 2044	-2.223	53.538	.030*
WHOQoL-Bref total	23.33 ± 18.70	37.96 ± 32.51	-2.759	78.217	.007**
WHOQoL-Bref physical health	27.38 ± 28.75	40.65 ± 32.18	-2.173	96.779	.032*
WHOQoL-Bref mental health	24.42 ± 17.02	40.39 ± 32.85	-3.053	73.525	.003**
WHOQoL-Bref social	24.42 ± 19.44	52.82 ± 23.85	-1.602	51.412	.115
WHOQoL-Bref environmental	27.95 ± 21.23	35.37 ± 28.08	-1.490	91.223	.140
Attention deficit	8.52 ± 5.14	5.54 ± 3.86	3.281	90.917	.001**
Hyperactivity	3.68 ± 3.16	2.82 ± 3.15	1.371	98	.174
Impulsivity	2.58 ± 2.29	2.00 ± 1.98	1.353	98	.179
Associated characteristics	24.76 ± 15.41	16.46 ± 10.86	3.113	88.045	.002**
A-ADHD total score	39.54 ± 23.63	26.82 ± 17.42	3.064	98	.003**
BIS plan	29.40 ± 5.67	24.78 ± 3.86	4.764	86.424	.000*****
BID motor	20.44 ± 4.65	18.40 ± 4.17	2.309	98	.023*
BIS attention	16.52 ± 3.81	14.74 ± 2.94	2.616	98	.010** , *** p < .001
BIS total	66.16 ± 12.14	57.62 ± 8.28	4.133	86.894	.000*****
SCL somatization	1.16 ± 0.75	0.59 ± 0.42	4.503	81.819	.000*****
SCL anxiety	1.14 ± 0.85	0.45 ± 0.56	5.080	71.370	.000*****
SCL obsession	1.28 ± 0.85	0.79 ± 0.56	3.320	84.454	.001**
SCL depression	1.30 ± 0.86	0.64 ± 0.57	4.588	83.143	.000*****
SCL interpersonal sensitivity	1.18 ± 0.86	0.64 ± 0.57	3.606	83.495	.001**
SCL psychotic symptom	0.66 ± 0.70	0.31 ± 0.44	2.992	82.450	.004**
SCL paranoid	0.88 ± 0.72	0.60 ± 0.61	2.125	98	.036*
SCL anger	1.12 ± 0.85	0.48 ± 0.47	4.618	76.663	.000*****
SCL phobic	1.03 ± 0.89	0.31 ± 0.37	5.289	98	.000*****
SCL appendix	1.05 ± 0.78	0.65 ± 0.55	2.957	88.132	.004**
SCL general	1.10 ± 0.70	0.55 ± 0.43	4.630	81.616	.000*****

P* < .05, *P* < .01, ****P* < 0.001.

X, mean score; SD, standard deviation; WHOQoL-Bref, World Health Organization Quality of Life Short Form; ADHD, attention deficit/hyperactivity disorder; BIS, Barratt Impulsivity Scale; PWE, people with epilepsy; SCL, Symptom Checklist.

mechanisms regarding the correlations between epilepsy and ADHD is an important consideration for clinical management. Screening all adult epilepsy patients for ADHD would be a reasonable approach for diagnosis and appropriate management of ADHD.

In our study, a weak negative correlation was found between the severity of attention deficit and impulsivity symptoms reported by the patients and their QoL scores. Impulsivity total level was a negative and significant predictor of general QoL. In the literature, it is stated

Table 4. Correlations of Clinical Markers and Scale Scores of PWE

Correlation	Spearman's Rho	WHOQoL-Bref		Attention		Associated Characteristics	A-ADHDI Total	SCL General	SCL Depression
		Mental Health	BIS Total	Deficit	Hyperactivity				
WHOQoL-Bref total score	<i>r</i>	.904**	-0.203*	-0.200*	-0.042	-0.131	-0.143	-0.247*	-0.247*
	<i>P</i>	.000	.043	.046	.675	.194	.157	.013	.013
Epilepsy age of onset	<i>r</i>	0.023	-0.359*	-0.328*	-0.176	-0.126	-0.193	-0.110	0.028
		.933	.010	.020	.221	.383	.179	.446	.850
Number of hospitalizations due to epilepsy	<i>r</i>	0.197	0.422*	0.526*	0.586**	0.306	0.463*	0.348	0.330
	<i>P</i>	.368	.045	.010	.003	.202	.026	.103	.125
Epilepsy duration	<i>r</i>	0.125	0.216	0.258	0.141	0.103	0.125	0.082	0.024
	<i>P</i>	.389	.131	.070	.321	.477	.389	.573	.869
Number of applications to outpatient treatment in a year	<i>r</i>	0.088	0.319*	0.301*	0.297*	0.330*	0.329*	0.363*	0.369**
	<i>P</i>	.542	.024	.034	.036	.019	.020	.010	.008
Education level	<i>r</i>	0.336**	-0.221*	-0.323**	-0.060	-0.104	-0.147	-0.264**	-0.210*
	<i>P</i>	.001	.027	.001	.554	.303	.146	.008	.036
Annual seizure frequency	<i>r</i>	-0.460**	0.115	0.57	-0.178	0.023	0.001	0.074	0.060
	<i>P</i>	.001	.433	.697	.221	.865	.995	.611	.684

WHOQoL-Bref, World Health Organization Quality of Life Short Form; ADHD, attention deficit/hyperactivity disorder; BIS, Barratt Impulsivity Scale; PWE, people with epilepsy; SCL, Symptom Checklist.

Table 5. A Multivariate Linear Regression Analysis

	<i>B</i>	Standard Error	β	<i>t</i>	<i>P</i>	Zero-order	Partial	Tolerance	VIF
Constant	117.134	19.889		5.889	.000				
Epilepsy age of onset	-0.135	0.304	-0.061	-0.445	.659	.110	-0.066	0.774	1.293
Attention-deficit	0.404	0.878	0.093	0.460	.648	-0.394	0.068	0.356	2.806
BIS total	-974	0.327	.527	-2.978	.005	-0.556	-.406	0.469	2.134
SCL general	-6.489	5.507	-0.205	-1.178	.245	-0.437	-0.173	0.463	2.069

Dependent variable WHOQoL-Bref general

total score $R = 0.583$, $R^2 = .339$, $F = 5.781$, $P = .001$, Durbin-Watson = 2.122, VIF, Variance Inflation Factor.

BIS, Barratt Impulsivity Scale; SCL, Symptom Checklist.

that PWE in the USA has difficulties in participating in social activities and that the difficulties in psychosocial health are reported to be associated with impaired QoL.²⁸ However, publications evaluating the contribution of impulsivity and inattention to these conditions are less. In our study, when life events were screened, physical trauma and job changes differed between the adult ADHD risk group and other epilepsy patients. In adult ADHD, various difficulties associated with unhealthy habits; frequently encountered legal problems as a result of difficulties in complying with rules, frequent job changes, and being unemployed have been noted.²⁹ Shaped by low threshold levels in response to environmental stimuli, motor actions, especially aggressive behavior are characteristic of adults with ADHD. Some harmful behaviors such as driving hazards, especially accidents, are also frequent in ADHD patients, being an expression of impulsivity.^{30,31} Considering the QoL as the most reliable parameter for the treatment and care of individuals with epilepsy, there is evidence in the literature that psychiatric evaluation and interventions will improve the QoL.^{32,33} As with other chronic disorders, psychiatric disorders and cognitive deficits often affect the QoL more negatively than seizure control.^{34,35}

It is known that PWE has a higher risk of psychiatric symptoms, cognition, and social adjustment which are barriers to a productive and satisfying social life compared to the normal population.^{36,37} In our results, SCL-90 general and all subscale scores were found to be statistically significantly higher than healthy controls, and 2 cases (4%) reported suicide attempts. At the same time in our study, the mean general psychopathology level, all SCL subscales, especially depression and anxiety, and impulsivity scores of adult ADHD patients with high risk were significantly higher than the other patients. In the literature, in addition to the core symptoms of ADHD, at least 87% of 1 psychiatric comorbidity, and 56% of individuals with at least 2 psychiatric comorbidities are reported.³⁸ Symptoms associated with the patient's burden of comorbidity may even mask the symptoms of inattention and hyperactivity, thus overlooking the diagnosis and treatment of ADHD.^{13,16} Given the existing and markedly increased psychiatric burden in epilepsy with added adult-ADHD comorbidity, routine psychiatric screening should be a standard component of epilepsy follow-up. It is emphasized as a necessity to recognize psychopathologies including adult ADHD, especially depression and anxiety, to provide adequate treatment, and to determine the risk of suicide, which is one of the preventable causes of death.

In our study, attention-deficit was predominant in adult ADHD in epilepsy patients and a negative correlation was found between attention-deficit scores and seizure-onset age. Consistent with the literature, childhood ADHD is mostly characterized by the inattentive variant in new-onset epilepsy.¹⁰ Demonstrating the association of ADHD, which is predominantly of the inattentive type, with a statistically significant

risk for the development of epilepsy, it is also thought that psychomotor slowing and attention-deficit may be a “behavioral biomarker” reflecting brain development anomalies in children with idiopathic epilepsy.³⁹ Although the statistical significance of positive screening of those with severe cognitive impairment for ADHD has been reported in previous studies, it is surprising that approximately one-fifth of adults with epilepsy and normal cognitive function have positive screening rates for ADHD.

The strengths of our study; first, patients with a confirmed diagnosis of primary epilepsy, followed for at least 1 year, at least 1 seizure in the last 6 months, and no history of psychiatric drug use was included. The second is the exclusion of patients with another serious medical problem and/or chronic illness that may affect their QoL. The limitations of our study are that our sample size is relatively small and it only emphasizes the relationship with its cross-sectional feature but gives little information about causality. Larger sample size may aid in better characterization of diseases by increasing the study's ability to detect differences between adult idiopathic epilepsy and healthy controls while also increasing the number of subjects falling into each seizure subgroup.

CONCLUSION

Epilepsy is an expensive and complex major public health problem. Adult attention deficit/hyperactivity disorder in epilepsy is associated with a significantly poorer QoL given the impulsivity clinic. In attention deficit/hyperactivity disorder comorbidity in PWE, early detection is essential as it will lead to a serious increase in the burden of epilepsy due to the high frequency of multimorbidity, psychosocial dysfunction, low QoL, and increased mortality risk. Our results show the need for closer collaboration between different specializations for PWE. Treatment requires close collaboration between a multidisciplinary team. Including the spouse, family, or close relationships of the adult in the treatment plan may contribute to improving the QoL. Finally, methylphenidate therapy currently offers an effective treatment for adult ADHD comorbidity in PWE, which is safe and well-tolerated. Given the far-reaching biopsychosocial consequences of PWE, knowledge of ADHD and related problems in PWE is valuable and crucial in helping those with epilepsy to a better QoL.

Ethics Committee Approval: The study was approved by Atatürk University Clinical Research Ethics Committee (Date: October 01, 2020, Decision No: B.30 .2.AT A.0.0 1.00/ 503).

Informed Consent: Written informed consent was obtained from all participants who participated in this study.

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