Epilepsy & Behavior 97 (2019) 75–82

Contents lists available at ScienceDirect

Epilepsy & Behavior

journal homepage: www.elsevier.com/locate/yebeh

Revisiting personality in epilepsy: Differentiation of personality in two epilepsies starting in adolescence

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ARTICLE INFO

Article history:
Received 22 March 2019
Revised 20 April 2019
Accepted 8 May 2019
Available online 10 June 2019

Keywords:
Mesial temporal lobe epilepsy
Juvenile myoclonic epilepsy
Personality traits
NEO-PI-R
NBI
Psychiatric symptoms

ABSTRACT

Purpose: The purpose of this study was to investigate personality characteristics and clinical parameters in two well-defined epilepsies: mesial temporal lobe epilepsy related to hippocampal sclerosis (MTLE/HS) and juvenile myoclonic epilepsy (JME) through NEO Revised Personality Inventory (NEO-PI-R) and Neurobehavior Inventory (NBI) standardized instruments.
Methods: One hundred patients undergoing corticoamygdalohippocampectomy (CAH), 100 patients with JME, and 100 control subjects answered the personality measures. Clinical parameters such as psychiatric symptoms, seizure frequency, duration of epilepsy, and side of the lesion in MTLE/HS group were investigated. Statistical analysis consisted of the mean and standard deviation (SD) of each variable. Student's t-test or Fisher exact test were used according to the variable studied.
Results: The three groups were within the average range of NEO-PI-R and NBI, although 'tendencies' and differences were demonstrated. The MTLE/HS and control subjects had a similar profile: low scores in Neuroticism and high in Conscientiousness ($r = -0.330$; $p < 0.001$/$r = -0.567$; $p < 0.001$, respectively) in opposition to what occurred in JME, low in Conscientiousness and high in Neuroticism ($r = -0.509$; $p = 0.005$). The NBI 'sense of personal destiny' trait was higher (3.15; $p = 0.003$) in MTLE/HS than in JME and controls. The JME 'law and order' scores were lower than in other groups ($p = 0.024$). A tendency towards specific NBI traits differentiates MTLE/HS (Factor 3) from JME (Factor 1) groups. Psychiatric symptoms and seizure frequency were correlated with worse scores in NBI and, especially, in Neuroticism domain of NEO-PI-R.
Conclusion: Specific personality features were linked to each epileptic disease. These findings highlight the importance of considering unique features linked to epilepsy conditions in daily clinical observation to develop support programmes.

1. Introduction

The controversial relationship between epilepsy and personality characteristics has been recognized for centuries, with important studies emphasizing this association [1–4]. In contrast, the findings and evidence of some studies for the existence of an epileptic personality are inconsistent [5–8].

The concept of 'epileptic personality' was based on the observation of institutionalized patients with chronic and severe epilepsy by the early of the 20th century [5]. The focus of most studies was in temporal lobe epilepsy (TLE) with evidence of hippocampal sclerosis (HS) [4]. After an initial precipitating injury, this condition initiates mainly during adolescence, has a consistent etiology, with unquestionable Magnetic Ressonance Imaging (MRI) examination of the brain and histopathological findings showing the involvement of limbic system structures, particularly the hippocampus and the amygdala, related to emotion and behavioral responses [9,10]. Traits of personality in TLE according to Bear and Fedio [3] comprises 18 characteristics, later increased to 20 [11], even though since then, all traits have not been found together in the literature report [7,8,12–14]. Some of the most cited are represented by religiosity and philosophical interest, sense of personal destiny, hypergraphia, hypermoralism, ethical arouse, tendency to be orderly, dependence, circumstantiality, irritability, increased emotionality, sadness, obsessionalism, altered sexuality, and other features related to interictal personality disorder of epilepsy, referred to as "Gastaut–Geschwind syndrome" [2,4]. Otherwise, Kraepelin

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https://doi.org/10.1016/j.yebeh.2019.05.004
1525-5050/

[15] observed very positive attributes in the majority of patients and described them as with peculiar nonsense, quiet, modest, devoted, friendly, helpful, industrious, thrifty, honest, and hyperethical [4].

Another epileptic condition starting in adolescence is juvenile myoclonic epilepsy (JME), which is also linked to unusual behaviors. It is a type of genetic generalized epilepsy, characterized by myoclonic jerks, generalized tonic–clonic seizures (GTCS), and, more rarely, absence seizures [16]. Janz and Christian in 1957, based on clinical observations, described for the first time a specific behavioral profile in JME, whose main traits are described as the following: unsteadiness, lack of discipline, hedonism, indifference towards the disease and treatment. Other traits observed in JME are distractibility, irresponsibility, a tendency to impulsive behaviors, dependency, unstable self-concept, lack of resoluteness, patience, and perseverance [17,18]. Problems in lifestyle have been considered precipitant factors and include sleep deprivation, fatigue, stress, alcohol, and drugs intake often complicating the treatment [16]. Modern neuroimaging techniques emphasized the thalamofrontocortical network dysfunction in JME, reflecting the specific cognitive, emotional, and behavioral processes and contributing to uniqueness personality characteristics in these patients [19–23].

Some investigations have focused on the analysis of mesial temporal lobe epilepsy related to hippocampal sclerosis (MTLE/HS) and JME; only a few of them compare personality profiles and clinical-related variables in homogeneous epilepsy conditions, such as MTLE/HS and JME, discussing possible functional, anatomic, and psychiatric symptoms related to these features [6,24–26].

Personality traits are described as a dimension of individual differences, with a tendency to show consistent patterns of thinking, feelings, and actions [27]. They are constant and long-lasting ways of reacting to environmental stimuli, and not necessarily pathological, disruptive, indicative of maladjustment, or associated with psychiatric diseases; otherwise, maladaptive personality traits can have a significant negative impact on the perception of social skills in patients with epilepsy [28]. The Five Factors Model or "Big Five", recognized since the 1960s, is a comprehensive organization of personality traits, based on statistical theory, and widely replicated across a great array of personality inventories and populations. The NEO Revised Personality Inventory (NEO-PI-R) is one of the inventories based on the Big Five Model and validated to Brazil [29]. Based on "Gastaut–Geschwind" records, another important instrument used to assess TLE interictal features is the Neurobehavior Inventory (NBI) developed by Blumer [11], according to Bear and Fedio's previous report [3]; this instrument has a Brazilian–Portuguese adaptation with evaluation of its psychometric properties [7].

Studies regarding personality in epilepsy are numerous and complex, yet only a few of them compare personality profiles and clinical-related variables in homogeneous epilepsy conditions, such as MTLE/HS and JME. The purpose of the current study was to investigate personality characteristics and clinical parameters in these well-defined epileptic diseases, using NEO-PI-R and NBI standardized instruments.

2. Methods

2.1. Participants

Mesial temporal lobe epilepsy related to hippocampal sclerosis: Group 1 consisted of 100 patients undergoing corticoamygdalohippocampectomy (CAH) from 2002 to 2015 after a presurgical protocol including detailed seizure semiology, video-electroencephalographic monitoring, psychiatric assessment, neuropsychological and quality of life evaluations, MRI with unilateral HS, and HS on histopathological examination. The personality evaluation was conducted at a mean of 6.1 (standard deviation (SD) = 3.77) years after surgical treatment. One hundred patients with a diagnosis of JME according to the International League Against Epilepsy proposal for syndrome classification [30], regularly followed in our Unit, composed the Group 2. Both clinical groups are outpatients at epilepsy center of the Department of Neurology and Neurosurgery, Universidade Federal de São Paulo. Group 3 consisted of 100 healthy volunteers with no history of chronic diseases and similar sociocultural level to that of patients.

2.2. Instruments

The NEO-PI-R is a standardized instrument, comprised of 240 items, answered on a 5-point Likert scale from 1 (Strongly disagree) to 5 (Strongly agree). This measure consists of 30 facets measuring five main domains: Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness. Neuroticism domain indicates the capacity to tolerate adverse situations, maintain stable emotional states, and contain impulsiveness. Extraversion domain refers to the quality of interpersonal relationships and the search of the environmental stimuli. The seeking for new experiences, the curiosity, and variety of interests constitute the Openness while Agreeableness is the domain of emphatic emotion, expressing the ability to help and cooperate for the well-being of society. The degree of persistence, responsibility, and determination in pursuit of a goal were characteristics related to Conscientiousness domain. The NEO-PI-R score ranges from 20 to 80, with an average of 45–56 points. A standardized statistical Program of Vetor Editora conducted the Inventory correction, according to the NEO-PI-R manual [29].

The Brazilian version of NBI is composed of 100 true/false statements, with a total score ranges from 0 to 100, grouped in 20 subscales, each one scoring from 0 to 5. A total score of 20 or more affirmative statements and three or more positive answers in each subscale determine the existence of the characteristic [11]. Neurobehavior Inventory traits will be classified according to de Oliveira et al. [7], which are included in Table 1 showing NEO-PI-R and NBI contents.

2.3. Procedure

In this cross-sectional study, the inclusion criteria comprised subjects older than 18 years of age, a minimal of 8 years of education, and the capacity to understand the inventories. Individuals with low educational level, intellectual disability, acute psychotic disease, and those who had epileptic seizures or alcohol consumed within the 72 h prior the evaluation were excluded. After the Ethical Committee approval, the informed consent was obtained and all the 300 participants completed the NEO-PI-R and NBI personality inventories. The initial face-to-face interview clarified possible doubts to answer the instruments. Sociodemographic and clinical variables included were age, gender, educational level, psychiatric illness, type of seizures, frequency of focal,

Table 1
NEO-PI-R and NBI content.

NEO-PI-R	NBI
Neuroticism: anxiety, angry hostility, depression, self-consciousness, impulsiveness, vulnerability	Emotions (Factor 1): mood, feelings of guilt, dependency, sadness, anger and temper, orderliness, suspicion, interest in details, sense of law and order, persistence and repetitiveness, hatred and revenge, somatic complaints
Extraversion: warmth, gregariousness, assertiveness, activity, excitement seeking, positive emotions	Hyposexuality (Factor 2): feelings about sex, seriousness, fearfulness
Openness: fantasy, esthetics, feelings, actions, ideas, values	Unusual ideas (Factor 3): religious convictions, cosmic interests, sense of personal destiny, writing tendency
Agreeableness: trust, straightforwardness, altruism, compliance, modesty, tender-mindedness	
Conscientiousness: competence, order, dutifulness, achievement striving, self-discipline, deliberation	

myoclonic, and GTCS, duration of epilepsy for patient groups, and side of the lesion for those with MTLE/HS.

Engel [31] and Prasad et al. [32] classifications were used to determining seizure frequency, according to the clinical group, as follows: in MTLE/HS group, patient's outcome was divided into Engel Class Ia and others (Engel Classes Ib–IV). In JME group, seizure frequency was divided as follows: as *Myoclonic seizures*: Group I: good control (<5 single seizures or clusters per month, rare seizures or occasional seizures); Group II: moderate seizure control (5–14 single seizures or clusters per month, several seizures or infrequent seizures) and poor seizure control (>15 single seizures or clusters per month or daily seizures); in relation to *GTCS*: Group I: good seizure control (<1 seizure per year); Group II: moderate seizure control (1–4 seizures per year) and poor seizure control (>4 seizures per year). Absence seizures were not quantified.

The psychiatric interview of the patients was performed by two psychiatrists (G.M.A.F. or L.M.), according to the Statistical Manual of Mental Disorders (DSM-IV), with the Structured Clinical Interview for DSM-IV Axis I disorders (SCID-I) and Axis II disorders (SCID-II) [33]. The control group did not have a formal psychiatric evaluation. A psychologist (N.B.A.) conducted a brief self-reported interview to these subjects, in order to check a previous or present psychiatric disease, as well as the use of psychiatric medication. Patients spent 50 min to 2 h to answer the questionnaires.

2.4. Statistical analysis

We compared the three groups across the NEO-PI-R and NBI domains. The analysis consisted of the mean and SD of each variable. The Statistical Package for Social Sciences (SPSS) 14.0 software was performed using Student's t-test or Fisher exact test according to the variable studied. Each clinical group was compared with controls, and JME versus MTLE/HS groups were studied in order to verify differences in NEO-PI-R and NBI traits between these groups. Clinical parameters such as the side of the lesion in patients with MTLE/HS, duration of epilepsy, seizure frequency, and psychiatric status and the interrelations with Neuroticism domain and NBI were examined. p values <0.05 were considered statistically significant.

3. Results

Sixty-four patients were women in MTLE/HS group, 67 in JME group, and 60 of the controls. The mean age of subjects was 40, 30.9, and 35.2 years, respectively. Most of them had 11 years of education, and the mean duration of epilepsy was 27 (±11.29) years in MTLE/HS group and 17 (±9.50) in JME group. With respect to seizure control, 35 patients were Engel Ia at the time of the evaluation. Eighty-three patients with JME had good control of GTCS, and 61 reached a good myoclonic seizures control. Forty-three patients in JME and 33 in MTLE/HS group had a psychiatric diagnosis. In JME group, 16/43 patients exhibit depression disorder; 19/43, anxiety disorder and 08/43, personality disorder. Twenty-six of 33 patients have depression disorder and 07/33, anxiety disorder in the MTLE/HS group. Six subjects among the controls stated to have had psychiatric treatment in the past. All these subjects received a diagnosis and treatment for depression disease in the past. None of them had depression or used medications for psychiatric disease in the moment of the evaluation. Demographic and clinical characteristics of the sample are seen in Table 2.

Table 2
Clinical and sociodemographic characteristics of the sample.

Characteristics	MTLE-HS group N = 100	JME group N = 100	Control group N = 100
Gender			
Men	36 (36%)	33 (33%)	40 (40%)
Women	64 (64%)	67 (67%)	60 (60%)
Mean age (years)	40.0 (11.46)	30.9 (9.33)	35.2 (10.86)
Education level			
<11 years	72 (72%)	59 (59%)	49 (49%)
>11 years	28 (28%)	41 (96%)	51 (51%)
Mean of epilepsy duration (years)	27.0 (11.29)	17.1 (9.50)	N/A
Side of lesion			
Left	52 (52%)	N/A	
Right	48 (48%)	N/A	N/A
Psychiatric diagnosis			
Yes	33 (33%)	43 (43%)	06 (6%)
No	67 (67%)	57 (57%)	
Seizure frequency			
Controlled	35 (35%)[a]	61 (61%)	
Uncontrolled	65 (65%)[b]	39 (39%)	N/A
Presence of GTCS[c]	N/A	17 (17%)	
No GTCS	N/A	83 (83%)	

[a] Controlled: Engel Class Ia.
[b] Uncontrolled: Engel classes Ib–IV.
[c] GTCS: generalized tonic–clonic seizures.

3.1. NEO-PI-R results

The normative population in the NEO-PI-R manual had a range from 45 to 56 points, and the scores of the three groups examined were within this interval. However, there were differences between the groups in the following NEO-PI-R domains: Neuroticism ($p < 0.001$), Agreeableness ($p = 0.003$), and Conscientiousness ($p < 0.001$), as demonstrated in Fig. 1. Twenty-two of the 30 NEO-PI-R facets showed statistical differences between the three groups, as seen in Table 3.

We analyzed the interrelation between Neuroticism and Conscientiousness domains across the three groups. Patients with MTLE/HS and the control subjects had a similar profile: lower scores in Neuroticism were correlated with higher Conscientiousness scores ($r = -0.330$; $p < 0.001$/$r = -0.567$; $p < 0.001$, respectively); the inverse correlation was observed in JME group: higher Neuroticism were indicative of lower Conscientiousness scores ($r = -0.509$; $p = 0.005$).

3.2. NEO-PI-R and clinical variables

The study association between Neuroticism domain and clinical variables, such as psychiatric diagnoses, seizure frequency, duration of epilepsy, and side of the lesion in MTLE/HS group, was conducted. Neuroticism domain showed a positive correlation with psychiatric symptoms in both MTLE/HS ($r = 0.201$; $p = 0.003$) and JME ($r = 0.145$; $p = 0.010$) groups. The side of the lesion in MTLE/HS group did not influence the presence of Neuroticism ($p = 0.862$). Again, Neuroticism was not correlated with epilepsy duration in MTLE/HS ($p = 0.340$) and JME ($p = 0.142$) groups. Otherwise, the presence of seizures after CAH ($p = 0.032$), myoclonic seizures ($p < 0.001$), and GTCS ($p = 0.001$) in JME group were correlated with higher Neuroticism scores.

3.3. NBI results

Neurobehavior Inventory total scores were 43.6 (±15.11), 42.9 (±14.69), and 38.7 (±13.46) in MTLE/HS, JME, and control subjects, respectively. A statistically significant difference between clinical groups and controls ($p = 0.034$) was demonstrated, however, no differences in total scores were observed between MTLE/HS and JME groups ($p = 0.728$) (Table 4).

The comparison between the three groups related to the existence of specific NBI traits was observed only for 'sense of personal' destiny trait in MTLE/HS group (3.15; $p = 0.003$). Moreover, there were differences between the three groups. In patients with MTLE/HS, higher values were observed in seriousness (2.76; $p = 0.013$), religious convictions (2.72; $p < 0.001$), writing tendency (2.41; $p = 0.005$), sense of personal destiny (3.15; $p = 0.003$), and cosmic interests (1.86; $p = 0.001$) while anger and temper (2.01; $p = 0.014$), dependency (2.04; $p = 0.002$), somatic complaints (2.29; $p = 0.012$), and emotions (2.82; $p = 0.012$) values were higher in JME group. Orderliness ($p = 0.006$) and interest

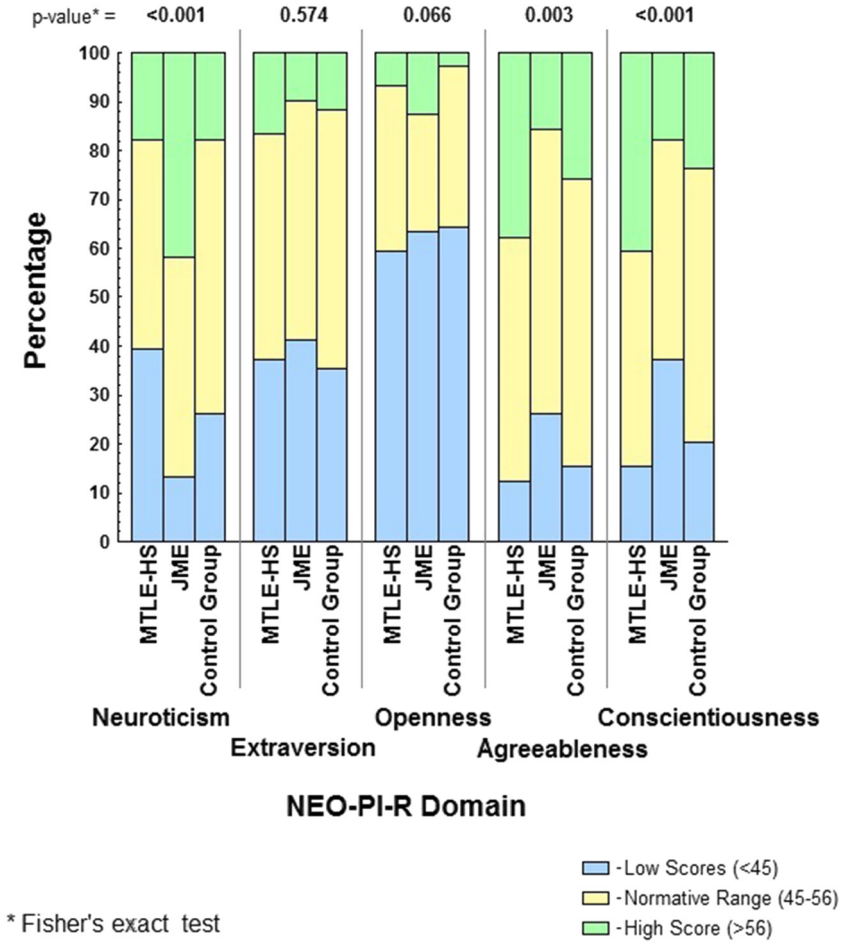

Fig. 1. NEO-PI-R percentiles in studied groups.

in details ($p = 0.002$) values were higher in both clinical groups than in controls, and JME endorsed lower values (1.94; $p = 0.024$) in sense of law and order.

3.4. NBI and clinical variables

Patients with psychiatric diagnoses in MTLE/HS group had higher total scores in NBI than those with no psychiatric symptoms (52.9 ± 15.76 versus 39.1 ± 12.58; $p < 0.001$). The same result was observed in JME group (48.2 ± 15.60 versus 38.9 ± 12.69; $p = 0.001$). In patients with psychiatric symptoms, 13/20 traits (65%) were higher in MTLE/HS group ($p < 0.05$) than in JME group, 9/20 (45%) ($p < 0.05$), as seen in Fig. 2.

Seizure frequency did not have an impact in NBI total scores in MTLE/HS group: 44.8 (± 15.14) in seizure-free and 41.3 (± 15.03) in patients with uncontrolled seizures ($p = 0.302$). In JME group, higher total scores in NBI were observed in patients with uncontrolled GTCS, 47.1 (± 14.70) compared with patients with a good GTCS control, 40.3 (± 14.18; $p = 0.032$). The presence of myoclonic seizures did not influence NBI total scores ($p = 0.477$). Duration of epilepsy in MTLE/HS ($p = 0.776$) and in JME groups ($p = 0.399$) and side of the lesion in MTLE/HS group were not correlated with NBI total scores ($p = 0.914$), and each specific subscale ($p > 0.05$).

4. Discussion

The major purpose of this study was to investigate specific personality traits in those with two well-defined epilepsy conditions compared with control subjects. In general, the three groups have similar personality profiles. The means of NEO-PI-R and NBI remained within the average range, however, these instruments highlighted some 'tendencies' across clinical groups.

4.1. NEO-P-R traits

4.1.1. Personality characteristics in MTLE/HS

In this series, patients were evaluated at least one year after CAH and lower Neuroticism, higher Agreeableness and Conscientiousness were found in this group. Changes in personality traits after epilepsy surgery are not substantial [34,35]. In a study comparing personality and mood in a TLE surgical sample, a significant decrease was observed in Neuroticism scores; however, at baseline, only depressed mood and introversion domains appeared elevated [36]. We hypothesize that lower scores in Neuroticism domain in MTLE/HS than in JME and control subjects were probably linked to improvement in seizure frequency and psychiatric symptoms after surgical procedure. On the other hand, higher scores in Agreeableness might be related to the expression of emotions and affects and reorganization of limbic areas after surgery, even though its links with the process of beneficial social interactions, adjustment, and reciprocity is yet poorly understood [37].

In a literature review, an increased warmth in social relationships in the first postsurgery months in a group of patients with TLE, independently of surgical outcome, was observed [38]. These patients developed more concerned with the attitudes and feelings of others and, in this sense, can be said to show a lessening of the egotism, which was a feature of the preoperative personality [38]. Furthermore, based on our previous study [39], patients undergoing CAH revealed marked benefits in independent living, emotional well-being, and family

Table 3
Mean and standard deviation of NEO-PI-R domains and facets in the groups.

Domain/facets	MTLE-HS	JME	Controls	p values
Neuroticism	47.8 (9.61)	54.1 (9.55)	49.8 (8.49)	<0.001
Anxiety +	46.7 (8.07)	50.9 (7.94)	48.5 (7.67)	<0.001#
Angry-hostility +	51.2 (11.00)	54.8 (10.04)	50.7 (10.34)	0.006###
Depression +	49.9 (9.69)	54.1 (9.91)	51.0 (8.33)	0.001#
Self-consciousness +	47.7 (8.93)	51.6 (9.15)	49.5 (8.14)	0.002#
Impulsiveness +	45.4 (8.63)	53.9 (10.29)	49.2 (8.74)	<0.001#
Vulnerability +	49.5 (10.51)	52.9 (10,33)	50.4 (8.73)	0.013#
Extraversion	46.8 (9.33)	45.4 (9.85)	47.8 (7.71)	0.182
Warmth	59.0 (9.65)	55.6 (9.53)	59.0 (8.45)	0.011#
Gregariouness	48.1 (9.78)	46.6 (9.68)	48.6 (9.27)	0.309
Assertiveness	46.3 (8.00)	46.9 (9.45)	46.5 (9.27)	0.884
Activity +	47.7 (9.04)	46.8 (8.88)	50.3 (8.22)	0.006####
Excitement seeking	47.2 (9.66)	48.6 (8.91)	47.2 (8.01)	0.464
Positive emotion	48.3 (10.20)	46.1 (9.26)	48.6 (7.80)	0.118
Openness	42.2 (10.48)	44.0 (9.48)	42.4 (7.17)	0.326
Fantasy +	42.7 (9.79)	45.5 (8.87)	43.6 (7.80)	0.029#
Esthetics +	47.6 (9.85)	46.2 (8.17)	45.0 (7.15)	<0.036##
Feelings	44.6 (10.71)	45.2 (9.69)	45.1 (8.26)	0.895
Actions	47.6 (10.05)	48.3 (8.18)	48.4 (7.38)	0.759
Ideas	45.0 (10.83)	44.9 (9.89)	43.6 (8.24)	0.540
Values −	41.3 (9.21)	46.7 (9.48)	45.2 (8.03)	<0.001#
Altruism +	51.1 (8.59)	48.2 (9.66)	50.6 (8.69)	0.023#
Agreeableness	54.0 (7.29)	44.9 (9.89)	43.6 (8.24)	<0.001#
Trust +	55.1 (7.63)	52.0 (6.95)	53.4 (7.29)	0.013#
Straightforwardness	55.1 (7.63)	52.0 (6.95)	53.4 (7.29)	0.003#
Altruism	51.1 (8.59)	48.2 (9.66)	50.6 (8.69)	0.052
Compliance +	53.8 (9.30)	47.8 (10.07)	51.0 (9.21)	<0.001#
Modesty	55.8 (7.26)	53.8 (8.09)	53.8 (8.01)	0.104
Tender-mindedness +	53.7 (7.48)	49.8 (8.04)	50.5 (7.75)	<0.001#
Conscientiousness	53.8 (8.99)	47.6 (9.53)	51.0 (7.86)	<0.001#
Competence −	50.3 (9.72)	46.4 (10.98)	49.1 (7.99)	0.004#
Order −	51.6 (9.06)	48.2 (10.12)	49.3 (9.03)	0.010#
Achievement striving −	52.2 (8.47)	48.2 (8.68)	50.5 (8.23)	<0.001#
Dutifulness −	54.4 (8.35)	49.3 (9.11)	51.5 (8.13)	<0.001#
Self-discipline −	53.9 (8.91)	48.2 (9.49)	52.4 (7.99)	0.001#
Deliberation −	54.2 (9.45)	48.6 (9.79)	51.9 (8.13)	<0.001#

+ high scores, − low scores. Statistical significant differences at $p < 0.05$ (Fisher test).
# Statistical differences between MTLE-HS and JME groups.
Statistical differences between MTLE-HS and controls.
Statistical differences between JME and controls.
Statistical differences between clinical groups and controls.

Table 4
Mean points and standard deviation of Neurobehavior Inventory traits in the groups.

NBI traits	MTLE/HS	JME	Controls	p values
Total score	43.6 (15.11)	42.9 (14.69)	38.7 (13.46)	0.034##
Sense of law and order	2.37 (1.39)	1,94 (1.48)	2.41 (1.51)	0.024###
Anger and temper	1.87 (1.71)	2.01 (1.65)	1.44 (1.52)	0.014###
Orderliness	2.72 (1.31)	2.95 (1.28)	2.36 (1.30)	0.006##
Feelings of guilt	2.22 (1.50)	2.33 (1.45)	2.37(1.33)	0.744
Sadness	1.28 (1.45)	1.34 (1.41)	1.05 (1.29)	0.296
Emotions	2.42 (1.57)	2.82 (1.43)	2.31 (1.29)	0.012###
Suspicion	1.36 (1.45)	1.42 (1.45)	1.23 (1.28)	0.616
Interest in details	2.58 (1.30)	2.63 (1.41)	2.02 (1.26)	0.002##
Persistence and repetitiveness	2.45 (1.59)	2.81 (1.44)	2.42 (1.40)	0.117
Hatred and revenge	1.13 (1.35)	1.37 (1.45)	1.27 (1.38)	0.475
Dependency	1.71 (1.11)	2.04 (1.36)	1.43 (1.10)	0.002###
Happiness	2.24 (1.31)	2.49 (1.35)	2.35 (1.13)	0.377
Feelings about sex	2.36 (1.61)	2.07 (1.39)	2.07 (1.39)	0.308
Fearfulness	2.15 (1.25)	2.38 (1.41)	2.12 (1.18)	0.295
Seriousness	2.76 (1.22)	2.44 (1.41)	2.34 (1.13)	0.013###
Writing tendency	2.41 (1.49)	1.87 (1.32)	1.89 (1.19)	0.005#
Religious convictions	2.72 (1.60)	1.79 (1.50)	2.06 (1.46)	<0.001#
Cosmic interests	1.86 (1.30)	1.27 (1.26)	1.30 (1.11)	0.001#
Sense of personal destiny	3.15 (1.10)	2.65 (1.29)	2.50 (1.12)	0.003#
Somatic complaints	1.86 (1.39)	2.29 (1.36)	1.74 (1.36)	0.012###

Statistical differences between MTLE/HS and JME groups.
Statistical differences between epilepsy groups and controls.
Statistical differences between JME or MTLE/HS groups and controls. (Student's t-test).

relationships. The psychosocial improvement resulted from the surgical treatment in a long-term is well-established, and gains obtained in psychosocial areas related to the surgery would lead to better scores in Agreeableness domain.

Our results demonstrated higher scores in Conscientiousness domain in MTLE/HS group (high end of average) compared with JME group, which may highlight a few personality traits associated with TLE, exemplified by attention to rules, persistence, and ethical righteous behaviors [3].

Regarding the NEO-PI-R, we agree with Locke et al. [40], who used the same instrument to evaluate personality traits in TLE versus extra-TLE and concluded that no consistent personality or psychopathology was present in TLE.

4.1.2. Personality characteristics in JME

The means of Neuroticism were higher (high end of average) in JME than in MTLE/HS and control subjects. Furthermore, in this group, lower scores were found in Conscientiousness. This domain may be related to executive functions, particularly with inhibitory control. The interrelation between Neuroticism and Conscientiousness domains in JME corroborates previous findings of association of higher Neuroticism levels and poorer planning ability and worse performance in executive tests function [41], as well as those of lower scores of Self-Directedness dimension using Cloninger Temperament and Character Inventory [42]. The latter may be correlated with lower scores in Self-Discipline facet of Conscientiousness, suggesting nonplanning impulsivity. Furthermore, higher Neuroticism level and lower Agreeableness and Conscientiousness might be associated with the pathophysiologic concept of a genetically determined involvement of mesial frontoinsular and thalamofrontocortical networks dysfunction, which plays a consistent role in cognitive impairment, unstable behavior, and problems in social adjustment found in JME [23].

4.2. NEO-PI-R and clinical variables

Both our MTLE/HS and JME groups endorsed psychiatric symptoms associated with higher scores in facets of Neuroticism domain. Few studies have compared personality traits associated with psychiatric comorbidities in MTLE/HS and JME/genetic generalized epilepsies; thus, for example, one of them confirmed the risk factor to development of affective symptoms associated only to TLE [24] whereas another showed a high prevalence of psychiatric disease in both patients with MTLE/HS and in those with JME [26]. Furthermore, an amount of clinical, psychosocial, and biological factors can be linked to increased psychiatric disorders in epilepsy [43]. Unfortunately, comparison of previous results of interictal personality features and psychiatric symptoms is complicated because of different personality instruments used in the researches, differences in epilepsy samples, lack of adequate control groups, and widely epilepsy-related variables.

4.2.1. Clinical variables in MTLE/HS

High levels of Neuroticism were linked with a psychiatric disorder in our subjects. A study comparison between personality traits and psychiatric symptoms in patients with TLE, extra-TLE, and a control group concluded that those with epilepsy have elevated personality disorder traits scores [44]. In our series, neither the side of the lesion in MTLE/HS nor epilepsy duration influenced Neuroticism scores. Our finding, with respect to lateralization of the lesion and personality characteristics in MTLE/HS, corroborates other researches in TLE [44–47]. Furthermore, in our patients, the relationship between Neuroticism scores and seizure outcome showed slight differences in seizure-free and other Engel classes. In seizure-free patients, Neuroticism scores were low in the average while in other Engel classes, they were within the normative range. In accordance with Swinkels et al.'s [44,46] findings, higher levels of psychiatric symptoms are related to seizure frequency in TLE.

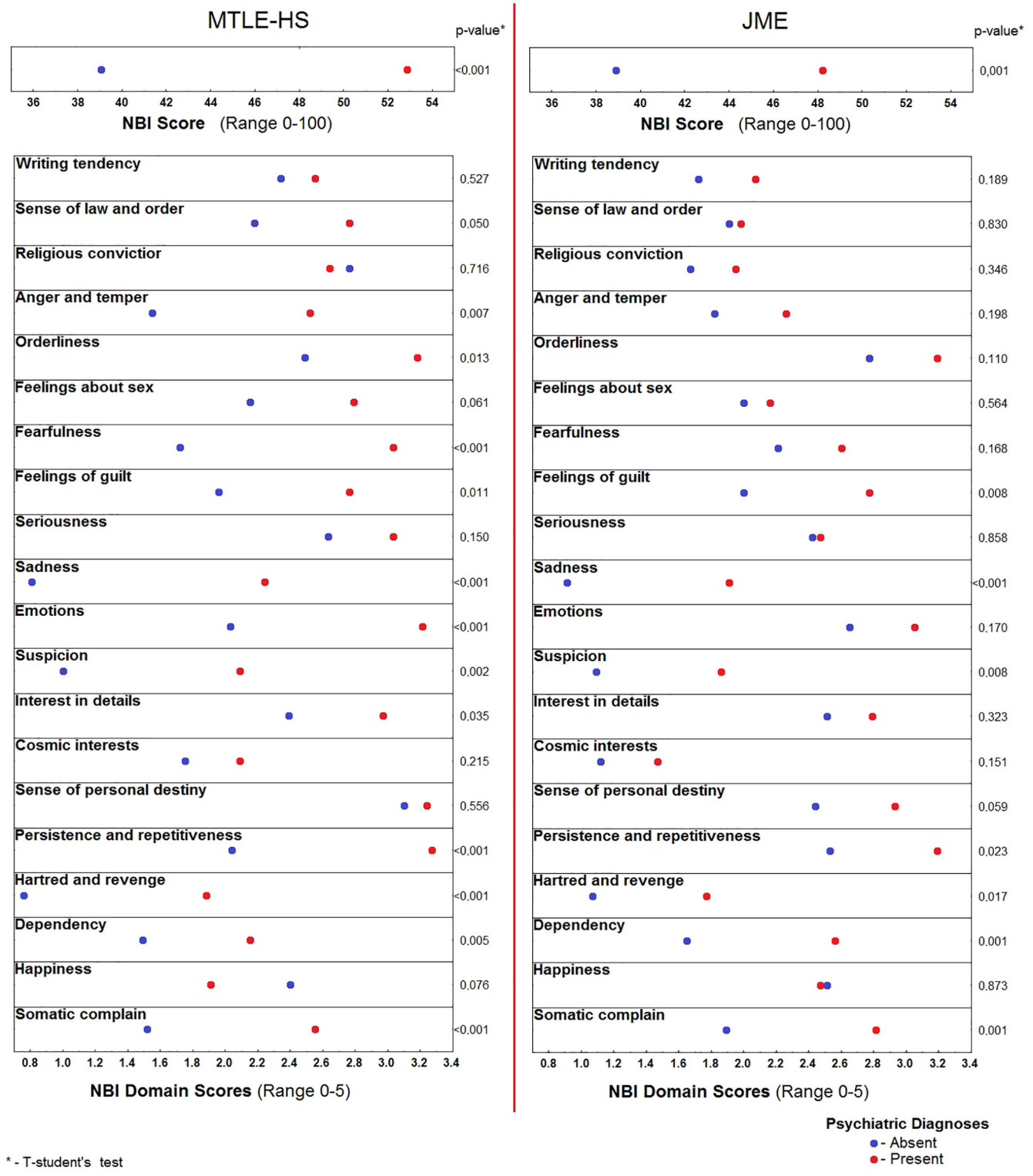

Fig. 2. Neurobehavior Inventory and psychiatric diagnoses in MTLE-HS and in JME.

4.2.2. Clinical variables in JME

Patients with JME obtained elevated scores in Neuroticism associated with psychiatric diagnoses. A study regarding personality traits and their relationship with psychiatric diagnoses showed that these patients endorsed two times more clinically relevant psychopathological symptoms than the normative population. Furthermore, they are prone to develop internalizing symptoms such as depression, anxiety, withdrawal, and social problems as well as externalizing signs, such as attention deficits [48].

The duration of epilepsy did not influence Neuroticism scores in our group; otherwise, studies have shown the negative impact of the chronicity of epilepsy in personality traits in both TLE and JME [44,48]. Seizure frequency was associated with an increased score in Neuroticism, expressed by apprehensive and worried personality, attributed by

some to frequent sudden loss of consciousness in GTCS [24]. Other articles have emphasized the association between psychiatric disorder/personality traits and worse seizure outcome in JME [49]. Yet, uncontrolled seizures lead to worse social, educational, and occupational prognoses in the long-term follow-up in this group [50].

4.3. NBI traits

Neurobehavior Inventory traits were in the normative range, except for 'sense of personal destiny', which was higher in MTLE/HS group. Otherwise, the comparison between the groups showed some tendencies. The sense of personal destiny, seriousness, religious conviction, writing tendency, and cosmic interest were significantly elevated in MTLE/HS while in JME, higher scores were found in anger and temper, dependency, emotion, and somatic complaints. De Oliveira et al. [7] identified three main components in NBI corresponding to features related to Gastaut–Geschwind syndrome: emotions (Factor 1), hyposexuality (Factor 2), and unusual ideas (Factor 3). In our JME group, higher scores were observed in traits of Factor 1 while in MTLE/HS, traits of Factor 3 were more elevated. Our data go on the opposite direction of the findings that underline that NBI does not distinguish patients with TLE from those with other epilepsies, individuals with behavioral and psychiatric disorders, as well as other neurologic conditions or healthy controls [14]. Nevertheless, several authors reported 'conspicuous traits' related to Gastaut–Geschwind syndrome [6–8,13].

4.4. NBI and clinical variables

In our epilepsy sample, higher NBI total (and also in each subscale) scores were observed in patients presenting psychiatric comorbidity when compared with those without psychiatric symptoms, corroborating the hypothesis that the percentage of variance in NBI traits could be accounted for the presence of psychiatric disorders. This result was independent of specific traits attributed to TLE [7,8,14].

The side of the lesion in MTLE/HS did not influence the presence of specific NBI traits, which corroborate the findings of Rodin and Schmaltz [12]. Epilepsy duration and seizure frequency did not influence our NBI results, except for GTCS in JME, since patients with uncontrolled GTCS revealed higher scores. In the classical Bear and Fedio study, no relationship between seizure frequency and their 18-item instrument was shown; in contrast, longer duration of epilepsy and the side of the lesion did correlate with most behavioral traits. While patients with right TLE reported more elation, obsessionalism, emotionality, and sadness, left showed anger and temper, suspicion, dependence, and sense of personal destiny [3].

5. Conclusion

In summary, there were no differences between MTLE/HS, JME groups, and control subjects in NEO-PI-R, a measure of normal personality traits, and in NBI, a specific inventory developed to evaluate TLE features. Nevertheless, uniqueness 'tendencies' across the epilepsy groups distinguish a few different characteristics using these instruments. Patients with MTLE/HS revealed greater emotional stability, persistence, responsibility, and empathy, besides showing other traits, such as seriousness, religious convictions, writing tendency, sense of personal destiny, and cosmic interests, confirming some characteristics related to Gastaut–Geschwind syndrome. The JME group is prone to act with unstable behavior, a low degree of persistence, and responsibility in adverse situations, higher levels of anger and temper, dependency, somatic complaints, emotions, and lower tendency to follow rules, traits described by Janz and Christian in JME. Furthermore, the presence of psychiatric symptoms increased Neuroticism levels and emphasizes some characteristics observed in NBI across both epilepsy groups. Our findings highlight the importance of objective measures to assess personality traits in epilepsy and that psychiatric disease may play an important role in the expression of uniqueness personality patterns. Finally, our data are in line with other studies that showed 'tendencies' in personality traits related to specific epilepsy diseases and this finding can be useful to conduct rehabilitation psychosocial programmes in MTLE/HS and JME conditions.

6. Limitations

The first limitation of our study is related to the selection of the group with TLE. Our sample enrolled patients undergoing surgical treatment. We did not have a personality evaluation before surgery, and it may be a bias, although, in current literature, no substantial changes in personality traits before and after temporal lobe epilepsy surgery have been found. The second limitation was the lack of the study about the possible influence of antiepileptic medication or other psychiatric therapy in personality evaluation. Third, a formal sociodemographic inventory was not applied in order to assess the social level of the participants, however, similarities in the groups related to the social level were considered in all enrolled participants of this research. Finally, although a formal psychiatric evaluation was not conducted in the control sample, possibly underestimating psychiatric symptoms, the subjective question answered by each participant may have been an indicator of the prevalence of psychiatric symptoms in this group.

Declaration of Competing Interest

None of the authors has any conflict of interest to disclose. We confirm that we have read the journal's position on issues involved in ethical publication and affirm that this report is consistent with those guidelines.

Acknowledgments

This study was supported by Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES). We greatly thank our patients and controls for participation in this study. We are grateful to Vivian dos Santos Altmann (Psychologist) for their contributions to interview evaluations and to Patricia Guilhem de Almeida Ramos for the statistical analysis.

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