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ARE THERE ANY GENDER DIFFERENCES IN THE QEEG POWER SPECTRUM IN PATIENTS WITH SCHIZOPHRENIA?

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A b s t r a c t: The aim of the study was to investigate the gender differences in patients with schizophrenia in age of onset, other demographic and clinical characteristics and their relationship with QEEG power spectrum measures.

Material and Methods: Thirty patients with schizophrenia were enrolled in the study, 17 female and 13 male, mean age 34 years. Comprehensive assessment of the symptoms of schizophrenia was performed using PANSS (Positive and Negative Syndrome Scale), BPRS (Brief Psychiatric Rating Scale) and CGI (Clinical Global Impression) scale. The age of onset of schizophrenia and the duration of psychosis was assessed using the medical history and parts of the IRAOS (Interview for Retrospective Assessment of Onset of Schizophrenia).

Results: Female patients had more severe psychopathology with statistically significant differences in PANSS and BPRS scores (larger total scores) and on the positive subscale of PANSS. QEEG power spectrum showed statistical significant difference only for the beta band in female patients. Women were less employed and had longer duration of illness and previous treatment. There were no differences in the mean age of onset of the disease (26 years in male and 25 years in female patients) and in the familiar occurrence.

Conclusion: Fast basic activity in beta bands was associated with female patients with schizophrenia who presented more severe psychopathology and had longer duration of the disease and previous treatment. Considering the relatively small sample the current results must be replicated with a larger group of subjects to confirm the findings.

Key words: schizophrenia, gender, QEEG, PANSS.

Introduction

Gender is one of the determinants of physical and mental health and also a risk for psychiatric disorder such as schizophrenia [1–3]. In the last decade there have been numerous studies examining the contribution of sex differences to the heterogeneity of schizophrenia phenomenology. The majority of investigations have been focused on these differences in the epidemiology and clinical expression of schizophrenia. Several studies have found differences in the onset of schizophrenia in younger male patients [4–6]. Some studies pay attention to other aspects of the disease like the course and the presented psychopathology where female patients tend to have a better short and middle-term course [7] and less bizarre delusions [4]. On the other hand male schizophrenic patients tend to present negative symptoms, less severe positive symptoms and poorer functional outcome [8]. According to some investigators duration of untreated psychosis could lead to the presence of negative symptoms and a poor outcome, but others have not found this relation [9] and the range of the duration of untreated psychosis varies between 25 and 166,4 weeks and even more [10]. Other investigators measured sex differences in the functional brain connectivity [11].

In an attempt to provide a more comprehensive assessment of the symptoms of schizophrenia in clinical and research settings the PANSS scale was developed and is regarded as a reliable means of symptom assessment [12].

Investigations current in recent years have been carried out in order to obtain a neuro-physiologic explanation for the disturbed behaviour and thinking in schizophrenia [13] and focus on the QEEG parameters in schizophrenia [14–18]. Research of QEEG activity power spectra has shown intriguing results in patients with schizophrenia [19]. While most of the studies reported that patients with schizophrenia have increased beta and slow frequency powers and reduced alpha power, amongst them the results from our previous investigation [20], others showed no differences, and even opposite results have been reported [21]. In recent studies different symptom clusters have been correlated to QEEG frequency bands [22]. Studies that performed EEG analysis of schizophrenic patients also examined influences of the sex and age, the duration of illness and clinical characteristics of the disease [23]. Others think that EEG abnormalities are associated with schizophrenia and reflect non-genetic, pathological developments of the brain [24] or that disruption of frontal-temporal connectivity appears to have a specific relationship to psychomotor poverty in schizophrenia [19].

Aims of the paper

In this study, we investigated the gender differences in patients with schizophrenia in the age of onset, other demographic and clinical characteristics

and their relationship with QEEG power spectrum measures. We also compared psychopathology and other clinical variables.

Material and Methods

Thirty (13 male and 17 female) inpatients from the University Psychiatry Clinic were recruited into the study. All the patients fulfilled the ICD-10 diagnostic criteria for schizophrenia and were drug-free or without antipsychotic therapy for at least two days before the QEEG recording in order to avoid the immediate effect of the drugs. Subjects with a history of neurological disorders, chronic medical disease, alcohol or drug abuse and mental retardation were excluded. Patients were recruited to the study on a voluntary basis and, after being given a complete description of the study, their written informed consent was obtained.

In the evaluation a complete medical history and clinical examination were performed. The patients' global psychopathology was evaluated with the PANSS scale. In the present study the following PANSS components were used: positive subscale, negative subscale and total score. For the evaluation of the severity of the disorder we also used BPRS and CGI scales [25]. The age of onset of schizophrenia and the duration of psychosis were assessed using the medical history and the IRAOS [26]. For the duration of the current episode we used the part of IRAOS that marks episode development as 1 = acute or sudden with duration within 7 days; 2 = sub-acute within 1 week up to 1 month; 3 = slowly, gradually developed episode of more than a month, but cannot be dated exactly, and 9 = unknown, cannot be evaluated.

Neurophysiologic examination was performed with quantitative EEG analysis. QEEG recordings were performed between 9 a.m. – 1 p.m. while the subjects were awake with their eyes closed. During recordings vigilance was controlled by visual monitoring of the prominence of the alpha frequency in the posterior parts of the brain and regular verbal contacts were maintained with the subjects. The standard 10–20 electrodes placement system with 19 electrodes on the scalp and one on both earlobes were used in the recordings. The resistance was kept below 10 kΩ. The EEG digital recordings were screened visually and 25 × 2 second artifact-free epochs were selected from the background activity of the recording for subsequent analysis. As a result of the Fast Fourier Transformation, the averaged power spectral values of the delta (0.5–3.5 Hz), theta (4.0–7.5 Hz), alpha (8–12.5 Hz), and beta 1 (13–19.5 Hz) and beta 2 (20.0 –29,5 Hz) bands were produced for each of the 19 scalp electrodes separately. In order to obtain topography of the main region of interest the following electrode placements were chosen for further analysis: F3; F4; C3; C4; T3; T4; P3; P4; O1 and O2.

Statistical analyses of the data were performed using the Statistical Package for the Social Sciences (SPSS) for Windows, version 13.0. The following

non-parametric tests were used for demographic characteristics: Yates' chi-square, Fisher's exact and Mann Whitney test. Analysis of the clinical scale scores and QEEG parameters were performed with ANOVA and ANCOVA with covariate variables: age and duration of the disease.

Results

The mean age of the patients was 34 ± 9.1 for the male patients and 33.5 ± 12 years for females (range: 18–55). The subjects were not significantly different in their demographic characteristics (marital status, level of education, handedness, family history) except for employment (women had a worse occupational history than male patients). These characteristics are shown in Table 1.

Table 1

Demographic characteristics of schizophrenic patients

Item		**Male (n = 13)**	**Female (n=17)**	**Analysis**
Married		5(50%)	8(47.1%)	Yates chi-square = 0.06 df = 1 p = 0.8
Employed		10(76.9%)	5(29.4%)	Yates chi-square = 6.6 df = 1 p = 0.01
Handedness	dextral	6(85.7%)	15(100%)	Fisher exact p = 0.32
	left-handed	1(14.3%)	0	
Positive family history		3(23.1%)	7(41.2%)	Fisher exact p = 0.31

Although there was no statistical difference, male patients tend to be diagnosed with paranoid and hebephrenic type of schizophrenia and female patients with undifferentiated or unspecified type of schizophrenia which data are shown in Table 2.

Table 2

Distribution according to diagnosis of schizophrenia

Schizophrenia	**N^o**	**M/F ratio**
paranoid	10	6/4
hebephrenic	6	4/2
catatonic	1	1/0
undifferentiated	6	2/4
residual	1	0/1
simple	2	0/2
unspecified	4	0/4

Analyzing the gender differences in hospital and previous treatment, recidivism of episodes and duration of current episode (according to IRAOS) statistical differences were not found, except for previous treatment in female patients, which results are presented in Table 3.

Table 3

Basic data for course of disease and treatment

Item		**Male (n = 13)**	**Female (n = 17)**	**Analysis**
Hospital treatment		10(76.9%)	14(82.3%)	Fisher exact p = 1.0
Previous treatment		7(53.8%)	15(88.2%)	Fisher exact p = 0.049
Recidivate episodes		11(84.6%)	14(82.3%)	Fisher exact p = 1.0
Duration of current episode	1	3(23.1%)	4(23.5%)	Mann-Whitney U = 97.0 p = 0.57
	2	6(46.1%)	5(29.4%)	
	3	4(30.8%)	8(47.1%)	

Mean duration of illness, age of onset in years, age of onset in patients with a positive family history and duration of the disease in months are shown in Table 4. The only statistical difference was the disease duration, which is longer in female patients.

Table 4

Duration of current episode and age of onset

Item	**Mean ± SD**		**ANOVA**			**ANCOVA**
	male N = 13 (43.3%)	female N = 17 (56.7%)	F	df	p	p
Age (years)	34 ± 9.1	33.5 ± 12	0.018	1	0.89	0.62[a]
Education (years)	11.5 ± 1.2	11.8 ± 2.5	0.09	1	0.77	0.8[b]
Age at onset (years)	26.2 ± 6.9	25 ± 7.4	0.22	1	0.64	0.62[b]
Age at onset (years, #)	24.3 ± 1.5	24.6 ± 7.7	0.003	1	0.96	0.11[b]
Duration of illness (months)	91.8 ± 89.1	116.5 ± 86.1	8.7	1	0.059	0.048[c]

[a] duration of illness as a covariate
[b] age and duration of illness as covariate
[c] age as covariate
patients with positive family history

The results of the assessment of the symptoms of schizophrenia with clinical scales are presented in Table 5 and show differences that the female patients scored higher than males in the PANSS total score, the score of the PANSS positive subscale and in the BPRS score. Although not statistically significant, male patients tend to present higher scores on the negative subscale of PANSS.

Table 5

Descriptive statistics of the clinical assessments

Clinical scale	**Mean ± SD**		**ANOVA / MANOVA***	
	male N = 13(43.3%)	female N = 17(56.7%)	F	p
BPRS total score	32.6 ± 8.8	37.9 ± 10.3	F = 3.94	< 0.05
PANSS score	85.8 ± 11.3	95.3 ± 17.3	F = 4.1	< 0.05
PANSS negative subscale	10.4 ± 6.5	7.4 ± 4.2	F = 1.37	> 0.05
PANSS positive subscale	4.7 ± 2.7	6.1 ± 4.2	F = 3.82	< 0.05
CGI	5.0 ± 1.3	5.2 ± 0.9	F = 0.34	> 0.05

*age and duration of illness are independent variables

When we analysed the basic activity with the power spectrum of the different band, statistical significance was found in beta activity in the lower ranges (beta 1) and in the faster beta 2 activity.

Table 6

Significance of gender differences in power spectrum

Band power	**male/female**	
	F	p*
Delta	0.73	0.68
Theta	0.65	0.75
Beta 1	2.1	0.049
Beta 2	3.21	0.001
Alfa	0.23	0.99

*calculated with Repeated Measures ANOVA

There were no significant differences between male and female in the QEEG power spectrum except for the beta 1 and beta 2 bands. Female patients have more pronounced activity and the results are shown in Figures 1 and 2 respectively.

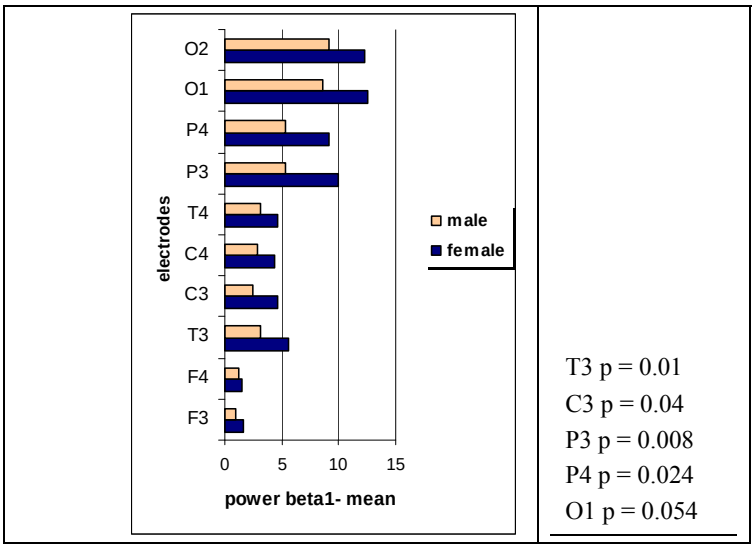

Fig. 1 – Distribution of gender differences in beta 1 power spectrum

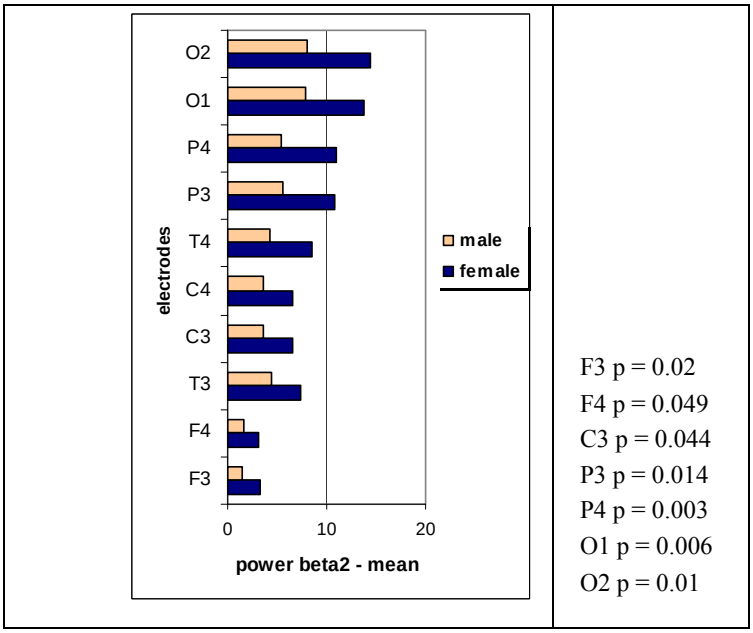

Fig. 2 – Distribution of gender differences in beta 2 power spectrum

Discussion

This study refers to the gender differences in schizophrenia patients in relation to duration of illness, age at onset, presented clinical psychopathology and QEEG power spectrum parameters. The main findings in our study were that female patients tended to have more pronounced beta activity over temporal, parietal and occipital regions mainly on the left hemisphere, more severe positive symptomatology, longer disease duration and were more frequently treated with medication than males and had a worse occupational history. Men were more often diagnosed as having a paranoid and hebephrenic form of schizophrenia and women as having an undifferentiated or unspecified form according to ICD-10 criteria. By contrast female patients showed a different pattern of ongoing symptoms and severity, being more likely to have more severe positive symptoms of the disease with higher scores in BPRS, PANSS scale and PANSS positive subscale when compared with male patients. This finding is consistent with previous observation that female patients display more affective symptoms, auditory hallucinations and persecutory delusions with more rapid and greater responsiveness to antipsychotics [5], but in this review, males consistently have an earlier onset and show more negative symptoms. Although insignificant, we found greater scores on the PANSS negative subscale in the male patient group that are similar to another previous study [6].

The gender differences at age of onset of schizophrenia are the most frequently reported, with earlier onset in male patients. In our study there were no gender differences in the age of onset, but when we account for the patients with a positive history, the age of onset of the disease was two years earlier in both gender groups which points to genetic aspects of schizophrenia. Our finding is similar to other studies which did not find gender differences in the age of onset in different countries [27–30].

Taking into account the previously discussed results we can conclude that our findings of increased power spectrum in the beta band of the basic EEG activity in female patients represent the neurophysiologic aspects of the pronounced presence of positive symptoms of schizophrenia in female patients, which is in accordance with some recent studies [11]. A similar correlation between absolute powers in the beta frequency band and clinical parameters measured with the PANSS scale was found in the beta range over frontal-central areas on the left side and were significantly correlated with positive subscale and total PANSS score [19]. Some previous studies positively linked BPRS scores and anxiety with fast beta bands [31]. Increase in beta 1 power was found in another study [32] but was positively correlated with negative symptoms of schizophrenia. We would like to point out consistently reported findings that beta activity is increased with anxiety and severe psychopathology in schizophrenia [13, 15]. Psychotic symptoms are most likely a consequence of dys-

function of multiple cortical areas and sub-cortical brain structures in patients with schizophrenia mainly in the left temporal and also in the right prefrontal areas which are pointed out as being specific for auditory hallucinations [33, 34].

Another gender difference in our study is that female patients were significantly less employed, which could be a result of some cultural aspects of the disease which are not in the scope of this investigation.

Our research suggested that female patients are more frequently treated than men which could be explained with the good relationship with the caregivers that appear to be stronger and longer-lasting for females, which is similar to some other studies [2]. However, in our study female patients had a longer duration of the disease (116,5 months) as opposed to males (91,8 months) and this may be a possible explanation for the previously noted difference in received treatment. This is the opposite to the finding that men have more hospitalizations and longer stays than women [7].

Our study has a number of limitations that need to be acknowledged. The sample has a small number of subjects, a heterogeneous group of types of schizophrenia with different lengths of illness and no control group.

Conclusion

Our study points to the significant gender differences in the beta QEEG power spectrum, psychopathology, duration of illness, received treatment and unemployment in female patients, which could be explained with the severity of the presented psychopathology measured with clinical rating scales. However, these findings need to be verified by future research.

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Р е з и м е

ПОСТОЈАТ ЛИ ПОЛОВИ РАЗЛИКИ ВО СПЕКТРАЛНАТА СНАГА НА QEEG КАЈ ПАЦИЕНТИ СО ШИЗОФРЕНИЈА?

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А п с т р а к т: Целта на трудот е да се испитаат половите разлики кај пациенти со шизофренија во однос на почетокот на болеста, демографските и клиничките карактеристики и нивната поврзаност со спектралната снага на квантифицирано ЕЕГ (QEEG).

Материјал и методи: Во истражувањето беа вклучени 30 пациенти со шизофренија, 17 жени и 13 мажи на средна возраст од 34 години. Проценката на симптомите беше направена со употреба на скала за позитивни и негативни симптоми на шизофренија (PANSS), кратка скала за психијатриска проценка (BPRS) и скала за глобална клиничка импресија (CGI). Почетокот на болеста и траењето на психозата беше проценувано преку историја на болеста и интервју за ретроспективна проценка на почеток на шизофренија (IRAOS).

Резултати: Жените со шизофренија имаа поизразена психопатологија со статистички значителни разлики во вкупните скорови на PANSS и BPRS и на позитивната субскала на PANSS. Спектралната снага на QEEG покажа статистички значителна разлика за бета активноста кај женските пациенти. Жените со шизофренија имаа подолго траење на болеста, почесто беа третирани и најчесто невработени. Немаше значителна разлика меѓу половите во однос на средната возраст на почеток на болеста (кај мажите 26 години, кај жените 25 години) и хередитетот.

Заклучок: Бета активноста беше асоцирана со женски пациенти со шизофренија кои имаат поизразена психопатологија, подолго траење на болеста и претходен третман. Овие разултати треба да се потврдат на поголем број испитаници со оглед на малиот примерок.

Клучни зборови: шизофренија, пол, QEEG, PANSS.

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