Clinical and cognitive correlates of formal thought disorder in early onset schizophrenia

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ORIGINAL ARTICLE

Abstract

OBJECTIVE: Although formal thought disorder and cognitive impairment are key features of schizophrenia, only a few studies evaluated both in adolescent population.

METHOD: 32 inpatients with early-onset schizophrenia spectrum disorders (SSD) and 32 matched healthy controls were studied with Thought, Language and Communication Scale and battery of neurocognitive tests and SSD subjects were also assessed with Positive and Negative Syndrome Scale and Clinical Global Impression Scale.

RESULTS: Patients presented impairment in both cognitive functioning and formal thought processes. Communication disturbances correlated with executive and verbal fluency dysfunction.

CONCLUSION: Communication disturbances in adolescent SSD patients may have both dysexecutive and dyssemantic origin.

INTRODUCTION

Beginning with the formation of concept of dementia praecox, and its subsequent development, disturbances of thinking, language and communication are considered central features of the illness (Bleuler 1911; Andreasen 1986). Results of longitudinal studies suggest that thought disorder in schizophrenia comprise both state-like and trait-like component and may be associated with underlying neurocognitive impairment (Spohn *et al.* 1986; Levy 2010).

Early-onset psychosis is considered more severe in terms of symptomatology and functional impairment than adult onset schizophrenia (Remschmidt 2002; Rabinowitz *et al.* 2006). Formal thought disorder in this population had been evaluated sporadically. Makowski *et al.* (1997) use Thought Disorder Index (TDI) to demonstrate that in adolescents with different psychiatric diagnoses most severe communication disturbances are seen in early-onset schizophrenia. In earlier age groups thought disorder should be differentiated from speech immaturity associated with developmental processes. Caplan (1994) finds that illogical thinking and loose association discriminate children above 7 with schizophrenia spectrum disorders (SSD) from matched healthy controls. Balxate & Simmonds (1995) concludes that communication disturbances in a group of 47 subjects with early onset schizophrenia (EOS) resemble deficits observed in adult patients. However Luoma *et al.* (2008) find positive thought disorder to be more common in patients with earlier onset of schizophrenia.

In clinical assessment thought disorder seems to be a complex, multifactorial syndrome. Adreasen (1986) define positive and negative thought disor-

ders. In three-factorial models thought disorder loads both on negative and disorganization factors (Marengo *et al.* 2000). Similarly, cognitive impairment in schizophrenia is associated with negative symptoms (Nieuwenstein *et al.* 2001, Rhinewine *et al.* 2005) both in adult-onset and early-onset schizophrenia, and also in some of the studies with disorganization factor (Nieuwenstein *et al.* 2001, Daban *et al.* 2002).

McGrath (1991) proposes, that inability to plan the talking according to logical rules, together with lack of monitoring of listener response (executive deficits) lead to communication disturbances. Indeed, in studies of adult patients thought disorder is found to be related to impairments in attention, working and semantic memory and executive functions (Kerns *et al.* 2002, Barrera *et al.* 2005; Subotnik *et al.* 2006; Stirling *et al.* 2006). Recently however, using three different psychometric tools in thought disorder assessment Docherty (2011) observes that from different speech disturbances only communication deficits are associated with cognitive impairment. Communication Disturbances Index is in this study related to attention, working memory and organizational and conceptual sequencing impairments, but not to typical executive functions measure Wisconsin Card Sorting Test (WCST).

Impairment of cognitive functioning in schizophrenia is almost universal finding both in adult patients (e.g. Badcock *et al.* 2005, Joyce & Roiser 2007, Szöke *et al.* 2008) and in youth with early onset psychosis (Kravariti *et al.* 2003, McClellan *et al.* 2004, Ueland *et al.* 2004; Holmen *et al.* 2009). In childhood-onset SSD study Caplan (1994) observe that generally formal thought disorder is not related to the full-scale IQ score. However in further analysis in this study loosening of associations, but not illogicality, is related to factors described as distractibility and verbal comprehension.

The relationship between thought disorder and more specific cognitive deficits including executive functions impairment in early onset schizophrenia (EOS) population has not been systematically evaluated. Yet studies in this age group of patients may be valuable, because they encompass a period of brain development and maturation of thinking, which may have specific pathogenic relevance to psychosis (Kyriakopoulos & Frangou 2007). Moreover, studies of adolescents (with recent-onset illness) allow avoiding the effects of disease chronicity and treatment. And finally, this population of patients is probably more homogenous than adults, with regard to severity of etiological factors (Remschmidt 2002).

The aim of the study was assessment of associations between psychopathological symptoms, cognitive functions and formal thought disorder in early onset schizophrenia. In comparison with control group the profile of thought disorder and level of cognitive impairment was also analyzed.

Based on the findings in the literature we hypothesized that in EOS: (1) In comparison with healthy controls patients present cognitive impairment and formal thought disorder (2) Formal thought disorder is associated with attention, operational memory and executive and semantic functions impairment, (3) Formal thought disorder and cognitive impairment are associated with severity of psychopathological symptoms.

METHODS

Participants

Thirty two inpatients, aged 13–18 years hospitalized due to acute psychotic episode in adolescent psychiatry ward from January 2005 to May 2009 were recruited. All participants had schizophrenia spectrum diagnosis (schizophrenia F20, schizotypal disorder F21, pervasive delusional disorder F22 or acute and transient psychotic disorder F23) made according to the diagnostic criteria specified in International Classification of Disease–10 (World Health Organization 1993). The psychiatric diagnosis was based on semi-structured psychiatric interview with the patient and his/her parents. Any diagnostic difficulties were verified within multidisciplinary treatment team comprising experienced senior psychiatrists. Most (29/32, 91%) of the patients were assessed during their first psychotic episode, in some cases treated ineffectively before in outpatient setting. In all patients current episode of illness was treated with risperidone. Five (16%) patients were assessed before introduction of pharmacotherapy, 27 (84%) within the first week of risperidone therapy. Additional medication (benzodiazepines n=7, decreasing doses of previous antipsychotic therapy n=2) was allowed. Exclusion criteria comprised schizoaffective disorder, current presence or history of psychoactive substance abuse, diagnosis of mental retardation according to ICD-10 criteria, pervasive developmental disorders and serious neurological or somatic disorder.

The control group (n=32) included age- and gendermatched healthy adolescents recruited from schools in the same area. Type of education (more or less demanding) was also controlled for. Exclusion criteria comprised current presence or history of any psychiatric disorder, presence of neurological or somatic disorder and psychiatric history in first-degree relatives. Both in patient and control group all participants spoke Polish fluently.

Study design and procedure

The study was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. The design of the study was accepted by Bioethics Committee of the Institute of Psychiatry and Neurology in Warsaw. All subjects and their parents signed informed consent for the study.

All assessments were made by the same rater (BR). The assessment took place during one meeting. Breaks were allowed when needed. Patients were assessed with the battery of tests and clinical scales during admission.

Control subjects were assessed with the battery of tests at schools, which they regularly attended.

Measures

Severity of symptoms was assessed with:

Positive and Negative Syndrome Scale (PANSS) (Kay *et al.* 1987). Polish validated version was used (Rzewuska 2002). Total score and positive, negative and general psychopathology subscales scores were analyzed.

Clinical Global Impression Scale – Severity (CGI) (Guy 1976). In this scale patient state is rated on a seven-point scale from 1 "normal" to 7 "among the most extremely ill patients".

In formal thought disorder assessment the following tools were used:

Thought, Language and Communication Scale (TLC) (Andreasen 1986). This widely used scale contains 18 items describing different kinds of thought disorders phenomena. Andreasen proposes also calculating total TLC score on the basis of classification of symptoms as more or less specific for psychosis (pathological). In analysis item scores and TLC total score were used.

Kent-Rosanoff Test (KRT). This test contains 100 common words. Patients are asked to give their first association to the each word. In schizophrenia patients more uncommon and idiosyncratic responses as well as more perseverative responses are observed (Sommer 1962; Shakov 1980). In this study, Polish version of the test and Polish frequency tables containing most common responses from general population sample were used (Kurcz 1967; Łobacz & Mikołajczak-Matyja 2002). Two parameters were analyzed: number of uncommon responses (responses not present in frequency tables) and number of perseverations.

Rationale for use of these scales is to measure different aspects of thought disorder. TLC includes wide spectrum of thought disorder symptoms. KRT can provide more specific data of peculiarity in verbal associations.

For cognitive function assessment WCST, Verbal Fluency Tests and Digit Span Test were chosen as possibly connected with formal thought disorder (Czernikiewicz 1998; Sponheim *et al.* 2003; Subotnik *et al.* 2006).

Wisconsin Card Sorting Test (WCST) computer version Heaton *et al.* 1993) was used. Results typically reported on the WCST include perseverative errors, nonperseverative errors and categories completed (Nieuwenstein *et al.* 2001; Li 2004; Subotnik *et al.* 2006). These three measures were used in present study.

Semantic and Phonological Verbal Fluency Tests. In Semantic Verbal Fluency test patients are asked to name possibly highest number of animals, plants, and birds in one minute for each task. In Phonological Verbal Fluency Test patients have to give possibly highest number of nouns starting with letters: K, S, and M (specific for

Polish lexical rules). Global indexes of semantic and phonological tasks were analyzed (Bokat & Goldberg 2003).

Digit Span Test Forward and Backward (DST) from Wechsler Adult Intelligence Scale Polish version (Brzeziński *et al.* 1996). Forward subtest is thought to be a measure of general attention, while backward is considered a measure of working memory.

Data analysis

For statistical analysis, SPSS package v. 18.0 for Windows was used (2009). Distribution of variables was assessed with Kolmogorov-Smirnov Test and null hypothesis of normal standard distribution was rejected, so nonparametric tests were used. For intergroup comparisons Mann-Whitney U test was used and in correlation analysis Kendall's tau-b coefficient was calculated.

All of these statistical tests were 2-tailed, with $p<0.05$ considered positive with statistically significant, and $p<0.08$ considered a statistical trend.

RESULTS

Demographic and clinical assessment

Demographic and clinical/psychopathology (in patient group) data are summarized in Table 1. Control group was individually matched on the basis of age-, sex- and type of school. No significant differences between patients and controls in demographic variables were observed. In patient group there were no statistically significant differences between girls and boys in age, duration of illness and age of onset.

Patients and controls comparison

Results of patients and controls comparison are summarized in Tables 2 and 3.

Patients compared with healthy controls had evident formal thought disorder and preformed worse on WCST and semantic verbal fluency tests. These differences were statistically significant. In control group different profile and milder forms of thought disorders were observed.

To avoid bias associated with heterogeneity of patient group, the same analysis in subgroup of 24 patients with narrowly defined schizophrenia diagnosis (F20.0–F20.9) and matched with them subgroup of healthy controls were performed, which did not change results. Observed differences in cognitive tests, TLC total score and most differences in TLC item scores remained statistically significant.

Formal thought disorder and cognition

In patient group only a few significant correlations were observed. Thought disorder measured by TLC test positively correlated with number of nonperseverative errors on WCST and negatively with verbal fluency tests' results. Number of nonperseverative errors in

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Tab. 1. Demographic, clinical and psychopathology data in patient and control groups. Where possible data are presented as mean±SD.

		Patient group	Control group
N (F:M)		32 (17F:15 M)	32 (17F:15M)
Age (years)		16.7 ±1.5 (range 13.3-18.8)	16.7 ±1.6 (range 12.9–18.8)
Diagnosis	Schizophrenia F20	24 (12F:12M)	None
	Schizotypal disorder F21	4 (2F:2M)	
	Delusional disorder F22	1 (0F:1M)	
	Acute and transient psychotic disorder F23	3 (3F:0M)	
Duration of psychotic symptoms (years)		0.8±1.0	
Duration of illness including prodromal phase (years)		1.1±1.3	
PANSS-T		80.0±16.8	
PANSS-P		17.1±4.6	
PANSS-N		24.4±5.3	
PANSS-G		38.4±9.7	
CGI		4.3±0.8	

F – female, M – male, PANSS – Positive and Negative Syndrome Scale; PANSS-T – total score; PANSS–P –positive subscale; PANSS–N – negative subscale; PANSS–G – general psychopathology subscale; CGI – Clinical Global Impression Scale

Tab. 2. Comparison of cognitive tests' results between early-onset schizophrenia spectrum patients and healthy controls. Data are presented as mean±SD, z-score, Z value of Mann-Whitney U Test, and level of statistical significance.

TEST	Patients (mean±SD)	Patients z-score	Controls (mean±SD)	Z	*p*-value
KRT perseverations	14.7±8.8	−0.20	16.6±9.5	−0.639	ns
KRT uncommon responses	50.8±12.9	1.42	39.8±7.7	−3.635	$p<0.0005$
DST Forward	5.9±1.8	−0.06	6.0±1.6	−0.459	ns
DST Backward	5.0±2.2	−0.61	6.3±2.1	−2.441	$p<0.05$
WCST perseverative errors	24.8±16.0	1.43	12.3±8.7	−3.663	$p<0.0005$
WCST nonperseverative errors	27.9±19.6	0.79	14.4±17.0	−3.621	$p<0.0005$
WCST completed categories	3.3±2.2	−1.42	5.3±1.4	−4.029	$p<0.0005$
Semantic Verbal Fluency	39.3±15.2	−1.29	54.1±11.4	−3.730	$p<0.0005$
Phonological Verbal Fluency	29.1±13.5	−0.45	34.0±10.7	−1.686	ns

KRT – Kent-Rosanoff Test; DST – Digit Span Test; WCST – Wisconsin Card Sorting Test; ns – not significant

WCST negatively correlated with number of perseverations in Kent-Rosanoff Test. Results of DST Forward were significantly associated with DST Backwards score and verbal fluency. Correlations coefficients are presented in Table 4.

Different correlation profile was observed in control group. Most of the tests did not correlate with each other. Positive correlation was found between Forward and Backward subtests of Digit Span Test. Number of perseverative errors in WCST negatively correlated with Phonological Verbal Fluency Tests. Results are presented in Table 5.

Severity of symptoms, and its relationship to cognition and formal thought disorder in patient group

Total PANSS, its subscales scores and CGI scores were used in correlation analysis. Total PANSS score negatively correlated with Phonological Verbal Fluency score and positively with number of uncommon responses in Kent-Rosanoff Test. Phonological Verbal Fluency score showed negative correlation with negative and general subscales of PANSS and CGI score. Digit Span Forward Test result also negatively correlated with CGI. Number of perseverative errors in WCST positively correlated with PANSS negative subscale, but with no other psy-

Tab. 3. Comparison of Thought, Language and Communication Scale results between early-onset schizophrenia spectrum patients and healthy controls. Data are presented as mean±SD, z-score, Z value of Mann-Whitney U Test, and level of statistical significance.

TLC item	Patients (mean±SD)	Patients z-score	Controls (mean±SD)	Z	*p*-value
Poverty of Speech	0.78±0.94	0.93	0.25±0.57	–2.665	*p*<0.01
Poverty of Content	0.62±0.94	3.27	0.03±0.18	–3.425	*p*=0.001
Pressure of Speech	0.03±0.18	–0.49	0.22±0.42	–2.250	*p*<0.05
Distractible Speech	0.03±0.18	NA	0±0	–1.000	ns
Tangentiality	0.16±0.45	0.4	0.06±0.25	–0.877	ns
Derailment	0.25±0.62	NA	0±0	–2.309	*p*<0.05
Incoherence	0.06±0.35	NA	0±0	–1.000	ns
Illogicality	0.09±0.30	NA	0±0	–1.760	*p*<0.08
Clanging	0.03±0.18	NA	0±0	–1.000	ns
Neologisms	0±0	NA	0±0	0.000	ns
Word Approximations	0.37±0.49	1.24	0.06±0.25	–3.000	*p*<0.01
Circumstantiality	0.25±0.57	0.07	0.22±0.42	–0.173	ns
Loss of Goal	0.31±0.74	1.5	0.03±0.18	–2.020	*p*<0.05
Perseverations	0.4±0.66	NA	0±0	–3.611	*p*<0.0005
Echolalia	0±0	NA	0±0	0.000	ns
Blocking	0.31±0.74	NA	0±0	–2.549	*p*<0.05
Stilted Speech	0.34±0.63	1.72	0.03±0.18	–2.524	*p*<0.05
Self Reference	0.09±0.296	0.33	0.03±0.18	–1.025	ns
Total score	6.59±5.39	3.06	1.56±1.64	–4.964	*p*<0.0005

ns – not significant; NA – not applicable

Tab. 4. Correlations between thought disorder and cognitive parameters in early-onset schizophrenia spectrum patients. For statistically significant correlations Kendall's tau-b correlation coefficient and level of significance are presented.

	TLC total	KRT uncommon responses	KRT perseverations	DST Forward	DST Backwards	Semantic Fluency	Phonological Fluency
WCST	NE: 0.30 (*p*<0.05)	ns	NE: –0.26 (*p*<0.05)	ns	ns	ns	ns
TLC–total		ns	ns	ns	ns	–0.34 (*p*<0.01)	–0.30 (*p*<0.05)
KRT uncommon responses			ns	ns	ns	ns	ns
KRT perseverations				ns	ns	ns	ns
DST Forward					0.52 (*p*<0.001)	0.29 (*p*<0.05)	0.42 (*p*<0.01)
DST Backwards						ns	ns
Semantic Fluency							0.43 (*p*<0.01)

KRT – Kent-Rosanoff Test; DST – Digit Span Test; WCST – Wisconsin Card Sorting Test; TLC – Thought, Language and Communication Scale; NE – nonperseverative errors, ns – not significant.

chopathological index. TLC total score did not correlate with any of PANSS scores, but did correlate with CGI. In correlation analysis for all correlations higher level of psychopathology was associated with worse results of the tests. Data are summarized in Table 6.

DISCUSSION

In this study we confirmed, previously reported disturbance of cognitive and communication functions in early-onset schizophrenic patients. To our best knowl-

Tab. 5. Correlations between thought disorder and cognitive parameters in healthy control subjects. For statistically significant correlations Kendall's tau-b correlation coefficient and level of significance are presented.

	TLC total	KRT uncommon responses	KRT perseverations	DST Forward	DST Backwards	Semantic Fluency	Phonological Fluency
WCST	ns	ns	ns	ns	ns	ns	PE: −0.28 ($p<0.05$)
TLC–total		ns	ns	ns	ns	ns	ns
KRT uncommon responses			ns	ns	ns	ns	ns
KRT perseverations				ns	ns	ns	ns
DST Forward					0.33 ($p<0.01$)	ns	ns
DST Backwards						ns	ns
Semantic Fluency							ns

KRT – Kent-Rosanoff Test; DST – Digit Span Test; WCST – Wisconsin Card Sorting Test; TLC – Thought, Language and Communication Scale; PE – perseverative errors; ns – not significant

Tab. 6. Correlations between PANSS and CGI scores and cognitive tests in early-onset SSD patients. For statistically significant correlations Kendall's tau-b coefficient and significance level are presented.

	PANSS-T	PANSS-P	PANSS-N	PANSS-G	CGI
WCST	ns	ns	PE: 0.31 ($p<0.05$)	ns	ns
DST Forward	ns	ns	ns	ns	−0.39 ($p<0.01$)
DST Backward	ns	ns	ns	ns	ns
Semantic fluency	ns	ns	ns	ns	ns
Phonological fluency	−0.31 ($p<0.05$)	ns	−0.27 ($p<0.05$)	−0.30 ($p<0.05$)	−0.47 ($p<0.01$)
TLC total score	ns	ns	ns	ns	0.41 ($p<0.01$)
KRT uncommon responses	0.26 ($p<0.05$)	ns	0.27 ($p<0.05$)	ns	0.28 ($p<0.05$)
KRT perseverations	ns	ns	ns	ns	ns

PANSS – Positive and Negative Syndrome Scale; PANSS-T – total score; PANSS–P –positive subscale; PANSS–N – negative subscale; PANSS–G – general psychopathology subscale; CGI – Clinical Global Impression Scale; KRT – Kent-Rosanoff Test; DST – Digit Span Test; WCST – Wisconsin Card Sorting Test; TLC – Thought, Language and Communication Scale; PE – perseverative errors; ns – not significant

edge, this was the first study which showed that formal thought disorder in this population may be associated with both executive and semantic dysfunction.

Impaired performance in WCST is almost universally reported in early-onset and adult-onset psychosis (Kenny & Meltzer 1991; Nieuwenstein *et al.* 2001; Subotnik *et al.* 2006). Our study was not unique in this regard, and further demonstrated disturbance of executive functions in psychosis. Reduced semantic verbal fluency is frequently reported in adults with schizophrenia (Bokat & Goldberg 2003). Recently, it has been associated with lack of asymmetry in paracingulate sulcus, which is in line with "psychosis as a price for language" hypothesis of schizophrenia (Clark *et al.* 2010). We also observed impairment in DST Backward, which is typically considered a measure of working memory. Similar results in adolescents are reported in previous studies (Kravariti *et al.* 2003; Ueland *et al.* 2004). Only in Phonological Verbal Fluency Test and DST Forward

(regarded as measure of attention) significant differences between patients and controls were not observed, which however unexpected corresponded with results of some other studies (Kiefer *et al.* 2002; Banashewski *et al.* 2004).

Our results may also confirm previous reports, which show prominent formal disturbances of thinking in adolescents. We observed described in adult studies tendency of SSD patients to give uncommon responses in Kent-Rosanoff Test (Shakov 1980), which recently has been echoed in hyper-priming hypothesis of schizophrenia (Manschreck *et al.* 1988; Spitzer 1993; Kiefer *et al.* 2009). Results obtained in current study may also indicate, that in TLC adolescents with SSD present different profile of formal thought disorder, than one observed in adult patients. Although poverty of speech and poverty of content are common findings both in adults and in our sample (Cuesta & Peralta 1999; Czerni-kiewicz 1998), other typical symptoms, e.g. distractible

speech, tangentiality or pressure of speech were seldom observed in present study. Moreover, mild forms of pressure of speech were significantly more common in healthy controls than in psychotic patients. Poverty of speech may reflect predominance of negative symptoms in early-onset schizophrenia. Presence of pressure of speech in controls may be connected with some immaturity of thought process in healthy adolescents (Caplan 1994). Alternatively the effect could be caused by pronounced poverty of speech in patient group.

Formal thought disorder was in our study assessed with TLC and KRT. No correlations between cognitive functions and thought disorder scales were observed in healthy controls. In patient group however communication disturbances were related to cognitive impairment. TLC showed correlation with both executive dysfunction and disturbances in verbal fluency. Inverse correlation was found between non-perseverative errors in WCST and perseverations in KRT. One can expect, that perseverations in KRT could be associated with diminished cognitive flexibility, which might be related to smaller probability of non-perseverative errors. Associations between cognition and thought disorder has not been systematically evaluated in pediatric population so we cannot contrast our results with previous research, there is however some literature concerning adult patients. Thought disorder in this age group is reported to be related to attention, memory and executive functions impairment (Kerns *et al.* 2002, Barrera *et al.* 2005), however lack of significant correlations is also described (Owashi 2009). Docherty (2011) observes that score of TLC scale is not related to cognitive impairment. In that study with performance in several cognitive areas is associated level of functional impairment in communication assessed with Communication Disturbances Index. In the Docherty's study the sample included outpatients of mean age about 42. Our sample differed in age, severity of symptoms and duration of illness and included patients during acute psychotic episode so this may be a possible explanation of different results.

Semantic origin of communication disturbances are suggested in adult studies of Manschreck *et al.* (1998) and Spitzer *et al.* (1993), who propose, that schizophrenic patients during speech tend to activate larger semantic network (hyperpriming), which leads to loosening of association or to incoherence. Recently, also in adults, Barrera *et al.* (2005) report that formal thought disorder is associated with all analyzed (4/4) tests of executive functioning and only one of four tests of semantic ability. Corresponding results are reported by Stirling *et al.* (2006), who conclude, that formal thought disorder is related more to semantic and executive dysfunction, than to syntax processing. Thus, current study seems to corroborate complex, executive and semantic etiology of communication disturbances.

TLC total score was related neither to total PANSS score nor to any of its subscales. This lack of association between severity of symptoms and level of language disturbances was against our expectations – thought disorder is often interpreted as one of pathognomonic symptoms of schizophrenia. Possibly it was caused by heterogeneity of language disturbances in schizophrenia. It seemed plausible, because other measures of linguistic functioning, namely KRT and Verbal Fluency Tests showed association with severity of symptoms. However, these results may also suggest, that in early-onset schizophrenia PANSS was not very sensitive tool for assessment of communication disturbances. This suggestion was corroborated with observation, that both TLC and KRT results showed correlation with severity of symptoms assessed with CGI.

Several cognitive measures also showed significant correlations with severity of symptoms. Phonological verbal fluency was associated with total score in PANSS and negative subscale score. This cognitive measure and DST Forward were also related to CGI score, whereas performance in WCST correlated specifically with negative symptomatology. Such pattern of correlations might suggest, that overall severity of symptoms may be related to disturbance of many cognitive functions, including basic ones, such as an attention. While on the other hand, disturbances of executive functions might be associated more specifically to negative symptoms. Such a relationship has been previously reported, both in adult (Nieuwenstein 2001) and adolescent (Rhinewine 2005) schizophrenia spectrum patients, however results are far from uniform (Morice & Delahunty 1996; Banaschewski *et al.* 2000).

There are several aspects of clinical relevance of cognitive impairment. In cross-sectional studies association of cognitive dysfunction with general and vocational level of functioning is confirmed (McGurk & Muesser 2004). On the other hand, improvement in cognitive functioning is related to decreased severity of negative symptoms (Schuepbach *et al.* 2002) and better functional outcome (Brekke *et al.* 2009). It is also suggested that cognitive impairment is more pronounced in EOS, then in adult onset schizophrenia (Biswas *et al.* 2006). Severity of thought disorder also seems to depend both on stage of illness (Andreasen & Grove 1986) and age of illness onset (Luoma *et al.* 2008). In our sample cognitive impairment correlated with negative PANSS subscale and was associated with thought disorder which also included prominent negative component. All these factors are related to poorer prognosis (Czernikiewicz 1998, Cohen *et al.* 2007; Bowie & Harvey 2008) and our results corroborate previous suggestions that EOS is a severe form of disorder. Longitudinal studies including EOS subjects may be warranted to determine the significance of cognitive impairments and thought disorder for prognosis and longer-term treatment planning.

The major advantage of present study was enrollment of patients during early phase of illness. Effects of chronicity of illness and neuroleptic medication in such

population are probably less pronounced. Also, control group of healthy adolescents was individually matched by demographic variables and type of education, which allowed a reliable assessment of the severity of cognitive and communication impairment.

However, several limitations should not be overlooked. There was a relatively small sample size and patients presented with various duration of illness. Also medication status was not controlled for, although all medicated patients received risperidone during assessment. The study had cross-sectional design and there was a possibility that after treatment of the acute episode some improvement in assessed parameters would be observed. To allow precise description of influence of executive and semantic dysfunction on formal thought disorder, longitudinal design with premorbid assessment should be performed.

CONCLUSION

Adolescent patients with schizophrenia spectrum diagnosis presented with pronounced impairment in executive functions, attention and working memory and in linguistic and communication functions. Thought disorder was related to executive and semantic dysfunctions more then to severity of symptoms. Further studies of neurobiological mechanism underlying thought and cognitive disorders are warranted.

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REFERENCES

1 Andreasen NC (1986). Scale for the assessment of thought, language, and communication (TLC). Schizophr Bull. **12**: 473–482.
2 Andreasen NC, Grove WM (1986). Thought, language, and communication in schizophrenia: diagnosis and prognosis. Schizophr Bull. **12**: 348–359.
3 Baltaxe CAM, Simmonds JQ (1995). Speech and language disorders in children and adolescents with schizophrenia. Schizophr Bull. **21**: 677–692.
4 Banaschewski T, Schulz E, Martin M, Remschmidt H (2000). Cognitive functions and psychopathological symptoms in early-onset schizophrenia. Eur Child Adolesc Psychiatry. **9**: 11–20.
5 Barrera A, McKenna PJ, Berrios GE (2005). Formal thought disorder in schizophrenia: an executive or semantic deficit? Psychol Med. **35**: 121–132.
6 Biswas P, Malhotra S, Malhotra A, Gupta N (2006). Comparative study of neuropsychological correlates in schizophrenia with onset in childhood, adolescence and adulthood. Eur Child Adolesc Psychiatry. **15**: 360–366.
7 Bokat CE, Goldberg TE (2003). Letter and category fluency in schizophrenic patients: a meta-analysis. Schizophr Res. **64**: 73–78.

8 Bowie CR, Harvey PD (2008). Communication abnormalities predict functional outcomes in chronic schizophrenia: Differential associations with social and adaptive functions. Schizophr Res. **103**: 240–247.
9 Brekke JS, Hoe M, Green MF (2009). Neurocognitive change, functional change and service intensity during community-based psychosocial rehabilitation for schizophrenia. Psychol Med. **39**: 1637–1647.
10 Brzezinski J, Gaul M, Hornowska E, Jaworowska A, Machowski A, Zakrzewska M (1996). [Wechsler Adult Intelligence Scale Revised (WAIS-R). Manual], Warsaw: Pracownia Testów Psychologicznych Polskiego Towarzystwa Psychologicznego.
11 Caplan R (1994). Communication deficits in childhood schizophrenia spectrum disorders. Schizophr Bull. **20**: 671–683.
12 Clark GM, Mackay CE, Davidson ME, Iversen SD, Collinson SL, James AC *et al.* (2010). Paracingulate sulcus asymmetry: sex difference, correlation with semantic fluency and change over time in adolescent onset psychosis. Psych Res. **184**: 10–15.
13 Cohen AS, Saperstein AM, Gold JM, Kirkpatrick B, Carpenter WT Jr, Buchanan RW (2007). Neuropsychology of the deficit syndrome: new data and meta-analysis of findings to date. Schizophr Bull. **33**: 1201–1212.
14 Cuesta MJ, Peralta V. (1999). Thought disorders in schizophrenia. Testing models through confirmatory factor analysis. Eur Arch Psych Clin Neurosci. **249**: 55–61.
15 Czernikiewicz A (1998). [Linguistic dimension of chronic schizophrenia]. Lublin: Akademia Medyczna w Lublinie.
16 Daban C, Amado I, Baylé F, Gut A, Willard D, Bourdel MC *et al.* (2002). Correlation between clinical syndromes and neuropsychological tasks in unmedicated patients with recent onset schizophrenia. Psychiatry Res. **113**: 83–92.
17 Guy, W (1976). ESDEU Assessement Manual for Psychopharmacology, revised. DHEW Pub. No. (ADM) 76–338. Rockville, MD: National Institute of Mental Health.
18 Heaton RK, Chelune GJ, Talley JL, Kay GG, Curtiss G (1993). Wisconsin Card Sorting Test Manual. Odessa, Florida: Psychological Assessment Resources.
19 Holmén A, Juuhl-Langseth M, Thormodsen R, Melle I, Rund BR (2010). Neuropsychological profile in early-onset schizophrenia-spectrum disorders: measured with the MATRICS battery. Schizophr Bull. **36**: 852–859.
20 Joyce EM, Roiser JP (2007). Cognitive heterogeneity in schizophrenia. Curr Opin Psychiatry. **20**: 268–272.
21 Kay S, Fiszbein A, Opler L (1987) The Positive and Negative Syndrome Scale (PANSS) for Schizophrenia. Schizophr Bull. **13**: 261–276.
22 Kenny JT, Meltzer HY (1991). Attention and higher cortical functions in schizophrenia. J Neuropsychiatry Clin Neurosci. **3**: 269–275.
23 Kerns JG, Berenbaum H (2002). Cognitive impairments associated with formal thought disorder in people with schizophrenia. J Abnorm Psychol 2002. **111**: 211–224.
24 Kiefer M, Apel A, Weisbrod M (2002). Arithmetic fact retrieval and working memory in schizophrenia. Schizophr Res. **53**: 219–227.
25 Kiefer M, Martens U, Weisbrod M, Hermle L, Spitzer M (2009). Increased uncouncious semantic activation in schizophrenia patients with formal thought disorder. Schizophr Res. **114**: 79–83.
26 Kravariti E, Morris RG, Rabe-Hesketh S, Murray RM, Frangou S (2003). The Maudsley Early-Onset Schizophrenia Study: cognitive function in adolescent-onset schizophrenia. Schizophr Res. **65**: 95–103.
27 Kurcz I (1967). [Polish frequency norms of free associations with 100 words from Kent-Rosanoff list.] Stud Psychol. **8**: 122–7.
28 Kyriakopoulos M, Frangou S. (2007). Pathophysiology of early onset schizophrenia. International Review of Psychiatry. **19**: 315–324.
29 Li CS (2004). Do schizophrenia patients make more perseverative errors than non-perseverative errors in Wisconsin Card Sorting Test? A meta-analytic study. Psychiatry Res. **129**: 179–190.