International Journal of Biomedicine 3(2) (2013) 94-99

INTERNATIONAL JOURNAL OF BIOMEDICINE

CLINICAL RESEARCH

Poor Executive Functioning Associated with the Risk of Aggressive Behavior Recidivism in the Forensic Community in Schizophrenic Patients

Ibishi F. Nazmie; Musliu R. Nebi, PhD; Hundozi Zylfije, PhD*; Haxhiu Bekim, PhD

University Clinical Center of Kosovo, Pristina, Kosovo

Abstract

Objective: The aim of this study was to investigate the relationship between the risk of aggressive behavior recidivism and poor executive functioning in a forensic setting in schizophrenic patients.

Methods: The data were collected over a two-year time period. The subjects in the study included 65 male adults ≥18, with schizophrenia disorder using SCID based on the DSM-IVR criteria and evaluated using PANSS, HCR-20, PCL-R and neuropsychological testing of the cognitive domains MMSE, WAIS-R, Stroop Color and Word Test, TMT A and TMT B tests. After a two-year follow up for recidivism of aggressive behavior, the subjects of the recidivism group were compared with a group showing no recidivism in terms of executive functioning, risk assessment, psychopathic and clinical psychopathology.

Results: The recidivism group revealed significantly lower and poorer scores in Stroop Color, Stroop Word, Verbal IQ, TMT A and TMT B tests than those belonging to the non-recidivism group. Logistic regression analysis determined that the poor verbal IQ and executive functions measured using the Stroop Word test were the strongest predictors of violent recidivism rate even age at first violence, social status, PANSS, PCL and total IQ factor accounted for.

Conclusion: Poor executive functioning appears to be associated with a high risk of aggressive behavior recidivism during mandatory treatment among the forensic community in patients with schizophrenia disorder. Neuropsychological assessments of executive dysfunction might probably identify psychiatric inpatients that could be at high risk for aggressive behavior recidivism in forensic settings.

Key Words**:** *aggressive behavior, executive function, risk assessment, schizophrenia.*

Introduction

Executive functions are broadly defined as comprising the abilities required to achieve and maintain a problem-solving set, and includes processes such as planning, organizational skills, selective attention and inhibitory control. Neuropsychological assessments of schizophrenic populations have demonstrated deficits across a wide range of cognitive domains, including impairments in attention, cognitive processing speed and IQ [1-2]. Schizophrenia has been linked with poor performance on several aspects of executive functioning using tests of working memory [3], inhibition [4], and strategy formation and planning [5]. It is also become increasingly evident that schizophrenia is associated with an elevated risk of violent behavior [6-7]. Widespread cognitive deficits are evident in schizophrenic patients including those individuals with and without a history of violence, although the deficits in executive function are more pronounced in the violent than in the nonviolent ones. These findings suggest that violence in schizophrenic patients is linked to many different aspects of impaired neuropsychological function [8]. Paschall and Fishbein [9] stated, "A large body of research from diverse fields suggests that impaired executive cognitive functioning (ECF) may play an important role in the etiology of aggression and violent behavior (AVB)."There are only a few studies available regarding the relationship between executive function impairment and aggressive behavior of in-patients with schizophrenia in the forensic community. Some studies [10-13] report an association between violence and impairment in executive function in the schizophrenic spectrum disorder, although not all the studies reported such an association [14-17]. No significant differences were observed in the average performance and verbal IQ scores obtained by the two patient

Corresponding author**:** *Zylfije Hundozi, MD, PhD. University Clinical Center of Kosovo. Te rrethi. 10000, Pristina, Kosovo. Phone: +37744399702. E-mail: zylhundozi@hotmail.com*

groups in the study conducted by Krakowski et al. [18]. Wong et al. [19] studied 39 male offenders with schizophrenic disorders, 20 of whom had committed several violent offenses and 19 who had committed only one violent offense, in a forensic hospital in the United Kingdom. Global IQ scores on the WAIS, however, did not differ in both groups.

The aim of this study was to evaluate whether the poor executive functioning of inpatients with schizophrenia disorders was associated with aggressive and violent behavior (AVB) recidivism during mandatory psychiatric treatment thereby helping to eventually predict recidivism when controlling for past violent history, personality characteristics and clinical psychopathology symptoms.

Subjects and Methods

A sample of 65 male in-patients, age ≥ 18, fulfilling the DSM–IVR criteria for schizophrenia diagnosis was drawn from a high security Forensic Unit in the Psychiatric Clinic.

Inclusion criteria: currently clinically stable on medication with ability to give informed consent.

Exclusion criteria: a history of organic brain syndrome, head injury, mental retardation.

All the subjects invited to participate in this study were already hospitalized at the University Psychiatric Clinic of Pristina, over a two-year time period between January 2010 and December 2011. Baseline data included a broad array of psychiatric, neuropsychological and psychosocial variables and were collected during the forensic psychiatric investigations. All neurocognitive assessments were performed by an experienced psychologist after hospital admission. The rest of the data and selection criteria of the diagnostic issues were performed by experienced mental health professionals. Aggressive and violent behaviors were defined as physical abuse, threat and violence against others and property. An incident was considered violent if the individual was the clear instigator or co-aggressor, and if the incident involved physical aggression to staff, in-patients or property. On this basis, we categorized the patients into non-violent (non-violent = 0 incidents) and violent (violent ≥ 1 incident) groups.

The protocol of this study was approved by the Institutional Ethical Review Board and each patient gave written informed consent for participation in the study.

Demographic and psychosocial data

The data covers the historical, demographic and violence aspects, including age at first conviction, type of violence offense, substance abuse problems using the records available for the forensic psychiatric investigations, besides the interviews conducted.

Symptom and psychopathic assessment

PANSS

Symptom severity was assessed using the Positive and Negative Syndrome Scale (PANSS) [15]. Data collected from this assessment procedure were applied to the PANSS ratings. Each of the 30 items is accompanied by specific definition as well as detailed anchoring criteria for all the seven rating points. Of the 30 items included in the test 7 constitute the Positive scale, 7 the Negative scale and remaining 16 the General Psychopathology scale.

PCL-R

Psychopathy was assessed based on the interview and file review using the Psychopathy Checklist – Screening Version (PCL – SV) [16]. Factor 1 of the PCL – SV reflects the affective/interpersonal traits, while Factor 2 reflects the behavioral/social deviance components of psychopathy. The cut-off was set at ≥17 for psychopathy and ≥ 11 for non-psychopathy.

Assessment of in-patient violence risk and aggressive behavior

HCR-20 was used to asses historical, clinical and risk management

The HCR-20 was further divided into three subscales. The Historical subscale has 10 items relating to the static variables present in the individual's past. The Historical subscale includes items that relate to a past history of mental illness, psychopathy, personality disorder, and substance misuse. The Clinical subscale includes 5 items relating to the current status of dynamic risk markers, namely lack of insight, negative attitudes, active symptoms of major mental illness, impulsivity and unresponsiveness to treatment. The Risk Management subscale has 5 items relating to the individual's future social and treatment circumstances and his projected reaction to these.

Neuropsychological assessments

WAIS

The WAIS-R consists of six verbal subtests and five performance subtests. The verbal tests cover: Information, Comprehension, Arithmetic, Digit Span, Similarities, and Vocabulary. The Performance subtests include: Picture Arrangement, Picture Completion, Block Design, Object Assembly, and Digit Symbol. The scores derived from this test reveal Verbal IQ (VIQ), Performance IQ (PIQ), and Full Scale IQ (FSIQ).

Stroop Color and Word Test

The Stroop Color and Word Test (Golden, 1978) examined the effects of interference on reading ability, selective attention, cognitive flexibility and processing speed in the evaluation of executive functions.

The Stroop test involves three steps: word page (the names of colors printed in black ink), color page (rows of X's printed in colored ink) and word-color page (the words from the first page are printed in the colors from the second page; however, the word meanings and ink colors are mismatched), each with 5 columns containing 20 items. The subject must look at each sheet and move down the columns, reading the words or naming the ink colors as quickly as possible, within a stipulated time limit (45 seconds).

TMT A and TMT B

Both sections of the Trail Making Test include 25 circles distributed across a sheet of paper. In Part A, the circles are numbered 1 – 25, and the patient is required to draw lines and connect the numbers in the ascending order. In Part B, the circles include both numbers (1-13) and letters (A-L); as in Part A, the patient needs to draw lines to connect the circles in an ascending pattern, but with the added task of alternating between the numbers and letters (i.e., 1-A-2-B-3-C, etc.). The patient should be instructed to connect the circles as quickly as possible, without removing the pen or pencil from off the paper. TMT A and TMT B tests were used to evaluate cognitive processing speed, visual

attention and task switching abilities.

Data analysis

Based on the follow-up data, the patients were classified into two groups: stable patients who maintained psychiatric stability with no AVB recidivism and patients with AVB recidivism. Both groups were assessed during the mandatory psychiatric treatment measure, and based on these results patients were assigned to non-violent (= 0 incidents) and violent recidivism (≥1 incident) groups, in the follow up period time of almost two years.

We presented the descriptive data of the average mean of the clinical characteristics in the PCL–R, HCR-20, PANSS test and neurocognitive test results for AVB recidivism *vs* the non-AVB recidivism group using ANOVA test to analyze the significance of difference.

The frequency and significance of difference of means was assessed for the socio-demographic and criminal data in both groups. The relapse rate for aggressive behavior was assessed, comparing the results of the recidivism in-patient group versus the non-recidivism in-patients, and the predictive ability of the various clinical and neurocognitive performance characteristics were investigated.

Binary logistic regression employing the enter method was used to examine the prediction of violent recidivism and relapse as the dependent variable. Only the sociodemographic, clinical and neuropsychological variables that were significantly different between the groups in the ANOVA or Chi square test were included in the model. All the tests were 2-tailed, with 0.05 as the standard for statistical significance.

Results

Sociodemographic, clinical symptoms and neurocognitive performance characteristics of both groups

The results of the clinical psychopathology symptoms are shown as the average means between both study groups and the higher score in each test indicates the worst results. In the clinical symptoms variables we found a significant difference between the groups in the PANSS total scores (F -13.807, p<0.001), whereas in the other clinical variables no significant difference between both groups was seen (Figure1).

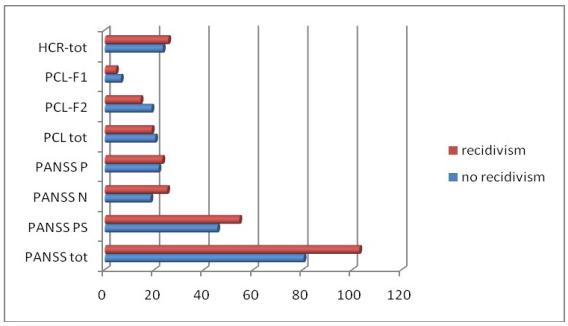

Figure 1.

Descriptive data results of clinical characteristics in violent recidivism versus non –violent recidivism group.

The results of the neurocognitive test (Figure 2) are shown as the average means in both study groups of inpatients with schizophrenia. According to the neurocognitive measurements, the recidivism group had significantly lower and poorer scores in the Stroop Color (52.14 *vs* 54.35, F-2.671, p <0.012), Stroop Word (72.79 *vs* 80.08, F-4.807, p<0.032), Verbal IQ (92.9 *vs* 87.78, F-3.469, p<0.029), TMT A (36.25 vs 40.76, F-4.023, p<0.044) and TMT B (75.36 vs 85.70, F-4.110, p<0.047) tests. For the other neurocognitive test performances no significant difference was observed.

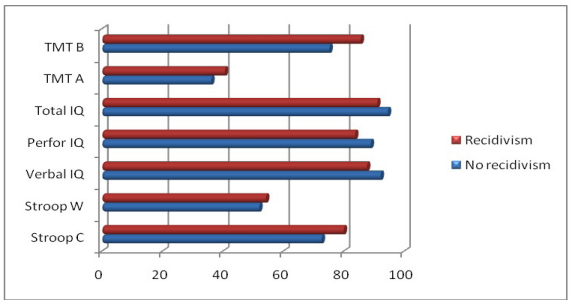

Figure 2.

Descriptive data results of neurocognitive test in violent recidivism versus non –recidivism group.

According to the sociodemographic data analysis of the results, significant differences between the groups in social status (p<0.018), age at first violence (p<0.023) and previous history of treatment (p<0.05) were recorded (Table 1). However, there were no significant group differences between the violent recidivism versus non-recidivism groups in terms of mean age, years of education, marital status, previous history of treatment, type of criminal offence, duration of illness and history of drug abuse.

Table 1.

Sociodemographic characteristics of the inpatients with schizophrenia

Parameters	**VRG** ***n-37 (%) mean ± s***	**NRG** ***n-28 (%) mean ± s***	**Total** ***n-65 (%) mean ± s***	**Sig.**
Age*	40.08±9.89	39.14±7.07	39.68±8.74	0.672
Duration of illness*	15.86±12.18	15.11±7.70	15.54±10.42	0.774
Age at first violence*	25.25±3.54	27.24±3.31	26.38±3.53	0.023
History of treatment**				0.050
Yes	25 (53.2)	22 (46.8)	47 (72.3)	
No	15 (83.3)	3 (16.7)	18 (27.7)	
History of drug abusing**				0.207
Yes	9 (75)	3 (25)	12 (18.5)	
No	28 (52.8)	25 (47.2)	53 (81.5)	
Education status**				0.935
Primary	19 (63.3)	11 (36.7)	30 (46.2)	
Secondary	14 (45.2)	17 (54.8)	31 (47.7)	
High degree	0	4 (100)	4 (6.2)	
Social status**				0.018
Low income	25 (78.1)	7 (21.9)	32 (49.2)	
Middle income	9(30.0)	21 (70.0)	30 (46.2)	
High income	0	3 (8.1)	3 (4.6)	
**Marital status ** **				0.322
Not married	20 (58.8)	14 (41.2)	34 (52.3)	
Married	9 (39.1)	14 (60.9)	23 (35.4)	
Divorced	8 (100)	0	8 (12.3)	
**Type of violent act ** **				0.949
Murder	3 (37.5)	5 (62.5)	8 (12.3)	
Domestic violence	14 (53.8)	12 (46.2)	26 (40.0)	
Physically threatening	20 (64.5)	11 (35.5)	31 (47.7)	

Note: s- Standard deviation, * Independent t-Test, **Chi -square test. VRG - violent recidivism group, NRG - non recidivism group.

The odds ratio of recidivism vs the non-recidivism group for all the participants (table 2) was used performing bivariate logistic regression analyses with the variables, which showed a significant difference of means between both groups as PANSS–total, social status, age at first violence, previous history of treatment, all neurocognitive test variables and recidivism as the dependent variable.

Table 2.

Logistic regression analysis of variables by being at risk of recidivism group (N-65)

Variable	OR	95% CI	Sig.
Age at first violence	1.188	1.004-1.406	0.045
Social status	0.923	0.862-0.988	0.021
History of treatment	5.417	1.350-5.196	0.643
PANSS-total	1.419	1.126-1.789	0.003
Stroop color	0.358	0.178-0.719	0.132
Stroop word	1.017	0.863-1.199	0.004
Verbal IQ	0.813	1.005-5.729	0.049
Performance IQ	0.518	0.268-1.003	0.081
Total IQ	0.623	0.177-0.753	0.211
TMT A	0.944	0.756-1.179	0.613
TMT B	0.863	0.724-1.029	0.101

.

Poor Stroop Word ability and poor Verbal IQ were independently explained as being at risk for violent recidivism occurring at statistically significant levels in the logistic regression model with risk of recidivism as the dependent variable, after adjusting for social status, age at first violence, previous history of treatment and PANSS-total as the confounder factor variable. Increasing the value of the Stroop Word variable corresponded to increasing the odds of the occurrence of recidivism, while decreasing the value of the Verbal IQ variable increased the odds of recidivism occurrence.

Age at first violence ($p<0.045$), social status ($p<0.021$) and total psychopathology of the positive and negative symptoms ($p<0.003$) were also strong predictors of the recidivism rate.

Discussion

This study investigated the role played by the neuropsychological factors, particularly with respect to the executive function in in-patient violence in schizophrenics and its association with the risk of aggressive behavior recidivism. This is one of the few studies to compare violent and nonviolent forensic in-patients with schizophrenia, based on the measured values of neuropsychological function; it clearly reveals the lack of well-powered studies examining the relationship between in-patient violence and specific neuropsychological deficits in schizophrenia.

In this prospective two-year follow-up study, schizophrenia offenders who had committed violent acts were followed for an average period of almost two years to determine the rate of violent recidivism and to quantify the relationships between the executive functions, clinical risk factors and recidivism. Of the total 65 in-patients who were schizophrenia offenders, 37 of them were recidivate with violent behavior during the entire follow-up period time of mandatory treatment, resulting in a total recidivism rate of 56.9%.This rate is higher when compared with the results from other long-term follow-up studies of mentally disordered offenders [20-22] discharged from a hospital and secure unit, varying between 6 and 15%, or 25 % of violent recidivism of schizophrenia disordered offenders, in the study conducted by Nilsson et al. [23].This can be explained by the findings that the predictors of violence in institutional settings are different from the predictors of violence in a community: variables such as sex, age, diagnoses and alcohol abuse play a minor role, while clinical and psychopathological variables are prominent. The history of violence is the only robust static predictor and the total level of positive and general psychotic symptoms appears to enhance the violence risk of inpatients according to Shteinert et al. [23] including the executive dysfunction that we found in our study. Our results support the previous findings [23] that age at first violence is associated with recidivism of violent behavior.

Our study was conducted in a male setting and the results of the recidivism rate are different depending upon gender than the results revealed in the study by Putkonen et al. [25] where only 8% of the female psychotic subjects committed repeated offenses. Future studies are warranted in terms of gender difference findings and their influence on the recidivism rate.

This study found significant differences in the mean scores on the battery of all the neurocognitive tests while the average total global IQ scores of both revealed no significant difference. They were similar to the results in other studies which found poor neurocognitive performance in the violent group [8,10,11]; however, they were different from the results in those studies which found no significant differences between the schizophrenic patients with a history of violent behavior and those with a history of nonviolent behavior, either in the outpatient forensic sample [16], or among the inpatient offenders [13-15, 18-19]. It appears that the difference was evident if the neurocognitive and clinical assessment occurred around the time of violent behaviors in order to evaluate the contribution of such symptoms to the violent behavior and the circumstances leading up to those behaviors.

The recidivism group of inpatients obtained significantly lower scores than the non-recidivism group on the Stroop Word and Color tests and also on the Verbal IQ test, while the results of this study on the total IQ scores in both groups were found well below the means usually reported for schizophrenic patients, as in the study of A. Kondel et al. [26]; besides, aggressive behavior reflects a lack in interpersonal skills [27].

Overall, we did not find that the recidivism patient group had higher positive (hallucinations and delusions) symptom scores on the PANSS than the non-violent inpatients, contrary to the previous studies that have reported a relationship between high PANSS positive scores and high rates of in-patient aggression [28] or higher levels of positive symptoms in violent individuals as compared with the non-violent ones [29-30].The total PANSS scores were associated with higher rates of in-patient violence in terms of the number of violent incidents.Similar to other studies, we did not observe any association between violence and negative symptoms.

In line with the earlier studies we found an association between violence and psychopathy [32] in the interpersonal affective traits of psychopathy and this partially confirms the study of Vitacco et al. [33] who found that both affective and antisocial components of psychopathy were associated with community violence in civil psychiatric patients. Our study, therefore, is quite

contrary with JL Skeem et al. [34-36], who found an association between the antisocial components of psychopathy and violence. This discrepancy may reflect differences in the samples (civil-forensic) and differences in the context in which violence occurs (inpatients vs outpatients).

A new aspect of this study was the finding that lower verbal IQ was a significant predictor of schizophrenia in-patient violence recidivism, whereas performance and total IQ were not found to be significant predictors of increased risk for violence recidivism.Logistic regression analysis determined that poor verbal IQ and executive functioning measured using Stroop Word were the strongest predictors of the violent recidivism rate even more than age at first violence, social status, PANSS, PCL and total IQ factor accounted for.

This study highlights the importance of the ECF deficit in the recidivism of AVB in the sample of forensic in-patients with schizophrenia.

The importance of the role played by the deficits in executive function in the expression of physical aggression was also highlighted by Seguin et al. [37] and Giancola et al. [38] whereas 59% of the in-patient aggression measure of factor variance was accounted for by the values recorded for executive dysfunction and clinical symptom severity, according to Serper et al.[39].

It appears that patients with executive dysfunction may not possess the needed amount of behavioral inhibition skills required to cope with the presence of symptoms and other stressful events that accompany acute psychosis and that hospitalization that may result, consequently, due to the increased manifestations of aggressive behavior [39].

The relationship between poor executive function and aggression, according to contemporary theories, may be related to poor strategy formulation, cognitive inflexibility or impulsiveness [40]. Finally, Frith [41], for example, postulated that executive impairment results in deficits in the patient's abilities to generate goals, plans and intentions and cognitive deficits, especially impulsivity, poor planning ability, mental inflexibility and low verbal intelligence..

Impaired attention limits the individual's ability to cope with mandatory treatment measures such as restrictions of freedom and movement on the unit, close contact with other patients and inability to access social support and the results of this study are consistent with those of Krakowski et al. [18], who suggested that psychiatric patients with EF deficit and psychosis experienced deficits in behavioral regulation and impulse control and the inability to benefit from reactions needed to modify their behavior according to the environmental demands, all culminating in increased aggression. These results support the need for adequate neuropsychological testing on acute psychiatric in-patients for violence prediction as well as the notion that acutely symptomatic patients with concomitant executive dysfunction are at high risk for aggression during the in-patient service.

Conclusion

The evidence available indicates that schizophrenia is associated with an increased risk for AVB recidivism towards others. Offenders with schizophrenia constitute a heterogeneous population. Developing a typology of offenders with schizophrenia that is relevant to the etiology and treatment will provide a clear framework for investigating the causal mechanisms as well as for studies on the effectiveness of treatment packages that address the characteristics of each type of offender.

Neuropsychological assessment of executive dysfunction may identify psychiatric in-patients, who may be at high risk for aggressive behavior recidivism in forensic settings.

Risk assessment instruments are widely used by mental health and criminal justice systems to help identify high-risk offenders and estimate the likelihood of recidivism during mandatory treatment and present the results of the study to advance knowledge on psychiatric risk factors in in-patients with violent recidivism. The main conclusions suggest that there may be scope for the prevention of violent recidivism in the in-patient forensic community sample by assessing their executive functions; however, further research is required to help assess whether these associations are causal and reversible. These findings highlight the importance of including measures of executive functions in the assessment of the risk of aggressive behavior recidivism in schizophrenic in-patients during the mandatory psychiatric treatment period.

References

1. Sharma T, Antonova L. Cognitive function in Schizophrenia. Deficits, functional consequences, and future treatments. Psychiatr Clin North Am. 2003;26 (1):25-40.

2. Goldberg TE, Gold JM. Neurocognitive functioning in patients with schizophrenia: an overview. In: Bloom, F.E. and Kupfer, D.J. (eds). Psychopharmacology: The fourth generation of progress. New York: Raven Press, 1995.

3. Pantelis C, Barnes T, Nelson H, Tanner S, Weatherley L, Owen AM, *et al. Frontal-striatal cognitive deficits in patients with chronic schizophrenia.* Brain. 1997;120:1823-43.

4. Perlstein WM, Carter CS, Barch DM, Baird JW. The Stroop task and attention deficits in schizophrenia: a critical evaluation of card and single-trial Stroop methodologies. Neuropsychology. 1998;12(3):414–425.

5. Morris RG, Rushe T,Woodruffe PW, Murray RM. Problem solving in schizophrenia: a specific deficit in planning ability. Schizophr Res. 1995;14(3):235- 46.

6. Link BG, Stueve A, Phelan J. Psychotic symptoms and violent behaviors: probing the components of "threat/control-override" symptoms. Soc Psychiatry Psychiatric Epidemiol. 1998;33(Suppl 1):S55–60.

7. Swanson JW, Holzer CE 3rd, Ganju VK, JonoRT. Violence and psychiatric disorder in the community: evidence from the Epidemiologic Catchment Area surveys. Hosp Community Psychiatry. 1990;41(7):761–70.

8. Barkataki I, Kumari V, Das M, Hill M, Morris R, O'Connell P, et al. A neuropsychological investigation into violence and mental illness. Schizophr Res. 2005;74(1):1-13.

9. Paschall MJ, Fishbein DH. Executive cognitive functioning and aggression: a public health perspective. Aggression and Violent Behavior .2002;17:215-235.

10. Krakowski M, Convit A, Jaeger J, Lin S, Volavka J. Neurological impairment in violent schizophrenic inpatients. Am J Psychiatry. 1989;146(7):849-53.

11. Adams JJ, Meloy JR, Moritz S. Neuropsychological deficits and violent behavior in incarcerated schizophrenics. J Nerv Ment Dis. 1990;178(4):253-6.

12. Forster HG, Hillbrand M, Silverstein M. Neuro-psychological deficit and aggressive behavior: a prospective study. Prog Neuropsychopharmacol Biol Psychiatry. 1993;17(6):939- 46.

13. Rasmussen K, Levander S, Sletvold H. Aggressive and non-aggressive schizophrenics: symptom profile and neuropsychological differences. Psychol Crime Law. 1995; 2:119- 29.

14. Roy S, Herrera J, Parent M, Costa J. Violent and nonviolent schizophrenic patients: clinical and developmental characteristics. Psychol Rep. 1987;61(3):855- 61.

15. Lapierre D, Braun CM, Hodgins S, Toupin J, Leveillee S, Constantineau C. Neuropsychological correlates of violence in schizophrenia. Schizophr Bull. 1995;21(2):253-62.

16. Lafayette MD, Frankle WG, Pollock A, Dyer K, Goff DC. Clinical characteristics, cognitive functioning, and criminal histories of outpatients with schizophrenia. Psychiatr Serv .2003;54(12):1635-40.

17. Silver H, Goodman C, Knoll G, Isakov V, Modai I. Schizophrenia patients with a history of severe violence differ from nonviolent schizophrenia patients in perception of emotions but not cognitive function. J Clin Psychiatry. 2005;66(3):300-8.

18. Krakowski M, Czobor P, Libiger J,Kunz M, Papezova H, Parker BB. Violence in schizophrenic patients: the role of positive psychotic symptoms and frontal lobe impairment. Am J Forensic Psychiatry. 1997;18:39-50.

19. Wong TH, Lumsden J, Fenton GW, Fenwick PB. Neuroimaging in mentally abnormal offenders. Issues Crim Leg Psychol. 1997;27:49-58.

20. Friendship C, McClintock T, Rutter S, Maden A. Re-offending: patients discharged from a regional secure unit. Criminal Behaviour Mental Health. 1999;9:226-236.

21. Maden A, Scott F, Burnett R, Lewis GH, Skapinakis P. Offending in psychiatric patients after discharge from medium secure units: prospective national cohort study. BMJ. 2004; 328(7455):1534.

22. Yoshikawa K, Taylor PJ, Yamagami A, Okada T, Ando K, Taruya T, et al. Violent recidivism among mentally disordered offenders in Japan. Crim Behav Ment Health. 2007;17(3):137–151.

23. Nilsson T, Wallinius M, Gustavson C, Anckarsäter H, Kerekes N. Violent recidivism: a long-time follow-up study of mentally disordered offenders. PLoS One. 2011;6(10):e25768. doi: 10.1371/journal.pone.0025768. Epub 2011 Oct 11.

24. Steinert T. Prediction of inpatient violence. Acta Psychiatr Scand Suppl. 2002;(412):133-41.

25. Putkonen H, Komulainen EJ, Virkkunen M, Eronen M, Lönnqvist J. Risk of repeat offending among violent female offenders with psychotic and personality disorders. Am J Psychiatry. 2003;160(5):947-951.

26. Kondel TK, Mortimer AM, Leeson VC, Laws KR, Hirsch SR. Intellectual differences between schizophrenic patients and normal controls across the adult lifespan. J Clin Exp Neuropsychol. 2003;25(8):1045-1056.

27. Bowie CR, Reichenberg A, Patterson TL, Heaton RK, Harvey PD. Determinants of real-world functional performance in schizophrenia subjects: correlations with cognition, functional capacity, and symptoms. Am J Psychiatry. 2006;163(3):418-25.

28. Fresa A, Apiquian R, de la Fuente-Sandovol C, Loyzaga C, Garcia-Anaya M, Meyenberg N, Nicolini H. Violent behavior in schizophrenia patients: Relationship with clinical symptoms. Aggress Behav. 2005;31:511–20.

29. Cheung P, Schweitzer I, Crowley K, Tuckwell V. Violence in schizophrenia: role of hallucinations and delusions. Schizophr Res. 1997;26(2-3):181–90.

30. Arango C, Calcedo-Barba A, Gonzalez-Salvador T, Calcedo-Ordo A. Violence in inpatients with schizophrenia: a prospective study. Schizophr Bull.1999;25(3):493–503.

31. Nolan KA, Volavka J, Czober P, Sheitman B, Lindenmayer JP, Citrome LL, McEvoy J, Lieberman JA. Aggression and psychopathology in treatment-resistant inpatients with schizophrenia and schizoaffective disorder. J Psychiatr Res. 2005;39(1):109–15.

32. Hare RD. Psychopathy: a clinical and forensic overview. Psychiatr Clin North Am. 2006;29(3):709–24.

33. Vitacco MJ, Neumann CS, Jackson RL. Testing a four-factor model of psychopathy and its association with ethnicity, gender, intelligence, and violence. J Consult Clin Psychol. 2005; 73(3):466–76.

34. Skeem JL. Mulvey EP. Psychopathy and community violence among civil psychiatric patients: results from the MacArthur Violence Risk Assessment Study. J Consult Clin Psychol. 2001;69(3):358–74.

35. Skeem JL, Mulvey EP, Grisso T. Applicability of traditional and revised models of psychopathy to the Psychopathy Checklist: screening version. Psychol Assess. 2003;15(1):41–55.

36. Skeem JL, Miller JD, Mulvey E, Tiemann J, Monahan J. Using a five-factor lens to explore the relation between personality traits and violence in psychiatric patients. J Consult Clin Psychol. 2005;73(3):454–65.

37. Seguin JR, Pihl RO, Harden PW, Tremblay RE, Boulerice B. Cognitive and neuropsychological characteristics of physically aggressive boys. J Abnorm Psychol. 1995;104(4):614-624.

38. Giancola PR, Mezzich AC, Tarter RE. Executive cognitive functioning, temperament, and antisocial behavior in conduct-disordered adolescent females. J Abnorm Psychol. 1998; 107(4):629-641.

39. Serper M, Beech DR, Harvey PD, Dill C. Neuropsychological and symptom predictors of aggression on the psychiatric inpatient service. J Clin Exp Neuropsychol. 2008; 30(6):700-9.

40. Dolan M, Anderson IM. Executive and memory function and its relationship to trait impulsivity and aggression in personality disordered offenders. Journal of Forensic Psychiatry 2002;13(3):503-526(24).

41. Frith CD. The cognitive neuropsychology of Schizophrenia. Sussex UK: Lawrence Erlbaum,1992