



Original article

Impulsivity in early psychosis: A complex link with violent behaviour and a target for intervention

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ABSTRACT

Background: Violent behaviour (VB) occurs in first episode of schizophrenia and can have devastating impact both on victims and patients themselves. A better knowledge of the underlying mechanisms of VB may pave the way to preventive treatments.

Objectives: 1) To explore the nature of the link between impulsivity and VB in early psychosis (EP) patients; 2) To explore the interactions between impulsivity and substance abuse, insight, and positive symptoms, the main dynamic risk factors of VB described to date.

Design and methods: Post hoc analysis of data acquired in the frame of a 36-months EP cohort study. A total of 265 EP patients, aged 18 to 35, treated at TIPP (Treatment and early Intervention in Psychosis Program), at the Department of Psychiatry in Lausanne, Switzerland, were included in the study. Logistic regression analyzes were performed as well as mediation analysis and interaction analysis

Results: Our data suggest that impulsivity is a predictor of VB when analyzed independently and as part of a multi-factorial model. Impulsivity continues to differentiate violent patients from non-violent ones at the end of the program. In addition, the relationship between impulsivity and VB is not mediated by substance abuse. Finally, the effect of impulsivity on the probability of VB is potentiated by the interaction of different levels of insight and positive symptoms.

Conclusions: Early intervention strategies in psychotic disorders should include evaluation of impulsivity considering it is linked to increased risk of VB and may respond to treatment.

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1. Introduction

Impulsivity which is a major risk factor of violent behaviour (VB) [1–3] in the general population of violent aggressors [4], has

become a focus of interest in forensic psychiatry, since as a “dynamic risk factor” (along with substance abuse), it is susceptible to change and could be influenced by therapeutic interventions, contrary to “static risk factors” (such as gender or past aggression) which cannot be modified.

Recent studies have explored impulsivity in schizophrenia and confirmed that its presence is associated with an increased risk of VB [5–7]. However, while the risk of VB is high in the early phase of psychosis [5,6], and although various authors have suggested that impulsivity could play a major role in this issue, studies on this topic are rather rare despite their potential usefulness in adapting treatment and developing preventive strategies [1,7–9].

The study of the nature of the links between impulsivity and VB has yielded contradicting results, some studies supporting a direct

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relationship while others suggested this link would be indirect [10]. Indeed, some data [11,12], including a meta-regression analysis of dynamic risk factors [7], suggest impulsivity is directly linked to VB, while other authors, considering the high levels of impulsivity in people with substance use disorder (SUD), have proposed that this link may actually be indirect [13] and mediated by SUD [14]. However, the study of this relationship is blurred by high rates of comorbid SUD and high prevalence of comorbid antisocial personality disorders in patients displaying VB [10,11,15–17] and the number of other factors which may mediate this link. These variations regarding the nature of the link between impulsivity and VB may also be explained by some degree of heterogeneity regarding number of risk factors displayed by each individual patient [15,18–20]. Although these studies demonstrated an elevated level of impulsivity with occurrence of violence in a subgroup of patients, they didn't clearly establish a link between VB and impulsivity. These conflicting results may also reflect a conceptual problem: if there is a general consensus regarding the definition on impulsivity which could be described as “a predisposition towards rapid, unplanned reactions to internal or external stimuli without regard to the negative consequences of these reactions to the impulsive individual or to others” [21], impulsivity is also considered as a multidimensional concept [16,22–24] and is assessed differently depending on the author. Finally, the fact that impulsivity can be investigated either as a *personality trait* or as a *personality state* which can vary according to pathology [13,14] or situational factors, also contributes to the inconsistencies between studies.

In an attempt to disentangle these issues and considering the fact that a better knowledge about the link between impulsivity and VB in EP patients may pave the way towards the development of preventive and therapeutic strategies [25,26], we planned this study in a prospective cohort of EP patients in order to answer the following questions: (1) is there a link between dynamic factors and VB? (2) Is the nature of the link between impulsivity and VB direct or indirect (mediated by other factors)? (3) Do various dynamic risk factors interact with impulsivity with regards to VB? (4) How does impulsivity evolve over the follow-up?

2. Patients and methods

2.1. Procedure and participants

The patients included in this study stem from a cohort of patients treated at the *Treatment and early Intervention in Psychosis Program (TIPP)*, a specialized early psychosis program launched in 2004 at the Department of Psychiatry CHUV, Lausanne, Switzerland [27,28]. Entry criteria to the program are: (i) age 18–35; (ii) residence in the catchment area; (iii) meeting threshold criteria for psychosis, as defined by the ‘Psychosis threshold’ subscale of the Comprehensive Assessment of At Risk Mental States scale [29]. Exclusion criteria are (i) antipsychotic medication for more than a total of 6 months, (ii) psychosis related to intoxication or organic brain disease, or (iii) an intelligence quotient <70. The local Research and Ethics Committee granted access to the clinical data for research purposes.

A specially designed questionnaire is completed for all patients enrolled in the program by case managers (CMs) who have up to one hundred contacts with patients during the three years of treatment. It allows assessment of demographic characteristics, past medical history, history of VB, penal status, past treatment in forensic psychiatry, exposure to life events as well as symptoms and functioning. It is completed on the basis of information gathered from patients and their family over the first weeks of treatment and can be updated during follow up if new information emerges. Follow-up assessments exploring various aspects of treatment and co-morbidities as well as evolution of psychopathology and

functional level are conducted, after 2, 6, 12, 18, 24, 30 and 36 months in treatment by trained psychologists for scale based assessment of psychopathology and by case managers for descriptive measures such as employment for example. Psychopathology was assessed on the basis of PANSS with good inter-rater reliability between psychologists.

At the time of the study, 265 patients had been followed-up prospectively over 36 months.

2.2. Violent behaviour

Definition: VB have been defined as “*serious violence*” i.e “*assault causing any degree of injury, any use of a weapon or any sexual assault. The term any was used when the severity of the violence was not specified*” [8].

Assessment of VB: Episodes of VB were identified in three distinct ways. Firstly, by CMs on the basis of a questionnaire completed for all patients, in the frame of the clinical interactions occurring between them and patients over the entire 36 month treatment period (averaging 100 contacts per patient). This questionnaire allows the recording of any violent offense and behaviour (such as assault and battery, threats with a weapon, . . .). A meta-analysis by Winsper et al. [30] established the good reliability and validity in the self-reporting of serious aggressions. Secondly, CMs gathered additional information through contact with parents, significant others and the forensic psychiatric services (hetero-reporting of aggression). Finally, episodes of VB occurring during the treatment phase were identified on the basis of the Staff Observation Aggression Scale [SOAS-R scale [31], which lists all critical events related to a VB during hospitalisations. Patients were considered as having displayed VB whether or not they had been brought to court.

The patients were stratified in 2 groups: as (a) “violent patients”(VP) and (b) “non-violent patients”(NVP) on the basis of the previous definition. Patients of the VP group had committed physical aggression against people at least once. NVP were patients who had not committed any violent actions. Considering that patients who had committed crimes which did not involve harm to people (examples: theft, drug trafficking) may nevertheless not be considered as completely non violent, they were excluded from the NVP group and were therefore not included in the analysis.

In addition, the VP group was considered in 2 complementary ways. Firstly, we looked at the whole sample of VP (N=72), composed of any patient who had committed at least one physical aggression, regardless of its time of occurrence (before entering to the program and/or during the program). Secondly, in order to explore the impact of characteristics recorded at entry to the program on the later occurrence of VB, we restricted the analysis patients who displayed violent behaviour exclusively during the treatment phase (N = 62) and compared them to NVP. The objective of these analyses was to explore whether impulsivity has an impact on subsequent VB. In addition, considering the fact that acts committed before the program may not necessarily have been related to psychosis, since they may have occurred before the first episode of psychosis, we decided to exclude these 10 patients from the analyses.

2.3. Dynamic factors assessed at the program entry with a potential impact on VB

On the basis of existing literature we considered the following characteristics as potential dynamic factors related to VB: Substance Use Disorder SUD (alcohol, marijuana and other substances) [32–34], presence of positive psychotic symptoms [35], lack of insight [36–40], and impulsivity.

All the dynamic factors were evaluated at program entry. Recent substance use disorder (SUD) was rated for each substance used in 2 ways: first, on the basis of DSM-IV criteria [41] and second as either “absent/light substance use” or “moderate to severe substance use” on the basis of Case Manager Rating Scale for substance use (CMRS, [42]). Insight was rated on a three point scale as present, partial and absent. Positive symptomatology was evaluated using the positive subscale (7 items) of the Positive and Negative Syndrome Scale [43] (33 items rating degree of symptoms from 1 to 7). Impulsivity was assessed by combining the scores of 2 PANSS items (“poor impulse control” and “difficulty in delaying gratification”) which corresponds to the definition of impulsivity proposed by Moeller et al. [21]. This last factor has been evaluated like the others and at each assessment time point.

2.4. Diagnostic assessment

Diagnosis is the result of an expert consensus (carried out by a senior psychiatrist and the senior psychologist who is in charge of scale based assessment over the treatment period) and based on the following elements: (1) diagnosis reported by treating psychiatrists in all medical documents and at the end of any hospitalization; (2) longitudinal assessment by clinical case managers, after 18 months and again after 36 months [44]. In this study, the main diagnoses established at 18 months of treatment, according to the DSM-IV [45] were taken into account. Main psychosis diagnosis is sub-divided into 3 classes: paranoid

schizophrenia, non-paranoid schizophrenia and other psychotic disorders, considering previous literature which suggests that diagnoses of schizophrenia and paranoid schizophrenia are risk factors for VB [6,32,46–49], we have controlled the effect of main diagnosis in analyses (potential confounding factor).

2.5. Statistical analysis

- Logistic regression was used to explore the link between impulsivity and VB (during the program) in two ways: firstly the dynamic variables were treated individually (odds ratio, OR, and 95% confidence intervals, CI), and secondly they were considered simultaneously through multivariate logistic regression. As mentioned above, for these analyses, we considered the dynamic factors as assessed at program entry, and conducted the analysis only for patients who committed violent acts during the treatment phase (N = 62).
- To assess evolution of impulsivity during the program and analyze the link between impulsivity and VB at the end of the program, we compared the VP and NVP at 2, 6, 12, 18, 24, 30 and 36 months. Differences between groups at the beginning and the end of the program were analyzed using *t*-test. More, a linear mixed effects model, which includes random interception for each individual, has been tested.
- *Mediation analysis* for binary outcome was performed in order to explore whether the relationship between impulsivity and VB was mediated by other variables. A series of path analysis models were estimated with VB as the dependent variable and

Table 1
Descriptive characteristics of the study sample of 250 patients.

Variable	% (n) ou M(SD)	N = 250	Violent behaviour Physical aggression		
			Violent (N = 72)	Non violent (N = 178)	P value
Gender (male)	% (n)	68.4 (171)	87.5 (63)	60.7(108)	<0.001
Age at the entry in the program	M(SD)	23.9(4.84)	23.06(4.46)	24.34(4.95)	0.059
Number of years at school		10.01(2.15)	9.46(1.98)	10.22(2.19)	0.022
Professional activity	% (n)	34.3(84)	21.7(15)	39.2(69)	0.111
<i>Main Diagnosis DSM-IV</i>					
Paranoid schizophrenia (% yes)	% (n)	32.4(81)	48.6(35)	25.8(46)	<0.001
Non-Paranoid schizophrenia (% yes)	% (n)	38.0(95)	27.7(20)	42.1(75)	0.042
Others psychotic disorders	% (n)	29.2(73)	31.9(23)	28.1(50)	0.14
<i>Substance Use Disorders</i>					
All substances	% (n)	56.2(140)	76.1(54)	48.3(86)	<0.001
<i>Consumption of Substances in the Last Month (CMRS)</i>					
CMRS alcohol	% (n)	47(111)	57.1(40)	42.8(71)	0.043
CMRS cannabis		32.5(77)	54.9(39)	22.9(38)	<0.001
CMRS tobacco		55.84 (129)	67.69 (44)	51.2 (85)	0.033
CMRS opioïdes		2.18 (5)	4.62 (3)	1.22 (2)	0.278
CMRS cocaïne		7.83 (18)	10.77 (7)	6.67 (11)	0.44
<i>Impulsivity (2 items)</i>					
Poor impulse control	M(SD)	2.85(1.38)	3.44(1.65)	2.64(1.21)	0.001
Difficulty in delaying gratification		1.54 (0.06)	1.91 (0.14)	1.41 (0.06)	0.001
		1.31 (0.05)	1.54 (0.11)	1.23 (0.05)	0.017
<i>Absence of Insight</i>					
Partial insight	% (n)	35 (84)	47.14 (33)	30 (51)	
Presence of insight		46.25 (111)	40 (28)	48.82 (83)	
		18.75 (45)	12.86 (9)	21.18 (36)	0.033
<i>Total PANSS positive</i>					
Items PANSS positive	M(SD)	13.75(4,70)	14.16(4.84)	12.9(4.58)	0.200
Delusions		2.45 (0.09)	2.48 (0.17)	2.44 (0.11)	0.832
Conceptual disorganization		1.93 (0.08)	2.07 (0.19)	1.89 (0.09)	0.374
Hallucinatory behaviour		1.88 (0.08)	1.86 (0.15)	1.89 (0.1)	0.842
Excitement		1.46 (0.06)	1.48 (0.12)	1.45 (0.06)	0.793
Grandiosity		1.39 (0.06)	1.41 (0.13)	1.38 (0.07)	0.842
Suspiciousness/persecution		2.67 (0.1)	2.77 (0.18)	2.64 (0.11)	0.544
Hostility		1.47 (0.06)	1.75 (0.14)	1.37 (0.06)	0.017

impulsivity as the independent variable. In order to account for their potential influence on VB, diagnostic and substance use were also introduced as independent variables. Insight and positive symptoms were considered as potential mediators. To further explore its role, substance use was also considered as a potential mediator rather than an independent variable in one alternative model. Finally the role of impulsivity as a potential mediator was also explored. A model was estimated separately for each potential mediator in order to determine whether significant indirect effects between independent and dependant variables could be highlighted, considering such indirect effect indicates the amount of mediation. These path analysis models were estimated using maximum likelihood estimation with robust standard errors (MLR) and Monte Carlo integration using Mplus v7.31.

- **Interaction analysis:** in order to study whether the relationship between impulsivity and VB could be moderated by other variables, a series of multivariate logistic regression models were estimated. SUD, impulsivity and insight were entered as independent variables while VB was selected as the binary dependent variable. Two-way and three way interaction terms between SUD, impulsivity and insight were also entered as predictors. Predictors were centered before computing the interaction terms. Finally, in order to control for diagnosis, this variable was coded as two dummy variables (with paranoid schizophrenia as the reference category) and entered as a predictor in the model. Significance of simple and interaction terms allows to study whether predictors of VB have additive respectively multiplicative effects.

3. Results

3.1. Violent behaviour against a person in the cohort study

Among the 265 patients of the cohort, 72 (27.2%) had committed at least one physical aggression against a person and 15 (5.7%) a crime against property only; these fifteen patients were excluded from the study considering they could be considered neither as control nor as VP. Analyses were therefore conducted on 250 subjects.

Of the 72 patients, 62 (23% of the cohort) have been violent during the program and 10 patients (4% of the cohort) only before entry into the program. The majority of patients who displayed VB (Physical aggression) were not criminally prosecuted (N = 42). When criminal proceedings were initiated, infractions were assault and battery (N = 18), robbery with physical aggression (N = 8), sexual aggression (N = 2) and murder (N = 2).

3.2. Descriptive characteristics of the study sample

When compared to NVP, patients in the VP sample were significantly more likely to be male ($p < 0.001$), with co-morbid diagnosis of SUD [($p < 0.001$) cannabis and alcohol use during last month], a diagnosis of paranoid schizophrenia ($p < 0.001$). Other detailed characteristics are outlined in [Table 1](#).

3.3. Relationship between dynamic factors and violent behaviour during the program

As we shown in a previous study on insight [40], with the exception of positive symptoms, all dynamic factors: (SUD: OR = 3.35, CI 95% 1.782–6.606, insight: OR = 2.05, CI 95% 1.127–3.73 and impulsivity OR = 1.527, CI 95% 1.224–1.927) increased the risk of VB when the variables were entered one by one.

When conducting a multivariate logistic regression analysis on the dynamic factors, the link between VB and impulsivity [$z(193) = 2.95$; $p = 0.001$] or SUD [$z(193) = 2.38$; $p = 0.04$] remained statistically significant, while the link with insight and positive symptoms was not significant any more (model 1, [Table 2](#)). When analysis was controlled for main diagnosis, there was no more statistically significant effect for SUD, while the presence of a diagnosis of paranoid schizophrenia became significantly linked to VB (model 2, [Table 2](#)).

3.4. Mediation effects

Our analysis suggests that the relationship between impulsivity and VB is mediated neither by diagnosis, SUD or insight, nor by positive symptoms, considering the absence of significant indirect effect between impulsivity and VB when SUD, insight or positive symptoms were sequentially considered as potential mediators. Furthermore, no significant indirect effects were revealed when impulsivity was chosen as a potential mediator between study variables and VB.

3.5. Effects of interaction

Our analysis revealed a three-way interaction between impulsivity, insight and positive symptoms [$B = -0.130$, $S.E = 0.057$, $p = 0.024$]. This interaction was plotted for clearer interpretation ([Fig. 1](#)). The effect of impulsivity on the probability of VB is potentiated both when impulsivity is accompanied with a low level of insight and a high level of positive symptoms, and when impulsivity is accompanied with a high level of insight and a low level of positive symptoms. In intermediate cases (low level of insight and positive symptoms or high level of insight and positive symptoms) there is no statistically significant interaction effect.

Table 2
Multivariate logistic regression on the dynamic factor and with control of the main diagnosis.

Models with or without the diagnosis	Estimate	Standard Error	P value
Model 1			
Impulsivity	0.44388	0.13974	0.00149
Absence of insight	0.49472	0.39246	0.20746
Substance Use Disorders	0.79695	0.39256	0.04234
Total PANSS positive	-0.04699	0.04937	0.34111
Model 2			
Impulsivity	0.49309	0.14262	0.000545
Absence of insight	0.41909	0.40602	0.301981
Substance Use Disorders	0.76667	0.41109	0.062186
Total PANSS positive	-0.06838	0.04991	0.170646
Paranoid schizophrenia	-0.9275	0.45685	0.042336
Non-Paranoid schizophrenia and other psychotic disorders	-0.89282	0.49514	0.071361

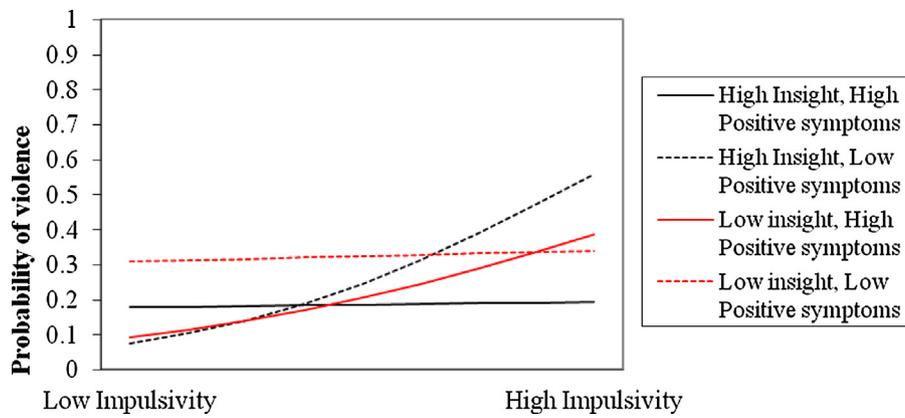


Fig. 1. Interaction effects between impulsivity, insight and positive symptoms.

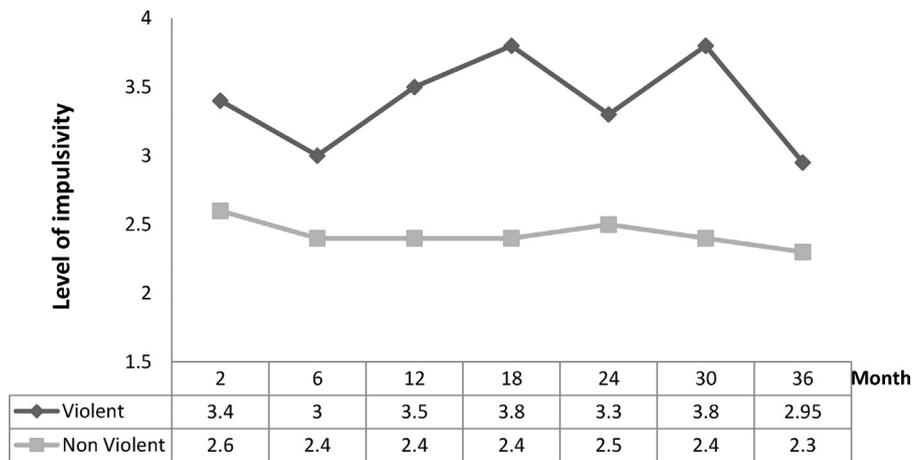


Fig. 2. Evolution of impulsivity over the 3 years of follow-up.

Interaction analyses were carried out on the whole sample rather than on the four subgroups separately.

3.6. Evolution of impulsivity over the 3 years of follow-up

The comparison between VP and NVP during follow-up showed that impulsivity did not decrease significantly in VP and NVP between beginning and end of the program. At the end of 3 years of follow-up, the difference between VP and NVP was still significant (Fig. 2).

The linear mixed effects model, which includes random interception for each individual, confirmed that in VP and NVP, impulsivity does not change over time (beta=0.012, se=0.01, p=0.2519).

4. Discussion

To our knowledge this is the first study exploring the nature of the link between impulsivity and VB in a prospective cohort of EP patients. Our main findings are the following: 1/VB is highly prevalent in a representative cohort of EP patients; 2/impulsivity increases the risk of VB, which suggests preventive strategies may be possible; 3/the relationship between impulsivity and VB is not mediated by the dynamic factors we studied; 4/the interaction between specific levels of impulsivity, insight and positive symptoms potentiates their impact on the risk of VB and 5/at

the end of 3 years of follow-up in an early intervention program, the level of impulsivity continues to differentiate VP from NVP.

In our cohort 27% of patients had been physically violent at least once [40], a slightly higher prevalence compared to previous studies reporting on VB against people in EP patients [8,9,30]. However, comparisons between studies are difficult due to variations in the definition of VB and the duration of follow-up [8,30]. This important rate of VB demonstrates the relevance of studies exploring risk factors of VB more precisely [25] in order to understand potential underlying mechanisms, considering they may pave the way to the development of preventive strategies [26].

Our analyses didn't confirm previous findings suggesting that positive symptoms are predictive of VB [7,35], especially during a first psychotic episode [50]. In line with recent studies [51,52], we can hypothesize that only the presence of a specific constellation of positive psychotic symptoms would be linked to an increased risk of VB? These results could also be related to the fact that the positive symptoms were not studied at the same time as the VB.

Although the impact of impulsivity on VB has already been reported in the general population of violent aggressors [1,53], our results reveal that it is also the case in EP patients, and that impulsivity is a significant risk factor of VB, even after controlling for the effect of other previously identified dynamic risk factors. We confirmed the importance of the role played by SUD regarding risk of VB [9] when the main diagnosis was not taken into account. However, our findings suggest that the diagnosis of paranoid

schizophrenia may be “linked” to VB, but the diagnosis was evaluated during the program.

We found that the relationship between impulsivity and VB is neither mediated by SUD nor by other variables studied. Conversely, impulsivity has no mediating effect on any of the other study variables and does not seem to influence the relationship between SUD and VB for example. These results suggest that these two dimensions are independent. In addition, we haven't found any interaction between SUD and impulsivity on the risk of VB. Therefore, while the presence of SUD has often been considered to bias analyses of impulsivity in VB, our results suggest that amplifying one another, their effect add up to increase risk of VB.

Moreover, we found that there is an interaction between impulsivity, insight and positive symptoms and that their impact on risk of VB depends on the respective levels of these three dimensions. Indeed, their combined effect is potentiated in impulsive subjects either with low insight and high levels of positive symptoms or with high insight and low levels of positive symptoms. These results may suggest that this interaction is involved in different groups of subjects, as they appear in the literature [15,18,20,40,54]. In addition, this complex interaction is independent of the diagnosis and the presence or not of SUD comorbidity.

Contrary to previous observations of a decrease of impulsivity over time [5,6], we observed that impulsivity levels were significantly different between VP and NVP both at the beginning and at the end of the treatment phase, and that impulsivity didn't decrease significantly during the treatment phase. These results would justify the development of more specific approaches targeting impulsivity [26,56].

4.1. Limitations

Several limitations must be mentioned. First, assessment of impulsivity was based on 2 PANSS items rather than on a specifically designed scale. The use of a more detailed scale could provide additional information but was unfortunately not available in this cohort study. Second, assessment of positive symptoms was not always carried out at the time very close to VB. Third, some VB may not have been reported to clinicians and researchers despite the three sources of information; however, we consider that the close relationship established over the entire treatment period between case managers and patients and their families or relatives minimises this risk of under-reporting. Fourth, the lack of sufficiently accurate and reliable information about the context in which the acts occurred prevented us to take this aspect of the problem into consideration. This important issue should be addressed in a future study. Fifth, the diagnostic procedure focused mainly on the psychosis dimension and failed to provide reliable information regarding the presence of personality disorder comorbidity which is known to be a risk factor for VB. Finally, dynamic factors other than those we considered may have had an impact on VB and could be related to impulsivity, and may therefore have influenced the mediation analyses. More, we did not examine the impact of some other potential moderating factors, such as social support or the level expressed emotions by carers, for example.

5. Conclusion

While it is important to stress that the vast majority of patients with psychosis or schizophrenia never display VB against others, our data show that this risk should not be neglected in EP patients. They also suggest that, similar to what is known for patients without psychosis, VB are influenced by the presence of

impulsivity and SUD. However, they seem to be additionally potentiated by an interaction between impulsivity, insight and positive symptoms. This interaction could be specific to the early psychosis phase, suggesting these patients should be the focus of specific attention. Considering the role played by impulsivity, there are good reasons to think that the development of treatments specifically aimed at its control may have a favourable influence on the risk of occurrence of VB. In addition, the observation that impulsivity failed to decrease over time in the context of our specialized EP program suggests that our current approach fails to address this issue and that new strategies are urgently needed.

Conflict of interest

No conflicts of interest to declare.

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