

## Review

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# Characterizing the relationship between psychosis and violence in the forensic psychiatric population: a systematic review

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**Abstract**

**Objective.** The relationship between psychosis and violence is often construed focusing on a narrow panel of factors; however, recent evidence suggests violence might be linked to a complex interplay of biopsychosocial factors among forensic psychiatric patients with psychosis (FPPP). This review describes violence incidents in FPPP, the factors associated with violence, and relevant implications.

**Methods.** This review was conducted following the preferred reporting items for systematic reviews and meta-analyses guideline. Databases, including CINAHL, EMBASE, Medline/PubMed, PsycINFO, and Web of Science, were searched for eligible studies that examined violence among adult FPPP. Screening of reports and data extraction were completed by at least two independent reviewers.

**Results.** Across the 29 included studies, violence was consistently related to prior contact with psychiatric services, active psychotic symptoms, impulsivity, adverse experiences, and low social support. However, FPPP who reported violence varied in most other biopsychosocial domains, suggesting the underlying combinatorial effects of multiple risk factors for violence rather than individual factors. Variability in violence was addressed by stratifying FPPP into subgroups using composite/aggregate of identifiable factors (including gender, onset/course of illness, system-related, and other biopsychosocial factors) to identify FPPP with similar risk profiles.

**Conclusions.** There are multiple explanatory pathways to violence in FPPP. Recent studies identify subgroups with underlying similarities or risk profiles for violence. There is a need for future prospective studies to replicate the clinical utility of stratifying FPPP into subgroups and integrate emerging evidence using recent advancements in technology and data mining to improve risk assessment, prediction, and management.

**Introduction**

Despite robust evidence associating individuals with active psychosis with a degree of risk for violence, it remains challenging to predict and prevent violent incidents in this population.<sup>1</sup> Studies aiming to characterize violence in patients with psychosis have highlighted the difficulty of predicting and preventing violence because it is a rare and complex event.<sup>1,2</sup> For example, patients with psychosis may behave violently as a direct result of their psychotic symptoms, due to other factors that increase risk in the context of psychosis or for other reasons unrelated to their illness.<sup>2</sup> The relationship between psychosis and violence is especially relevant in forensic psychiatry due to the relatively high prevalence of violent incidents, psychotic disorders, and the emphasis on mitigation of the risk for violence in forensic population—prevention of recidivism.<sup>3</sup> Describing common pathways that are related to violent behavior in this population may uncover opportunities for more nuanced risk assessment and targeted intervention.

The characterization of violence in patients with psychosis in existing literature has often related violence to certain panels of few clinical factors, including active psychotic symptoms, low treatment adherence, substance abuse, and antisocial behavior.<sup>1,4–6</sup> This construct of violence based on these panels of clinical factors often implies that violence can result from at least two pathways: acute psychopathology or premorbid conditions.<sup>4–6</sup> However, such construct is limited because these factors are neither necessary nor sufficient to cause violence. For example, some studies aiming to describe an explanatory model for propensity for violence have highlighted various biological, psychological, and social differences or factors.<sup>5</sup> In this regard,

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brain imaging studies have reported functional deficits in the frontal cortex, hippocampus, and amygdalae of violent patients, possibly leading to impairments in executive functioning and emotion regulation, compared to nonviolent patients.<sup>7</sup> In psychology literature, the relationship between psychosis and violence has been proposed to be moderated by cognitive impairment, psychopathy, and negative affective states.<sup>8–10</sup> Similarly, studies focusing on social and environmental factors have related violence to low social support, childhood trauma, and victimization as adults, among others.<sup>11,12</sup>

While existing studies on violence and psychosis provide valuable data for understanding the correlates of violent behavior in psychosis, their findings have not led to blockbuster improvements in clinical practice or patients' outcomes. Risk assessment currently relies on a combination of clinical **judgment**, which has been shown to have low validity on its own, and structured assessment measures, which have been criticized for lacking validation and nuance in forensic psychiatric patients with psychosis (FPPP).<sup>13–15</sup> Even the most robust risk assessment tools predict violence with only small to moderate effect sizes, suggesting that they may benefit from additional indicators of risk and integration of emerging evidence using innovative practices and recent advancements in technology.<sup>16,17</sup>

Most of the existing evidence on the relationship between violence and psychosis comes from studies conducted in the general psychiatric population.<sup>1,2,4,5</sup> However, the forensic psychiatric population is unique, and findings in the general psychiatric population may not be representative of them. For instance, FPPP tend to have a higher prevalence of violent incidents and comorbid conditions, more severe clinical phenotypes, and a different treatment context compared to the general psychiatric patients, all of which can modify their risk of violence.<sup>18</sup> Moreover, given that most patients in the forensic psychiatric system had previous contact with general psychiatric mental services, they may represent a particularly high-risk or special group of patients that could have been identified earlier in their trajectory with the proper tools and understanding of their risk profile. Identifying high-risk groups depends on forming an evidence-based biopsychosocial-clinical gestalt that goes a step further than individual characteristics. We conducted this review to characterize violent behavior among FPPP. Specifically, this study provided an overview of the characteristics of the violent incidents and behavior in FPPP and discussed the clinical implications of these findings in light of the need for optimal assessment and mitigation of violence risk in forensic settings.

## Methods

The present study was completed following the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines.<sup>19</sup> Eligibility included all study designs (e.g., cross-sectional studies, retrospective chart reviews, prospective observational studies, and interventional trials) published till 2023. We excluded correspondences, editorials, case reports, case series, protocols, reviews, and articles in languages other than English. Eligible studies needed to have samples consisting of forensic psychiatric patients above the age of 18 with findings of “not criminally responsible” or “permanently unfit to stand trial” or equivalent findings in their jurisdiction. Some fraction of the study participants needed to have psychotic disorders or psychotic symptoms, with an independent description of this group. Eligible studies also needed to comment on violence as a primary outcome or focus of the study.

## Search strategy

Search strategy was developed in consultation with the librarian at the McMaster University Health Sciences Library. We searched major databases, including CINAHL, EMBASE, Medline/PubMed, PsycINFO, and Web of Science using a combination of keywords and database-specific subject headings for violence, psychosis, and forensic psychiatry. [See [Supplementary Material S1](#) for search strings, and strategy used for the databases]

## Study selection

Screening, quality assessment, and data extraction were conducted independently by AS, SB, WP, and supervised by ATO. Titles and abstracts were screened independently by at least two authors to select studies eligible for full-text review. Full-text articles were reviewed, and data extraction was completed independently by at least two authors according to the inclusion criteria. Any disagreements were resolved through discussion between reviewers or in consultation with the senior author (ATO) to reach consensus.

## Quality assessment

The Study Quality Assessment Tools of the National Institutes of Health (NIH) were used to determine the quality of the included studies.<sup>20</sup> All authors rated each study on a range of 12–14 items based on the study design to determine their methodological strengths, limitations, and risk of bias. Scores from all three authors were collated, and disagreements were resolved by discussion between authors or in consultation with ATO. Studies were determined to be good, fair, or poor quality based on their average score relative to other included studies.

## Data collection and presentation

Relevant data points were extracted independently by at least two authors from each included study. Data items were decided a priori and included study characteristics, participant characteristics, assessment of psychosis, assessment of violence, main findings, clinical recommendations, and study limitations. We organized the patients' characteristics that emerged from the included studies into five domains: clinical, criminological, biological, psychological, and social domains. Patient subgroups with similar characteristics or profiles were described next. Given the heterogeneity of assessment and outcome measures, a meta-analysis could not be conducted.

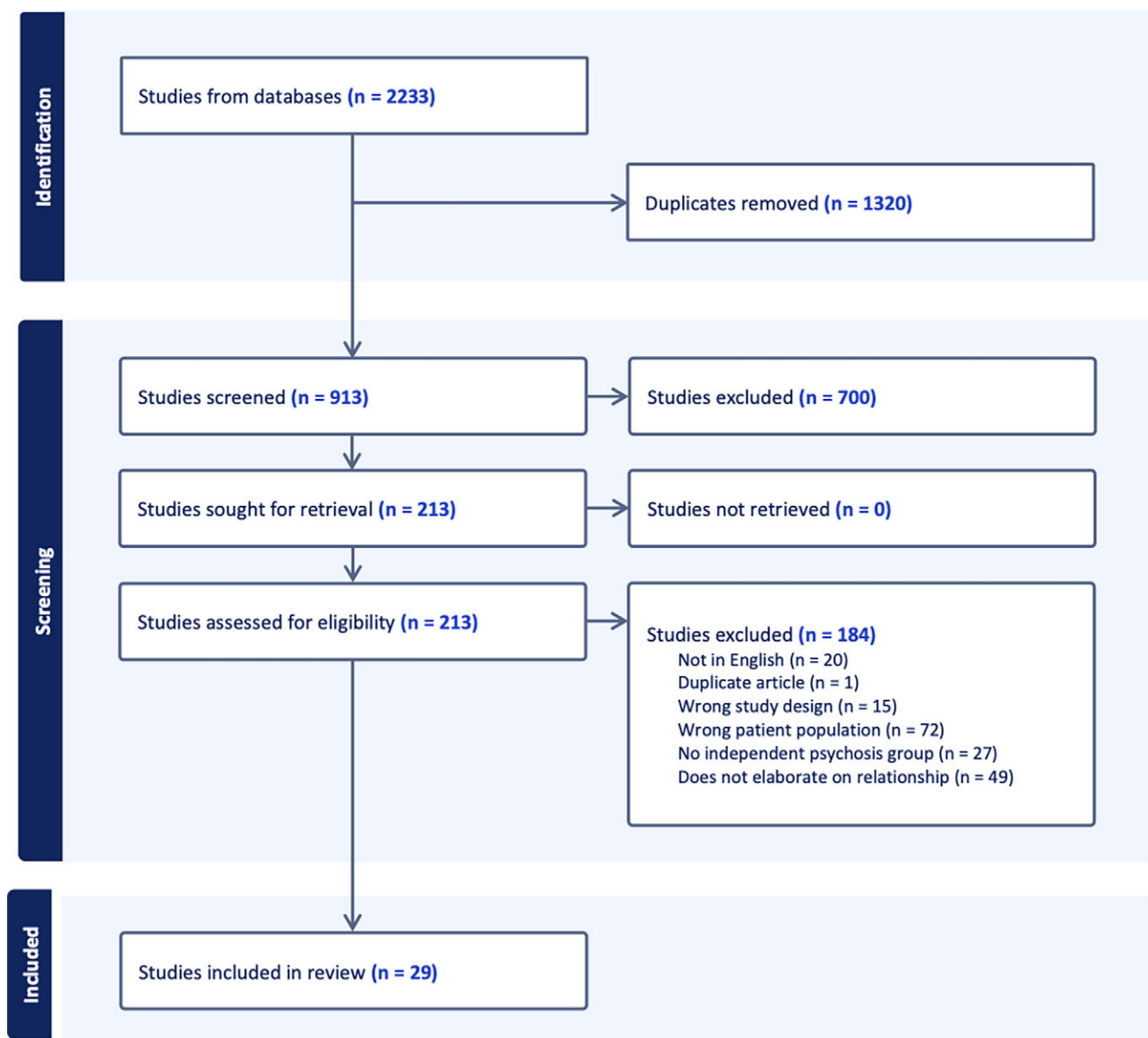
## Results

### Study selection

Of a total of 913 reports identified from all databases after duplicates were removed, 29 eligible articles were selected for inclusion in the final report.<sup>17,18,21–47</sup> The screening and selection process is presented in the PRISMA flow diagram in [Figure 1](#).

### Study characteristics

[Table 1](#) presents the characteristics and main findings from the included studies ( $n = 29$ ). The publication dates of the included reports spanned three decades, from 1999 to 2023, with 16 studies that were published in the last 5 years. Majority of the eligible studies were conducted in Canada ( $n = 7$ ), Croatia ( $n = 3$ ) and two



**Figure 1.** Prisma flow diagram.

each in England, Greece, Ireland, and Switzerland. Two studies included settings across several European countries (and one report each was from Australia, Brazil, England, Japan, Poland, Turkey, and the USA). Only three studies had prospective study designs,<sup>17,38,41</sup> and we assessed 11 studies as high quality, 13 studies as fair quality, and 5 studies as poor quality. [See [Supplementary Material S2](#) for detailed results of the quality assessment].

In all the included studies, there were a total of 7,042 participants, consisting of inpatients in forensic settings, albeit six studies included participants from outpatient forensic settings.<sup>22,23,32,33,38,39</sup> Six studies focused on severe violence (defined as homicide, attempted homicide, or serious injury to the victim)<sup>24,26,31,32,41–43,46</sup> and two studies only included homicide offenders in their sample.<sup>26,31</sup> With the exception of the study by Ferranti and colleagues,<sup>26</sup> all studies predominantly included male participants, and six studies had male samples

entirely.<sup>17,25,30,32,46,47</sup> Schizophrenia was the most common diagnosis across the samples.<sup>17,22–24,27,31,32,34,36,38–47</sup> The dyad of cases and controls recruited across the included studies varied significantly: five compared FPPP with the general psychiatric population<sup>18,21,29,33,46</sup>; four compared FPPP with and without violent behavior<sup>17,28,32,45</sup>; and three compared FPPP to healthy individuals.<sup>22,23,40</sup> Furthermore, two studies each compared FPPP with nonforensic offenders<sup>30,47</sup>; and individuals with high and low trait psychopathy scores.<sup>25,27</sup> Some studies ( $n = 2$ ) compared FPPP who started offending prior to the onset of illness and those who started offending afterward,<sup>39,44</sup> and two reports compared FPPP who offended during the first-episode psychosis with those who offended later in the course of the illness.<sup>34,36</sup> One study compared FPPP with more and less severe violence<sup>24</sup>; one compared FPPP to forensic patients with other diagnoses<sup>31</sup>; one compared FPPP with and without a history of conduct disorder<sup>35</sup>; one compared female and male FPPP<sup>26</sup>; one

**Table 1.** Summary of Studies Included in the Systematic Review

Study	Study design	Quality	Sample	Key factors	Main findings
Barlati et al <sup>21</sup> 2022 Italy	Retrospective case-control	Good	N = 100, 86% males	Education, substance use, symptoms, violence risk, psychopathy, cognition	<ul style="list-style-type: none"> <li>FPPP with a history of violence had more school failures, substance use, excitatory symptoms, HCR-20 risk management score, PCL callousness score, worse working memory, and better attention compared to nonoffender patients with schizophrenia</li> </ul>
Battaglia et al <sup>22</sup> 2020 Canada	Retrospective cohort	Fair	N = 45, 75.6% males	Violence history, aggression	<ul style="list-style-type: none"> <li>FPPP with history of violence had more physical aggression than healthy controls</li> <li>Verbal and attitudinal aggression were correlated with severe aggressive institutional incidents</li> </ul>
Battaglia et al <sup>23</sup> 2022 Canada	Retrospective case-control	Fair	N = 45, 75.6% males	Cognition	<ul style="list-style-type: none"> <li>FPPP with history of violence had worse interpersonal perception and over-estimated their accuracy compared to healthy controls</li> </ul>
Chan & Shehtman <sup>24</sup> 2019 Canada	Retrospective case-control	Good	N = 287, mean age = 34.2 (SD=10.86), 84.3% male	Symptoms, victim relationship	<ul style="list-style-type: none"> <li>Command hallucinations, threat/control-override delusions, and Capgras syndrome were risk factors for acute severe or fatal violence from FPPP</li> <li>First-degree relatives were more likely to be victims of acute severe or fatal violence</li> </ul>
De Girolamo et al <sup>18</sup> 2023 Five European countries:Austria, Germany, Italy, Poland and United Kingdom	Retrospective case-control	Good	N = 398, 84.4% male	Sex, children, treatment engagement, cognition, functioning	<ul style="list-style-type: none"> <li>FPPP with history of violence were more likely to be male, have children, spend less time in therapeutic activities, poorer attention, and overall lower functioning than non-offender patients with schizophrenia spectrum disorders</li> </ul>
Dolan & Davies <sup>25</sup> 2006 England	Retrospective cohort	Fair	N = 134, mean age = 35.6 years (SD 9.47), all males	Psychopathy, substance use, treatment engagement, insight	<ul style="list-style-type: none"> <li>High psychopathy scores in FPPP were associated with increased risk of pro-criminal attitudes, substance misuse/trafficking, low treatment engagement, low insight into risk status, and institutional violence</li> </ul>
Ferranti et al <sup>26</sup> 2013 USA	Retrospective cohort	Fair	N = 94, 50% males	Sex, comorbid disorders, symptoms	<ul style="list-style-type: none"> <li>Female homicide offenders with psychosis were more likely to have an affective disorder, borderline personal disorder, and delusions of being followed compared to male counterparts</li> </ul>
Fullam & Dolan <sup>27</sup> 2006 England	Retrospective cohort	Fair	N = 61, mean age = 37.79 (SD=8.52)	Psychopathy, violence history, family history, interpersonal style, symptoms, violence risk	<ul style="list-style-type: none"> <li>In a sample of FPPP, high psychopathy scores were associated with previous offences, family criminality, more coercive and less compliant interpersonal style, more grandiose and hostile symptoms, higher violence risk, and institutional aggression</li> </ul>
Hofmann et al <sup>28</sup> 2022 Switzerland	Retrospective case-control	Good	N = 352, mean age = 33.98 (SD=10.21), 92.9% male	Ward conduct, symptoms, impulsivity	<ul style="list-style-type: none"> <li>Using a machine learning approach, the most predictive factors for violent behavior from FPPP were (i) negative behavior toward other patients, (ii) breaking of ward rules, and (iii) PANSS score at admission</li> </ul>
Iozzino et al <sup>29</sup> 2022 Austria, Germany, Italy, Poland and England	Retrospective case-control	Good	N = 115, 84.3% males	Cognition, impulsivity	<ul style="list-style-type: none"> <li>FPPP with a history of violence had poorer cognitive performance and decision-making in all subscales except deliberation time compared to nonforensic patients with schizophrenia spectrum disorders</li> </ul>
Joubert & Zaumseil <sup>17</sup> 2020 Canada	Prospective cohort	Good	N = 3293, mean age = 35.94 (SD=12.33), all males	Symptoms, insight, treatment engagement	<ul style="list-style-type: none"> <li>FPPP with an increase in aggressive incidents during admission exhibited more active psychotic symptoms, less insight, and lower treatment engagement compared to patients with decreasing or infrequent aggressive incidents</li> </ul>
Kolla et al <sup>30</sup> 2021 USA and Canada	Retrospective case-control	Fair	N = 137, all males	Brain morphometry	<ul style="list-style-type: none"> <li>Compared to healthy incarcerated offenders, FPPP with history of violence had reduced weights in the superior, transverse, and middle temporal gyrus, and anterior cingulate and increased weights in the basal ganglia, thalamus, parahippocampal gyrus, frontal pole, precuneus, and visual cortex</li> </ul>
Kovacevic et al <sup>31</sup> 2008 Croatia	Retrospective cohort	Poor	N = 87	Criminological factors, substance use	<ul style="list-style-type: none"> <li>Domestic homicide offenders with schizophrenia were more likely to use more force, target males, commit sibicide and parricide, be unprovoked by the victim, display indifference toward the offense, and</li> </ul>

Table 1. Continued

Study	Study design	Quality	Sample	Key factors	Main findings
					were less likely to be intoxicated compared to offenders with other psychiatric diagnoses
Kuroki et al <sup>32</sup> 2017 Japan	Retrospective case-control	Fair	N = 57, age range = 20–60, all males	Brain morphometry	<ul style="list-style-type: none"> <li>FPPP with a history of serious violence had lower gray matter volumes in the right inferior temporal area and right insular area, and only the right inferior temporal area after controlling for substance use, compared to nonviolent patients with schizophrenia</li> </ul>
Markiewicz et al <sup>33</sup> 2020 Poland	Retrospective case-control	Poor	N = 81, age range 38–41, 77.8% male	Education, violence history, aggression, symptoms	<ul style="list-style-type: none"> <li>FPPP with substance use had more education, violent incidents in the past, aggression, and psychotic symptoms (especially negative symptoms) than nonforensic patients with one or both diagnoses</li> </ul>
Markopoulou et al <sup>34</sup> 2021 Greece	Retrospective case-control	Good	N = 78, mean age = 38.68 (SD=12.06)	Offending during first episode vs. later in illness, victim relationship, treatment response	<ul style="list-style-type: none"> <li>FPPP with violent offences during first-episode psychosis were more likely to be younger, have experienced recent stressors, assaulted family members, and experienced more symptomatic improvement during admission than FPPP offending later in illness</li> </ul>
Study	Study design	Quality	Sample	Key factors	Main findings
Markopoulou et al <sup>35</sup> 2022 Greece	Retrospective cohort	Good	N = 78, 89.7% male	Conduct disorder, Criminological factors, substance use, symptoms, aggression, impulsivity	<ul style="list-style-type: none"> <li>FPPP with a history of conduct disorder were more likely to offend at a younger age, cause bodily harm, have preoffense hospitalizations, and higher levels of substance use, positive symptoms, anger, hostility, and impulsivity compared to those without conduct disorder</li> </ul>
Nielssen et al <sup>36</sup> 2011 Australia	Retrospective case-control	Fair	N = 272, mean age = 34.2 (SD=11.2), 86% male	Offending during first episode vs. later in illness, criminological factors, comorbid disorders, violence history	<ul style="list-style-type: none"> <li>FPPP who committed homicide during first-episode psychosis were more likely to be younger, be born overseas, report depressed mood, have affective psychosis, and use firearms than FPPP offending later in the course of illness, who were more likely to have prior convictions and exhibit thought disorder at the time of their offense</li> </ul>
O'Reilly et al <sup>37</sup> 2019 Ireland	Retrospective case-control	Good	N = 55, mean age=40 (SD=9.7), 89% males	Cognition	<ul style="list-style-type: none"> <li>Specific moral cognitions were shown to mediate the relationship between specific psychotic symptoms and their relevance to the violent behavior, form of violence, and seriousness of violence</li> </ul>
Penney et al <sup>38</sup> 2016 Canada	Prospective cohort	Fair	N = 87, mean age = 36.44 (SD=9.82)	Recidivism, victimization, readmission	<ul style="list-style-type: none"> <li>After discharge, FPPP had similar rates of violence (23%) and elevated rates of victimization (29%) and hospital readmission (28%) compared to general psychiatric patients, and outcomes were predicted by historical risk</li> </ul>
Penney et al <sup>39</sup> 2019 Canada	Retrospective cohort	Good	N = 91, mean age = 35.22 (SD=15.12), 89% male	Offending before vs. after illness onset, offending motive, substance use, comorbid disorders, violence risk	<ul style="list-style-type: none"> <li>FPPP were primarily motivated to offend by psychotic symptoms</li> <li>FPPP who were antisocial before psychosis onset had more substance use, personality disorders, conventional offending motives, and a higher level of historical and risk management factors</li> </ul>
Rasanen et al <sup>40</sup> 1999 Finland	Retrospective case-control	Poor	N = 84, majority male	Recidivism, comorbid disorders, testosterone	<ul style="list-style-type: none"> <li>In a sample with high violent criminality, forensic patients with personality disorders had higher testosterone than FPPP</li> </ul>
Richter et al <sup>41</sup> 2018 Ireland	Prospective cohort	Good	N = 69, mean age = 39.72 (SD=11.13)	Program completion, length of stay, cognition, psychopathy	<ul style="list-style-type: none"> <li>Risk assessment and program completion scores improved during admission, especially for FPPP with admissions less than 2112 days</li> <li>Baseline program completion, cognition, and psychopathology were significant predictors of program completion</li> <li>The effect of cognition on violence proneness was mediated by program completion</li> </ul>

Table 1. Continued

Study	Study design	Quality	Sample	Key factors	Main findings
Ružić et al <sup>42</sup> 2011 Croatia	Retrospective cohort	Poor	N = 99, mean age = 47.37 (SD=13.2)	Treatment	<ul style="list-style-type: none"> <li>There was no difference in the aggressiveness and symptom reduction of FPPP using first- and second-generation antipsychotics</li> </ul>
Ružić et al <sup>43</sup> 2008 Croatia	Retrospective cohort	Poor	N = 99, mean age = 47.37 (SD=13.2)	Symptoms, family functioning, quality of life	<ul style="list-style-type: none"> <li>In a sample of FPPP, psychoticism and negative family functioning were predictors of aggressiveness</li> <li>Facets of aggressiveness were also negatively correlated with quality of life, physical health, and emotional satisfaction</li> </ul>
Simpson et al <sup>44</sup> 2015 Canada	Retrospective case-control	Fair	N = 232, mean age = 43.19 (SD=11.40), 88% male	Timing of illness onset and offending behaviour, violence history, substance use, comorbid disorders, victim relationship	<ul style="list-style-type: none"> <li>Identified three subgroups of patients based on the onset of offending relative to illness onset</li> <li>Early starters had more previous convictions, substance use, and personality disorders</li> <li>Late starters had fewer issues with early maladjustment and were more likely to offend against spouse</li> </ul>
Sonnweber et al <sup>45</sup> 2021 Switzerland	Retrospective case-control	Fair	N = 369, mean age = 34.1, 91.6% male	Length of admission, age at diagnosis, criminal history, various	<ul style="list-style-type: none"> <li>Using a machine learning approach, most predictive factors for distinguishing FPPP with and without a history of violent behavior were (i) time spent in current forensic hospitalization, (ii) younger age at schizophrenia spectrum disorder diagnosis, and (iii) more time spent in prison</li> </ul>
Teixeira & Dagalarrondo <sup>46</sup> 2009 Brazil	Retrospective case-control	Fair	N = 60, all males	Negative affect, symptoms	<ul style="list-style-type: none"> <li>FPPP with history of violence were less likely to exhibit negative affect, more likely to act on beliefs, and less likely to refrain from acting because of beliefs compared to FPPP with no history of violence</li> </ul>
Ural et al <sup>47</sup> 2013 Turkey	Retrospective case-control	Fair	N = 83, all males	Criminological factors, symptoms	<ul style="list-style-type: none"> <li>FPPP were more likely to offend later in life, engage in daytime crime, and target family members than incarcerated offenders</li> <li>At the time of offense, most FPPP (70.9%) experienced symptoms including persecutory delusions, referential delusions, and delusions of jealousy</li> </ul>

Abbreviation: FPPP, forensic psychiatric patients with psychosis.

compared FPPP with longer and shorter admissions<sup>41</sup>; and one compared FPPP treated with typical and atypical antipsychotics.<sup>43</sup> Three studies lacked a control group.<sup>37,38,42</sup>

### Findings on violence from the included studies

The main findings on violence in FPPP in the included studies (n = 29) are presented in Table 1 and summarized below.

#### Clinical characteristics associated with violence in FPPP

##### Previous psychiatric history

A significant proportion of FPPP with violent behavior (89%) had received psychiatric treatment before the index offense<sup>39</sup> and FPPP were more likely to have received psychiatric treatment before the index offense in a study that compared offenders with individuals with nonschizophrenia psychiatric diagnoses ( $\chi^2 = 6.183$ ,  $p = 0.013$ ).<sup>32</sup> Active contact with mental health services shortly before the offense was reported in 71.4 and 78.1% by two reports, and 66.7%–88.1% were prescribed antipsychotic medication and 21.7%–85% adhered to treatment in the same reports.<sup>18,39</sup> One report that used machine learning model found that olanzapine equivalents at discharge were a predictor of belonging to FPPP with violent rather than nonviolent offences.<sup>45</sup> On a different note, no difference in aggressiveness ( $t = -0.13$ ,  $p = 0.895$ ), side effects ( $t = -0.23$ ,  $p = 0.819$ ), and length of hospitalization ( $t = -0.87$ ,

$p = 0.387$ ) was found when first- and second-generation antipsychotic medications were compared in FPPP with violent behavior.<sup>43</sup>

##### Psychotic symptoms

Psychotic symptoms were associated with violent behavior,<sup>18,21,26,28,33,39,45</sup> and as much as 79.2–97% of FPPP experienced delusions at the time of the offense.<sup>24,36,39</sup> Persecutory delusions were the most common.<sup>34,36,38,45,47</sup> In two reports, 79–87.9% of patients endorsed auditory hallucinations, of which 24.2–49.3% were command hallucinations.<sup>36,39</sup> Two machine learning studies found that the severity of psychotic symptoms was among the most predictive variables of violent behavior in FPPP.<sup>28,45</sup> In some studies (n = 4), psychotic symptoms were confirmed as common prior to and at the time of the index offense and were present in the days to weeks prior to the offense.<sup>18,24,34,36</sup> Comparing symptom severity between patients with and without a history of violent behavior produced mixed results, including De Girolamo and colleagues<sup>18</sup> reporting no significant difference ( $p=0.226$ ) while Barlati and colleagues<sup>21</sup> reported more severe excitatory symptoms in the violent group ( $p < 0.001$ ).

##### Personality disorders

The prevalence of personality disorders among FPPP with violent behavior varied between 3.37 and 28.4% across all the included studies.<sup>18,22,23,33,43,44</sup> Compared to nonforensic samples, FPPP with violent behavior were more likely to have personality

disorders ( $p < 0.005$ ).<sup>18,33</sup> Antisocial personality disorder (ASPD) was the most common personality disorder across studies, with its prevalence ranging from 14.4 to 28%.<sup>18,22,23,43</sup> Further, FPPP were more likely to be diagnosed with ASPD than nonforensic patients ( $p = 0.002$ ).<sup>18</sup> Similarly, FPPP with a history of conduct disorder were more likely to offend at a younger age ( $U = 522.500, p = 0.042$ ), cause bodily harm, use substances ( $\chi^2 = 3.661, p = 0.056$ ), and engage in more violence directed toward others following the offense ( $\chi^2(1) = 6.255, p = 0.012$ ), and exhibited more severe positive psychopathology ( $t(76) = 2.036, p = 0.045$ ) even after treatment.<sup>35</sup>

#### Substance use

The prevalence of substance use disorder among FPPP with violent behavior ranged widely from 10 to 82.2%.<sup>22,23,32,34,36,38,39,45,47</sup> At the time of the offense, 20–47.2% of FPPP were reported to have recently used alcohol or other substances.<sup>24,34,36,39</sup> One study determined that 30.4% of the sample experienced symptoms that were caused or exacerbated by substance use before the offense.<sup>39</sup>

#### Criminological characteristics associated with violence in FPPP

##### Criminal history

Two studies reported that the prevalence of previous criminal convictions among FPPP with violent behavior was 44% and 66.5%.<sup>18,36</sup> One machine learning study identified that time spent in prison and number of criminal record entries were among the most predictive variables for distinguishing FPPP with and without violence offences.<sup>45</sup> On average, there was a 2-year interval between the onset of psychotic symptoms and violent offending and a 6.3-year interval between initial psychiatric evaluation and violent crime.<sup>36,45</sup> Another study found that FPPP had fewer violent convictions compared to nonforensic offenders ( $\chi^2 = 5.12, p = 0.02$ ).<sup>47</sup>

##### Nature of index or present offense

Across samples, 50–67.9% of patients were reported to perpetrate severe or fatal violence.<sup>18,34,37</sup> One study reported that FPPP were more likely to use physical force than forensic patients with other diagnoses (13.6% and 7.0%, respectively).<sup>31</sup> Another study found that patients motivated by psychotic symptoms were more likely to commit severe offences ( $\chi^2 = 12.13, p < .05$ ) and cause harm ( $\chi^2 = 9.54, p < .05$ ) compared to patients with predominantly disorganization or mood symptoms.<sup>39</sup> Regarding weapons used in the offense, one study reported that FPPP with violent offences most frequently used knives (52%).<sup>36</sup> Another found that the most common method of assault was using hands (44.2%), followed by sharp or blunt instruments (34.6%), and this was not significantly different from nonforensic offenders ( $p > 0.05$ ).<sup>47</sup> The prevalence of FPPP committing violent offences against family members or intimate partners varied from 25.5 to 76%.<sup>24,35,36</sup> One study reported that this was higher than the percentage of nonforensic offenders (10%).<sup>38</sup> One study found that offences against first-degree relatives were associated with severe violence ( $\chi^2 = 8.52, p = 0.004$ ).<sup>24</sup>

#### Biological characteristics associated with violence in FPPP

Approximately, 22% of FPPP with violent behavior had previous brain injuries with loss of consciousness.<sup>36</sup> Furthermore, a brain morphometry study found that FPPP with violent behavior had greater loading weights in the frontal pole, precuneus, visual cortex ( $F_{1,132} = 13.1, p < 0.001$ ), basal ganglia ( $F_{1,132} = 9.7, p = 0.002$ ), thalamus, parahippocampal gyrus ( $F_{1,132} = 16.5, p < 0.001$ ) and lower loading weights in the anterior cingulate ( $F_{1,132} = 11.4,$

$p = 0.001$ ), superior, transverse, and middle temporal gyrus compared to nonforensic offenders without psychosis.<sup>30</sup> Another study found that FPPP with violent behavior had lower gray matter volume (GMV) in the right inferior temporal area ( $p = 0.001$ ) and the right insular area ( $p = 0.003$ ) compared to nonoffender patients with schizophrenia.<sup>32</sup>

#### Psychological characteristics associated with violence in FPPP

##### Psychological motive related to the offense

In a report, 70.3% of FPPP were reported to be primarily motivated to commit their index offense by psychotic symptoms and acted consistently with its content and themes. In 15.4% of these cases, there was a secondary conventional motivation, most often reactive anger (59.1%) or antisocial attitudes (31.8%), contributing to their offense.<sup>39</sup> Two other studies reported that the violence perpetrated by FPPP was more often reactive (69% and 73.1%) than instrumental (31% and 26.9%).<sup>18,37</sup>

##### Personality structure

In two studies, FPPP with violent behavior scored higher on measures of overall aggression compared to nonforensic patients with schizophrenia ( $\omega^2 = 0.11, p = 0.004$ ) and measures of physical aggression ( $t(43) = 2.10, p = 0.042$ ) compared to healthy controls.<sup>22,33</sup> Similarly, FPPP with violent behavior were reported to have more difficulty with interpersonal perception ( $t = -3.14, p = 0.003$ ) especially with respect to identifying kinship dynamics ( $t = -2.70, p = 0.010$ )<sup>23</sup> and have higher trait psychopathy than nonforensic patients with psychosis ( $p < 0.001$ ) and PCL-R “callousness” predicted belonging to the forensic group ( $p = 0.031$ ).<sup>21</sup> Psychopathy was also associated with other risk factors, including previous offences as an adult ( $\chi^2 = 5.08, p < 0.05$ ), family criminality ( $\chi^2 = 4.71, p < 0.05$ ), positive and negative syndrome scale (PANSS) hostility (Mann–Whitney  $U = 262.00, p < 0.01$ ), PANSS grandiosity (Mann–Whitney  $U = 281.50, p < 0.05$ ), total historical, clinical and risk management-20 (HCR-20) score ( $t(57) = 4.09, p < 0.001$ ). In this sample, FPPP in the high psychopathy group displayed a more hostile interpersonal style in interactions with staff and patients and were more likely to engage in institutional aggression than those with low psychopathy scores ( $\chi^2 = 7.1, p < 0.01$ ).<sup>27</sup> Similarly, another study reported that FPPP with high psychopathy scores were more likely to have procriminal attitudes (AUC 0.89 (SE 0.03)  $p = 0.000$ ), low work ethic (AUC 0.78 (SE 0.05),  $p = 0.000$ ), low insight into their violence (AUC 0.72 (SE 0.05)  $p = 0.003$ ), substance use (AUC 0.77 (SE 0.04),  $p = 0.000$ ), and institutional incidents (AUC 0.65 (SE 0.04),  $p = 0.002$ ).<sup>25</sup> Antisocial behavior during admission predicted institutional violence in one machine learning study.<sup>28</sup>

##### Cognitive ability

In their report, de Girolamo et al. found that FPPP with violent behavior had poorer performance in verbal memory ( $p = 0.015$ ), verbal fluency ( $p = 0.021$ ), and processing speed ( $p < 0.001$ ) compared to nonforensic patients with psychosis.<sup>18</sup> Similarly, others have reported poorer working memory ( $p = 0.037$ ) and processing speed ( $p = 0.026$ ) but better attention ( $p < 0.001$ ) in FPPP with violent behavior compared to nonforensic patients with psychosis.<sup>21</sup> On measures of impulsivity, FPPP with violent behavior exhibited more risk-taking behavior ( $t = -2.09, p = 0.039$ ) and less deliberation time (95% CI 277.1–1.625.4,  $p = 0.003$ ) as compared to nonforensic patients.<sup>29</sup> Specific moral cognitions were shown to mediate the relationship between specific psychotic symptoms, relevance to violence, form of violence, and seriousness of violence.<sup>37</sup> Again, an assessment of inpatient program

completion showed that the effect of cognition on violence risk was mediated by changes in program completion.<sup>41</sup>

### Social characteristics associated with violence in FPPP

#### *Adverse childhood experiences*

Approximately 15% of FPPP with violent behavior experienced childhood trauma ( $\chi^2 = 0.00, p = <0.549$ )<sup>36</sup> and history of childhood abuse was common in several FPPP samples.<sup>26,27,33,35</sup> One machine learning study found that childhood poverty was a robust predictor of belonging to FPPP with violent rather than nonviolent offences.<sup>45</sup> In the same vein, FPPP with violent behavior were more often victims of violence ( $p = 0.186$ ) or had witnessed violence ( $t = 4.36, p = 0.037$ ) compared to nonforensic patients with psychosis (26.7% and 17.9%) ( $p = 0.186$ ).<sup>18,29</sup>

#### *Social support*

With respect to support, 26.4% of FPPP with violent behavior were observed to have no fixed address when they committed their index offense.<sup>39</sup> Across studies, 54.5–90% of FPPP with violent behavior had never married,<sup>18,31,34,42,44,45</sup> although one study noted that FPPP with psychosis were more likely to have children ( $t = 4.77, p = 0.029$ ) and even so in those with schizophrenia ( $p = 0.004$ )<sup>18,29</sup> compared to nonforensic patients with psychosis. Both negative family functioning and poor quality of life were predictors of aggressiveness ( $p < 0.05$ ) in a report.<sup>42</sup> According to a machine learning model, social isolation in adulthood was identified as a strong predictor of belonging to FPPP with nonviolent rather than violent offences, with rates of 84.9% compared to 68.1%.<sup>45</sup>

#### *Education and employment*

Across studies, most FPPP with violent behavior were often less educated compared to the control group,<sup>22,23,26,27,31,32,34</sup> and one report found that FPPP with violent behavior had more school failures than nonforensic patients with psychosis ( $\chi^2 = 823.0; p < 0.002$ ).<sup>21</sup> Another study reported that education was protective against violence ( $p < 0.001$ ), with each year of education leading to a 12% reduction in the probability of belonging to the violence group.<sup>18</sup> Rates of unemployment among FPPP at the time of their violent offense were high, ranging between 40.9 and 80.6%.<sup>24,31,34,45</sup>

### Characterization of violence in FPPP based on subgroups with clinical relevance

#### *Male and female offenders*

Ferranti et al. compared male and female FPPP with homicide offences.<sup>26</sup> The study reported that females were more likely to use knives (43% vs. 32%,  $p < 0.05$ ), offend against victims under 18 years old (44% vs 0%,  $p < .001$ ), target family members (64% vs. 25%,  $p < .001$ ) have borderline personality disorder (60% vs. 9%;  $p < 0.05$ ), and present with an affective component to their illness (51% vs. 21%,  $p < 0.01$ ) be the victim of childhood sexual abuse (58% vs. 18%,  $p < 0.01$ ) and intimate-partner violence (65% vs. 19%,  $p < 0.01$ ).<sup>26</sup>

#### *Violent offending relative to illness onset*

Some of the studies on FPPP have dichotomized their sample into groups to understand offending before and after the onset of illness.<sup>39,44</sup> The findings indicated that FPPP who were arrested for violent crimes prior to psychiatric symptom onset (“early starters”) had higher rates of trauma, poor social support, substance use disorder ( $\chi^2 = 4.11, p < .05$ ), personality disorder (especially ASPD;  $\chi^2 = 5.83, p < .05$ ), and treatment nonadherence compared to FPPP who started offending after illness onset (“late starters”).<sup>39,44</sup> Similarly, early starters reported higher rates of

psychopathy ( $F_{(2, 164)} = 13.24, p < 0.01$ ) and previous criminal convictions ( $F_{(2, 219)} = 8.84, p < 0.01$ )<sup>44</sup> and were more likely to have nonillness related motives for offending ( $\chi^2 = 4.14, p < 0.05$ ), whereas late starters were often motivated to offend by psychotic symptoms.<sup>39</sup> A third group of FPPP who offended after 10 years of illness or past the age of 37.5 years (“late-late starters”) was more likely to offend against their spouse ( $\chi^2_{(2, N = 232)} = 9.00, p = 0.01$ ).<sup>44</sup> These differences were also reflected in their overall risk, with early starters carrying the highest level of risk and criminogenic need.<sup>39,44</sup>

#### *Violent offending relative to the illness course*

The course of illness was also used to understand violent offending along the trajectory of a psychotic illness. In this respect, patients were disaggregated based on whether their index offense occurred during the first episode of psychosis (“FEP offenders”) or later in the course of illness (“later offenders”).<sup>34,36</sup> Compared to later offenders, FEP offenders were more likely to commit severe index offences ( $p = 0.010$ ). Their actions were more likely to be motivated by delusions ( $p = 0.004$ ) and persecutory ideation ( $p = 0.015$ ) in the FEP group. Their index offences were also more often preceded by a stressful life event ( $\chi^2 = 4.805, p = 0.028$ ) and followed by a suicide attempt.<sup>34</sup> A study reported that FEP offenders were more often born overseas ( $\chi^2 = 20.4, p = 0.001$ ) in a non-English speaking country ( $\chi^2 = 39.7, p = 0.001$ ), report depressed mood at the time of the offense ( $\chi^2 = 8.76, p = 0.003$ ), and use a firearm to commit their offense ( $\chi^2 = 5.94, p = 0.014$ ).<sup>36</sup> By comparison, later offenders were more likely to have chronic psychopathology and worse overall outcomes ( $p = 0.032$ ).<sup>24</sup> Both studies found that later offenders were more likely to have prior convictions than FEP offenders ( $p < 0.05$ ).<sup>34,36</sup>

#### *Violent offending during admission*

One study identified three subgroups based on institutional violence over 18 months.<sup>17</sup> Patients who had moderate aggression at baseline and became more aggressive over time were more likely to exhibit active psychotic symptoms, emotional and behavioral dysregulation, family problems, low treatment adherence, and low insight than patients who exhibited low aggression or became less aggressive.<sup>17</sup>

#### *Violent offending after discharge*

Considering violent behavior among FPPP within 12 months after forensic discharge,<sup>38</sup> FPPP had high rates of victimization (29%) and hospital readmission (28%) but comparable rates of violence (23%) compared to patients discharged from general psychiatric services. They reported that historical risk factors (e.g., previous violence, young age at first violent incident, relationship history) were predictive of all three aforementioned outcomes with no additional contribution of dynamic risk factors.<sup>38</sup>

## Discussion

This review presents findings from a qualitative synthesis of findings in 29 eligible studies that examined violence among FPPP covering several international contexts, albeit with a particular slant toward countries where forensic psychiatric practice is well developed. While the study findings buttressed the need for novel approaches to the assessment and management of violence, some of the observations in the included studies are generally consistent with previous reviews from the general psychiatric populations, underscoring the significance of clinical and other criminogenic factors in relation to violence in FPPP.<sup>1,5</sup> Ultimately, we hope the



findings in this review will improve the current understanding and advance the assessment and management of violence in forensic psychiatric settings.

Findings from the included studies showed that FPPP who reported violence were more likely to have prior contact with psychiatric services, active psychotic symptoms, impulsivity, adverse childhood experiences, and poor social support.<sup>18,21,24,26,28,32,33,39,45</sup> Notably, violence in FPPP was related to experiencing active psychotic symptoms prior to and during their offense, with persecutory delusions and auditory hallucinations being the most common.<sup>32,34,39,45–47</sup> Also, comorbidities of both substance use disorders or personality disorders (most often ASPD) were related to violent behavior among FPPP, and both comorbidities were shown to exacerbate the risk of violence.<sup>18,22,23,32–34,36,38,39,43–45,47</sup> Taking together, the above findings highlight the importance of assessments coupled with early and effective management of mental health and addiction problems to mitigate the risk of violence and avert future violent offending.<sup>48,49</sup> This is particularly important because the literature suggests that FPPP with violent offences had frequent contact with psychiatric services prior to their index offense<sup>18,32,39</sup>; however, assessment of violence as well as treatment adherence can be variable and challenging.<sup>17,49</sup> Numerous strategies to improve adherence (e.g., psychoeducation, insight counseling, motivational interviewing, use of depot medications and integrated community care etc.) have been described as beneficial to support mitigation of violent offences.<sup>48–51</sup> Notably, long-acting injectable (LAIs) antipsychotics have been linked with good adherence and overall outcomes due to their practical and pharmacokinetic advantages.<sup>49</sup> Pertinent to this review, LAIs have been shown to reduce the frequency and severity of violence in patients with psychosis and prior violence.<sup>49</sup> However, none of the included studies in this review commented on the impacts of LAIs compared to oral medications on violence in this population, pointing to the need for further investigation on this topic. On a related note, indicated assessments, treatment, and care should be provided to individuals with persistent, severe, or resistant symptoms using evidence-guided interventions to mitigate violence.<sup>34</sup> For example, clozapine has been shown to have beneficial effects for preventing violence, especially in patients with treatment-resistant psychotic illness or significant comorbidity, and has been linked with an antiaggression effect that is independent of its antipsychotic effect.<sup>50</sup>

It is important to highlight that violent offences among FPPP varied significantly in their severity, motive, and victim.<sup>18,34,37</sup> In acute psychosis, FPPP are generally more likely to cause severe violence and target family members than other violent offenders.<sup>24,35,36,39,52</sup> Consequently, experts have suggested the role of multiple criminogenic factors beyond psychosis and other associated clinical factors. In support of this formulation is the finding that FPPP with previous violent convictions were associated with aggressive incidents even after the resolution of their psychosis.<sup>39,44</sup> In this regard, biological and cognitive findings have been proposed to explain additional risk for violence in FPPP. For instance, neuroimaging findings in FPPP with violent behavior included reduced temporal and frontal lobe volumes, particularly in the orbitofrontal and anterior cingulate cortex and these are consistent with those elucidated in ASPD.<sup>30,32,53,54</sup> Furthermore, lower grey matter volume in the insular cortex was associated with premeditated violence compared with impulsive violence in FPPP.<sup>32</sup> While FPPP could be motivated to commit violent offences for illness-related or

conventional reasons,<sup>39</sup> premeditated offences and conventional motives were characterized by high-trait psychopathy.<sup>39</sup> Similar to FPPP with ASPD, psychopathy was associated with additional criminogenic and clinical needs that can impede treatment<sup>21,25,27</sup> suggesting that these FPPP have heterogeneous pathways to violence.

Partly underlying the abovementioned findings on heterogeneous pathways to violence, FPPP also had a mixture of strengths and weaknesses across multiple cognitive domains compared to nonforensic patients with psychosis.<sup>18,21,29</sup> It was hypothesized that better cognitive performance may identify patients who are prone to callous and premeditated violent acts, whereas cognitive deficits may identify patients with impulsive outbursts when they are distressed.<sup>21</sup> In other studies, specific moral cognitions were shown to mediate the relationship between psychosis and violence, and the effect of cognition on violence was shown to be modified through engagement in psychosocial programming.<sup>37,41</sup> FPPP with violent behavior also varied widely in their access to employment, housing, and social support.<sup>18,29,45</sup> Childhood trauma, adult violent victimization, and low education were consistently associated with violent offending, and similar findings have been replicated in other reviews.<sup>18,26,27,29,33,35,36,45,54</sup> Addressing additional criminogenic needs, including social support, family, accommodation, education, employment, or vocational needs<sup>18,22,23,26,27,31,32,34,39,42,44,45</sup> and bolstering of protective factors, are gaining traction. Moreover, clinicians are encouraged to routinely conduct assessments and develop integrated treatment plans that are consistent with current evidence and best practices to address multiple contributors to violence.<sup>48–51</sup> Along this line, there is growing evidence for psychological interventions, especially cognitive-based approaches with short-term rewards, for rehabilitating offenders with antisocial behavior or substance misuse.<sup>55–57</sup>

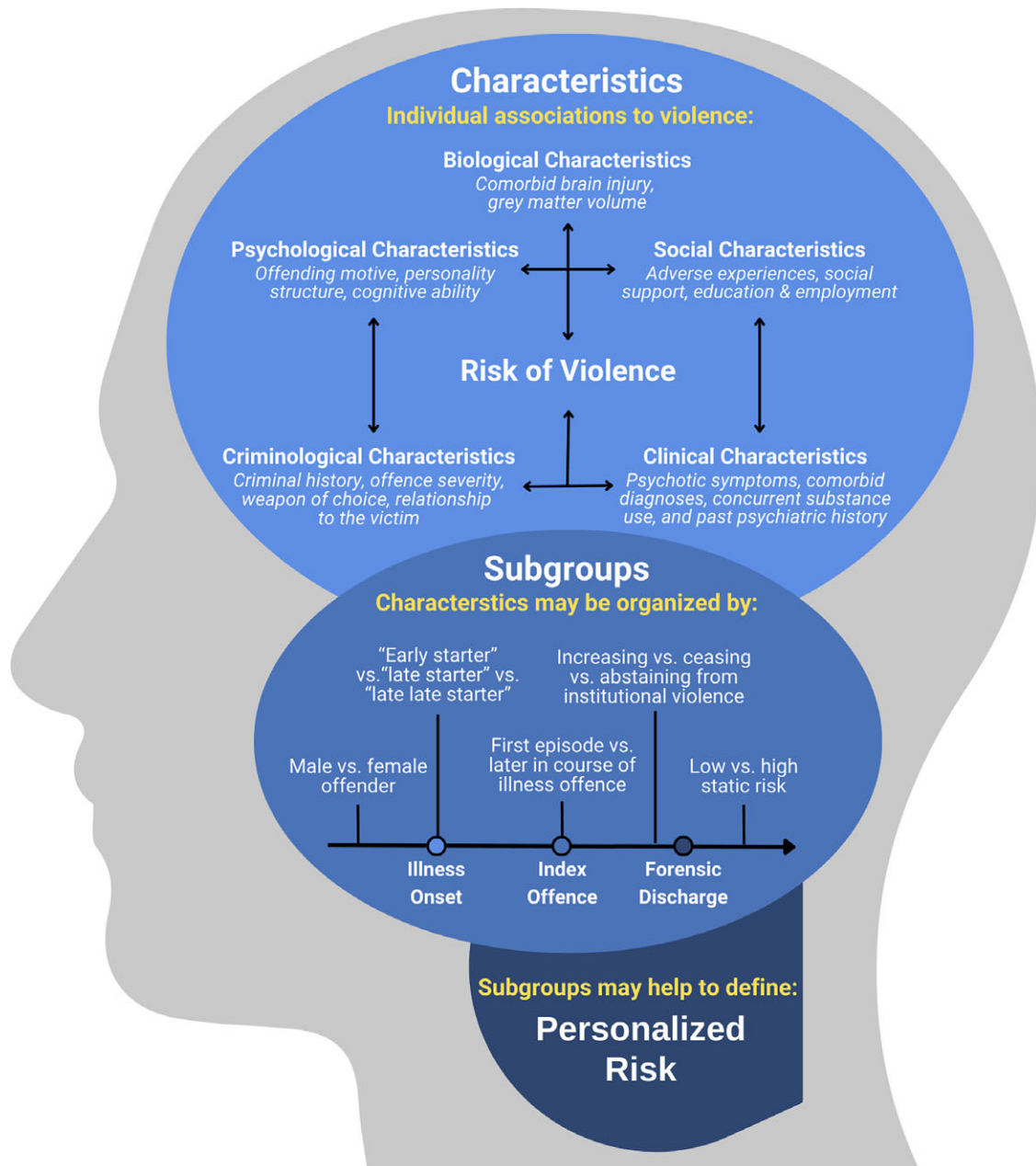
A major source of challenge in the assessment and management of violence in FPPP is the limitations associated with predicting the risk of violence reliably. Except for certain characteristics, this review found that FPPP with violent behavior was a heterogeneous group. This variability can make it difficult to assess risk, since the evidence that applies to some FPPP may be less relevant to others. For this reason, detailed history and mental status exams obtained from clinical assessments are essential for placing this evidence in context.<sup>13</sup> While clinical prediction tools help assist clinicians in gathering appropriate data, they may have certain limitations, including focusing a panel of few risk factors with known clinical relevance.<sup>14,15</sup> Predictive models relying on few individual factors do not cohere with the view that violence can result from the combinatorial effects of many variables.<sup>22,23,26,27,31,32,34,39,42,44,45</sup> Rather than solely identifying individual characteristics or panel of certain factors that are associated with violence, recent trends and efforts are focused toward describing subgroups of FPPP with underlying biopsychosocial similarities and risk profiles that make it easier to predict their risk for violence and personalize interventions. To accommodate for heterogeneity, prediction tools may benefit from specifying when and where to apply evidence. In particular, this review identified the strategy of stratifying FPPP into subgroups to be more accurate and clinically relevant to describing their risk. Specifically, subgroups at different times in their trajectory were identified.<sup>17,26,34,36,38,39,44</sup> Samples were stratified by their sex, the timing of their violent offending relative to illness onset, the timing of their index offense in their illness course, their trajectory of violent offending during

admission, and their trajectory of violent offending after discharge. The resulting subgroups were more homogenous in terms of their risk and behavior than the entire sample, which may make it easier to predict and prevent future violence in each group. Clinicians may also find it more intuitive to place patients in subgroups that correspond with their pre-existing schemas instead of measuring individual risk factors. These findings are considered in the context of the ability to integrate multiple risk factors into an algorithm that helps apply recent technology for data mining to recommend future directions in clinical and research practice.<sup>28,45</sup> Figure 2 includes a model of explanatory pathways for violence in FPPP based on a summary of the findings from the included reports in this review. Notably, a model summarizing risk factors for violence similar to what we did in the present study ought to be designed with some flexibility

and be ‘dynamic’ to allow the integration of emerging evidence on risk factors for violence in FPPP.

**Study limitations**

This systematic review must be considered in the context of some limitations. First, the quality of the included studies was variable. Most studies acknowledged significant limitations in their methodology, including retrospective study design, small sample size, and unaccounted confounding factors. Studies with retrospective designs have limitations with establishing causal relationships, and we were unable to differentiate whether the characteristics associated with violence in FPPP act as correlates, causes, or consequences of either psychosis or violence. Again, this review included only studies conducted in jurisdictions where patients are found “not criminally



**Figure 2.** A model on explanatory pathways for violence in FPPP.

responsible” or “permanently unfit to stand trial” to enter the forensic system. This definition was used to identify samples whose index offences were specifically attributed to mental illness. Second, while individual study findings were presented in quantitative terms as much as possible, we were unable to compare effect sizes or statistical significance across studies and conduct a meta-analysis due to the heterogeneity among research questions, study designs, and outcomes in the included studies. Third, our research question was intentionally broad to capture the full breadth of characteristics that have been investigated to underlie violence in FPPP. Fourth, we speculated that the variability in our findings was explained by true variation between FPPP and supported this hypothesis with studies that produced more consistent results by dividing their samples into subgroups. The population of FPPP may not be as heterogeneous as the present findings suggest, and its heterogeneity may not be resolved by stratifying the population into subgroups. Regardless, this review identified an emerging approach to risk stratification that warrants further investigation. Lastly, this review does not provide an exhaustive overview of FPPP subgroups identified in the literature. Guided by these results, future research is needed to ask more focused research questions that are suitable to meta-analyse and help identify subgroups with the greatest clinical significance to validate those discussed in this review.

## Conclusion

The present review represents an effort to consolidate several areas of research on the relationship between psychosis and violence in FPPP. Consistent with previous literature, violence was related to certain identifiable biopsychosocial factors, albeit some heterogeneous findings were also identified. Some areas of heterogeneity on the findings on violence among FPPP were addressed by stratifying samples using a combinatorial model based on sex, timing of violence relative to illness onset, timing of index offense in the illness course, violent offending during admission, and violent offending after discharge. The resulting subgroups may have more predictable patterns of risks and behaviors that are associated with violence in FPPP. There is a need for high-quality future studies to replicate the clinical utility of this approach and integrate emerging evidence. For example, prospective studies with robust methodology to assess the performance of a model that stratifies FPPP into subgroups to predict violent outcomes would be necessary. Ultimately, identifying high-risk subgroups may provide an avenue to improve risk assessment and personalize interventions aimed at mitigating violence. Furthermore, this review did not capture an exhaustive list of factors associated with violence. Future research efforts on this study theme would benefit from considering more factors linked to violence in psychosis (e.g., poor insight, psychiatric comorbidity, LAI versus oral medications and aspects of the clinical environment)<sup>1,5,6,49</sup> to support their clinical relevance in FPPP. Lastly, risk assessment, prediction, and management can also benefit from innovative application of recent advancements in data mining, machine learning, and artificial intelligence to test a combinatorial model for risk factors associated with violence in FPPP. Such innovative applications need to be operationalized and tested in future research to generate evidence for translation into practice.

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