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Sexually transmitted infections, sexual life and risk behaviours of people living with schizophrenia: systematic review and meta-analysis

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Background

Sexually transmitted infections (STIs), along with sexual health and behaviour, have received little attention in schizophrenia patients.

Aims

To systematically review and meta-analytically characterise the prevalence of STIs and sexual risk behaviours among schizophrenia patients.

Method

Web of Science, PubMed, BIOSIS, KCI-Korean Journal Database, MEDLINE, Russian Science Citation Index, SciELO and Cochrane Central Register were systematically searched from inception to 6 July 2023. Studies reporting on the prevalence or odds ratio of any STI or any outcome related to sexual risk behaviours among schizophrenia samples were included. PRISMA/MOOSE-compliant (CRD42023443602) random-effects meta-analyses were used for the selected outcomes. Q-statistics, I^2 index, sensitivity analyses and meta-regressions were used. Study quality and publication bias were assessed.

Results

Forty-eight studies ($N = 2\,459\,456$) reporting on STI prevalence (including 15 allowing for calculation of an odds ratio) and 33 studies ($N = 4255$) reporting on sexual risk behaviours were included. Schizophrenia samples showed a high prevalence of STIs and higher risks of HIV (odds ratio = 2.11; 95% CI 1.23–3.63), hepatitis C virus (HCV, odds ratio = 4.54; 95% CI 2.15–961) and hepatitis B virus (HBV; odds ratio = 2.42; 95% CI 1.95–3.01) infections than healthy controls. HIV prevalence was higher in Africa compared with other continents and in in-patient (rather than out-patient) settings. Finally, 37.7% (95% CI 31.5–44.4%) of patients were sexually active; 35.0% (95% CI 6.6–59.3%) reported consistent condom use, and 55.3% (95% CI 25.0–82.4%) maintained unprotected sexual relationships.

Conclusions

Schizophrenia patients have high prevalence of STIs, with several-fold increased risks of HIV, HBV and HCV infection compared with the general population. Sexual health must be considered as an integral component of care.

Keywords

Psychotic disorders/schizophrenia; STI; sexual life; contraception; HIV.

The World Health Organization defines sexual health as 'a state of physical, emotional, mental, and social well-being in sexuality'.[1] Sexuality is a natural aspect of human behaviour and a significant factor in quality of life and maintaining healthy relationships.[2] However, for individuals living with schizophrenia, sexual health has received little attention or recognition as a fundamental aspect of their subjective quality of life and associated care.[3] Data suggest that people with schizophrenia have both quantitative and qualitative differences in their sexual lives compared with the general population,[4] identifying this area of health as one with unmet needs,[5] although sexual interest and activity do not disappear after diagnosis.[6,7]

Indeed, individuals with schizophrenia are at a higher risk of engaging in risky sexual behaviors,[7] with potentially harmful physical and mental health consequences such as unwanted pregnancies,[8] exposure to interpersonal violence in relationships[9] and increased prevalence of sexually transmitted infections (STIs).[10] The relationship between STIs and schizophrenia is complex and multifactorial, with an increase of risk of STIs due to psychiatric symptoms (e.g. disorganised behaviour leading to hypersexuality[11] or negative symptoms leading to a lack of skills to assertively negotiate safer relationships[12]). Severe stigmatisation, particularly in romantic relationships,[13] and high rates of comorbidity with other mental disorders and substance use,[14,15] among many other factors, also contribute to this problem. On the other hand, early exposure to certain microorganisms such as hepatitis C virus (HCV)[16] or chlamydia[17] is associated with a higher risk of developing schizophrenia.[18,19] Comorbidity between schizophrenia and viral diseases leads to a poorer prognosis for both conditions.[20]

Despite all the above findings, the sexual lives and risky behaviours of individuals living with severe mental health disorders in general, and schizophrenia in particular, continue to be neglected both in clinical practice and research. There is a significant knowledge gap in the available literature, in contrast to other important aspects of quality of life.[4]

Considering these complexities, this systematic review and meta-analysis aimed to fill this gap and examine the prevalence of STIs in this population, their increased risk compared with the general population, and the demographic, clinical and methodological factors influencing this risk. Second, we aimed to characterise the sexual risk behaviours associated with schizophrenia.

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Method

This study protocol was registered on PROSPERO (registration number: CRD42023443602). The study was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)[21] (Supplementary Table 1 available at https://doi.org/10.1192/bjo.2024.49) and MOOSE (Meta-Analyses of Observational Studies in Epidemiology[22] (Supplementary Table 2) checklists, following the EQUATOR reporting guidelines.[23]

Search strategy and selection criteria

A systematic literature search was carried out dually and independently by two investigators (C.A. and B.P.). The search encompassed the Web of Science database (Clarivate Analytics), including the Web of Science Core Collection, PubMed, the BIOSIS Citation Index, the KCI-Korean Journal Database, MEDLINE, the Russian Science Citation Index, and the SciELO Citation Index, as well as the Cochrane Central Register of Reviews and Ovid/PsycINFO databases, from inception until 6 July 2023. Two separated searches were conducted: one to identify articles containing information on the prevalence and relative risk of sexually transmitted diseases among people with a diagnosis of schizophrenia spectrum disorder, and the other to identify articles reporting on outcomes related to sexual behaviour among the same population. The complete search terms are available in Supplementary Table 3.

Articles identified underwent an initial screening of their abstracts by the two reviewers. Subsequently, after exclusion of those that did not meet the inclusion criteria, the full texts of the remaining articles were dually assessed for eligibility and inclusion. Inclusion criteria for the systematic review and meta-analysis were: (a) individual studies with original data; (b) reporting on patients meeting criteria for any schizophrenia spectrum disorder (including schizophrenia, schizophreniphorm disorder, schizoaffective disorder, delusional disorder, and brief psychotic disorder, according to DSM-5-TR[24] or ICD-11[25] criteria); (c) reporting either quantitative data on the prevalence of an STI (including HIV, human papillomavirus, hepatitis B virus (HBV), HCV, *Treponema pallidum*, *Neisseria gonorrhoeae*, *Mycoplasma genitalium* and *Chlamydia trachomatis*) using a serological, microbiological or clinical diagnosis provided by a healthcare specialist, or either any outcome related to sexual behaviour (a complete list of the sought-out, standardised outcomes is available in Supplementary Table 4); (d) non-overlapping samples (overlap was ascertained by examining the inclusion dates, the demographics of the population and the country where the study was conducted; the study with the largest sample was selected); and (e) written in the English language. Exclusion criteria were (a) reviews, clinical cases, study protocols or qualitative studies, conferential proceedings, letters and commentaries; (b) reporting on patients with an affective psychotic disorder according to DSM/ICD criteria;[24,25] (c) reporting on a subsample of schizophrenia patients specifically selected for their characteristics or risk of an STI; and (d) written in languages other than English.

Data extraction

Three reviewers (B.P., L.M. and J.G.) independently conducted data extraction from all the studies included, starting on 20 July 2023. Subsequently, the three databases were cross-checked, and any inconsistencies were resolved through consensus under the supervision of a senior researcher (A.C.).

For the included articles, a summary of the selected variables included: first author and year of publication, country and city, sample size, age in years (mean ± s.d.), sex (percentage female), STI diagnostic method, relationship status (percentage in stable relationship), substance use disorder according to any DSM or ICD criteria (excluding nicotine) (%), quality assessment (see below) and key findings. When stratified data were available, data were extracted separately for male and female populations.

Risk of bias (quality) assessment

Risk of bias was independently assessed by B.P. and C.A. using a modified version of the Newcastle–Ottawa Scale (NOS) for assessing the quality of non-randomised studies. This choice was made taking into account the heterogeneity expected in the included studies[26] (Supplementary Table 5). Any discrepancy between the two assessments was resolved through consensus.

Strategy for data synthesis

First, we provided a systematic synthesis of the findings from the included studies structured around two main topics: the prevalence and relative risk of the examined STIs, and the included sex behaviour outcomes (Table 1 and Supplementary Table 6, respectively).

Second, where data allowed, we performed meta-analyses using as primary effect size the prevalence (percentage and standard error, when available) of the STIs. Each STI was separately analysed. Then, for those articles where the prevalence of STIs in a comparison group of healthy controls (defined as people without any mental health disorder) was also available, the odds ratio with a 95% confidence interval was calculated using the number of individuals with any particular STI and samples sizes for each sample, without adjusting by any variable, and then separately meta-analysed for each STI. An odds ratio greater than 1 indicated that the schizophrenia group had a higher risk of presenting with any particular STI than the healthy control group. Separate proportion meta-analyses were also conducted to study the pooled prevalence of each sexual behaviour or risk behaviour when three or more samples were available.

The heterogeneity between studies was measured using the Q-statistic, and percentages of overall variability in the estimates of ORs were determined using the I^2 index, classifying the heterogeneity into low ($I^2 = 25\%$), medium ($I^2 = 50\%$) and high ($I^2 = 75\%$).[27]

Meta-regressions were performed to study the effects of (a) age, (b) publication year, (c) percentage of females, (d) percentage of patients with substance use disorder, (e) percentage of patients in a stable relationship, and (f) risk of bias (NOS score) on outcomes where seven or more articles provided the data. Sensitivity analyses were performed to determine differences depending on (a) sample continent, (b) sample type (first-episode psychosis, defined as patients presenting with psychosis for fewer than 5 years from the initial onset,[24] versus chronic schizophrenia), and (c) setting (in-patient versus out-patient) with respect to the study outcomes when more than ten articles were available. A random-effects model was used, owing to the expected high heterogeneity. Publication bias was assessed by visual inspection of the funnel plots; when more than ten articles were available, Egger's test was also performed.

All analyses were conducted within R 4.2.2[28] using the metafor package.[29] The significance level was set at $P < 0.05$, two-sided.

Results

Sexually transmitted diseases

The literature search of electronic databases yielded 1734 citations, which were screened for eligibility; 95 articles underwent full-text assessment, and 47 were excluded. The final sample for the

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Table 1 Characteristics of the studies included in the sexually transmitted infections systematic review

Study	Country	STI	*N*, schizophrenia patients (STI)	*N*, healthy controls (STI)	Age in years, mean (s.d.)	Percentage women	Setting	Percentage with SUD	Percentage in stable relationship	NOS
Opondo et al, 2017	Botswana	HIV	545 (152)	–	30.3 (3.8)	22%	In-patient	n.a.	5%	7
Said et al, 2001	Jordan	HBV	192 (14)	192 (5)	39.9 (n.a.)	45%	In-patient	n.a.	n.a.	6
Doufik et al, 2022	Morocco	HIV	444 (0)	–	33.5 (9.2)	10%	Other	n.a.	24%	5
		HBV	444 (7)	–						
		HCV	444 (4)	–						
		T. pallidum	444 (16)	–						
Mona et al, 2022	South Africa	HIV	370 (45)	–	n.a.	30%	In-patient	n.a.	6%	7
Mwelase et al, 2023	South Africa	HIV	294 (62)	–	n.a.	31%	In-patient	53%	58%	8
Lundberg et al, 2013	Uganda	HIV	224 (26)	15 108 (1330)	n.a.	51%	Other	n.a.	14%	8
Maling et al, 2011	Uganda	HIV	87 (13)	–	n.a.	n.a.	In-patient	n.a.	n.a.	8
Mbewe et al, 2006	Zambia	HIV	160 (5)	–	37.5 (21.4)	28%	In-patient	56%	n.a.	6
Wang et al, 2016	China	HBV	415 (28)	3038 (101)	18.5 (1.6)	48%	Other	n.a.	n.a.	6
Zhan et al, 2018	China	*T. pallidum*	1586 (53)	–	n.a.	n.a.	Other	n.a.	n.a.	8
Zhu et al, 2015	China	HBV	1649 (181)	–	34.0 (n.a.)	54%	Other	n.a.	n.a.	7
Chaudury et al, 1994	India	HBV	100 (11)	100 (2)	54.6 (8.4)	0%	In-patient	n.a.	n.a.	4
Imani et al, 2022	Iran	HBV	92 (1)	–	n.a.	n.a.	Other	n.a.	n.a.	7
Nakamura et al, 2004	Japan	HCV	455 (28)	197 827 (2374)	n.a.	n.a.	In-patient	n.a.	n.a.	8
Chang et al, 2021	Taiwan	HBV	15 914 (465)	–	40.1 (9.7)	n.a.	Other	n.a.	n.a.	9
		HCV	15 914 (181)	–						
Chiu et al, 2017	Taiwan	HCV	6097 (127)	6097 (85)	43.3 (13.7)	48%	Other	2%	n.a.	7
Hung et al, 2012	Taiwan	HBV	511 (53)	–	42.5 (10.7)	42%	In-patient	n.a.	n.a.	8
		HCV	577 (11)	–						
Hariri et al, 2011	Turkey	HIV	88 (0)	–	34.9 (8.8)	64%	Out-patient	n.a.	n.a.	8
		HBV	88 (0)	–						
		HCV	88 (0)	–						
De Hert et al, 2009	Belgium	HIV	595 (3)	–	36.7 (11.2)	35%	Other	n.a.	13%	7
		HCV	595 (4)	–						
Fellerhoff et al, 2011	Germany	*C. trachomatis*	72 (2)	–	n.a.	n.a.	Other	n.a.	n.a.	7
Krause et al, 2010	Germany	*C. trachomatis*	31 (8)	–	n.a.	n.a.	Other	n.a.	n.a.	7
Grassi et al, 1999	Italy	HIV	33 (1)	–	35.3 (8.1)	35%	Other	43%	15%	6
Cuadrado et al, 2020	Spain	HCV	425 (8)	–	36.5 (n.a.)	47%	Other	n.a.	n.a.	7
González-Torres et al, 2015	Spain	HIV	235 (5)	–	n.a.	n.a.	In-patient	n.a.	n.a.	7
Bauer-Staeb, 2017	Sweden	HIV	21 232 (44)	6 815 931 (5909)	46.0 (8.1)	50%	Other	4%	n.a.	8
		HBV	21 232 (112)	6 815 931 (112)						
		HCV	21 232 (1194)	6 815 931 (41 600)						
Jallow et al, 2016	Sweden	HIV	10 347 (65)	–	n.a.	46%	Out-patient	n.a.	n.a.	8
Karabulut et al, 2016	Turkey	HIV	489 (0)	–	42.5 (11.3)	16%	Other	n.a.	n.a.	7
		HBV	489 (32)	–						
		HCV	489 (1)	–						
Heslin et al, 2022	United Kingdom	HIV	8562 (174)	–	n.a.	n.a.	Out-patient	n.a.	n.a.	9
Closson et al, 2019	Canada	HIV	6454 (835)	507 670 (12 499)	n.a.	41%	Other	49%	n.a.	8
Sockalingam et al, 2010	Canada	HCV	110 (3)	–	44.7 (10.8)	32%	Other	7%	n.a.	7
Rodgers-Johnson et al, 1996	Jamaica	HIV	201 (5)	–	n.a.	38%	In-patient	n.a.	17%	7
Alvarado-Esquivel et al, 2005	Mexico	HBV	33 (4)	–	n.a.	n.a.	In-patient	n.a.	n.a.	7
Baillargeon et al, 2008	USA	HIV	4736 (173)	–	n.a.	n.a.	Other	n.a.	n.a.	5
Blank et al, 2002	USA	HIV	8208 (98)	374 253 (2062)	40.3 (17.6)	47%	Other	n.a.	n.a.	6
Carney et al, 2006	USA	HCV	1074 (7)	726 262 (492)	40.2 (11.9)	53%	Other	9%	n.a.	7
Dinwiddie et al, 2003	USA	HCV	153 (14)	–	n.a.	n.a.	In-patient	n.a.	n.a.	7

(*Continued*)

Table 1 (*Continued*)

Study	Country	STI	*N*, schizophrenia patients (STI)	*N*, healthy controls (STI)	Age in years, mean (s.d.)	Percentage women	Setting	Percentage with SUD	Percentage in stable relationship	NOS
Doyle et al, 1997	USA	HIV	138 (0)	–	32.0 (13.7)	n.a.	In-patient	27%	n.a.	5
Freudenreich et al, 2007	USA	HCV	98 (8)	–	44.7 (n.a.)	25%	Out-patient	n.a.	n.a.	6
Fuller et al, 2011	USA	HCV	6521 (1076)	6521 (124)	57.2 (n.a.)	6%	Other	65%	n.a.	8
Hart et al, 1999	USA	HIV	38 (2)	16 (0)	n.a.	n.a.	Other	n.a.	n.a.	4
Himelhoch et al, 2007	USA	HIV	89 189 (858)	67 965 (346)	55.5 (11.9)	5%	Other	25%	25%	7
		HCV	89 189 (6287)	67 965 (1708)						
Huckans et al, 2006	USA	HCV	2207 (219)	73 687 (3888)	n.a.	n.a.	Other	n.a.	n.a.	6
Prince et al, 2012	USA	HIV	221 017 (1413)	4 089 407 (24 607)	n.a.	n.a.	Other	n.a.	n.a.	8
Rosengerg et al, 2005	USA	HIV	495 (18)	–	n.a.	32%	Other	29%	n.a.	7
		HCV	495 (96)	–						
Walkup et al, 2010	USA	HIV	2 047 199 (37 054)	–	n.a.	n.a.	Other	n.a.	n.a.	6
Brown et al, 2021	Australia	HIV	69 (1)	–	19.6 (10.8)	42%	Other	n.a.	10%	9
		C. trachomatis	69 (5)	–						
Williams et al, 2020	Australia	HIV	97 (0)	–	46.0 (n.a.)	40%	Out-patient	n.a.	n.a.	6
		HBV	97 (0)	–						
		HCV	97 (7)	–						
Santos da Silva et al, 2019	Brazil	HIV	66 (0)	–	n.a.	n.a.	Out-patient	n.a.	n.a.	8
		HBV	66 (1)	–						
		HCV	66 (0)	–						
		T. pallidum	66 (0)	–						

STI, sexually transmitted disease; SUD, substance use disorder; NOS, Newcastle–Ottawa Scale; HBV, hepatitis B virus; HCV, hepatitis C virus.

systematic review and STI meta-analyses included 48 studies (Supplementary Fig. 1(a)).

Twenty-eight studies (58.3%) included data on HIV,[30,57] 20 (41.7%) on HCV,[36,40,45,48,50,51,54,55,57,67] 14 (29.2%) on HBV,[36,48,50,51,54,57,60,64,68,72] three (8.3%) on *C. trachomatis*[17,49,73] and three (6.3%) on *T. pallidum*.[36,48,74] No studies fulfilling our inclusion criteria were found regarding other STIs included in our search. The full sample included 2 459 456 patients with schizophrenia. The mean age of the sample was 50.3 years, ranging from 16 to 73 years (s.d. = 11.9); 21.1% were female, 24.8% were in a stable relationship, and 23.7% presented with a comorbid substance use disorder other than nicotine-related. Among the studies reporting the prevalence of a comorbid substance use disorder, two reported on alcohol and cannabinoids,[30,32] four reported on the use of injectable drugs,[41,51,53,58] four reported on both of these categories,[40,45,49,63] and six did not specify the substance or substances used.[39,43,54,59,62,66] Studies included samples from 24 countries in six continents: 17 (35.4%) from North America, ten (20.8%) from Europe, ten (20.8%) from Asia, eight (16.7%) from Africa, two (4.2%) from Oceania and one (2.1%) from South America. The mean NOS score for the included studies was 6.9 ± 1.2 (Table 2A and Supplementary Table 6).

Fifteen of the included studies provided data for a healthy control comparison group, thereby enabling the calculation of an odds ratio. Of these studies, seven included data on HIV,[33,38,39,41,44,45,54] seven on HCV[45,54,61,63,66,67] and four on HBV[54,69,72,75] (Table 2B).

HIV

The prevalence of HIV among people with schizophrenia was reported in 28 studies, comprising a total sample of 2 421 702 patients. All HIV diagnosis were serological. The pooled prevalence of HIV was 1.67% (95% CI 0.82–3.37%) (Fig. 1). Meta-regressions found a statistically significant higher prevalence of HIV among samples with higher prevalence of substance use disorder (β = 8.079; 95% CI 0.003–4.020) but no statistically significant effect of age, sex, relationship status, risk of bias or publication year (Supplementary Table 7). Prevalence of HIV was significantly higher in samples from Africa (7.32%; 95% CI 1.51–28.94%) and in in-patient settings (5.94%; 95% CI 1.78–18.04%) when compared with other continents or with out-patient settings (Supplementary Table 9). No publication bias was identified by visual inspection of the funnel plot (Supplementary Fig. 3(a)) or by Egger's test ($P = 0.48$).

Seven of these studies also included the prevalence of HIV in a healthy control comparison sample (total sample: 346 362 patients with schizophrenia and 11 870 350 healthy controls), allowing for an odds ratio calculation. The odds ratio for HIV infection was 2.11 (95% CI 1.23–3.63, $P < 0.01$), implying a statistically significant higher risk of HIV infection in the schizophrenia sample (Fig. 2). Meta-regressions revealed no statistically significant effect of risk of bias or publication year. The funnel plot did not suggest the presence of publication bias (Supplementary Fig. 3(b)).

Hepatitis C virus

The prevalence of HCV among the schizophrenia sample was reported in 20 studies (total sample: 146 326 patients). All diagnosis were serological. The pooled prevalence of HCV was 2.82% (95% CI 1.51–5.20%) (Supplementary Fig. 2(a)). Meta-regressions found a statistically significant higher prevalence of HCV prevalence in older samples (β = 0.143; 95% CI 0.090–0.196) and samples with higher prevalence of substance use disorder (β = 4.201; 95% CI 0.692–7.710) and in older articles (publication year β = −0.097; 95% CI −0.187 to −0.007) (Supplementary Table 8). No effect of

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Table 2A Prevalence of sexually transmitted infections

STI	Number of studies	Sample size	Prevalence	95% CI	Heterogeneity I^2 (%)	Heterogeneity *P*
HIV	28	2 421 702	0.0167	0.0082–0.0337	99.6	<0.01
HCV	20	146 326	0.0282	0.0151–0.0520	99.0	<0.01
HBV	14	41 322	0.0326	0.0157–0.0664	98.4	<0.01
C. trachomatis	3	172	0.0850	0.0069–0.5540	82.4	<0.01
T. pallidum	3	2096	0.0329	0.0197–0.0545	0.00	0.96

STI, sexually transmitted infection; HCV, hepatitis C virus; HBV, hepatitis B virus.

Table 2B Odds ratio for the risk of each sexually transmitted infection among schizophrenia samples compared with healthy control samples

STI	Number of studies	Schizophrenia patient sample	Healthy control sample	Odds ratio	95% CI	*P*-value	Heterogeneity I^2 (%)	Heterogeneity *P*
HIV	7	346 362	11 870 350	2.11	1.23–3.63	0.01	99.5	0.00
HCV	20	126 775	7 894 290	4.54	2.15–9.61	0.00	99.5	0.00
HBV	4	21 939	6 819 261	2.42	1.95–3.01	0.00	0.00	0.59

STI, sexually transmitted infection; HCV, hepatitis C virus; HBV, hepatitis B virus.

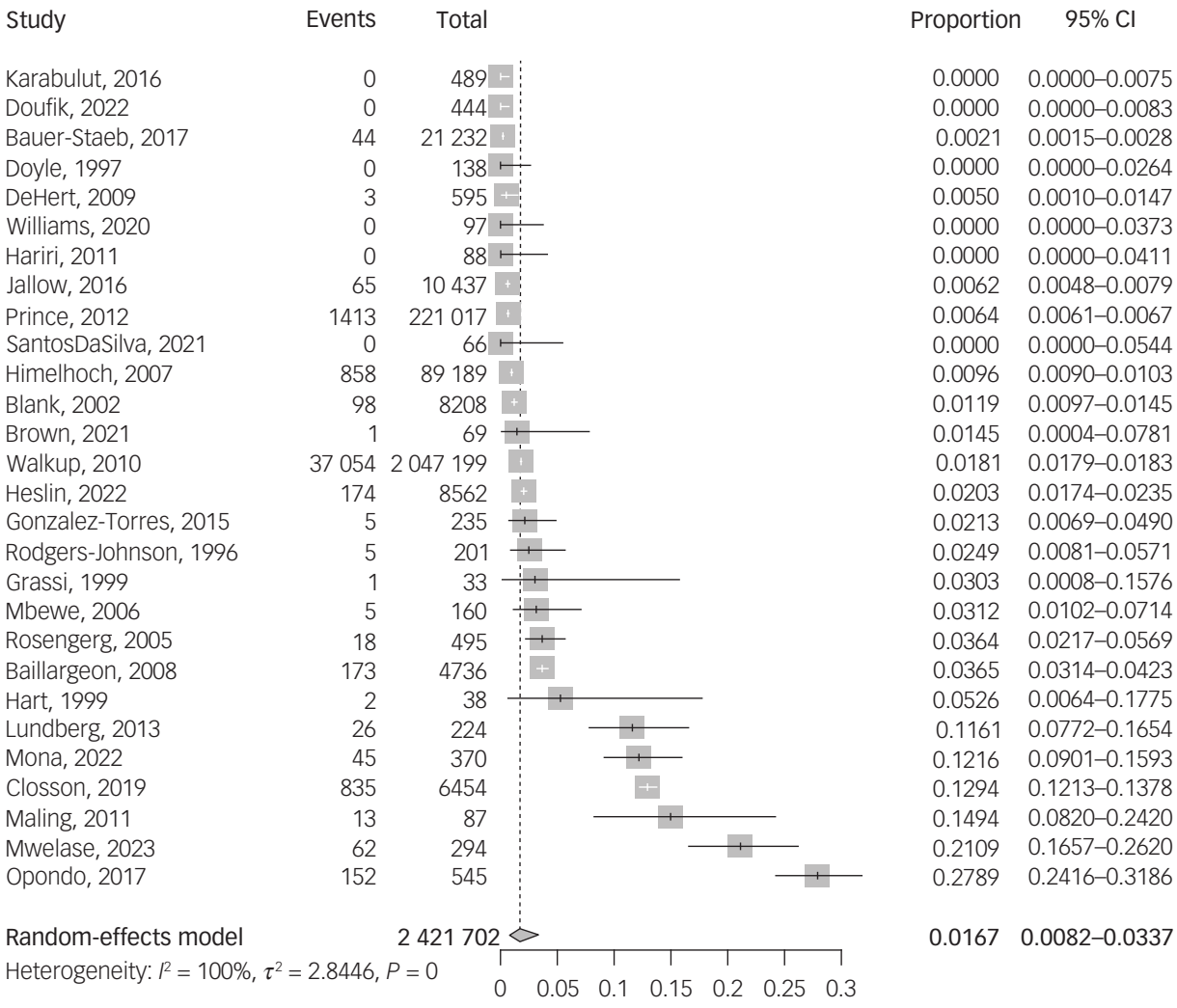

Fig. 1 Forest plot of HIV prevalence.

setting was detected in the sensitivity analyses (Supplementary Table 10), and no publication bias was identified (Supplementary Fig. 3(c)).

Seven of these studies also included the prevalence of HCV for a healthy control comparison group (total sample: 126 775 patients with schizophrenia and 7 894 290 healthy controls), allowing for

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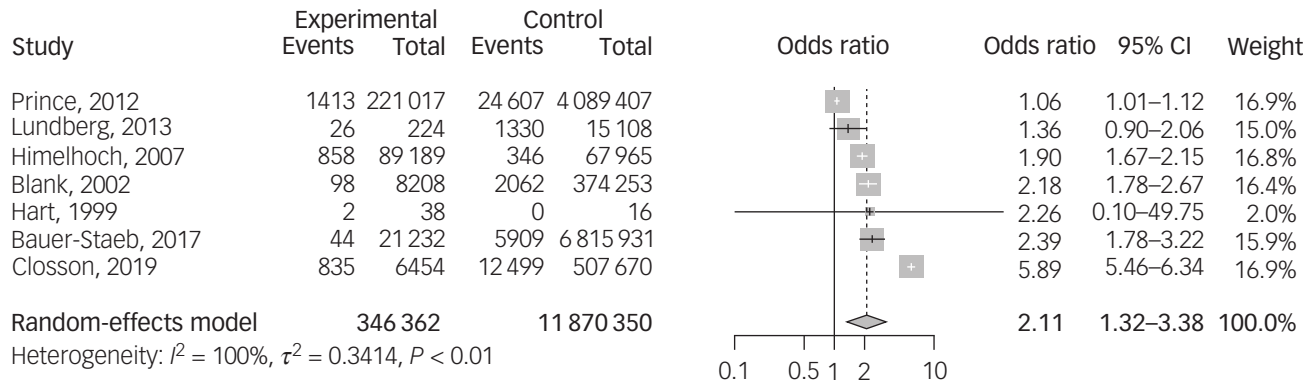

Fig. 2 Forest plot of HIV infection odds ratios. An odds ratio greater than 1 implies that the schizophrenia population has greater risk of the infection.

an odds ratio calculation. The odds ratio for HCV infection was 4.54 (95% CI 2.15–9.61, $P < 0.01$), implying a statistically significant higher risk of HCV infection in the schizophrenia sample (Supplementary Fig. 2(b)). Meta-regressions revealed no statistically significant effect of risk of bias or publication year, and the funnel plot did not suggest the presence of publication bias (Supplementary Fig. 3(d)).

Hepatitis B virus

The prevalence of HBV among people with schizophrenia was reported in 14 studies, comprising a total sample of 41 322 patients. All diagnosis were serological. The pooled prevalence of HBV was 3.26% (95% CI 1.57–6.64%) (forest plot available in Supplementary Fig. 2(c)). Meta-regressions found a statistically significant higher prevalence of HBV prevalence in older articles (publication year β = −0.082; 95% CI −0.157 to −0.007) (Supplementary Table 8), and sensitivity analyses found a greater prevalence of HBV among in-patient samples (9.81%; 95% CI 6.99–13.60%) compared with out-patient or mixed samples (Supplementary Table 10). No publication bias was identified (Supplementary Fig. 3(e)).

Four of these studies also included the prevalence of HBV for a healthy control comparison sample (total sample: 21 939 patients with schizophrenia and 6 819 261 healthy controls), allowing for an odds ratio calculation. The odds ratio for HBV infection was 2.42 (95% CI 1.95–3.01, $P < 0.01$), implying a statistically significant higher risk of HBV infection in the schizophrenia sample (Supplementary Fig. 2(d)). The funnel plot did not suggest the presence of publication bias (Supplementary Fig. 3(f)). Not enough data were available to perform any meta-regression or sensitivity analysis.

C. trachomatis

The prevalence of *C. trachomatis* in the schizophrenia sample was reported in three studies (total sample: 172 patients). One article provided clinical diagnosis by the patients' general practitioners,[49] another reported serological diagnosis[73] and the third used molecular diagnosis through DNA polymerase chain reaction.[17] The pooled prevalence of chlamydia was 8.50% (95% CI 0.69–55.40%) (Supplementary Fig. 2(e)). Not enough data were available to perform any meta-regression or sensitivity analysis, or to calculate an odds ratio for *C. trachomatis* comparing a schizophrenia sample with a healthy control comparison sample.

T. pallidum

The prevalence of *T. pallidum* in the schizophrenia sample was reported in three studies (total sample: 2096 patients). All diagnoses were serological. The pooled prevalence of *T. pallidum* was 3.29% (95% CI 1.97–5.45%) (Supplementary Fig. 2(f)). Not enough data were available to perform any meta-regression or sensitivity analysis, or to calculate an OR for *T. pallidum* comparing a schizophrenia sample with a healthy control comparison sample.

Sexual behaviour

The literature search of electronic databases yielded 789 citations, which were screened for eligibility; full texts of 344 articles were assessed, and 311 articles were excluded. The final sample for the systematic review and meta-analyses included 33 studies (Supplementary Fig. 1(b)).

The full sample comprised 4255 patients with schizophrenia. The mean age of the sample was 38.0 years, ranging from 16 to 65 years (s.d. = 8.02); 51.2% were female, 33.72% declared themselves to be in a stable relationship, and the mean duration of illness was 11.9 years (s.d. = 7.4). Studies included samples from 14 countries in five continents. The mean age at first sexual relationship was 18.15 years. The mean NOS score of the included studies was 6.7 ± 1.2 (Table 2).

A detailed description of the meta-analytical results can be found in Table 2; 37.77% (95% CI 18.93–61.22%) considered themselves to be in a stable relationship.[49,50,53,76,91] 59.66% (95% CI 43.57–73.91%) reported being interested in sexual relationships with others[4,76,77] and 53.71% (42.85–64.22%) were satisfied with their sex life.[77,85,92] Whereas 74.10% (95% CI 53.20–87.89%) had had sexual relationships with another person at least once in their lifetime,[37,49,53,77,79,81,93] only 37.72% (95% CI 31.52–44.35%) were sexually active (defined in most cases as sexual intercourse at least once over the previous 12 months).[50,53,77,79,84,85,92,94,98] Among those who were sexually active, 35.37% (95% CI 15.56–61.92%) reported having multiple partners,[50,53,83,84,87,96] 30.95% (95% CI 11.88–59.84%) had paid for sexual relationships,[50,53,92] and 13.38% (95% CI 5.02–31.09%) reported having had relationships in exchange for goods or money.[50,83,87] Only 34.98% (95% CI 16.58–59.29%) reported consistent use of a condom in their relationships,[37,49,53,80,83,96] whereas 55.28% (95% CI 24.59–82.41%) reported having unprotected sexual relationships,[49,50,80,87,98,99] and 28.72% (95% CI 8.38–63.99%) of patients had experienced an unplanned pregnancy on the part of themselves or their partners[49,50,92,100,101] (Table 3A and Supplementary Fig. 2(g,i)). Meta-regressions and sensitivity analyses revealed no statistically significant differences regarding age, sex, risk of bias, publication year, continent or setting for any of the studied outcomes (Supplementary Tables 8 and 10, respectively). The funnel plots did not suggest the presence of publication bias for any of the outcomes (Supplementary Fig. 3).

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Table 3A Prevalence of each of the studied sexual and risk behaviours

	Number of studies	Sample size	Prevalence	95% CI	Heterogeneity I^2 (%)	Heterogeneity *P*
Stable relationship (%)	20	2127	0.3777	0.1893–0.6122	93.4	<0.01
Lifetime sexual relationship (%)	7	881	0.7410	0.5320–0.8780	91.9	<0.01
Satisfaction with sex life (%)	3	391	0.5371	0.4285–0.6422	49.7	<0.01
Interest in sexual relationship (%)	3	576	0.5966	0.4357–0.7391	70.8	0.03
Sexually active (%)	16	2292	0.3772	0.3152–0.4435	85.9	<0.01
Among sexually active people with schizophrenia						
Prostitution use (%)	3	223	0.3095	0.1188–0.5984	80.8	0.01
Prostitution work (%)	3	612	0.1338	0.0502–0.3109	77.3	0.01
Consistent use of condom (%)	6	577	0.3498	0.1658–0.5929	93.5	<0.01
Hormonal contraception (%)	3	154	0.1297	0.0017–0.9300	94.5	<0.01
Unprotected sexual relationship (%)	6	937	0.5528	0.2459–0.8241	97.9	<0.01
Unplanned pregnancy (%)	5	286	0.2872	0.0838–0.6399	92.0	<0.01
Multiple partners (%)	6	861	0.3537	0.1556–0.6192	97.0	<0.01

Table 3B Odds ratio for the risk of being in a stable relationship and being sexually active among schizophrenia samples compared with healthy controls

	Number of studies	Schizophrenia patient sample	Healthy control sample	Odds ratio	95% CI	*P*-value	Heterogeneity I^2 (%)	Heterogeneity *P*
Stable relationship (%)	6	489	518	0.18	0.07–0.45	0.00*	86.5	0.00
Sexually active (%)	4	285	317	0.19	0.13–0.29	0.00*	27.2	0.00

When compared with healthy controls, patients with schizophrenia were significantly less likely to be in a stable relationship ($k = 6$, odds ratio = 0.18, 95% CI 0.07–0.45, $P < 0.01$)[49,50,78,79,84,89] or to be sexually active ($k = 4$, odds ratio 0.19, 95% CI 0.13–0.29, $P < 0.01$)[50,79,84,92] (Tables 2B and 3B, and Supplementary Fig. 2(h, j)).

Discussion

To the best of our knowledge, this is the first systematic review and meta-analysis to comprehensively assess the prevalence and odds ratios of STIs among people living with schizophrenia, along with their sexual risk behaviours.

Several important findings have been made. First, a high prevalence of STIs was noted. The pooled HIV prevalence was 1.67% (with an odds ratio of 2.11 compared with the general population), whereas for HCV and HBV, positivity prevalence reached 2.82 and 3.26%, with ORs of 4.54 and 2.42, respectively. A high prevalence was also been found for less-studied STIs such as *T. pallidum* (3.3%) and *C. trachomatis* (8.5%). It is important to highlight that the included studies were cross-sectional, so it can be anticipated that the proportion of individuals with schizophrenia who develop an STI over the course of their lifetime will be substantially higher than reported here. This is in line with previous findings in literature, from systematic reviews[102] and large cohort studies.[10,103] Positive symptoms are associated with disorganised behaviour, substance use (including injection drug use, another major source of contagion for the studied viruses) and hypersexuality in some cases.[87,104] In our meta-analysis, HIV prevalence was substantially higher in samples with higher substance use disorder comorbidity and in samples from Africa, at 7.32%. A previous meta-analysis examining the prevalence of HIV seropositivity among patients with first-episode psychosis patients in the African continent found an even greater pooled prevalence of 26%, which they hypothetically linked to longer duration of untreated schizophrenia, low access to health services and high prevalence of infection in the continent.[105] On the other hand, and more encouragingly, the prevalence of HBV and HCV appears to be lower according to more recently published articles (and in the case of HCV, for samples with younger mean age). Global trends for hepatitis B and C have shown a positive evolution over the last decades,[106] especially with the appearance of direct-acting antiviral treatments for HCV.[107] This has been especially notorious in some correctional institutions,[108] where patients with severe mental health disorders are overrepresented.[109]

On the other hand, another important finding of our study was that individuals with schizophrenia were significantly less likely to be in a stable relationship (odds ratio = 0.18) or engage in sexual activity with other people (odds ratio = 0.19) compared with healthy controls. This is consistent with previous findings in the literature, with studies reporting both lower rates of marriage and higher rates of divorce among people with schizophrenia.[110] Furthermore, the overall pooled prevalence of patients in our study who declared themselves to be sexually active was under 40%. This could be attributed to several factors. Positive symptoms such as sex-related delusions and hallucinations can have a negative impact on relationships and sexual life,[111] whereas negative symptoms are associated with sexual dysfunction and deficits in sexual interest and activity.[76] In our meta-analysis, 59.6% of patients (pooled prevalence) reported being interested in maintaining sexual intercourse with other people. Bianco et al reported a bimodal distribution of sexual interest among adults with schizophrenia, with most patients reporting either no problem with sexual interest or severe impairment in that area.[76] Even when sexual interest is present, sexual dysfunction is a frequent side-effect associated with the use of antipsychotic medications, occurring both directly through elevated prolactin due to blockade of dopamine D2 receptors[112] and indirectly through other adverse effects such as metabolic syndrome and obesity.[113] Other sources of sexual dysfunction may include concomitant use of antidepressants and anxiolytics, comorbidity with other mental health and substance use disorders[114] and, in more severely affected populations, the closed management model of most psychiatric inpatient units, which leads to a lack of privacy and limits the

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chance of having sexual activity.[5] It is important to address this, as a satisfactory romantic and sexual life has proven to be beneficial for the recovery of people with schizophrenia, increasing self-confidence, treatment compliance and even overall survival.[5,115]

Among those who were sexually active, a great prevalence of risk behaviours was found. Only 34.9 and 12.9% of patients with schizophrenia reported consistently using condoms or hormonal contraception in their sexual relationships, whereas 55.3% of the pooled sample regularly had unprotected intercourse. Moreover, 35.4% of patients reported having multiple concurrent sexual partners, and 28.7% had experienced an unwanted pregnancy either themselves or in their partners. This pattern of concerning sexual behaviours among people living with schizophrenia has been described in previous studies, with a prevalence of risky practices of up to 83%.[83,87] It is important to note that a similar behavioural pattern has been identified among people who have suffered traumatic experiences, particularly sexual trauma, with a higher risk of engaging in risky sexual behaviours such as compulsive sexual behaviour and unprotected sexual intercourse.[116,117] Considering that sexual traumatic history is greatly overrepresented among schizophrenia samples,[118] future research should focus on exploring whether the presence of traumatic history could be a major mediating factor in this population.

Our findings pose significant implications for the understanding and care of individuals living with schizophrenia. It is essential to note that most of the studies included in our analyses involved samples that had undergone STI screening for research purposes. This hardly reflects the clinical reality of many centres, where routine screening is not commonly performed in patients with severe mental disorders. Tailored sex education and preventive measures (including regular screening for STIs) are essential for all members of society, and people with schizophrenia are no exception. Interventions targeted at individuals with severe mental health disorders must be put in place to reduce the burden associated with STIs and other adverse consequences of risky sexual behaviours.

Limitations

The findings of this study should be interpreted considering certain limitations, primarily the significant heterogeneity detected in most of the studied outcomes. Although high heterogeneity is expected in proportional meta-analyses,[119] samples included in this work were heterogeneous in terms of their geographic origin, severity and characteristics, which on the other hand allows for better generalisation of our results. Owing to a lack of data, some potentially moderating factors such as religion,[120] antipsychotic treatment[121] or access to sexual health services[122] were not analysed. Furthermore, it was not possible to stratify the studied outcomes by sex, even though significant gender-related differences may exist.[123] Another crucial determinant for the transmission of the infections studied is the use of injectable drugs. Although we addressed the effect of a comorbid substance use disorder on the prevalence of STIs through meta-regressions, unfortunately there were insufficient data to stratify the effect of each substance, or the injection route. In the case of sexual behaviour outcomes, most of the data in the original studies were obtained through self-report, which can be potentially subject to social desirability bias; this has proven to be particularly problematic in studies on this topic.[124] Although it remains unclear whether this bias differentially affects populations with severe mental health disorders, it should be considered in future research. Finally, most of the studies included in this analysis were cross-sectional in nature. Longitudinal research is needed to better understand the temporal dynamics of sexual behaviour and STI risk in individuals with schizophrenia.

Future implications

Patients with schizophrenia exhibit a high prevalence of STIs, having several-fold increased risks of HIV, HBV and HCV infection compared with the general population. Although individuals in this population are significantly less likely to be in a stable relationship or engage in sexual activity, they show extremely high prevalence of risky sexual behaviours, engaging in unprotected sexual relationships. These findings highlight the need to incorporate sexual health into the overall care framework for patients with schizophrenia, with the aim of preventing and treating sexually transmitted diseases.

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Supplementary material

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Data availability

The data that support the findings of this study are available from the corresponding author, C.A., on reasonable request.

Author contributions

C.A.: conceptualisation, methodology, project administration, writing – original draft; B.P.: conceptualisation, data curation, writing – original draft; G.S.d.P.: writing – review and editing, formal analysis; L.M.: data curation, writing – review and editing; J.G.: data curation, writing – review and editing; V.S.-G.: conceptualisation, writing – review and editing; P.F.-P.: conceptualisation, writing – review and editing, supervision; P.M.: conceptualisation, writing – review and editing; M.A.G.-T.: conceptualisation, writing – review and editing; A.C.: supervision, formal analysis, validation, writing – review and editing.

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