Brazilian Journal of Psychiatry
bjp
Revista Brasileira de Psiquiatria

Braz J Psychiatry. 2022 Sep-Oct;44(5):478-485
doi:10.47626/1516-4446-2021-2248
Brazilian Psychiatric Association


ORIGINAL ARTICLE

# Gender differences in progression to crack-cocaine use and the role of sexual and physical violence

Fernando Pezzini **Rebelatto**,[1,2] Felipe **Ornell**,[1,2] Vinícius Serafini **Roglio**,[1,2] Breno **Sanvicente-Vieira**,[3] Rodrigo **Grassi-Oliveira**,[4,5] Flavio **Pechansky**,[1,2] Felix Henrique Paim **Kessler**,[1,2] Jaqueline Bohrer **Schuch**,[1,2] Lisia **von Diemen**[1,2]

[1]*Centro de Pesquisa em Álcool e Drogas, Hospital de Clínicas de Porto Alegre, Universidade Federal do Rio Grande do Sul (UFRGS), Porto Alegre, RS, Brazil.* [2]*Programa de Pós-Graduação em Psiquiatria e Ciências do Comportamento, UFRGS, Porto Alegre, RS, Brazil.* [3]*Laboratório de Pesquisa em Diferenças Individuais e Psicopatologia, Departamento de Psicologia, Pontifícia Universidade Católica do Rio de Janeiro, Rio de Janeiro, RJ, Brazil.* [4]*Developmental Cognitive Neuroscience Lab, Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, RS, Brazil.* [5]*Translational Neuropsychiatry Unit, Department of Clinical Medicine, Aarhus University, Aarhus, Denmark.*

**Objective:** This study aimed to evaluate whether progression from first drug use to crack-cocaine use differs according to gender, and whether the report of sexual or physical violence impacts the time of progression.
**Methods:** We interviewed 896 crack-cocaine users (548 men; 348 women) from addiction treatment units. Cox regression models evaluated the time of progression from first drug use to crack use. We analyzed gender differences according to the absence or presence of sexual or physical violence, also considering whether violence, when present, had occurred before or after the onset of crack use.
**Results:** Women presented a faster progression to crack use regardless of exposure to sexual or physical violence ($p < 0.05$). Compared to unexposed men, there was a similar progression for men exposed to sexual or physical violence before the first use of crack ($p = 0.167$ and $p = 0.393$, respectively). In both genders, we observed a faster progression among individuals exposed to these types of violence after the onset of crack use ($p < 0.01$).
**Conclusions:** We found a faster progression to crack use among women and among individuals exposed to sexual and physical violence after the onset of crack use. These results encourage differentiated treatment strategies, focused on gender and individual characteristics.

**Keywords:** Drug addiction; crack cocaine; gender differences; sexual violence; physical violence

## Introduction

Crack cocaine is a highly addictive street drug, administered through smoking. Individuals addicted to this substance usually have lower socioeconomic status, higher risk of sexual and violent behaviors, and compromised health,[1] which make for a complex clinical and psychosocial profile. Brazil is one of the largest crack-cocaine markets in the world,[2] and the use of this drug leads to a major public health concern.

Drugs with a higher potential for addiction, such as crack cocaine, are not frequently reported as substances of primary use. Overall, the use of legal drugs (such as alcohol and nicotine), as well as marijuana and snorted cocaine, precedes crack use.[3] Previous studies have investigated the progression of drug use among crack users[4] and methamphetamine users.[5] This outcome represents the transition to the use of drugs that eventually lead to treatment, and could be defined by the difference between the age at onset of crack use and the age at first use of any substance. However, few studies have evaluated associated factors and the time elapsed between the onset of use of any substance and the onset of use of substances that often lead to greater impairment.[6,7] Compared to users of other drugs, such as alcohol, crack users frequently seek treatment earlier.[8] Besides, studies indicate that the transition from first use to dependence is usually faster for women – known as the "telescoping" effect.[9,10] In addition, early experimentation with addictive substances is suggested as a high-risk behavior that may precede future problems, including a faster progression to the use of different illicit drugs,[6,11] involvement with illegal activities and violent experiences,[12,13] and development of drug addictions.[14]

The use of psychoactive substances is often associated with exposure to adverse experiences in childhood

Correspondence: Lisia von Diemen, Universidade Federal do Rio Grande do Sul, Hospital de Clínicas de Porto Alegre, Centro de Pesquisa em Álcool e Drogas, Rua Ramiro Barcelos, 2350, Santa Cecília, CEP 90035-903, Porto Alegre, RS, Brazil.
E-mail: ldiemen@hcpa.edu.br
Submitted Sep 15 2021, accepted Jan 24 2022, Epub Jul 15 2022.

**How to cite this article:** Rebelatto FP, Ornell F, Roglio VS, Sanvicente-Vieira B, Grassi-Oliveira R, Pechansky F, et al. Gender differences in progression to crack-cocaine use and the role of sexual and physical violence. Braz J Psychiatry. 2022;44:478-485. http://doi.org/10.47626/1516-4446-2021-2248

or adolescence.[15] Several studies have shown that early exposure to adverse events, which threaten an individual's physical and/or psychological integrity, could result in negative repercussions for physical and mental health in adulthood.[16] A recent meta-analysis of longitudinal studies showed that exposure to abusive experiences (such as sexual and physical violence), rather than negligent experiences, plays an important role in the development of illicit substance use disorders.[17] Furthermore, once drug-seeking behaviors are present, individuals are more prone to victimization, increasing the risk of exposure to experiences of violence.[18]

Moreover, men and women who use crack show distinct characteristics related to addiction and adverse events. For instance, women present a more frequent use of crack, greater severity of drug use, more impulsive behaviors, and report childhood abuse more often.[19,20] Although some studies have explored these aspects in men,[21] the evaluation of gender differences is crucial to determine the effect that exposure to violence might have on the progression of drug use in men and women.

Considering these topics, this study aims to evaluate whether men and women who use crack differ in time of progression from first drug use to crack use. Given the close relationship between exposure to violence and the onset of psychoactive substance use,[15] we also aim to evaluate the time of this progression, taking into account the exposure to sexual and physical violence. We hypothesize that women – as well as individuals exposed to sexual or physical violence prior to crack use – may present a faster progression to crack use.

## Methods

### *Sample and procedures*

This is a cross-sectional cohort study, with retrospective data assessment, of a convenience sample of 896 adults (548 men; 348 women) recruited from inpatient and outpatient addiction units in the public health-care system in six state capitals from different regions of Brazil. Primary data collection took place from March 2011 to April 2017. Inclusion criteria were: 1) fulfilling DSM-5 criteria for crack-cocaine use disorder; 2) self-reporting crack as one's primary drug of choice; 3) being age 18 or older; 4) self-reporting data on physical and sexual violence; 5) absence of any significant cognitive deficit that might compromise data reliability, according to clinical evaluation. Gender was self-declared, and no participant enrolled in this study considered themselves as transgender or nonbinary. Further details were previously described elsewhere.[20,22]

Individuals who met inclusion criteria and did not exhibit acute cocaine withdrawal symptoms were recruited in the first week of admission for inpatient (n=674) or outpatient (n=222) treatment. After giving informed consent, inpatients were interviewed by undergraduate health sciences students, who were previously trained and were constantly under the supervision of a senior investigator (psychologist or psychiatrist). Substance-related data were assessed through the sixth version of the Addiction Severity Index, a structured interview validated in Brazil.[23] This instrument evaluates the impact of drug use on different areas, such as medical, employment, legal involvement, and psychiatric symptoms. Variables selected for the present study were: primary psychoactive substance use – whether it was legal (alcohol and tobacco) or illegal (cannabis, inhalants, cocaine, and crack-cocaine) –, age at onset of drug use, presence of sexual and/or physical violence (carried out by a known or unknown person) and their respective age of occurrence, and sociodemographic information (gender, age, ethnicity, marital status, and education level).

### *Statistical analyses*

Statistical analyses were performed in R software (version 3.6.1).[24] Continuous variables were initially evaluated for normality of distribution by using the Kolmogorov-Smirnov test and histograms. Continuous variables with normal distribution are represented by mean and standard deviation (SD) and were compared by Student's *t* test and analysis of variance (ANOVA) with the Tukey test for post-hoc analysis; continuous variables with non-normal distribution are represented by median and interquartile range (IQR) and were compared by the Mann-Whitney *U* test. Categorical variables are represented by n (%) and were compared by the chi-square test with Yates' continuity correction and prevalence ratio (PR). For statistical significance, a p-value $< 0.05$ was adopted and effect sizes (Cohen's *d*, *r* test, eta squared, and Cramer's V) were verified.[25]

We performed survival analyses to evaluate the main outcome, i.e., progression to crack use. This variable was defined by the difference between the age at onset of crack use and the age at first use of any substance. Following the assumptions for survival analyses, the value of this difference should not be 0. Therefore, we attributed the value of 1 year in the time of progression in cases where individuals whose initial substance of use was crack, or when the first use of this drug occurred within 1 year after experimentation with the first substance. Only those individuals with valid answers and no missing data for each variable were eligible for the regression models. Initial analyses were performed using the log-rank test to analyze the progression to crack use by comparing men and women.

To evaluate the effect of adverse events on the progression to crack use, we performed multivariate analyses by fitting Cox proportional hazard models. To investigate the proportional hazards assumption of the Cox model, the correlation between Schoenfeld residual and survival time was verified along with the regression line. Gender and absence or presence of adverse events (i.e., sexual or physical violence), as well as the period at which the event occurred, were used to categorize subgroups. In this sense, subgroups of each adverse event comprise six categories: women (or men) with no history of an adverse event, women (or men) who experienced an adverse event before the onset of crack use, and women (or men) who experienced an adverse event after the onset of crack use. In the sexual violence model, only two men reported sexual

violence after the onset of crack use; therefore, this category was not included in the final model. Ethnicity, education level, and primary use of licit or illicit drugs were included as covariates in these analyses. We selected as covariates only variables that could somehow influence the main outcome and which were related to sociodemographic status, such as educational level, or baseline variables that do not change over time, such as ethnicity and category of first substance use (licit or illicit).

### *Ethics statement*

All individuals included in the study provided written informed consent. The three larger projects that originated the present research were reviewed and approved by the ethics committee of Hospital de Clínicas de Porto Alegre (14-0249 and 14-0395) and by the ethics committee of Pontifícia Universidade Católica do Rio Grande do Sul (10/05214). This study was conducted in accordance with the Declaration of Helsinki.

## Results

### *Descriptive analyses*

Sociodemographic data for men and women are described in Table 1. Overall results showed significant differences between genders concerning age, ethnicity, marital status, and education level. However, all had small effect sizes (ranging between 0.07 and 0.28).[25]

### *Gender and exposure to violence*

In the overall sample, physical violence (67.3%) was more prevalent than sexual violence (20.3%); both were more frequent in women. Sexual violence was reported by 41.4% of women and 6.9% of men (PR = 5.97, 95% confidence interval [95%CI] 4.28-8.31, $p < 0.001$), while physical violence was highly reported by both genders: 73% of women and 63.7% of men (PR = 1.15, 95%CI 1.05-1.25, p = 0.004). Table 2 summarizes other gender differences regarding exposure to sexual and physical violence. Sexual violence occurred later in women, with a broader age distribution in comparison to men (median 13, IQR 9-19 for women; median 8, IQR 6-10 for men, $p < 0.001$). There was no significant difference in the age of occurrence of physical violence between genders (p = 0.407). Also, no relationship was observed between the type of first drug used and the occurrence of sexual (p = 0.158) or physical (p = 0.253) violence, in either gender.

It is noticeable that women had an earlier onset of crack use when compared to men, regardless of the occurrence of sexual or physical violence ($p < 0.001$ for both analyses) (Table 2). In addition, women exposed to

**Table 1** Sociodemographic data compared by gender

| | Total (n=896) | Men (n=548) | Women (n=348) | Effect size | p-value |
|---|---|---|---|---|---|
| Age, mean (SD)[†] | 28.5 (8.4) | 27.6 (8.5) | 29.9 (8.2) | 0.28 | < 0.001 |
| Ethnicity (non-white)[‡] | 514 (57.4) | 297 (54.2) | 217 (62.4) | 0.07 | 0.019 |
| Marital status (single)[‡] | 614 (68.5) | 392 (71.5) | 222 (63.8) | 0.07 | 0.018 |
| ⩽ 8 years of education[‡] | 557 (62.2) | 322 (58.8) | 235 (67.5) | 0.08 | 0.010 |

Data presented as n (%), unless otherwise specified.
SD = standard deviation.
[†] Student's *t* test for independent samples. Effect size: Cohen's *d*.
[‡] Chi-square test with Yates' continuity correction. Effect size: Cramer's V.

**Table 2** Substance use and exposure to violence, comparison between genders

| | Men | | Women | | | |
|---|---|---|---|---|---|---|
| | Present (n=38) | Absent (n=510) | Present (n=144) | Absent (n=204) | Effect size | p-value |
| First sexual violence exposure | | | | | | |
| First type of drug used (illicit), n (%)[†] | 13 (34.2) | 249 (48.8) | 61 (42.4) | 88 (43.1) | 0.050 | 0.158 |
| Age at onset of drug use (years)[‡] | 12.3 (3.2)[a,b] | 13.2 (3.1)[a] | 11.9 (3.2)[b] | 12.9 (3.3)[a] | 0.024 | < 0.001 |
| Age at onset of crack use (years)[‡] | 26.1 (8.4)[a] | 23.9 (8.0)[a] | 19.4 (7.8)[b] | 20.6 (7.7)[b] | 0.061 | < 0.001 |
| Age of the first occurrence of sexual violence, median (IQR)[§] | 8.0 (6.0-10.0) | - | 13.0 (9.0-19.0) | - | 0.363 | < 0.001 |
| | Present (n=349) | Absent (n=199) | Present (n=254) | Absent (n=94) | Effect size | p-value |
| First sexual violence exposure | | | | | | |
| First type of drug used (illicit), n (%)[†] | 160 (38.9) | 102 (24.8) | 106 (25.8) | 43 (10.5) | 0.035 | 0.253 |
| Age at onset of drug use (years)[‡] | 12.9 (3.3)[a] | 13.6 (2.8)[b] | 12.5 (3.6)[a] | 12.3 (2.4)[a] | 0.019 | < 0.001 |
| Age at onset of crack use (years)[‡] | 23.8 (7.9)[a] | 24.6 (8.3)[a] | 20.5 (8.2)[b] | 19.0 (6.5)[b] | 0.061 | < 0.001 |
| Age of first occurrence of physical violence, median (IQR)[§] | 16.0 (11.0-23.0) | - | 17.0 (13.0-24.0) | - | 0.034 | 0.407 |

Data presented as mean (standard deviation).
IQR = interquartile range.
[†] Chi-square test. Effect size: Cramer's V.
[‡] One-way analysis of variance (ANOVA). Effect size: $\eta^2$.
[§] Mann-Whitney *U* test. Effect size: *r*.
Groups with different letters (a, b) represent significant difference ($p < 0.05$) according to Tukey's honestly significant difference (HSD) post-hoc analysis.

sexual violence were more prone to earlier drug use ($p < 0.001$), whereas a similar scenario was observed in men exposed to physical violence ($p < 0.001$).

Among individuals who reported lifetime occurrence of sexual violence, men were more frequently exposed to it before crack use than women (94.7 vs. 71.5%, respectively, PR = 1.32, 95%CI 1.17-1.50, p = 0.003). A similar pattern was observed regarding exposure to physical violence (74.2% of men, 60.2% of women, PR = 1.23, 95%CI 1.10-1.39, $p < 0.001$). It is worth noting that lifetime sexual violence was recurrent for 70.3% of those exposed to it (63.9% of men, 71.9% of women, p = 0.461), whereas the prevalence of recurrent physical violence was 82.9% (83.4% of men, 82.1% of women, p = 0.754). Furthermore, we observed a short interval of time between the occurrence of sexual violence and the onset of crack use in women (mean 3.76, 95%CI 5.74-1.77 years before crack use) when compared to men (mean 16.95, 95%CI 20.34-13.56 years before crack use, $p < 0.001$). Similar results were also found regarding physical violence (mean 1.96, 95%CI 3.27-0.66 years before crack use for women and mean 5.95, 95%CI 7.05-4.85 years before crack use for men, $p < 0.001$). Men experienced either sexual or physical violence earlier, usually long before their first use of crack.

### *Survival analyses and regression models*

We initially evaluated the main outcome – progression to crack from first drug use – in a bivariate analysis, according to gender, by using a log-rank test. Women showed a shorter time of progression (median 6, IQR 3-11) when compared to men (median 9, IQR 5-16, $p < 0.001$) (Figure 1A).

We also performed multivariate analyses using Cox regression models (Table 3). According to the correlation between the Schoenfeld residual and survival time for each covariable (maximum r = 0.15), we consider the proportional hazards assumption to be supported (Tables S1 and S2 and Figures S1 and S2, available as online-only supplementary material). Progression to crack use in men was similar regardless of the presence of sexual violence (p = 0.167). Additionally, we observed a faster progression to crack use among men exposed to physical violence after crack use (p = 0.004), whereas unexposed men and men exposed to physical violence before crack experimentation presented a similar progression (p = 0.393). As for sexual violence in women, all subgroups of women presented a faster progression to crack use when compared to men (p-values ranging between 0.046 and $< 0.001$). Considering the subgroups of women, there was a faster progression to crack among those exposed to sexual or physical violence after crack use ($p < 0.001$).

Figure 1 also displays the adjusted survival curves for the subgroups presented in the two models: sexual (B) and physical violence (C). As seen on both curves, men who were not exposed to sexual or physical violence had an approximate 30% chance of progressing to crack use within 5 years after their first drug experimentation. On the other hand, the chance of progression to crack use was about 60% within the same time frame for women exposed to sexual violence after using crack. Similarly, women exposed to physical violence after the onset of crack use had an approximate 55% chance of progressing to crack use within 5 years after first drug experimentation. The ratio between these odds (as presented in Table 3) was constant over time.

## Discussion

To our knowledge, this is the first study to evaluate the time of progression to crack-cocaine use from first drug use in a large sample of men and women who use crack, taking into account the effect of exposure to sexual and physical violence on this progression. Our findings reveal that women presented a faster progression to crack use when compared to men. Furthermore, we observed a faster progression to crack use among those exposed to sexual or physical violence after the onset of crack use when compared to those who were not so exposed or were exposed to sexual or physical violence prior to the first use of crack.

In our sample, we observed a relatively earlier onset of drug and crack use among women in comparison to men, as well as a faster progression from the first drug used to crack. Evidence shows important differences between genders concerning drug addiction. Despite limited data available on how women and men transition to heavier drugs of abuse, previous studies suggest that women tend to develop addictions faster than men.[9] Moreover, although some studies indicate that women may often exhibit a later onset of drug use,[26] they are more prone to the telescoping effect (i.e., rapid transition from drug experimentation to addiction) than men.[10] This is observed not only among women who use crack, but also among women who use other drugs, such as alcohol, opioids, and cannabis.[9,10] Additionally, women seek treatment earlier and often present greater severity of drug use.[8,20] Thus, our findings highlight differences concerning the trajectories of substance use between women and men as another potential marker of drug use pattern.

Drug addiction is a complex behavior, and many factors are associated with drug abuse in women. These include social vulnerabilities, cultural stereotypes against women, family aspects (such as issues related to child custody), and even biological features.[10,27] Also, violent experiences – especially those earlier in life – arise as an impactful aspect associated with susceptibility to several psychiatric disorders,[16] and men and women may respond to such events differently, with distinct repercussions.[17,28]

Our findings reveal a high prevalence of sexual and physical violence among crack users, especially among women. They are usually more prone to victimization than men, since women's estimated prevalences for sexual and/or physical violence are about 30% for the general population.[29] Among drug users, these percentages are even higher, with some studies reporting up to 40-60%.[30,31] Our findings also indicate that women are more susceptible to lifelong sexual violence, in consonance with previous studies.[32,33] However, men were

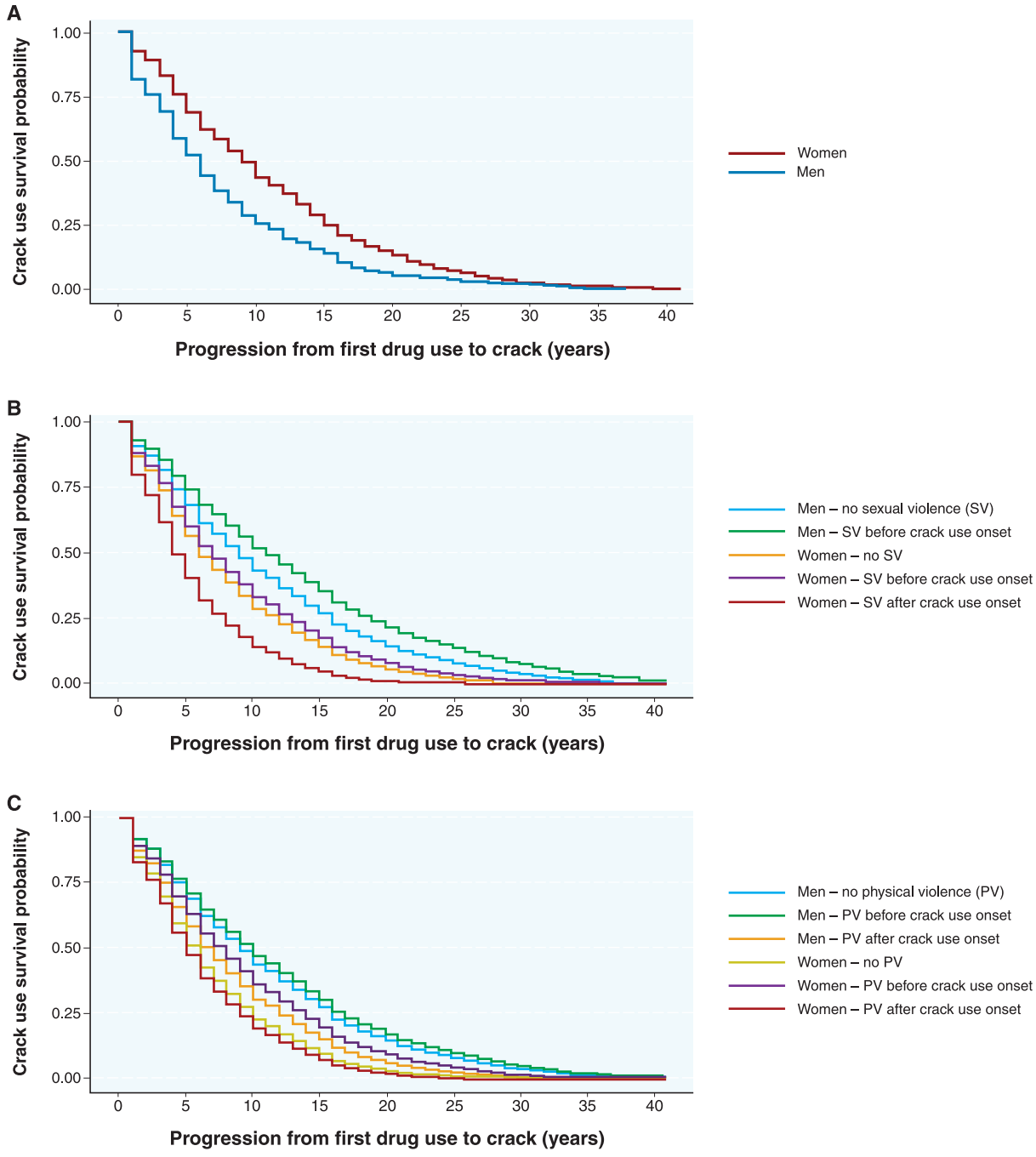


**Figure 1** Kaplan-Meier survival curves for progression from first drug use to crack use according to gender (A). Adjusted survival curves for progression from first drug use to crack use according to gender and exposure to sexual (B) and physical violence (C).

more likely to suffer sexual violence earlier in life – a period of more vulnerability for these individuals. A large body of evidence has shown the impact of early sexual violence victimization on men's emotional development, which is related to mental health issues in adult life.[34] Concerning physical violence, however, there was no significant difference in age at first occurrence. As physical violence was evaluated as perpetrated by a known or unknown person, it is likely that individuals were more susceptible to this type of violence later in life (since the context of drug use includes exposure to situations with high potential for violence), rather than earlier in childhood.[35,36] Besides, women who use crack are often involved in abusive relationships, and more prone to intimate partner violence.[10] It is worth mentioning that, among those individuals who were exposed to sexual or physical violence, such experiences were recurrent for the vast majority of the sample. Different studies have

**Table 3** Cox regression for progression from first drug use to crack use, in years, according to gender and exposure to sexual or physical violence

| | Sexual violence (n=894) | | | Physical violence (n=896) | | |
|---|---|---|---|---|---|---|
| | Median (IQR) | HR (95%CI) | p-value | Median (IQR) | HR (95%CI) | p-value |
| Men | | | | | | |
| No violence (reference) | 9.0 (5.0-15.0) | - | - | 9.0 (5.0-15.5) | - | - |
| Violence before crack use onset | 13.5 (9.75-20.2) | 0.79 (0.56-1.11) | 0.167 | 11.0 (6.0-16.5) | 0.92 (0.77-1.11) | 0.393 |
| Violence after crack use onset | - | - | - | 5.5 (3.0-10.8) | 1.45 (1.13-1.87) | 0.004 |
| Women | | | | | | |
| No violence | 6.0 (3.0-11.0) | 1.50 (1.27-1.76) | < 0.001 | 5.0 (2.25-9.0) | 1.81 (1.41-2.32) | < 0.001 |
| Violence before crack use onset | 6.0 (4.0-12.0) | 1.33 (1.07-1.65) | 0.010 | 8.0 (4.0-13.0) | 1.24 (1.00-1.54) | 0.046 |
| Violence after crack use onset | 2.0 (1.0-7.0) | 2.38 (1.73-3.28) | < 0.001 | 3.0 (1.0-7.0) | 2.01 (1.58-2.57) | < 0.001 |

Both models were adjusted for ethnicity, education level, and first type of drug used (licit/illicit).
95%CI = 95% confidence interval; HR = hazard ratio; IQR = interquartile range.

already reported that this is common among drug users,[35,37] raising a debate on its association with impulsivity – either as a personality trait or deficiency in inhibitory control.[38]

Violent experiences are frequent among crack users, both in childhood, before the onset of drug use, and later in adult life, when drug addiction is established.[35] Thus, we hypothesized that such experiences could be also related to the progression to crack use, especially as a preceding risk factor. However, exposure to either sexual or physical violence before the onset of crack use was not related to a decrease in time of progression, even after adjusting the analyses for sociodemographic data. Interestingly, our findings suggested a faster progression to crack use among women and men exposed to these types of violence after their first use of crack. Therefore, we propose that latent characteristics of greater severity of psychopathology may have led to a faster drug use progression, which cumulatively increased the vulnerability of these individuals to violent experiences. Given the complexity of this disorder, many aspects could help elucidate these findings. Individuals with drug addiction frequently present more impulsivity, novelty-seeking, and sensation-seeking behaviors, other neuropsychiatric conditions, and intrinsic biological characteristics that may contribute to an earlier use of drugs, a faster progression to crack use, and addiction to crack.[10-12,19,39] Since these individuals are often homeless, lack formal employment, and attend violent environments (such as crack houses), those latent characteristics and these circumstances may augment susceptibility to violent situations, indicating that this could be a more vulnerable subgroup of crack users.[30,36]

This study has limitations regarding the inferentiality of its estimates. It is a secondary analysis of a non-probability, multicenter convenience sample, and the inference would benefit from the use of sample weights to improve the analysis. However, traditional methods of weighing samples require that population totals be known, and we did not have access to this data. Analyzing a complex sample as a simple sample, although very common in clinical research, can inflate type I error and requires us to be more careful when making inferences. Type II error is also inflated simply by using a convenience sample, which may lack sufficient power to detect group differences. On the other hand, the only way to reduce these two types of inferential errors simultaneously is to increase the sample size, and this study did have a large sample size compared to the published literature on crack-cocaine users.

Additionally, given the cross-sectional cohort design, data on the retrospective profile of drug use and the occurrence of violence were obtained through self-report, and therefore may be subject to recall bias. Nevertheless, one should note that the sample comprised individuals with no significant cognitive deficit, reinforcing the reliability of our data. Another limitation involves a possible underreporting of sexual violence among men, due to social and cultural issues related to this population. Previous studies have raised this issue[40]; however, it has also been consistently indicated that sexual violence is less prevalent in men when compared to women.[30,33] Besides, this study did not evaluate the direct impact of violence as a traumatic experience, but as a single lifetime exposure – which may or may not constitute psychological trauma. Therefore, further research should evaluate more robustly the impact of violence on drug use progression (such as psychological trauma following violence exposure) in order to obtain more conclusive results on this topic.

In summary, this study showed that the time of progression from the first drug use to crack-cocaine use was shorter for women than it was for men. Also, our sample presented a high prevalence of sexual and physical violence, especially among women, reinforcing the importance of gender-focused research and intervention. Despite its crucial impact on emotional development, early exposure to violence was not a predictor associated with our main outcome. In fact, we found that exposure of individuals to sexual and physical violence after their first crack use was a potential marker of a faster progression to crack use as one's primary drug of choice. Our findings suggest that individuals with faster drug use progression comprise a more vulnerable subgroup, with distinct characteristics. Their exposure to violence after the use of drugs that lead to greater impairment, such as crack, reinforces the need for personalized treatment. Studies evaluating response to treatment should focus on individual characteristics in order to better predict this outcome.

## Acknowledgements

This study was supported by the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq; grants 466802/2014-5 and 478492/2013-8), Secretaria Nacional de Políticas sobre Drogas (SENAD)/Ministério da Justiça e Segurança Pública (grants 822647/2015 and 08129. 015636/2017-78), Fundo de Incentivo à Pesquisa e Eventos, Hospital de Clínicas de Porto Alegre (FIPE-HCPA; grants 2014-0249 and 2014-0395), and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brazil (CAPES; finance code 001). The funders had no role in study design, data collection, analysis and interpretation of data, preparation of the manuscript or decision to publish.

## Disclosure

The authors report no conflicts of interest.

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