

# **The reasons for and consequences of the combined use of crack cocaine and alcohol in Brazil: a qualitative study**

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## **Abstract**

*The objective of this study was to investigate, through the speeches of crack cocaine users, the reasons that lead them to combine crack cocaine with alcohol and the consequences of this combination, in Brazil. The lack of public policies and effective treatments has led crack cocaine users in Brazil to seek alternatives to cope with problems related to drug addiction. One adopted alternative is the consumption of crack cocaine together with other psychotropic drug. This study used the principles and instruments of qualitative research. A purposeful sample was constructed using key informants and gatekeepers whose sample size (N = 30) was defined by the theoretical saturation point. The study participants were subjected to in-depth interviews, and the responses were subjected to content analysis for the identification of thematic units. Alcohol use played many roles, including increasing the courage of drug users to go to the point of sale for psychotropic drugs, reducing thirst, and prolonging the positive effects of crack cocaine. The combination of alcohol and crack cocaine is commonly used to modulate the effects of the latter. A vicious cycle is established in which the consumption of alcohol stimulates the consumption of cocaine and vice versa. The participants also reported cost savings but admitted an increase in aggressiveness. The combined use of crack cocaine and alcohol can become a strong conditioned stimulus for the consumption of the former. The formation of the active metabolite cocaethylene in this drug combination may explain the prolongation of the effects of crack cocaine. Moreover, both drugs act in the mesolimbic dopaminergic system and consequently produce a synergistic effect. Severe outcomes such as cardiotoxicity, which can lead to death, in addition to aggression and the possibility of relapse to crack cocaine use, make this drug combination a public health problem that is greater than the individual consumption of these psychotropic drugs.*

**Keywords:** crack cocaine, alcohol, crack cocaine and alcohol association, Brazil

## **1. Introduction**

The first crack cocaine seizure made by the Civil Police of São Paulo occurred in 1991 [1]. The

characteristics of the drug, including ease of use, low price, rapid and intense effect, and lower probability of HIV infection, led to the rapid acceptance of crack cocaine by drug users [2, 3].

In this period, Brazil was experiencing an HIV/AIDS epidemic, in which intravenous cocaine users were a risk group [4]. In this context, crack cocaine has become an alternative for these users who first began using crack cocaine to avoid HIV infection [5].

Health professionals were focused on this scenario and considered [5, 6] that the change in the route of cocaine consumption was a harm-reduction strategy because HIV infection was decreased in places where the intravenous route was replaced by the pulmonary route [7].

This situation may have contributed to the fact that health professionals who were involved in addiction care underestimated the severity of the crack cocaine epidemic at that time, although drug problems had already started to emerge [8]. Moreover, this situation was likely responsible for the state's late response to drug problems, with the first crack cocaine program of the Brazilian government being launched in 2011, twenty years after this psychotropic drug became available [9].

The lack of public policies and the lack of effective treatments for crack cocaine addiction [10] may have led crack users to seek their own strategies to cope with the problems related to drug addiction. Some researchers investigated these strategies and highlighted that the combination of crack cocaine and other psychotropic drugs modulates the effects of the former [11-13]. Oliveira and Nappo [3] evaluated crack cocaine users and reported that the use of drug combinations could modulate the intensity or duration of the effects of this drug either by decreasing the adverse consequences or intensifying and prolonging the favorable effects.

Gonçalves and Nappo [12] analyzed the association of marijuana with crack cocaine and observed that the craving for the latter was decreased with the use of the former.

However, in addition to marijuana, alcohol has been used in combination with crack cocaine in Brazil. The most recent national survey on crack cocaine use in Brazil conducted by the Oswaldo Cruz Foundation (FIOCRUZ) [14] revealed that among the drug users interviewed, 64% of women and 73% of men reported using the crack cocaine-alcohol combination, demonstrating that this drug combination is common. International studies also reported the use of this combination, and 50% to 90% of cocaine users reported using alcohol [15, 16].

The literature indicates that the main reason for this drug association is the ability of alcohol to modulate the effects of crack cocaine [17]. However, considering the physical, psychological, and social problems caused by alcohol, this association is a cause for concern. This concern is further supported by data from the 2014 Global Status Report on Alcohol and Health of the World Health Organization [18], which reported that alcohol consumption causes 3.3 million deaths per year and accounts for 5.9% of all deaths worldwide. This percentage is higher than that attributed to HIV/AIDS (2.8%) or violence (0.9%). In Brazil, the situation is worrying, and data from the II National Survey of Alcohol and Drugs (Levantamento Nacional de Álcool e Drogas–LENAD) [19] indicate that the prevalence of alcohol addiction in 2012 was 10.48% among men and 3.63% among women.

Considering the limited number of studies that have explored the consequences of the combined use of crack cocaine and alcohol from the perspective of the user, the objective of this study was to identify the reasons for and consequences of the combined use of these two psychotropic drugs in Brazil.

## **2. Materials and Methods**

A qualitative methodology was used because it allowed us to analyze study participants' beliefs about the combination of alcohol and crack cocaine based on their own views and concepts [20-22].

### **2.1 Sample recruitment**

Eight key informants (KIs) were selected during the first phase of the study - two psychiatrists, four ex-crack cocaine users and two psychologists – who had varied knowledge about the study topic and the study population [22]. These KIs were invited for an informal conversational interview without a previously prepared script. Relevant questions regarding the topic arose in the context of these conversations [23, 24]. The interviews were recorded, transcribed, and analyzed, and the data generated was then used by the researchers to prepare an interview script that was used with the study participants (crack cocaine users who associated alcohol) [22]. Due to difficulties in accessing the study population due to the illegality of crack cocaine use, some of the KIs also played a gatekeeper role (i.e., they provided access to the study participants) [20]. Because the gatekeepers were known by the study population, they inspired the trust of the drug users, facilitated the participation of that population in the study, and were the first point of contact between the study population and the researchers. Each gatekeeper identified potential participants and discussed the study with them prior to introducing the researchers. Those who agreed to participate were instructed to contact the researchers. In-depth interviews were conducted using purposeful sampling, the components of which followed particular criteria (criterion sampling) [22]: crack cocaine users who were older than 18 years of age and who had combined crack cocaine with alcohol use a minimum of 25 times, thereby ensuring that experimental users were not included in the sample [25]. These criteria led to a sample size of 30 participants, all of whom were selected in the city of São Paulo during the years 2012–2013. The first interviewees who were contacted by the KIs identified other possible participants, thereby using the snowball technique to compose the sample. Sampling using the snowball technique starting with the first interviewee created a chain of interviewees [24, 26]. To include the largest possible number of user profiles in the sample who met the inclusion criteria proposed, various chains of interviewees were sought, and seven chains were identified, which ranged from 3 to 5 individuals each. The sample size was adequate to cover all of the topics of interest and various user profiles. This assumption was met when the interviewees' responses became redundant. At this point, termed the theoretical saturation point, the lack of new information and the repetition of responses were identified [20, 22, 24].

### **2.2 Instruments used**

Semi-structured interviews were conducted using a script of topics that were selected based on the information provided by the KIs [22, 23]. The script was composed of previously standardized questions to facilitate comparisons among responses and reduce interviewer interference. Additional questions emerged to clarify specific topics during each interview, allowing for improvement of subsequent understanding [23, 24]. The script consisted of socio-demographic data, history of drug use, history of crack cocaine use, associated alcohol use, and damages/"advantages" of the combination. The questions relating to the socioeconomic data were evaluated using the *Brazilian Economic Classification Criteria*

2008 scale, published by the ABEP (Brazilian Association of Research Companies-*Associação Brasileira de Empresas de Pesquisa*) [27]. This scale mainly considers the consumer goods possessed by the family and classifies respondents into classes A1, A2, B1, B2, C, D and E (A1 is the category with the greatest ownership, whereas E delineates a lack of ownership and includes the homeless). The criteria for dependency, as defined by the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) [28], were also incorporated into the script. After obtaining the consent of the interviewees, the interviews were recorded, each of which lasted approximately 70 min.

### ***2.3 Qualitative analysis of the content***

Each interview was identified by an alphanumeric code in which the first letter was the first initial of the interviewee's name, followed by his or her age and gender. The interviews were transcribed and reviewed by the researchers. They were then analyzed using the content analysis technique based on Bardin's theoretical framework [29]. The various parts of the interviews were split and then grouped according to each research theme. For the analysis, NVivo Software Version 10 [30] was used, which allowed for greater data analysis consistency and facilitated organization. The importance of the themes identified was analyzed by considering the emic approach. This step, defined as categorization, was developed by the two researchers who independently and simultaneously analyzed the data. Then, these two analyses were compared to obtain consistency and coherence in the results. Finally, inferences supporting the explanations were initiated and conclusions were generated. *Quotes* from the interviewees' statements are presented in the results section; they are identified by their code and shown in italics.

## **3. Results**

### ***3.1 Sample characteristics***

Most of the study population were young men (18 to 30 years old), with low socioeconomic status (classes E and D according to ABEP classification) [27] and little schooling (incomplete elementary education). Only eight respondents reported living with their families, and the remaining lived on the streets or in shelters. Approximately 90% of the participants were unmarried and unemployed at the time of the interview. All participants were considered dependent on crack cocaine and alcohol according to DSM IV criteria [28].

### ***3.2 History of drug use***

None of the interviewees reported using crack cocaine as the first drug of choice. Licit drugs such as alcohol and solvents were the most common as starting drugs. Moreover, almost all participants reported having used cocaine in the form of aspirates and/or injectable and marijuana. A small percentage of the sample also reported having used LSD, psychotropic drugs, and ecstasy. Crack cocaine began being used by this population after this sequence of drugs.

### ***3.3 Problems related to drug abuse***

Drug use was not always recreational, and all study participants reported having problems related to the

abuse of psychotropic drugs. However, all respondents indicated that crack cocaine was the drug that most affected them psychically, physically, and particularly socially, leading to marginalization, theft, and loss of social status, financial status, employment, and family.

### **3.4 Strategies used to address drug abuse**

The study sample reported having adopted some strategies to cope with the problems related to crack cocaine use, including the search for medical treatment, attachment to religion/spirituality, use of other psychotropic drugs to replace crack cocaine, avoiding carrying cash, and the combination of crack cocaine with other drugs. This last factor was explored in this study but was limited to the association of crack cocaine and alcohol.

### **3.5 Choice of drug combination**

The analysis of the criteria used by the participants for choosing the drug combination indicated that this decision was simple. The choice was based on information from friends and/or experimentation and the consequent evaluation of the effects of the tested association. Crack cocaine was most commonly combined with alcohol and/or marijuana.

*I did not like marijuana, so I traded for beer, then for cachaça and gin. (S33M)*

*Alcohol makes me want to use crack. Marijuana relaxes me. I become sleepy. (C29M)*

The respondents were asked whether the drug dealer at the time of the purchase of crack cocaine advised them to associate crack with other psychotropic drugs. All respondents replied that there was no dialogue with the drug dealer because the dealer did not allow this type of approach. The contact with the drug dealer was fast enough for the consumer to buy the drug and leave the point of sale.

*There was no dialogue. The drug dealer does not want to talk to us because he is in the condition of a seller; a condition higher than mine is, and I am in the condition of an addict and buyer (C21M).*

In addition, the drug dealer did not allow the consumption of crack cocaine in the vicinity of the point of sale because this situation could jeopardize the security of the place, which could be identified by the police, reinforcing the sparse dialogue between dealers and users.

*There is no conversation. You buy what you want and cannot smoke there. You have to smoke somewhere else. Smoking there could put my life at risk (F30M)*

### **3.6 Combination of crack cocaine and alcohol**

#### **3.6.1 Type of alcoholic beverage used in association with crack cocaine**

Cachaça (Brazilian alcoholic beverage extracted from sugarcane with an alcohol content of 38–48%) was mentioned by most of the interviewees as the beverage of choice for combination with crack cocaine because the beverage is inexpensive and easily accessible.

The drug users could not dispense with alcohol after they started using the crack cocaine-alcohol combination. Moreover, in the absence of an alcoholic beverage, the participants used other alcohol-containing products, some of which were not indicated for human consumption, including fuel ethanol, deodorant and substance that removes nail polish (acetone).

*I have already drunk acetone with water to lower the effect of smoking crack. I need to drink something, even acetone or fuel alcohol. (C33M)*

*I drank deodorant. I had nothing to drink, I arrived at a friend's house, I needed alcohol, he offered me deodorant. I drank the whole bottle. (A19M)*

Fuel ethanol was also consumed in the absence of cachaça.

*I would not smoke without alcohol. I needed to have at least R\$ 1 (USD 0.25) in my pocket. With this money, I would buy alcohol from the gas station, mix it with water, add sugar, and drink it (24M).*

### 3.6.2 Reasons for using the cocaine-alcohol combination

#### 3.6.2.1 Facilitates the daily routine of the drug user

##### - *Increases courage*

The participants reported that going to the point of sale was dangerous. The lack of intimacy with the drug dealer and the rules imposed by traffic worsened the situation. Some interviewees witnessed the death of friends at the point of sale and therefore were afraid to go to these places. However, the consumption of alcohol gave them courage to buy cocaine. The disinhibition caused by alcohol and the desire to consume cocaine made them audacious.

*Alcohol disinhibited and gave me the courage to go to the point of sale and buy crack. I drank three doses of cachaça and afterwards was not aware of anything. I was going to the point of sale and did not care who was on my way. Nothing stopped me, not the police, my mother, or my family. I completely lost my fear (G24M).*

##### - *Use of alcohol to replace crack*

It is important to highlight that, in these cases, alcohol was not used to replace the effects of crack but had an auxiliary role, i.e., it was consumed because the user was forced into abstinence by not having the means to buy crack cocaine.

*Crack was finished and what now? ... I have no money to buy ... I have nothing else to sell, what am I going to do? Drink alcohol. (A19M)*

#### 3.6.3.2 Modulates the physical and psychological effects of crack cocaine

##### - *Reduces thirst*

The respondents reported that the consumption of crack cocaine made them thirsty. The mouth became dry during crack consumption, and the most pleasant beverage at that time was an alcoholic beverage. Water could not fulfill the role of relieving thirst, and some participants even attributed negative consequences to water consumption.

*When I smoke crack, the mouth starts to dry, so I need to drink some liquid, but never water. Water will diminish the effect of the drug, and the stomach does not accept water in this condition. It can be beer, cachaça, or other alcoholic beverages. (P34M)*

##### - *Reduces the negative effects of crack cocaine and relaxes the user*

The interviewees reported using alcohol to reduce the harmful consequences of crack cocaine. After crack cocaine consumption, the users wanted to relax and only achieved this state with alcohol. The participants reported that alcohol limited the adverse effects of crack cocaine and promoted a state closer to normal.

*I smoked crack and drank alcohol. Alcohol eliminates some of the effects of crack. It prevents me from getting too crazy. I was more in control and did not have paranoia (T24M).*

Some participants reported that crack cocaine hampered sleep whereas alcohol contributed to sleep.

*Crack with alcohol helps me to sleep. To sleep, I would drink half a liter of alcohol and I would be relaxed. Whenever I went to bed, I carried a bottle of alcohol and drank in big sips (P23M).*

*- Prolongs the positive effects of crack cocaine*

Most respondents reported that the pleasurable effects of crack cocaine were prolonged in the presence of alcohol. With the extended use of crack cocaine, the favorable effects are significantly reduced and are replaced by transient paranoid symptoms. Therefore, alcohol is consumed to prevent or decrease these symptoms and prolong the positive effects of crack cocaine.

*After using only crack for some time, the positive effect of the drug disappears. In this instance, I am smoking only because of the paranoia. With alcohol, I feel the effects of crack a lot longer, and the paranoia almost disappears (S24M).*

Alcohol was also used to decrease the craving for cocaine, and this goal was achieved with the use of this drug combination.

*Alcohol cuts off the craving, the desire to use crack again. So, I drank alcohol to get drunk, and this state diverted my focus from craving and I forgot about it. (F30M)*

### 3.6.3 Consequences of the use of the cocaine-alcohol combination

#### 3.6.3.1 Aggressiveness

The respondents reported that this drug combination triggered aggressiveness. Some individuals reported that this feeling led them to violent and risky behavior and the loss of control of drug consumption.

*I was not the same person. I was strange. I was aggressive. Anything would spark my desire to fight. One of those times I hit a guy so hard I almost killed him. I thought he stole my drug. (R32M)*

#### 3.6.3.2 Alcohol increases the desire to use crack cocaine and vice versa

Not all participants could control the unpleasant effects of crack cocaine with alcohol consumption. Over time, alcohol use triggered the craving for crack cocaine and vice versa, with the aggravating outcome that the craving for crack cocaine was added to the craving provoked by the alcohol.

*I drank alcohol after smoking ... the more I drank, the more I wanted to use crack. Even if I did not use crack cocaine for 3 days, if I drank alcohol immediately the urge to use crack cocaine happened. I drank and smoked and vice versa until I ended up in the hospital. (F34M)*

A vicious cycle of drinking and smoking seems to occur, and drug users cannot end or limit this cycle. In fact, users can only interrupt this cycle after the occurrence of a severe outcome due to alcohol or crack cocaine poisoning or both, which can lead to hospitalization.

*When I drink alcohol, the urge to smoke crack comes. When I smoke crack, the urge to drink alcohol comes. Each time I want more and more. I am gradually killing myself. I have been on this cycle of drinking alcohol and smoking crack for a long time. I will eventually have an overdose and die. (D35M)*

### 3.6.3.3 Investment savings

The respondents reported spending less money on this drug combination. Reducing crack cocaine consumption by reducing the craving for crack cocaine with alcohol resulted in cost savings. Nonetheless, despite the cost savings with crack cocaine, there was a considerable expenditure on the purchase of alcohol.

*If I usually spend R\$ 200 (approximately USD 57 dollars) a night with crack and alcohol, only R\$ 20 (USD 5) is used for the purchase of crack and the rest is spent on alcohol. (H42M)*

However, cost savings cease to exist after the installation of the vicious cycle of crack cocaine-alcohol consumption.

*As soon as I finished smoking crack, the first thing that came to my mind was alcohol. It was instant and endless. I spent all my money buying crack and alcohol. (R27M)*

### 3.6.4 Situations that favor the use of the cocaine-alcohol combination

The optimal time for alcohol intake was an individual decision that was directly correlated with the effect sought with the use of this drug combination.

The analysis of the reports suggested a rational choice about the optimal time to use this drug combination. Drug addicts usually drink alcohol before using crack cocaine to further stimulate crack cocaine consumption. In this context, alcohol facilitated crack cocaine consumption.

*Sometimes I used alcohol first and then I wanted to use crack. (C33M)*

By contrast, those who ingested alcohol after using crack cocaine intended to modulate the effects of the latter.

*I actually use crack before drinking alcohol. Alcohol comes later and helps me have a pleasant effect. (P34M)*

However, this rationale was not maintained over time for many respondents, who indifferently used these two psychotropic drugs concomitantly.

## 4. Discussion

The interviewees reported that alcohol had many functions during crack cocaine addiction, including: increasing their courage to go to the point of sale to buy the drug, reducing the harmful effects of crack, and prolonging the favorable effects. However, the unpleasant effects of this combination are severe enough to discard the use of alcohol as a strategy to mitigate the damage caused by crack cocaine.

The study sample consisted primarily of young men, with little schooling and low socioeconomic status, who were single, unemployed, and living on the streets or in shelters. These characteristics agree with the official profile of crack consumers defined by Fiocruz [14].

The study participants revealed that before starting this drug combination, alcohol consumption was beneficial to them by giving them the courage to go to the point of sale to buy crack cocaine. In Brazil, violence at the point of sale is one of the greatest risks for crack users [11]. Haasen and Krausz [31] claimed that crack-related homicides were directly related to the risks posed by the illicit drug market. According to the Ribeiro et al. [11], drug dealers impose rules in these places, and noncompliance with these rules puts users at risk, including the risk of death. The prohibitions include failing to honor debt



with the dealers, stealing, or using psychotropic drugs in the vicinity of the point of sale; these rules are not easily met by crack cocaine user. The high demand for the drug and the developed craving cause these users to remain too long at the point of sale and suffer the consequences of disrespecting the rules in these areas. Therefore, the fear of going to the point of sale is well founded. The interviewees consumed alcohol to reduce their apprehension and give them the courage to confront unsafe conditions at the point of sale. However, alcohol impairs judgment on the dangers of risk behaviors, and thus, the consumption of alcohol to confront the dangers at the point of sale can be detrimental to these users, whose ability to acknowledge the associated risks is jeopardized [32, 33].

Another important finding is that many alcoholic beverages are consumed in combination with crack cocaine, including those not intended for human consumption, such as fuel alcohol. In some cases, the respondents used acetone in the absence of alcohol. Alcohol appears to be essential for crack cocaine use, and there is cross-sensitivity between these two drugs [31]. Lau-Barraco e Schmitz [34] reported that crack users were asked to choose between crack cocaine and/or alcohol use and preferred the drug combination rather than each drug individually. The authors consider that because alcohol and crack cocaine are consumed together and repeatedly, from a behavioral point of view, one drug may become a strong conditioned stimulus for the consumption of the other, and abstaining from one drug when the other is being consumed is difficult Lau-Barraco e Schmitz [34]. Fox et al. [35] found that access to one of these drugs during abstinence in users who used the cocaine-alcohol combination increased the self-reported craving for both drugs, reinforcing the hypothesis of a conditioned stimulus. This mechanism would explain, at least in part, how alcohol consumption increases cocaine consumption and vice versa [36, 37]. Thirst seems to be an unpleasant symptom caused by the reduction of salivary flow due to cocaine consumption, accompanied by xerostomia [38]. The authors claim that hyposalivation may lead to oral burning, soreness, or altered taste sensations [39], which increases the need for water intake by cocaine users. However, the respondents argued that despite the thirst, they preferred alcohol to water. In this respect, Knackstedt et al. [40] evaluated rats pretreated with cocaine and observed that the animals preferred ethanol to sweet water. The authors attributed this preference primarily to the anxiolytic effect of alcohol, which would motivate the alcohol intake of cocaine users.

The respondents indicated that the crack cocaine-alcohol combination prolonged and enhanced the euphoric effects of crack cocaine. This assertion is supported by the fact that this drug combination leads to the formation of cocaethylene (CE), an active metabolite homologous to cocaine [41]. CE causes euphoric effects similar to those produced by cocaine [42] but has a longer action and is less anxiogenic than cocaine [37, 43], and these factors may explain the improvement of the pleasurable effects of crack cocaine and the decreased craving for cocaine. Knackstedt et al. [40] observed that the longer duration of CE action might mask the onset of the anxiogenic effects of crack cocaine and thus produce a more desirable effect for the drug user. Bunney et al. [44] reported that the improvement of the effects of crack cocaine might occur because the mesolimbic dopaminergic pathway mediates the reinforcing effects of alcohol and cocaine, and therefore, the two substances act synergistically to increase dopaminergic activity. This characteristic might contribute to the co-abuse of these psychotropic drugs [31].

Gossop et al. [37] found differences in the pattern of combination of alcohol with cocaine powder or crack cocaine, demonstrating that the route of administration of the drug interferes with this pattern. Crack

cocaine users tend to use alcohol at the end of the crack use session and consume smaller amounts of alcohol. The authors observed that in contrast to cocaine powder users, crack cocaine users consume smaller amounts of this psychotropic drug when combined with alcohol. These findings are in line with the responses of the interviewees, indicating that smaller amounts of crack cocaine are consumed in the presence of alcohol. However, it is unclear whether the consumption of alcohol was lower. In addition, the finding by Gossop et al. [37] that alcohol was consumed only after crack cocaine consumption was not observed in our study. In our sample, the timing of the drug combination depended on the purpose of the user, i.e., the consumption of alcohol before crack cocaine use was intended to stimulate the consumption of the latter, whereas the intake of alcohol after crack cocaine use was intended to decrease the craving for cocaine and prolong its positive effects.

Brache et al. [17] analyzed the reasons and consequences of using the cocaine-alcohol combination and observed that there was a significant financial cost in the consumption of the two psychotropic drugs. By contrast, the study participants stated that they saved money when using the drug combination. This statement seems plausible because the respondents stated that alcohol use decreased the consumption of crack. This difference in discourse reinforces the findings of Gossop et al. [37] about the existence of different patterns of alcohol and cocaine association depending on the route of administration of cocaine. However, cachaça, a Brazilian alcoholic drink that was cited by the interviewees as the drink of choice in the drug association, is inexpensive (one liter of cachaça costs approximately USD 1), which may contribute to the lower costs of the drug combination. However, this does not indicate a low consumption of alcohol. Another factor to be considered is that the cost savings cease to exist when the consumption of one drug leads to the consumption of the other and vice versa.

One of the adverse consequences of the use of the drug combination cited by the respondents was aggressiveness. Several studies reported an increase in the number of injuries and violence caused by alcohol consumption [45, 46]. However, the association of cocaine and alcohol is related to more severe psychological problems [36] and in particular with an increment of suicidal and homicidal behavior [47] with respect to the use of cocaine or alcohol alone. Considering the synergistic effect of crack cocaine and alcohol, the authors claim that this drug combination may lead to violent thoughts and an increase in aggressive behaviors [48]. Other studies also identified this problem, and users of this drug combination presented adverse outcomes, including non-consensual sexual intercourse and criminal activities [36, 37]. In this respect, the authors claim that alcohol consumption produces a conditioned motivational state for cocaine use by increasing the craving for cocaine. This phenomenon may lead to relapse to crack cocaine use [49]. This result reinforces the findings of McKay et al. [50], who found that 62% of those who experienced relapse to cocaine use within 6 months of treatment consumed alcohol on the same day of relapse.

The concomitant addiction to these two drugs is another cause for concern [51]. The use of alcohol seems to be a unique feature of crack cocaine users considering that all study participants were dependent on both drugs. Previous studies found similar results, including the Epidemiological Catchment Area study developed in the United States, which reported that 85% of cocaine addicts were also alcohol abusers [52]. Other studies indicated a high prevalence of alcohol addiction ( $\geq 60\%$ ) among cocaine addicts [53, 54]. This group of users, simultaneously addicted to these two drugs, presents much more difficulties to be

treated [55] and some authors believe that this population does not respond to the available treatments [53, 56].

Cardiovascular complications are the most significant problems caused by the cocaine-alcohol combination [57]. This drug combination is arrhythmogenic, and the resulting cardiotoxicity is greater and more prolonged than that caused by crack cocaine alone [41, 42]. These symptoms occur because of the formation of CE, which is more toxic than cocaine [58, 59]. In addition, CE potentiates adverse events such as ischemia, infarction, and arrhythmia associated with cocaine [60]. These events lead to high mortality among users of this drug combination, as reported by Lucena et al [61], who found that alcohol was involved in approximately 76% of cocaine-related sudden deaths.

## **5. Conclusion**

Although the intention of crack cocaine users to combine cocaine with alcohol is to modulate the unpleasant effects of crack cocaine, practice has shown that the consequences of this combination are severe. The cross-sensitivity between these two drugs leads to the consumption of crack in the presence of alcohol and vice versa and may lead to relapse to crack cocaine use during the abstinence period. Furthermore, aggressiveness, which is a risk behavior in this group, and severe cardiotoxicity, which may cause death, make this drug combination a public health problem greater than the individual consumption of these drugs.

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### **Ethics approval and consent to participate**

The study protocol was approved by the Research Ethical Committee of the Federal University of São Paulo (CEP 1602/11). In the study, oral informed consent was obtained from each participant at the beginning of the initial interview after they were given information about the study and informed that they could withdraw at any time. With permission, interviews were recorded using a digital recorder and later transcribed in full. Anonymity of participants was maintained.

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## 7. References

1. Dunn J, Laranjeira RR, Da Silveira DX, Formigoni ML, Ferri CP. Crack cocaine: an increase in use among patients attending clinics in São Paulo: 1990–1993. *Substance Use & Misuse*. 1996;31(4):519–27.
2. Nappo SA, Galduróz JCF, Noto AR. Crack use in São Paulo. *Substance Use & Misuse*. 1996;31(5):565–79.
3. Oliveira LG, Nappo SA. Characterization of the crack cocaine culture in the city of São Paulo: a controlled patterned of use. *Rev Saude Publica*. 2008;42(4):664 –71.
4. Grangeiro A, Silva LL, Teixeira PR. Resposta à aids no Brasil: contribuições dos movimentos sociais e da reforma sanitaria. *Pan Am J Public Health*. 2009;26(1):87–94.
5. Bastos FI, Szwarcwald CL. AIDS and pauperization: principal concepts and empirical evidence. *Cad Saúde Pública*. 2000;16(1):65–76.
6. Fonseca EM, Nunn A, Souza-Junior PB, Bastos FI, Ribeiro JM. Decentralization, AIDS, and harm reduction: the implementation of public policies in Rio de Janeiro Brazil. *Cad Saúde Pública*. 2007;23(9):2134–44.
7. Mesquita F, Kral A, Reingold A, Bueno R, Trigueiros D, Araujo PJ, et al. Trends of HIV infection among injection drug users in Brazil in the 1990s: the impact of changes in patterns of drug use. *J Acquir Immune Defic Syndr*. 2001;28(3):298–302.
8. Inciardi JA. In: Monteiro MG, Inciardi JA, editors. *Brazil-United States. Binational Research*. São Paulo: CEBRID – Centro Brasileiro de Informações sobre Drogas Psicotrópicas; 1993. p. 63–75.
9. Plano integrado de enfrentamento ao crack e outras drogas (Integrated plan for dealing with crack and other drugs. 2010. Available in: [[http://www.planalto.gov.br/ccivil\\_03/\\_Ato2007-2010/2010/Decreto/D7179.htm](http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2010/Decreto/D7179.htm)] (accessed in December 20, 2019)
10. Fischer B, Cruz MS, Bastos FI & Tyndall M. Crack across the Americas – a massive problem in continued search of viable answers: exemplar views from the North (Canada) and the South (Brazil). *International Journal of Drug Police*. 2013;24(6): 631-3.
11. Ribeiro LA, Sanchez ZM, Nappo SA. Surviving crack: a qualitative study of the strategies and tactics developed by Brazilian users to deal with the risks associated. *BMC Public Health*. 2010;10:671.
12. Gonçalves JR, Nappo SA. Factors that lead to the use of crack cocaine in combination with marijuana in Brazil: a qualitative study. *BMC Public Health* 2015;15:706.
13. Chaves TV, Sanchez ZM, Ribeiro LA, Nappo SA. Crack cocaine craving: behaviors and coping strategies among current and former users. *Rev Saude Publica*. 2011;45(6):1168–75.
14. FIOCRUZ- Oswaldo Cruz Foundation –2012. National Survey on the Crack Cocaine Use. Available in: [<https://programadrogas.fiocruz.br/publicacoes/livros/51>] (accessed in November 15, 2019).
15. Wiseman EJ, Mc Millan DE. Combined use of cocaine with alcohol, cigarettes. *Am J Drug Alcohol abuse*. 1996;22(4):577-587.

16. Magura S, Rosenblum A. modulating effect of alcohol use or cocaine use. *Addict Behav.* 2000;25:117-22.
17. Brache K, Stockwell T, Macdonald S. Functions and harms associated with simultaneous polysubstance use involving alcohol and cocaine. *Journal of Substance Use.* 2012;17(5–6):399–416.
18. WHO - World Health Organization. *Global Status Report on Alcohol and Health: 2014.* Available in: [[http://www.who.int/substance\\_abuse/publications/global\\_alcohol\\_report/en/](http://www.who.int/substance_abuse/publications/global_alcohol_report/en/)] (accessed in November 3, 2019).
19. II LENAD (II National Survey of Alcohol and Drugs), 2014. Available in: [<http://inpad.org.br/lenad/>] (accessed in November 4, 2019).
20. WHO - World Health Organization. *Qualitative research for health programs.* Geneva: Division of Mental Health; 1994.
21. Taylor SJ, Bogdan R. *Introduction to Qualitative Research Methods.* New York: John Wiley & Sons Inc; 1998. Patton M. *Qualitative research and evaluation methods.* 3rd ed. Thousand Oaks: Sage Publications; 2002.
22. Kvale S. *InterViews: an introduction to qualitative research interviewing.* Thousand Oaks: Sage Publications; 1996.
23. Creswell JW: *Research design: Qualitative, quantitative and mixed methods approaches.* 3rd edition: London: Sage Publications; 2009.
24. Siegel RK. Cocaine smoking. *J Psychoactive Drugs.* 1982;4(4):271–359.
25. Biernacki P, Waldorf D. Snowball sampling: problems and techniques of chain referral sampling. *Sociol Methods Res.* 1981;10(2):141–63. ABEP (Associação Brasileira de Empresas e Pesquisa). *Critério de Classificação Econômica Brasil.* 2012.
26. DSM: *Diagnostic and Statistical Manual of Mental Disorders.* 4th edition. Washington DC: American Psychiatric Publishing; 2000.
27. Bardin L. *Análise de Conteúdo,* vol. 70. 3rd ed. Lisboa: Edições; 2004
28. NVivo qualitative data analysis Software; 2012 QSR International Pty Ltd. Victoria Australia. Version 10. Available in: <http://helpv10.qsrinternational.com/desktop/welcome/welcome.htm>. Accessed in May 26, 2017.
29. Haasen C, Krausz M. Myths versus evidence with respect to cocaine and crack: learning from the US experience. *Eur Addict Res.* 2001;7(4):159-60.
30. Amlung MT , Morris DH, and McCarthy DM. Effects of Acute Alcohol Tolerance on Perceptions of Danger and Willingness to Drive after Drinking. *Psychopharmacology (Berl).* 2014;231(22):4271–4279.
31. Livingston JA, Testa M, Windle M, Bay-Cheng LY: Sexual risk at first coitus: Does alcohol make a difference? *J Adolesc.* 2015;43:148-58.
32. Lau-Barraco C, Schmitz JM. Drug Preference in cocaine and alcohol dual-dependent patients. *The American Journal of Drug and Alcohol Abuse.* 2008; 34:211-217.

33. Fox HC, Talih M, Malison R, Anderson GM, Kreek MJ, Sinha R. Frequency of recent cocaine and alcohol use affects drug craving and associated responses to stress and drug –related cues. *Psychoneuroendocrinology*. 2005;30:880-891.
34. Heil SH, Badger GJ, Higgins ST. Alcohol dependence among cocaine-dependent outpatients: demographics, drug use, treatment outcome and other characteristics. *J Stud Alcohol*. 2001;62:14–22.
35. Gossop M, Manning V, Ridge G. Concurrent use and order of use of cocaine and alcohol: behavioural differences between users of crack cocaine and cocaine powder. *Addiction*. 2006;101:1292-1298.
36. Antoniazzi RP, Sari AR, Casarin M, Moraes CMB, Feldens AA. Association between crack cocaine use and reduced salivary flow. *Braz Oral Res*. 2017; 31:e42.
37. Woyceichoski IEC, Costa CH, Araujo CM, Brancher JA, Resende LG, Vieira I, Lima AAS. Salivary buffer capacity, pH, and stimulated flow rate of crack cocaine users. *Journal of Investigative and Clinical Dentistry*. 2013;4:160–163.
38. Knacksted LA, Ben-Shahar O., Ettenberg A. Alcohol consumption is preferred to water in rats pretreated with intravenous cocaine. *Pharmacology, Biochemistry and Behavior*. 2006;85:281-286.
39. McCance E. F., Price L. H., Kosten T. R., Jatlow P. I. Cocaine: pharmacology, physiology and behavioural effects in humans. *J Pharmacol Exp Ther* 1995;**274**: 215–23.
40. Pan W. J., Hedaya M. A. Cocaine and alcohol interactions in the rat: contribution of cocaine metabolites to the pharmacological effects. *J Pharmacol Sci* 1999;**88**: 468–76.
41. Graziani M, Nencini P, Nistico R. Gender and concurrent use of cocaine and alcohol: Pharmacological aspects. *Pharmacological Research*. 2014; 87:60-70.
42. Bunney EB, Appel SB, Brodie MS. Cocaine potentiates ethanol-induced excitation of dopaminergic reward neurons in the ventral tegmental area. *Journal of Pharmacology and Experimental Therapeutic* 2000; 293(2);383-389.
43. Borges G, Cherpitel C, Orozco R, MasDonald S, Giesbrecht N, Moskalewics J, Swiatkiewicz G, Cremonte M. Alcohol as a trigger for medical emergencies. *Subst Use Misuse*. 2013;48(7):484-489, 2013.
44. Zerhouni O, Begue L, Brousse G, Carpentier F, Dematteis M, Pennel L, Swendsen J, Cherpitel C. Alcohol and violence in the emergency room: a review and perspectives from psychological and social sciences. *Int J Environ Res Public Health*. 2013;10(10):4584-4606.
45. Salloum IM, Daley DC, Cornelius JR, Kirisci L, Thase ME. Disproportionate lethality in psychiatric patients with concurrent alcohol and cocaine abuse. *Am J Psychiatry* 1996;153:953–5.
46. Pennings EJM, Leccese AP, de Wolff FA. Effects of concurrent use of alcohol and cocaine. *Addiction*. 2002;97(7), 773–783.
47. Marks KR, Pike E, Stoops WW, Rush CR. Alcohol administration increases cocaine craving but not cocaine cue attentional bias. *Alcohol Clin Exp Res*. 2015; 39(9),1823-1831.
48. McKay JR, Alterman AI, Rutherford MJ, Cacciola JS, McLellan AT. The relationship of alcohol use to cocaine relapse in cocaine dependent patients in an aftercare study. *J Stud Alcohol*. 1999;60:176-180.

49. Rubio G, Manzanares J, Jiménez M, Rodríguez-Jiménez R, Martínez I, Iribar-ren MM, et al. Use of cocaine by heavy drinkers increases vulnerability to developing alcohol dependence: a 4-year follow-up study. *J Clin Psychiatry*. 2008;69:563–70.
50. Regier DA, Farmer ME, Rae DS, Lacke BZ, Keith SJ, Judd LL, Goodwin FK. Comorbidity of Mental disorders with Alcohol and other Drug Abuse. Results from the Epidemiologic catchment Area (ECA) study. *Jama*. 1990;264(19):2511-18.
51. Carroll KM, Rounsaville BJ and Bryant KJ. Alcoholism in treatment-seeking cocaine abusers: Clinical and prognostic significance. *J. Stud. Alcohol*. 1993; 54:199-208.
52. Higgins ST, Budney AJ, Bickel WK, Foerg FE, and Badger GJ. Alcohol dependence and simultaneous cocaine and alcohol use in cocaine-dependent patients. *J. Addict. Dis*. 1994;13:177-189.
53. Ahmadi J, Kampman KM, Oslin DM, Pettinati HM, Dackis C, Sparkman T. Predictors of treatment Outcome in Outpatient Cocaine and Alcohol Dependence treatment. *Am J Addict*. 2009;18(1):81-86.
54. Brady KT, Sonne E, Randall CL, Adinoff B, Malcon R. Features of cocaine dependence with concurrent alcohol use. *Drug Alcohol Depend*. 1995;39:69-7.
55. Laizure SC, Parker RB. Pharmacodynamic evaluation of the cardiovascular effects after the coadministration of cocaine and ethanol. *Drug Metab Dispos*. 2009;37(2):310–314.
56. Wilson LD, Jeromin J, Garvey L, Dorbandt A. Cocaine, ethanol, and cocaethylene cardiotoxicity in an animal model of cocaine and ethanol abuse. *Acad Emerg Med*. 2001;8:211–22.
57. Bailey DN. Plasma cocaethylene concentrations in patients treated in the emergency room or trauma unit. *Am J Clin Pathol*. 1993;99:123–7.
58. Foltin RW, Fischman MW. Ethanol and cocaine interactions in humans: cardiovascular consequences. *Pharmacol Biochem Behav* 1998; 31: 877–83.
59. Lucena J, Blanco M, Jurado C, Rico A, Salguero M, Vazquez R, Thiene G, Basso C. Cocaine-related sudden death: a prospective investigation in south-west Spain. *Eur Heart J*. 2010;31(3):318-29.