

Brazilian female crack users show elevated serum aluminum levels

Usuárias brasileiras de crack apresentam níveis séricos elevados de alumínio

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Abstract

Objective: There is no information in the literature on the impact of crack smoking using crushed aluminum cans as makeshift pipes, a common form of crack use in Brazil. Since aluminum intake is associated with neurological damage, we measured serum aluminum levels in crack smokers. The objective of this study was to ascertain the levels of aluminum in crack users who smoke on makeshift aluminum pipes. **Method:** 71 female crack smokers, their mean age being 28.0 (\pm 7.7), provided information about their drug use, and had blood samples tested for serum aluminum level. **Results:** 56 (79%) subjects smoked crack from crushed can pipes, while 15 (21%) smoked from other containers. Fifty-two (73.2%) out of the 71 subjects presented a serum aluminum level of 2 μ g/l and 13 (18.3%) had a serum aluminum level of 6 μ g/l cut-off point, which is above the reference value. When compared to non-drug users matched by their mean age and gender, they had similar median values and interquartile ranges for serum aluminum level [3 (2-4.6) for crack smokers; 2.9 (1.6-4.1) for controls], but with different means and standard deviations (4.7 \pm 4.9 and 2.9 \pm 1.7, respectively). **Discussion:** Crack smokers have high serum aluminum level, but we are unsure of its complete association with aluminum cans. Further studies are needed. If such association is proven true in future research, further issues will be raised in dealing with this important disorder, including proper planning and evaluation of public health policies in this area.

Descriptors: Aluminum; Crack cocaine; Public health; Toxicity; Serum

Resumo

Objetivo: Não há informação na literatura sobre o impacto do uso de crack fumado em latas de alumínio utilizadas como cachimbos improvisados, uma forma comum de uso de crack no Brasil. Uma vez que a ingestão de alumínio está associada a dano neurológico, nós medimos alumínio sérico em usuários de crack. O objetivo deste estudo foi avaliar os níveis de alumínio em usuários de crack que fumam em cachimbos improvisados de lata de alumínio. **Método:** Setenta e uma usuárias de crack, com média de idade de 28,0 anos (\pm 7,7), forneceram informação sobre seu uso de drogas e tiveram amostras de seu sangue testadas para níveis séricos de alumínio. **Resultados:** Cinquenta e seis (79%) sujeitos fumaram crack usando cachimbos de lata e 15 (21%) fumaram em outros formatos. Cinquenta e dois (73,2%) dos 71 sujeitos apresentaram níveis de alumínio sérico de 2 μ g/l e 13 (18,3%) tinham níveis no ponto de corte 6 μ g/l, o que está acima dos valores de referência. Quando comparados com não-usuários pareados por média de idade e do mesmo gênero, os sujeitos tiveram valores medianos e intervalos inter-quartil para níveis séricos similares [3 (2-4,6) para usuários de crack; 2,9 (1,6-4,1) para os controles], porém com médias e desvios-padrão diferentes (4,7 \pm 4,9 e 2,9 \pm 1,7, respectivamente). **Discussão:** Usuários de crack apresentam altos níveis de alumínio sérico, mas não temos certeza disto estar associado completamente com as latas de alumínio. Mais estudos são necessários. Se tal associação se mostrar verdadeira em pesquisa no futuro, questões terão que ser debatidas a respeito deste problema, incluindo planejamento apropriado e avaliação das políticas públicas nesta área.

Descritores: Alumínio; Cocaína crack; Saúde pública; Toxicidade; Soro

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Introduction

Aluminum is found in large quantities in nature, and concerns about the systemic effects of chronic exposure have been observed in the literature.¹ Aluminum as well as phenol and manganese are among the most toxic substances to the environment and to humans,² since they can alter underground water. Despite of the advances in the study of biokinetics and bioavailability, it is still unknown whether there is a biological function for aluminum in the human body.³ Nevertheless, a healthy person ingests approximately 8 to 9 mg/day of this metal through food and water, which are its primary natural sources. Aluminum can spread to the brain through the oral or nasal cavity.^{1,4} Residual aluminum deposits have been detected in the organs and tissues of normal individuals through several techniques, including histochemistry and coloration.⁵

Aluminum intoxication causes alterations in cognitive and neurological functioning, resulting in mental confusion, derealization disorders, depression, apathy, apprehension, nervousness, loss or reduction of temporal perception; its presence has also been indicated in dementia associated with dialysis.^{1,4} Epidemiologic evidence also suggests that high aluminum levels in the cerebral tissue could be related to the pathogenesis and progression of Alzheimer's Disease, but a direct causal association has not been clearly established yet.^{1,6-9}

Possible sources of aluminum contamination include antacids, kitchen utensils and cookware, aluminum foil, gasified water, baking powder, cheese, wheat flour, tooth paste tubes, and antiperspirants.³

With regard to drug use, only one published study investigated the possible toxic effects of aluminum,¹⁰ showing an increase in bronchial hyperactivity rates in individuals that inhaled cocaine mixed with heroine heated over aluminum foil. Unfortunately, serum aluminum levels were not examined in this study.

In Brazil, the use of aluminum beer or soft drink cans for crack smoking has been well documented. Crack smokers typically make holes in the surface of the can, cover the top of the holes with aluminum foil, and place crack and cigarette ashes on top for smoking. After smoking, some users will scrape the inner layers of the can, which contain some residues of crack, and smoke that mixture again.

We hypothesized that repeated contact with the cans and foil, and the subsequent inhalation of the aluminum they contain, would increase serum aluminum levels. Based on the potential harm that chronic use of aluminum cans and foil might produce among crack users, we measured blood levels of aluminum in a convenience sample of female crack users recruited for a larger study on domestic violence among drug-addicted couples and the transition from snorted cocaine into crack,* who reported recent crack smoking using aluminum implements.

Method

Using chain referral and snowball sampling techniques, outreach workers recruited 76 female crack users in Porto Alegre, Brazil, during 2004. They were brought to a public health clinic for HIV, HCV and Serum Aluminum Level (SAL) testing, as well as to provide data on their drug use and exposure to violence. This paper describes only the findings related to SAL.

Inclusion criteria were ages 18 and above and crack use at least once in the last 30 days. All subjects signed informed consents before providing blood and interview data. The study was approved by the Institutional Review Board (IRB) of Hospital de Clínicas of Porto Alegre, as well as the University of Delaware's IRB. Blood samples were refrigerated and sent to Toxilab®, which conducted the aluminum assays. Data collection instruments contained questions to assess various methods of crack smoking, including aluminum cans, glass or plastic pipe, and "macaquinho (little monkey)" – smoking crack inside a marijuana cigarette. Exclusion criteria included any neurological or severe psychiatric symptoms such as psychosis, severe depression, and drug intoxication that could interfere with the interview.

We tested SAL in whole blood using a vial with heparin for specific metal dosage. Blood samples were refrigerated at 6 °C until bioassays were conducted. Dosages were obtained by means of an atomic absorption spectrometer with a graphite oven and the Zeeman corrector (Perkin Elmer Instruments, model SIMAA 6000). Calibration was conducted using Merck ICP Multi Element Standard Solution, Lot OC 254877. Results were provided in absolute values, in µg/l.

Categorical variables are described by relative percentages. Continuous variables with symmetrical distribution are described using means and standard deviations and compared using Student's t test. For asymmetrical distributions, we used median and interquartile range (IQR). Since SALs showed an asymmetrical distribution, we compared levels between groups by means of the Mann-Whitney test. For analytic purposes, we used a first cut-off point for SAL at 2 µg/l ("normal"), with a second cut-off point at 6 µg/l. The values were transformed into dichotomous variables, which were then analyzed using the Fisher's exact test. We used Spearman's rank correlation coefficient to ascertain correlations between the reported number of crack rocks used in the month prior to interview and SALs. For all the analyses we established a level of statistical significance of 0.05.

Results

Seventy-three subjects were initially contacted for the study. SAL data from two cases could not be measured due to hemolysis. Therefore, we present data on 71 complete cases.

Subjects had a mean age of 28.0 years (\pm 7.7). Their median family income was US\$ 131 per month, with an interquartile range between US\$ 58 and US\$ 187. Just over 76% reported having a steady sexual partner, and 88.7% had at least one child. The mean years of education were 4.5 (\pm 2.3); 78.9% (n = 56) of the subjects reported smoking crack in an aluminum can. The other 15 described smoking crack either in glass or plastic tube pipes. The overall median SAL was 3.0, (IQR 2.0-4.6) with no differences in distribution with regard to the method of use (from a can or other container). Fifty-two (73.2%) out of the 71 subjects had a SAL of 2 µg/l, again with no difference between can users and non-can users (80.4% vs. 86.7%, respectively). Thirteen subjects (18.3%) were identified with a SAL of 6 µg/l; 26.8% of the subjects who used aluminum cans had this SAL, compared to 26.7% of the other group. However, no statistical difference was found. On average, subjects described using a mean of 30 crack rocks (IQR 10-62) per month, with no difference between groups. We ran correlation tests between

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the number of crack rocks used in the month prior to interview and aluminum levels, and found no statistical significance ($r = -0.11$ and $p = 0.35$).

Since this was the first attempt to describe such type of findings, we needed to compare these preliminary data to SALs on non-drug users. Therefore, we obtained sample data from subjects matched by mean age and gender who were non-drug users from the files of Toxilab; we found similar median values and interquartile ranges for SAL between groups [3 (2-4.6) for crack smokers; 2.9 (1.6-4.1) for controls], but with different means and standard deviations [(4.7 ± 4.9 for crack smokers; 2.9 ± 1.7 for controls ($p = 0.059$, Mann-Whitney's test)], as shown in Figure 1.

Discussion

To the authors' knowledge, this is the first study that evaluates SAL in crack users. Because the prevalence of crack use continues to increase in Brazil and elsewhere, the potential association of aluminum intoxication and Alzheimer's Disease in this growing population represents a significant public health issue. As has been recently reported by Ribeiro et al., mortality rates are very high in crack cocaine users. Any measure that could reduce mortality rates among this population should be studied in detail.¹¹

It is clear that a certain amount of aluminum is retained in the body, most likely in the skeleton and cerebral tissue. Most of the aluminum ingested, however, is excreted through urine in a few days or weeks.⁵ A straightforward assumption would be that, since some aluminum is retained in the body, the more consistent the contact with aluminum, the stronger the potential for intoxication. Therefore, subjects who reported longer histories of crack use should yield higher levels of aluminum in the assays – which was not the case in our study. There might be other hypotheses to consider at this point, as well as other potential forms of contact with heated aluminum utensils (such as kitchen pans), or with aluminum existing in drinking water – which might possibly confound

the findings of this study. Also, we did not assess whether there was other contact with the metal in this sample, such as aluminum foil placed on top of glass or plastic pipes for smoking, since there have been reports of such use by local key informants. Therefore, we cannot rule out that other potential sources of aluminum contamination have a role in SAL in this sample, since we did not control for water source supplies or asked specific questions about kitchen utensils, use of soda cans, use of aluminum foil on top of a plastic pipe, combinations of drug use, or either for the potential presence of other forms of aluminum mixed with the drug itself, such as medications used to "cut" cocaine that may have aluminum in its content. The higher standard deviation found among subjects who reported use by means of makeshift aluminum pipes only suggests a higher source of aluminum contamination that must be ascertained by a more controlled methodology in a future study.

If the association between high aluminum levels and Alzheimer's Disease proves conclusive in the future, important prevention issues will be raised, such as the continuous evaluation of public health policies in this area. However, we have not yet established whether it is the can, foil, or other source of aluminum related to the drug used that is associated with the increase in aluminum levels. Also, a more specific control group must be used in future studies. Our study could not rule out other potential sources of aluminum exposure to account for the high SALs in our sample, as well as its expected impact on males, since this was a female-only convenience sample of subjects recruited for a larger study with further purposes. A subsequent study with males and with more control over the potential confounding biases that have been highlighted in this paper has been submitted for funding to either confirm or refute our hypotheses.

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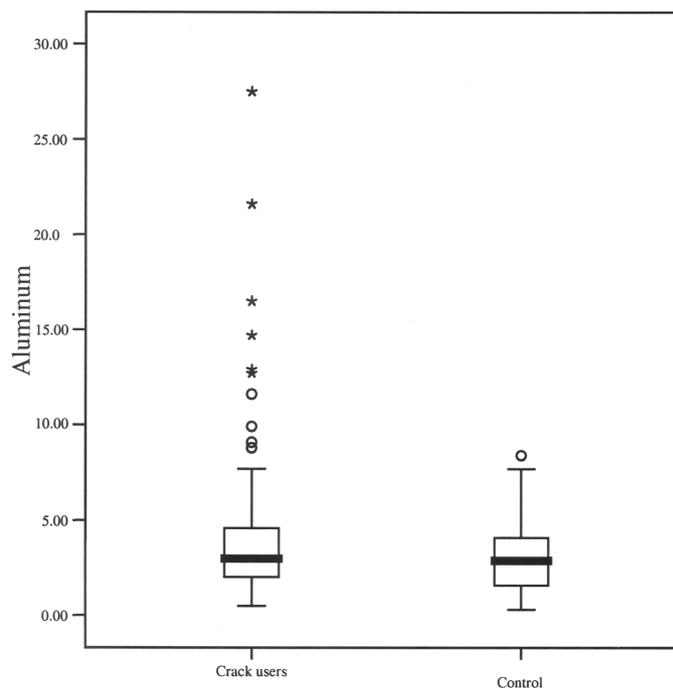


Figure 1 - Comparison of median serum aluminum levels between crack users and controls

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