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To cite this article: Abigail Olinde, Chelsea Hayman, Ivan Ivanov, Lauren Schwartz, Joshua Bloom, Mark K. Su & Rana Biary (2025) A survey study of urban retailers selling alkyl nitrites ("poppers") in the New York City area which led to public health interventions, Clinical Toxicology, 63:4, 273-277, DOI: [10.1080/15563650.2025.2455531](https://doi.org/10.1080/15563650.2025.2455531)

To link to this article: <https://doi.org/10.1080/15563650.2025.2455531>



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Published online: 12 Mar 2025.



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A survey study of urban retailers selling alkyl nitrites (“poppers”) in the New York City area which led to public health interventions

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ABSTRACT

Introduction: Alkyl nitrites (“poppers”) are used recreationally for sexual enhancement, muscle relaxation, and euphoria. However, they can be toxic and cause adverse reactions such as methemoglobinemia. While inhalation is the typical route of usage, the New York City Poison Center has noted an increase in calls related to ingestion. Given the uncertainty of usage instructions at the point of sale, our study aimed to assess instructions provided to consumers about alkyl nitrite use and to evaluate the proximity and co-sale of alkyl nitrites with similarly appearing energy drink shots.

Methods: We conducted a cross-sectional convenience sample survey of smoke shops, cannabis dispensaries, and exotic shops within the catchment area of an urban poison center. Plain clothes “investigators” (i.e., the researchers) visited these retailers and followed a predetermined protocol and script to request information regarding the availability and usage of alkyl nitrites. Additionally, the researchers attempted to visually assess the proximity of alkyl nitrites to similarly appearing energy drink shots during their visit.

Results: Ninety-eight stores were visited in the New York City area, and eighty-six met the inclusion criteria of selling alkyl nitrites. After being questioned, forty-one (48%) retailers advised inhalation. Thirty-eight (44%) vendors were unsure how to use alkyl nitrites or refused to answer. Seven (8%) stores recommended ingestion. Furthermore, fifty-one (59%) vendors also sold 5-Hour Energy® drinks and alkyl nitrites were located near these energy drink shots in twenty (39%) of these fifty-one stores.

Discussion: Many commercial alkyl nitrite retailers in our survey area lack knowledge or provide potentially inaccurate information regarding the use of alkyl nitrites. Additionally, alkyl nitrites are often sold alongside commercial energy drinks, potentially increasing the risk of incidental ingestion.

Conclusions: Further research is necessary to determine the impact of these patterns of sale and potential misinformation. Discussing preliminary results of our survey with the New York City Department of Health led to the rapid creation of an informational poster and local outreach. Clinicians should report cases of alkyl nitrite use to their regional poison center to allow for more targeted and timely public health intervention.

ARTICLE HISTORY

Received 13 August 2024
Revised 9 January 2025
Accepted 14 January 2025



KEYWORDS

Alkyl nitrite; energy drink; ingestion; inhalation; poppers

Introduction

Alkyl nitrites, commonly known as “poppers,” are a group of drugs that include amyl nitrite, butyl nitrite, and isopropyl nitrite. These substances are typically sold in small bottles, which are held to the nostrils for inhalation. The term “poppers” originated from the sound of glass vials being crushed before inhalation. Amyl nitrites were first described in the medical literature in the 1860s when they were found to help alleviate angina [1]. When nonprescription sales were restricted in 1968, sex and drug paraphernalia shops began selling small vials marketed as room deodorizers or liquid incense [2]. Recreational alkyl nitrite use increased in the 1970s amidst the disco club scene, and alkyl nitrites continue to be popular today [3].

Alkyl nitrites are rapid-onset, short-acting vasodilators that are used recreationally to enhance sexual activities due to their psychoactive and muscle relaxant effects. Common side effects of inhaling alkyl nitrites include headache, tachycardia, dizziness, visual disturbances, and facial flushing. More serious adverse effects can include methemoglobinemia, hemolysis, maculopathy, and dermatitis [2]. The 2021 Global Drug Survey reported that 15.8% of respondents used alkyl nitrites at least once in their lifetime, with 5.8% reporting use within the last year [4]. In the United States (US), recent epidemiological research on alkyl nitrite use is limited. A 2020 study found that approximately 3.3% of US adults have used alkyl nitrites during their lifetime [5]. Among homosexual men, a study conducted in three large US cities (Atlanta,

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[enters shop]

[looks for 5h energy or energy shots, or poppers, in display cases]

Q1 (only ask if you don't see poppers on display; if you do, switch to Q2)

[to cashier/shopkeep] either:

"Hi, do you sell poppers?"

AND/OR

"Hi, I'm looking for RUSH"

Q2: Ask only if the shop sells poppers/RUSH

"What do I do with these?"

OR

"Do you know how I'm supposed to use these?"

[declines to buy poppers, leaves shop]

Figure 1. Predetermined protocol and script to request information regarding the availability and usage of alkyl nitrites.

Chicago, and New York City) found that 20.7% of respondents had used alkyl nitrites within the past three months, second only to cannabis [6].

Today, the recreational use of alkyl nitrites is illegal in the US, but online shops and novelty stores bypass this legal restriction by selling alkyl nitrites as products marketed as air fresheners, video head cleaners, and fingernail polish removers [3]. A 2014 New York State regulation mandates that the packaging must "clearly indicate the legitimate purpose or use of the product on the package" [7]. Therefore, in order to deter individuals from using the product for "intoxication, inebriation, excitement, stupefaction, or the dulling of his brain or nervous system," the packaging does not provide information on any methods of use [7]. This lack of information can lead people to ingest alkyl nitrites as opposed to inhaling them.

A recent analysis of National Poison Data System® data found an increase in alkyl nitrite use and a corresponding rise in the number of cases of methemoglobinemia specifically linked to alkyl nitrite ingestion [8]. This study aims to assess urban vendors' understanding of how alkyl nitrites are used and to evaluate the co-sale and proximity of alkyl nitrites to similarly looking energy shot drinks.

Methods

Study design

We conducted a cross-sectional convenience sample survey of smoke shops, cannabis dispensaries, and exotic item stores within the catchment area of the New York City Poison Center in May 2023. Our investigator team consisted of a heterogeneous group of healthcare providers and educators in Emergency Medicine and Medical Toxicology varying in age, race, and gender. Google Maps was originally utilized to locate and create a list of vendors in New York City neighborhoods: forty-seven in Manhattan, fifteen in Queens, and nine in Brooklyn. Investigators on foot subsequently refined this list by adding or removing retailers based on their own discretion. These investigators dressed in plain clothes and individually visited retailers as potential buyers using a predetermined



Figure 2. Example of energy drink shots located in close proximity to alkyl nitrites in a commercial display.

protocol and script to request information regarding the availability and usage of alkyl nitrites (Figure 1). Inclusion criteria required that stores sold alkyl nitrites at the time of the investigation. Responses to the survey questions were recorded by the investigator immediately after leaving the store and later transposed to a Google Sheet. This study was reviewed and deemed exempt by the Institutional Review Board of the New York City Department of Health and Mental Hygiene.

Outcomes

The primary outcome of the study was to determine whether vendors instructed investigators to inhale, ingest, were unsure

(how to use the substance, what the substance was, or how to answer the question), or declined to answer. Our second outcome was to assess how many stores that sold alkyl nitrites also sold energy drink shots and whether these products were located in close proximity (same shelf or cabinet) to alkyl nitrites (Figure 2).

Analysis

Responses to the survey questions were divided into three different categories: "unsure/refused to answer", "inhalation", and "ingestion". The frequency of responses on how to use alkyl nitrites and if alkyl nitrites were in close proximity to 5-Hour Energy® drinks (same shelf/cabinet) were calculated.

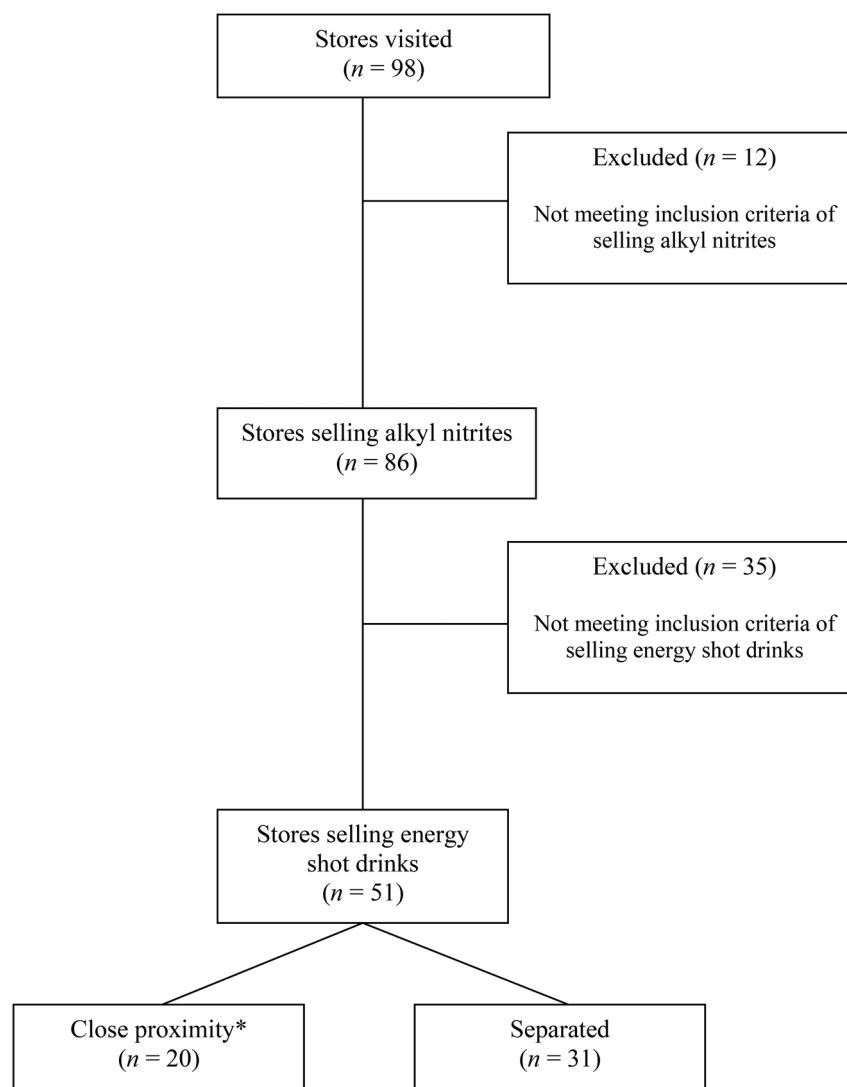
Results

A total of ninety-eight stores were identified and surveyed by our investigator team over a two-week period. Stores in

three of the five New York City boroughs were surveyed: seventy-one in Manhattan, thirteen in Brooklyn, and fourteen in Queens. Of those stores, eighty-six met the inclusion criteria of selling alkyl nitrites at the time of the investigation. When vendors were asked about the appropriate usage of alkyl nitrites, thirty-eight vendors (44%) were unsure or refused to answer, forty-one (48%) advised inhalation, and seven (8%) advised ingestion. Additionally, fifty-one (59%) of these sellers also sold energy drinks such as 5-Hour Energy®. Of these stores, alkyl nitrites were noted to be in close proximity (same shelf or cabinet) in twenty stores (39%) (Figure 3).

Discussion

While both inhalation and ingestion of alkyl nitrites are associated with the occurrence of methemoglobinemia, a recent study of US National Poison Data System® data conducted over 10 years found that a greater percentage of individuals



*- Same shelf or cabinet

Figure 3. Number of total stores visited and excluded; location of energy shot drinks and alkyl nitrites in stores selling both products.

who ingested alkyl nitrites experienced more major adverse outcomes and hospitalizations compared to those who inhaled, [8]. Prior to this, multiple case reports have similarly noted an increased toxicity of alkyl nitrite ingestion compared to inhalation [9–14]. While less than 10% of our survey vendors suggested that ingestion was the “correct” way to use alkyl nitrites, only 48% responded that inhalation was how alkyl nitrites should be used. Since alkyl nitrite use can lead to morbidity and even death, it is important that stores selling alkyl nitrites provide potential users with accurate information about how to minimize harm when using alkyl nitrites.

In this survey of stores, we found that 39% of stores had energy shot drinks and alkyl nitrites being displayed on the same shelf or cabinet. This close proximity of these two products could further increase the risk of customers buying and mistakenly ingesting the drug. In 2021, the US Food and Drug Administration warned the public via its website and social media of the similarity between alkyl nitrites and energy shot drinks [15]. Multiple case studies have reported unintentional ingestion of alkyl nitrites [16–18]. In 2023, Vachhani et al. [19] documented a case study of a man mistaking alkyl nitrites for an energy shot drink and who subsequently developed methemoglobinemia.

Following the completion of the data collection for this study, preliminary results were submitted to the New York City Department of Health and Mental Hygiene, leading to a multidisciplinary effort to inform the public of this issue. Over a three-month period, public health authorities released a health advisory for healthcare providers, along with social media posts (Figure 4) and informational posters (Figure 5), to educate the public about adverse reactions associated

with ingestion [20]. Social media communications were picked up by media outlets [21].

Several limitations of this study should be noted. The group of investigators varied in age, race, and gender, which could have influenced vendor response based on the appearance of the individual asking questions. Additionally, the investigators were all employed in healthcare-related professions and were aware of the hypothesis being tested in the study, which may have introduced biases into their interactions. Our application of a scripted protocol was an attempt to minimize or remove this bias. We only spoke to the vendor present at the time of our visit, which may not represent the knowledge of other vendors at the same store. It is unknown whether the condition of our study accurately replicates typical alkyl nitrite purchases or how often similar conversations occur at the point of sale. Vendors may generally be cautious discussing the use of products such as alkyl nitrites, which could have legal implications; these concerns may have biased the responses we observed. Our initial study design did not incorporate a difference between “refusing to answer” and “not knowing,” and therefore, these data were combined into a single category.

Our poison center has a unique relationship with the Department of Health, which allowed for a multipronged public health response to the data collected in this study. This also means that replication of this study or interventions may be less feasible in other locales. Additionally, alkyl nitrite



Figure 4. An example of a social media post warning of potential adverse effects to alkyl nitrites.

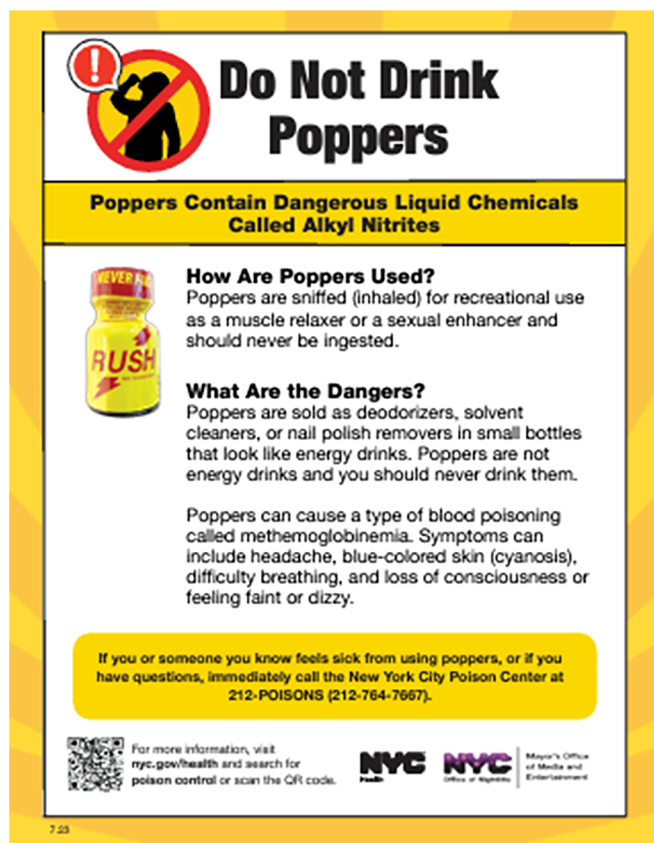


Figure 5. An informational poster sent to commercial retailers to educate the public about adverse reactions associated with the use of alkyl nitrites.

regulations vary by location, and our results may not be easily generalizable because of this. However, it is notable that common alkyl nitrite brands like Rush® are sold in multiple areas with consistent labeling, suggesting that popper brands are using a common strategy to avoid regulations across jurisdictions.

Conclusions

Based on the results of this study, we determined that many commercial alkyl nitrite retailers either do not know or offer potentially inaccurate information about the use of alkyl nitrites. Additionally, alkyl nitrites are often sold in close proximity to commercial energy shot drinks. Both of these factors potentially increase the risk of purchasers mistakenly ingesting alkyl nitrites, which can lead to an increased frequency of adverse reactions. After the completion of the study, the results were shared with the New York City Department of Health and Mental Hygiene, which led to a rapid multidisciplinary response to educate the public on this issue of concern. Further research and public health efforts are necessary to address these risks and improve safe use practices for alkyl nitrites.

Acknowledgement

This research was presented at the North American Congress of Clinical Toxicology in 2023.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

The authors reported there is no funding associated with the work featured in this article.

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