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## Associations between Delta-8 THC and Four Loko retail availability in Fort Worth, Texas

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## Associations between Delta-8 THC and Four Loko retail availability in Fort Worth, Texas

### Abstract

Alcohol and cannabis are two of the most widely used substances among young people, and availability and price are two of the most significant determinants of use. Four Loko products contain up to 5.5 standard alcoholic drinks in a single can, are one of the least expensive ready-to-drink alcohol products on the market and are commonly consumed by underage drinkers. Delta-8 THC is a psychoactive substance with no federal regulations regarding minimum purchase age, ingredients and synthesis, marketing, and testing for potency or contaminants. Delta-8 THC products can be inexpensively synthesized and are sold for low prices. Given that young people often use both products, and use of these products can result in negative consequences, it is important to understand whether these products are being sold in the same stores, which would indicate the presence of niche stores marketing high-risk, youth-oriented substances. This study included 360 locations with off-premise beer or beer/wine licenses in Fort Worth, Texas. Locations were called and asked whether they sold Delta-8 THC. Four Loko's availability was determined using the manufacturer's website. A logistic regression model examined associations between the availability of Delta-8 THC and Four Loko. Of the 360 locations, 38% sold Four Loko and 9% sold Delta-8 THC. Delta-8 THC availability was significantly associated with higher odds of Four Loko availability (OR=2.15, 95%CI=1.05, 4.43). Given the associations between the retail availability of Delta-8 THC and Four Loko, policies that limit access to such products, including near schools and in stores that youth patronize, may be warranted.

### Keywords

Four Loko, supersized alcopop, Delta-8 THC, hemp-derived cannabinoid, retail license

### Authors

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## Associations between Delta-8 THC and Four Loko Retail Availability in Fort Worth, Texas

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### Abstract

Alcohol and cannabis are two of the most widely used substances among young people, and availability and price are two of the most significant determinants of use. Four Loko products contain up to 5.5 standard alcoholic drinks in a single can, are one of the least expensive ready-to-drink alcohol products on the market and are commonly consumed by underage drinkers. Delta-8 THC is a psychoactive substance with no federal regulations regarding minimum purchase age, ingredients and synthesis, marketing, and testing for potency or contaminants. Delta-8 THC products can be synthesized inexpensively and are sold for low prices. Given that young people often use both products, and use of these products can result in negative consequences, it is important to understand whether these products are being sold in the same stores, which would indicate the presence of niche stores marketing high-risk, youth-oriented substances. This study included 360 locations with off-premise beer or beer/wine licenses in Fort Worth, Texas. Locations were called and asked whether they sold Delta-8 THC. Four Loko's availability was determined using the manufacturer's website. A logistic regression model examined associations between the availability of Delta-8 THC and Four Loko. Of the 360 locations, 38% sold Four Loko and 9% sold Delta-8 THC. Delta-8 THC availability was significantly associated with higher odds of Four Loko availability (OR = 2.15, 95%CI = 1.05,4.43). Given the associations between the retail availability of Delta-8 THC and Four Loko, policies that limit access to such products, including near schools and in stores that youth patronize, may be warranted.

**Keywords:** Four Loko, supersized alcopop, Delta-8 THC, hemp-derived cannabinoid, retail license

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### Introduction

Supersized alcopops are beverages with high alcohol content and sugar-sweetened flavors (Rossheim & Thombs, 2013, 2018). Four Loko is the most popular brand of supersized alcopops among underage drinkers (Fortunato et al., 2014). Four Loko

beverages are most often sold in a single 23.5-ounce can that is not re-sealable, facilitating rapid consumption during a single drinking event (Rossheim et al., 2019a; Rossheim & Thombs, 2018; Rossheim et al., 2020b). A single can of Four Loko may contain up to 5.5 standard alcoholic drinks (Rossheim et al., 2019a; Rossheim et al.,

2020b). However, drinkers often underestimate the number of alcoholic drinks in a single can of Four Loko (Rossheim et al., 2018; Rossheim et al., 2020b). This presents a public health concern, given the number of negative consequences (e.g., alcohol-related injuries) related to Four Loko use, particularly among adolescents and young adults (Albers et al., 2015; Rossheim et al., 2020a; Rossheim et al., 2021).

Consuming a single can of Four Loko in a sitting results in heavy episodic drinking, which is related to a higher burden of negative consequences including blacking out, vomiting, injury, calls to poison control centers, and emergency department visits (Albers et al., 2015; Cleary et al., 2012; Rossheim et al., 2019a; Rossheim et al., 2021; Rossheim & Thombs, 2018). Consuming two cans of Four Loko drastically increases the risk of experiencing alcohol poisoning (Rossheim & Thombs, 2018). Despite the numerous negative consequences associated with the consumption of supersized alcopops, young adults often consume more than one can in a single sitting (Rossheim et al., 2019a; Rossheim et al., 2020a).

Four Loko products are primarily sold in gas stations or neighborhood/convenience stores at inexpensive prices, and price promotions are common (Rossheim & Thombs, 2013; Rossheim et al., 2019b). These are often the types of retail locations where adolescents and young adults access alcohol (Freisthler et al., 2003; Merrill et al., 2000; Paschall et al., 2007). Adolescents and young adults are likely to prefer supersized alcopops because of their low price, easy accessibility, and marketing (e.g., sugar-sweetened, bright colors, and social media presence) (Olson et al., 2022; Rossheim et al., 2020a; Rossheim et al., 2022; Rossheim et al., 2019b).

Another substance commonly used among adolescents and young adults is

cannabis (National Survey on Drug Use and Health (NSDUH), 2021). Although most use of the cannabis plant occurs in the form of Delta-9 THC, use of the isomer Delta-8 THC has been on the rise since it was implicitly legalized by the 2018 Farm Bill (Johnson-Arbor & Smolinske, 2021; Kruger & Kruger, 2022; Leas, 2022). Because Delta-8 THC is implicitly legal at the federal level, there are no minimum age restrictions, childproof packaging is not required, and factors such as ingredients, synthesis, and marketing are not federally monitored or restricted (United States Congress, 2019). To our knowledge, no national data demonstrate the prevalence of Delta-8 THC usage. However, recent data using a convenience sample of cannabis users indicated that 16.7% of them had used Delta-8 THC in the past month (Livne et al., 2022).

Similar to Four Loko, many Delta-8 THC products have brightly colored packaging that is appealing to youth (Leas, 2022). There have also been reports of negative consequences arising from Delta-8 THC use (Akpunonu et al., 2021; Chan-Hosokawa, 2021; United States Food and Drug Administration, 2022). Specifically, from January 1<sup>st</sup>, 2021 through February 28<sup>th</sup>, 2022, there were 2,362 calls to poison control relating to Delta-8 THC use (United States Food and Drug Administration, 2022). Notably, 41% of these calls involved youth, and 40% were due to unintentional exposure to Delta-8 THC (United States Food and Drug Administration, 2022).

The marketing of high-risk substances is often related, and more exposure to substance-related marketing is strongly associated with substance use (Davis et al., 2019; Jackson et al., 2018; Rose et al., 2019). Research also indicates that more shelf space dedicated towards single-serve alcoholic drinks is associated with more violence around the outlet (Parker et al., 2011). Similarly, easy access to substances is associated with more substance use (Broman,

2016). Therefore, it is vital to identify potential co-marketing of substances, as this may increase accessibility to both substances and thus, may increase subsequent use and related harms. This study assessed the potential associations between Delta-8 THC and Four Loko retail availability. This is vital information given the high prevalence of use among adolescents and young adults and related consequences.

## Methods

### Sampling Frame and Data Collection

We used data from a larger parent study that assessed the retail availability of Delta-8 THC in Fort Worth, Texas. Locations with alcohol, tobacco, or CBD retail licenses were called from July 20th through July 28th, 2022. Of the 1,223 locations called, 1,026 locations (84%) answered the question, "Do you sell Delta-8?" Rossheim (2022) provides additional information. In the current study, we examined the sub-set of locations that had licenses to sell beer or beer and wine to be consumed off-premise ( $n = 360$ ) because these are the types of stores that most often sell Four Loko (Rossheim et al., 2019b; Rossheim et al., 2015). These locations also may have had other retail licenses such as spirit, tobacco, or on-premise licenses.

Information regarding the retail availability of Four Loko at each location was collected using the Four Loko retailer's website. Two independent reviewers (authors SO and VS) gathered data from the Four Loko manufacturer's website from August 5th through August 7th, 2022. Cohen's Kappa for the reliability of determining Four Loko retail availability was 0.98 (Fleiss et al., 2013), demonstrating near-perfect agreement between the independent reviewers and little change in retail availability during this brief time.

## Measures

During each phone call, trained researchers asked retailers, "Do you sell Delta-8?" which was dichotomized as yes (1) or no (0). Using the Four Loko website, locations were coded as either selling Four Loko (1) or not (0).

## Data Analysis

Frequencies were used to describe sample characteristics. A chi-square test was used to examine associations between the retail availability of Four Loko and Delta-8 THC; an effect size was calculated based on results from the chi-square test. We used a logistic regression model to examine associations between Delta-8 THC and Four Loko retail availability. We used Stata version 15.1 (College Station, TX) for analyses.

## Results

Among the 360 locations, 135 (37.5%) sold Four Loko and 33 (9.2%) sold Delta-8 THC. There were 117 locations (32.5%) that only sold Four Loko, 15 locations (4.2%) that only sold Delta-8 THC, 18 locations (5%) that sold both Four Loko and Delta-8 THC, and 210 locations (58.3%) that sold neither Four Loko or Delta-8 THC. A chi-square test indicated Delta-8 THC retailers also tended to sell Four Loko ( $p = .034$ ). The effect size of the chi-square test was  $w = 0.11$ , indicating a relatively small effect. Among those locations that sold Delta-8 THC, 54.5% (18/33) also sold Four Loko. Logistic regression results indicated that selling Delta-8 THC was statistically significantly associated with higher odds of selling Four Loko products (OR = 2.15, 95% CI: 1.05, 4.43; overall model fit:  $p = .037$ , Pseudo  $R^2 = 0.0091$ ).

## Discussion

To the best of our knowledge, this study is the first to examine associations between retail availability of Delta-8 THC and Four Loko. Findings indicated that Delta-8 THC retailers had higher odds of also selling Four Loko. These findings are important given that Four Loko and Delta-8 THC are both commonly used by adolescents and young adults, a population at high risk of experiencing substance-related negative consequences (Chan-Hosokawa, 2021; United States Food and Drug Administration, 2022; Fortunato et al., 2014; Rossheim et al., 2020a; Rossheim et al., 2022). Importantly, both Four Loko and Delta-8 THC products are easily accessible for inexpensive prices (Rossheim, 2022; Rossheim & Thombs, 2013; Rossheim et al., 2019b). Thus, these may be particularly high-risk locations in terms of providing access to multiple high-risk substances.

## Strengths and Limitations

There are several strengths and limitations to be mentioned. First, data were from a single city in Texas, which limits the generalizability of study findings. However, using data from a single city increases internal validity by reducing the potential for bias from comparing cities with differing laws. Second, the Four Loko website was only a proxy for current availability, as it captured recent deliveries from wholesalers. Regardless, the intent of providing this information on the company's website is to direct prospective customers to where they can most likely purchase the product. Moreover, to maximize the response rate from retailers, the questions were kept brief, limiting information about other covariates. Lastly, due to relatively small sample sizes, estimates may be imprecise. Regardless, this was the first study to examine associations

between specific types of high-risk alcohol and cannabis product availability. Future research should assess the geographic distribution and density of these locations, their distance from schools, and how they relate to the etiology of health disparities and crimes in the neighborhoods surrounding retail stores.

## Implications for Health Behavior Research

The use of alcohol and cannabis, two of the most widely used substances among adolescents and young adults, is strongly impacted by price and accessibility (Broman, 2016; National Survey on Drug Use and Health (NSDUH), 2021; Zvorsky et al., 2019). The retail environment shapes health behaviors, and the availability of high-risk products can drive the prevalence and spatial distribution of acute harms (Galster, 2012). Simultaneous alcohol and cannabis use is common, and concurrent availability of these products may facilitate use (LoParco et al., 2023). This is especially true when considering the low price of Four Loko and Delta-8 THC products, which are both available for less than \$5 (Rossheim, 2022; Rossheim et al., 2019b). Given the youth-oriented marketing for both Delta-8 THC and Four Loko and the price-sensitivity among youth, it is likely that adolescents and young adults will be impacted the most by the presence of these retail locations (Johnson-Arbor & Smolinske, 2021; Leas, 2022; Rossheim et al., 2020a; Rossheim & Thombs, 2013). Notably, youth and young adults have a high risk for experiencing alcohol- and cannabis-related harms given the ongoing development of their neurocognition and the formation of long-term behaviors (Hurd et al., 2014; Meruelo et al., 2017; Saha et al., 2007; Silveri, 2012).

Underage individuals tend to purchase alcohol at gas stations and convenience stores

(e.g., locations with off-premise alcohol retail licenses), as they often do not verify age through the driver's license or other accepted forms of identification and commonly overestimate age (Freisthler et al., 2003; Merrill et al., 2000; Paschall et al., 2007). Thus, efforts restricting where individuals can purchase high-risk products such as Delta-8 THC and Four Loko may benefit public health and safety. For example, zoning laws that set a minimum distance to schools or other public places frequented by youth may decrease access among youth (Rossen & Pollack, 2012). These zoning laws should consider the multitude of harmful substances for which youth should not be exposed to marketing, including alcohol, tobacco, and cannabis products. However, the creation of local zoning laws is pre-empted by some state laws, demonstrating the importance of considering both state and local laws to limit outlet density (Campbell et al., 2009). Moreover, minimum unit pricing (MUP) laws that are based on price per standard alcoholic drink may be beneficial in reducing heavy alcohol use via supersized alcopops, particularly among adolescents and young adults (Stockwell et al., 2012). Lastly, the marketing of these products is of particular concern, as both are often in packaging that is brightly colored and advertises sweet flavors, which is attractive to younger age groups (LoParco, 2023; Rossheim & Thombs, 2013). Implementing laws that control how these products are marketed and advertised may be particularly important for preventing initiation and decreasing use prevalence among youth.

### Discussion Questions

Study findings indicated statistically significant associations between Delta-8 THC and Four Loko retail availability. How may this co-marketing and availability have

potential implications relating to simultaneous/polysubstance use?

Delta-8 THC and Four Loko retail availability were strongly associated. What aspects of the retail environment may change the strength of these associations (e.g., potential effect modifiers)?

### Ethical Approval Statement

The University of North Texas Institutional Review Board classified this study as not being human subjects research.

### Conflict of Interest

The authors declare no conflicts of interest.

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