ORIGINAL RESEARCH

CBD Retailers in NC Promote CBD Online to Treat Pain Violating FDA Rules About Medical Claims and Offer Low-CBD/High-Price Products

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Introduction: Cannabidiol (CBD) products are available nearly nationwide in the US and can coexist with medical or recreational programs. North Carolina (NC) is an example of a state with a program dedicated to integrating hemp cultivation and medicinal CBD exclusively, containing a multitude of retailers selling it as a primary product. The Food and Drug Administration (FDA) mandates that non-FDA approved CBD products cannot be marketed using medical or health-related claims and has sent warning letters to retailers violating these terms. We aim to characterize the online content of the NC CBD market by analyzing retailers' websites to determine whether hemp/CBD shops comply with FDA regulations in terms of medical claims and analyze the claimed CBD content and price of products offered online.

Methods: We randomly selected three CBD retailers from the ten most populated cities of NC. We analyzed their website content: product type, medical claims, other disclaimers, price, and CBD content.

Results: We found that edible, oral, inhalable, and topical products are offered in similar proportions. Word analysis of product description revealed that "pain" and "pain relief" were the most common medical claim, followed by inflammation and anxiety. Health claims were mostly related to wellbeing. Other attributes indicate that products are associated with pleasant flavors or sensations (ie, cool, lavender, delicious, honey, menthol), which resembles the strategies used for tobacco advertisement. Most products (61%) claimed to contain less than 1000 mg of CBD. The median price of products ranged from $15–30 per 300 mg. We found a positive correlation between CBD content and price.

Discussion: Our data demonstrate that the NC online CBD market does not comply with FDA regulations, primarily targets patients with pain, inflammation, or anxiety, and offers products with low CBD concentration and high prices. New policies should limit the access and online promotion of non-pharmaceutical grade CBD products.

Keywords: cannabidiol, hemp, medical marijuana, dispensary, cannabis market, misleading claims

Introduction

Public interest in the use of cannabidiol (CBD), a non-intoxicating hemp derived compound, has become increasingly prominent in the United States (US). Demand for products containing CBD is growing as states legalize medicinal cannabis programs and companies promote health and medical applications of the compound.[1,2] The rising relevance of CBD and its availability have followed the legalization of ingredients derived from hemp, including CBD, by the United States Congress,[3] authorizing trade of hemp products and stimulating consumer participation in the market.

Simultaneously, the Food and Drug Administration (FDA) has only approved a single CBD medication (Epidiolex) and cautions consumers about the claims made by cannabis companies based on little or low-quality evidence.[4]

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Currently, only one prescription medication containing CBD is approved by the FDA; Epidiolex. While Epidiolex is marketed consistent with FDA regulations to treat seizure disorders,[5–7] the FDA mandates that products containing CBD cannot be marketed for therapeutic purposes or benefits without prior approval from the FDA's Center for Drug Evaluation and Research, use false and/or misleading information, or convey the product is approved or endorsed by the FDA without FDA approval. The FDA has not approved CBD as a dietary supplement and has prohibited addition of CBD to food products, thereby restricting advertisement regarding therapeutic properties or general health benefits.[5] Resulting from the 2018 Farm Bill and state actions, the FDA has identified hemp/CBD dispensaries and shops are making medical claims that are both unproven and ambiguous. In accordance, FDA has indicated that actions will be taken when CBD-containing products are marketed using illegitimate unproven medical claims.[5]

Currently, states across have varying regulations regarding cannabis products and their integration into the market for consumption.[8] State laws range from excluding all marijuana access, legalization of high CBD and low delta-9-tetra-hydrocannabinol (THC, the major intoxicating compound in cannabis) products, medical use of THC products, and recreational use of THC products.[9] Interestingly, CBD products are available nearly nationwide in the US since only three states do not have any legal cannabis program as of February of 2022.[10] In North Carolina (NC), delta-9-THC containing products or marijuana cultivation are illegal recreationally and medicinally but cultivation of hemp by licensed individuals was legalized in 2015.[11] North Carolina serves as an example of a state with a program dedicated to the integration of hemp cultivation and medicinal CBD exclusively, containing a multitude of retailers selling it as a primary product. In fact, about half of growers in the state cultivate hemp for CBD production,[12] demonstrating its increasing prominence and its role as a significant motivation for growing hemp.

North Carolina defines industrial hemp as a cannabis plant containing 0.3% THC or less, following the 2018 Farm Bill. Hemp is a rich source of raw materials and nutrients. Hemp fibers are used for clothing and paper, while seeds are used for cooking and cosmetic products. Importantly, CBD is extracted from the flower of the hemp plant and the seed oil can be used to dissolve the CBD extract, so hemp growers can use virtually all components of the plan, making it an attractive and profitable crop and commodity.[1] There are no laws which restrict individuals to sell CBD products in NC if offered in an established business and an individual is approved to cultivate it. Notwithstanding, NC legislature complies with FDA rulings in the prohibition of CBD in food, medical claims of CBD, and labeling as a nutritional supplement.[13] In parallel, the use of CBD for medical purposes is regulated in the state under the NC Epilepsy Alternative Treatment Act[14] which serves to protect NC patients with epileptic disorders by reserving the ability to possess and administer hemp extract as an alternative form of treatment when traditional solutions have proven ineffective for an individual's symptoms. Hemp extract is defined by the NC Department of Health and Human Services as an extract from a cannabis plant, or a mixture or preparation containing cannabis plant material that must be composed of less than 0.9% THC by weight, at least 5% CBD by weight, and may contain no other psychoactive substances.[15] The hemp extract in possession must obey NC guidelines and patients and caregivers both undergo an approval process.[14] This program in NC is not limited to the conditions by which Epidiolex is approved and therefore offers a potential treatment for other types of epilepsy. Whether this program offers advantages to NC patients with refractory epileptic syndromes over the FDA-approved CBD medication, Epidiolex, is unclear.

Many companies are not compliant with marketing claim regulations, especially when promoting their products online. The FDA issued over thirty-nine warning letters to companies for noncompliance with their CBD products between the years 2015 and 2019 using online advertisement.[4] These violations include falsely labeled CBD as a registered drug or as a dietary supplement or food, and marketing illegal therapeutic claims about CBD. The FDA revealed that twenty seven more letters have been released since then.[4] We have analyzed the content of those FDA warning letters and uncovered that companies are targeting two major populations using online advertisements; healthy individuals (with products such as dietary supplements and food additives) and those suffering symptoms of chronic diseases (like cancer, diabetes, inflammation, pain, arthritis, anxiety, depression, and others).[4]

Upon consideration of the development of the CBD industry and the history of government intervention across the country to protect consumers, we aim to characterize the online content of the NC CBD market by analyzing retailers' websites to determine whether hemp/CBD shops comply with FDA regulations. Accordingly, we analyzed health and medical claims (eg, to preserve or enhance health or prevent or treat medical conditions) made by hemp/CBD shops and

whether sensory traits (flavor, aroma, etc.) or psychoactive effects (sedation, relaxation, etc.) were included on their websites and for specific CBD products. Additionally, we aim to determine whether this analysis provides insight regarding the potential benefits of state CBD programs that offer alternative access to CBD for untreatable seizure disorders – as the NC program (and many other states) is designed for this purpose. Considering the availability of Epidiolex, it is plausible that legal CBD programs are conceived to offer a more accessible alternative in terms of mode of administration, potency, and/or price.

Methods

Selection of North Carolina Cities and CBD Retailers

Retailers dedicated to sell CBD or hemp products (for simplicity, referred to as CBD retailers) were randomly selected from the ten most populated cities in North Carolina. Most populated cities were chosen based on their higher density of commercial establishments when compared to less populated areas. According to the World Population Review (which utilizes data from the 2020 Census), the most populated cities in North Carolina are the following, in descending order: Charlotte, Raleigh, Greensboro, Durham, Winston-Salem, Fayetteville, Cary, Wilmington, High Point, and Concord. We randomly selected three CBD dispensaries per city, for a total of 30 dispensaries across NC (Figure 1). This sample size is comparable to or more robust than other studies of cannabis dispensaries.[16–18] Google Maps, which has been used successfully by our team and others to locate cannabis dispensaries[19] or other type of retailers,[20] was used to identify CBD retailers in the selected cities. We standardized the search criteria by using "CBD hemp cannabidiol dispensaries/shops in 'city' "NC" for each of the ten cities (ie, CBD hemp cannabidiol dispensaries in Charlotte NC). The basis of the order in which the retailers were listed by Google in the search results was unknown and inconsistent with distance, consumer rates, location within city limits, and other potential measures. Therefore, we randomly selected three CBD dispensaries per city. We obtained three numbers using an online random number generator (https://www.randomizer.org) and these numbers were used to select the three dispensaries from the Google search result list for each city. A dispensary selected by this method was included in the analysis only if its listed address was in the correct city or the website indicated it sold its products in the correct city. Thus, selected dispensaries that were not located in the proper city, did not have a physical address, or did not have a website were excluded from this selection process. If the dispensary chosen based on the obtained random number did not fit the criteria or was a dispensary already chosen in a different location, the succeeding dispensary that fit the criteria was selected from the result list. If unable to continue chronologically down the list, a preceding dispensary was chosen.

Presence of Claims, Warnings, and Disclaimers

We searched on the home page, hovered over a tab, or navigated to a non-product related page containing other information to identify whether the studied websites make general health claims, general medical claims, presence of safety health warnings, and FDA disclaimers (or references to uncertain/unguaranteeable/not yet proven benefits of CBD with FDA references). We quantified the number and percent of CBD retailers that made these claims somewhere on their website.
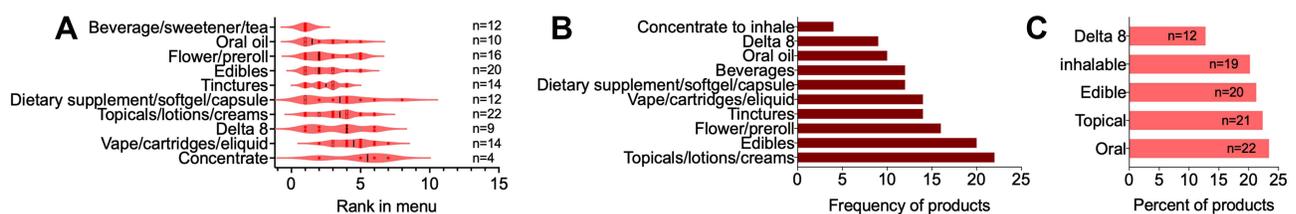

Figure 1 Study flow chart.

Featured Product Categories

Once the websites of selected retailers were visited, the main menu was located to determine the type of products offered and the order in which these product categories appeared in the menu. We focused on consumable products and excluded textiles, basketry, cordage, and other non-consumable product. Product types were given a score related to their order of appearance, 1 for the type of product that was listed first, 2 for the second, and so forth to chronologically list the order in which each website presented its product categories, as we have previously described.[21] We also quantified the number of dispensaries featuring each type of product in their menus to determine their frequency of appearance.

Product Characterization

Two products from each of the major product categories (edibles, oral, inhalable, and topical) were selected in each included dispensary (Figure 1). We defined a priori that the first two CBD products in these categories were going to be selected to collect information. A CBD product was defined as a product claimed to contain CBD as one of its ingredients. Products that contain only THC or with no content of CBD were skipped (excluded). Products that contain other hemp or cannabis derived products in combination with CBD were considered CBD products and were included (ie, products with Delta-8 and CBD). Some selected dispensaries only displayed a photo of their products and did not provide any other product information (CBD content, price, chemovar, or claims); therefore, these dispensaries were excluded from the study at this time (Figure 1).

We evaluated whether these products had descriptions that included health claims (defined as non-medical attributes referred to a general state of wellbeing or health improvement not related to a disease), medical claims (defined as any mention of a disease, symptom, or therapeutic property or effect), sensory traits (defined as flavor, taste, smell, or aroma), and psychoactive effect claims (defined as subjective or psychotropic effects). First, we recorded the description of each studied product and then input the information verbatim into an online word counter (databasic.io/en/wordcounter). We obtained single word, bigram, or trigram frequencies. Two independent investigators extracted medical related terms, health-related terms, sensory trait terms, and psychoactive related terms. A third senior investigator reconciled discrepancies (ranged between 5% and 25%). The resulting extracted information was further analyzed by the three investigators and only unanimously selected terms were included in the final results. The data were organized to reflect the most frequent words, bigram, or trigram terms per category.

We recorded the total content of CBD and the price of the studied products when available. Then, we calculated the price per 300 mg of CBD per product category. This concentration was chosen since it seems the minimal clinically relevant concentration of CBD based on studies on epileptic syndromes[22] or anxiety.[23]

Analysis and Statistics

Frequencies (in the form of percentages) were calculated for each type of claim, and for the presence and rank of different types of product categories in menus. Average or median values for CBD content (in mg) and product prices were calculated and compared among product categories using one-way ANOVA and Tukey's multiple comparisons test. Correlation analyses for CBD content and price were conducted using Pearson correlation coefficients. GraphPad Prism 9 software was used for statistical analysis.

Results

Featured Product Categories

We first determined products' rank location in the filter menus or their frequency in dispensary menus. Figure 2A depicts the order in which CBD products most likely appear in website menus. Notably, when present, beverages are consistently featured at the top of the menus, followed by oral oils, flower/preroll, edibles, tinctures, etc. Figure 2B depicts the frequency in which different product types appear in website menus (out of 25 included dispensaries). In this case, topicals were more frequently featured in menus, followed by edibles, flower/preroll, tinctures, vaping products, etc.

We noticed that different types of products belong to a similar category based on form of consumption or administration, except for non-CBD products such as Delta 8. Thus, we grouped oral oils, dietary supplements, and tinctures
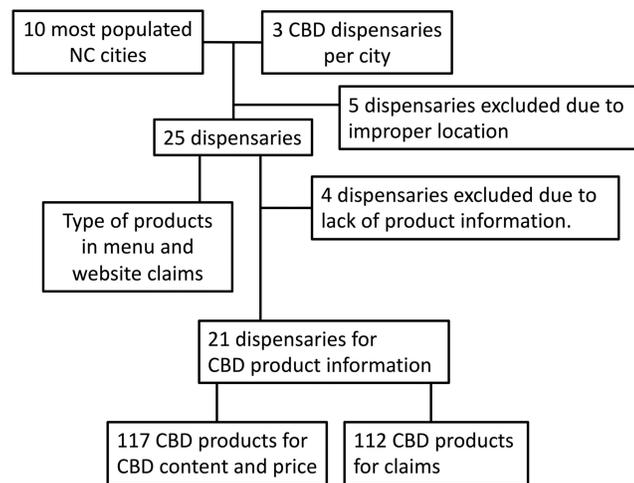
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┌─────────────────────┐      ┌─────────────────────┐
│ 10 most populated   │      │ 3 CBD dispensaries  │
│ NC cities           │      │ per city            │
└─────────────────────┘      └─────────────────────┘
                                    ┌──────────────────────────────┐
                                    │ 5 dispensaries excluded due to│
                    ┌─────────────┐ │ improper location            │
                    │ 25          │ └──────────────────────────────┘
                    │ dispensaries│
                    └─────────────┘ ┌──────────────────────────────┐
                                    │ 4 dispensaries excluded due to│
    ┌─────────────────┐             │ lack of product information. │
    │ Type of products│             └──────────────────────────────┘
    │ in menu and     │
    │ website claims  │
    └─────────────────┘
                    ┌─────────────────────┐
                    │ 21 dispensaries for │
                    │ CBD product         │
                    │ information         │
                    └─────────────────────┘
    ┌─────────────────────┐   ┌─────────────────────┐
    │ 117 CBD products for│   │ 112 CBD products    │
    │ CBD content and     │   │ for claims          │
    │ price               │   │                     │
    └─────────────────────┘   └─────────────────────┘
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Figure 2 Characterization of product types in website menus. Product rank in menu and number of dispensaries featuring product types in their menu; data presented as median (black lines) and 95% CI (dotted gray lines); (**A**). Frequency of product type menu appearances in dispensaries (**B**). Percent of products found in dispensary menus (**C**).

into "oral category", edibles and beverages into "edible category", and concentrate to inhale, vape and herbal products into "inhalable category". We found that the frequency of these categories, inhalable, edible, topical, and oral, was similar, and Delta 8 products were slightly less frequent (Figure 2C).

Claims in Websites
First, we analyzed retailer websites. We observed that 39.4% of the included retailer websites (25 included retailers) featured general medical claims, 35.7% included health claims, 10.7% claimed CBD as food supplement, and 7.1% displayed safety or health warnings.

Claims in Products
Second, we analyzed the descriptions of selected products. Word analysis for medical related terms using product descriptions (from 21 dispensaries featuring product descriptions) uncovered that the most frequent single word was "pain" (including pain and pains), followed distantly by "inflammation" (including "inflammation and anti-inflammatory"), "anxiety", "stress", and "aches/achy" (Figure 3A). Based on the available scientific evidence about CBD's medical effects, we found remarkable "epilepsy" was found only two times in the evaluated product descriptions. The most frequent bigrams for medical related terms revealed a similar trend, with "pain relief/pain management", "anti-inflammatory properties" (including also "reduce inflammation" and "for inflammation"), and "sore muscles/achy muscles" (Figure 3B). The most frequent trigrams for medical related terms were "under the/your tongue", "water soluble CBD", "into the skin", "muscle and joints", and "aches and pain" (Figure 3C).

Word analysis for health-related terms uncovered that the most frequent single word was "organic" (including organic and organically), followed by "natural" (including "natural", "naturally", "all-natural"), "help", "benefits", and "health/healthy"
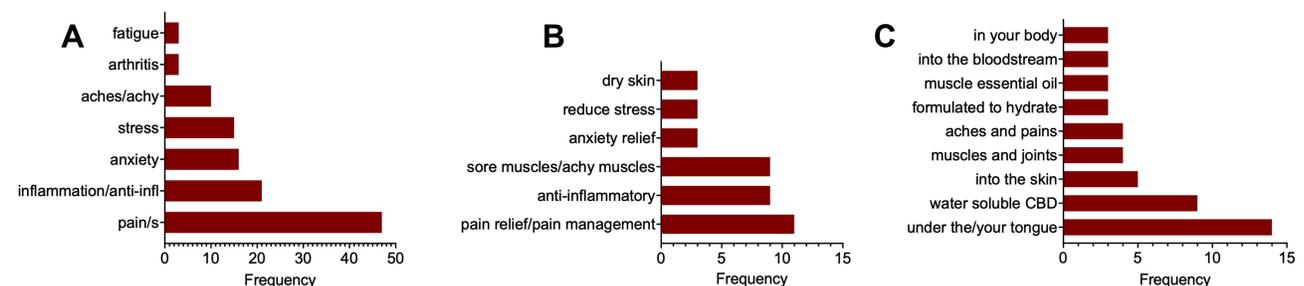

Figure 3 Product description word analysis for medical-related terms. Frequency of medical-related single words (**A**), bigrams (**B**), and trigrams (**C**).
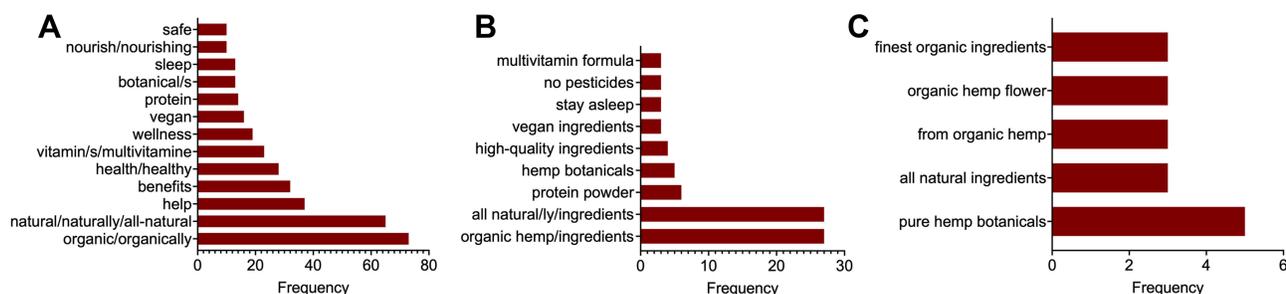
Figure 4 Product description word analysis for health-related terms. Frequency of health-related single words (**A**), bigrams (**B**), and trigrams (**C**).
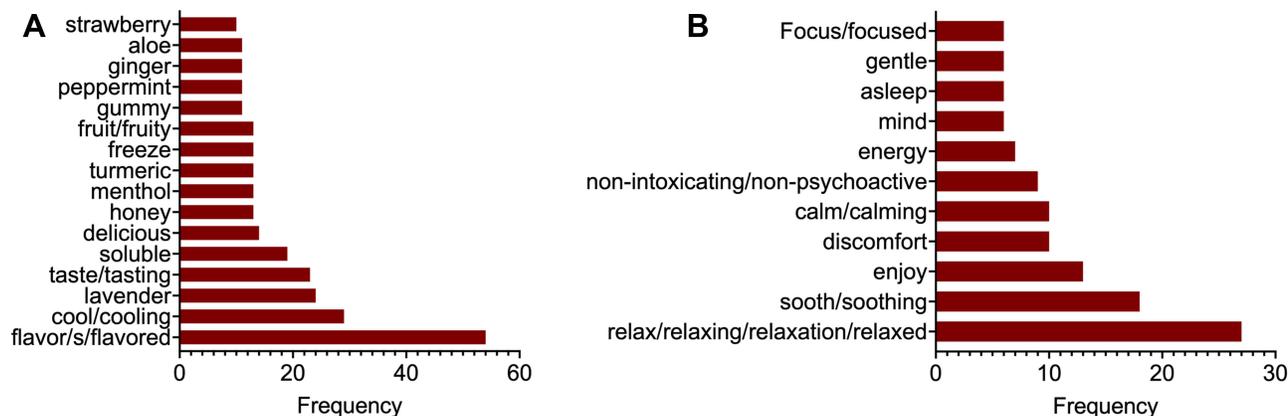

Figure 5 Product description word analysis for sensory traits and psychotropic effects-related terms. Frequency of sensory trait single words (**A**) and psychotropic effect single words (**B**).

(Figure 4A). The most frequent bigrams for health-related terms revealed a similar trend, with "organic hemp" (including "organic hemp", "organically grown", "finest organic", "pure organic" and "organic ingredients"), "all natural" (including "all natural", "natural ingredients", "naturally occurring", and "naturally flavored") (Figure 4B). The most frequent trigrams for health-related terms were "pure hemp botanicals", "all natural ingredients", and "from organic hemp" (Figure 4C).

For sensorial trait related terms, we found that the most frequent individual word was "flavor"; (including "flavor", "flavors", and "flavored"), "cool/cooling", "lavender", and "taste/tasting" (Figure 5A). For psychoactive related terms, we found that the most frequent individual word was "Relax"; (including "relax", "relaxing", "relaxation", and "relaxed"), "sooth/soothing", "enjoy", and "discomfort" (Figure 5B).

CBD Content

We observed that the concentration of CBD products is consistently given as the total amount of CBD in the entire product content rather than per serving, with the exception of inhalable products that is given in percent of total product weight. To make herbal CBD concentrations comparable to other types of products, we converted the percent of CBD to mg in inhalable products when information was available. Even though we did not find a statistical difference in CBD concentrations among edibles (median 300 mg; 150–750 mg 95% CI), oral (750 mg; 500–1000 mg), topical (500 mg; 200–600 mg) or inhalable (625 mg; 200–600 mg), we observed that oral products have the largest range of concentrations and the category with the highest amount of CBD (Figure 6A). Most products, regardless of category, contain less than 1500 mg (101/117; 86%) in total, and the majority of products contain less than 1000 mg (71/117; 61%; Figure 6B). Products with less than 500 mg constituted 29% (34/118) of the total studied products (Figure 6B). These findings contrast with the minimal clinically relevant dose of CBD, 300 mg.[24,25]

Price of Products

We normalized the price per product in relation to 300 mg as a clinically meaningful dose.[22,23,26] Even though we did not find statistical differences in the price of products among edibles (median $26; $18–50, 95% CI), oral ($25.48; $18–30),
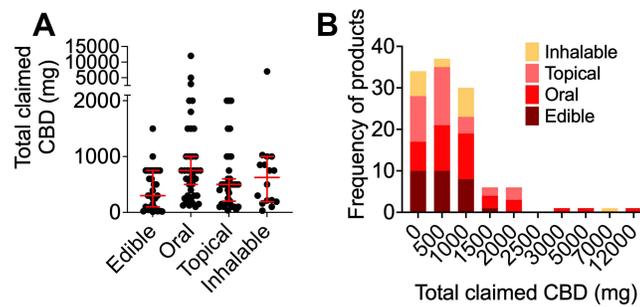
Figure 6 CBD claimed concentration. Total CBD claimed concentration of product per category (median and 95% CI; (**A**)), and CBD claimed concentration frequency distribution (**B**).
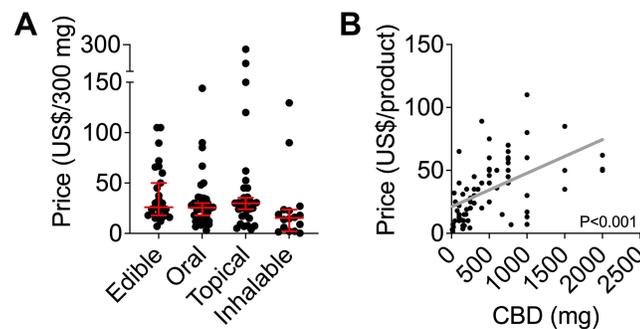

Figure 7 Product price and price correlation to CBD concentration. Price per 300 mg of product per category (median and 95% CI); one-way ANOVA + Tukey's post test (no significant differences; (**A**) correlation of price and CBD concentration; $P < 0.001$ by Pearson correlation coefficient (**B**).
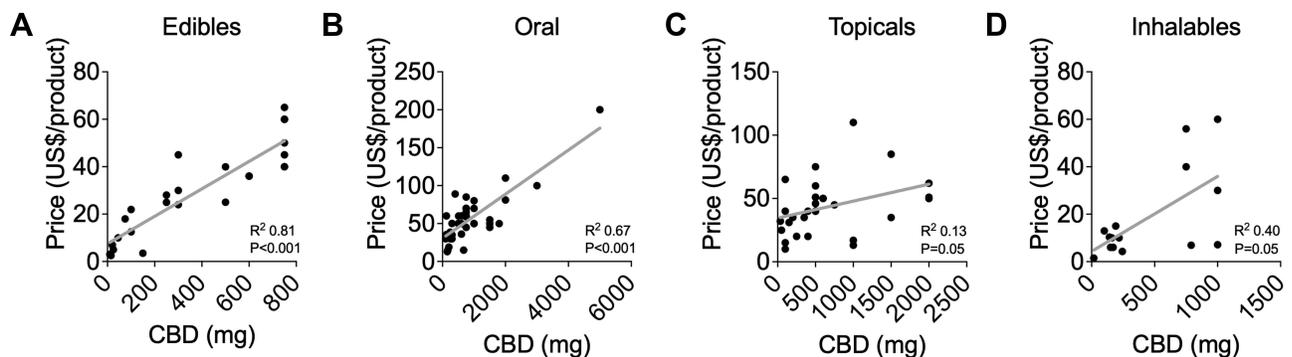

Figure 8 Product price correlation to CBD concentration per type of product. Price per 300 mg of product and its correlation to price in edibles (**A**), oral (**B**), topicals (**C**) and inhalables (**D**); P values by Pearson correlation coefficient.

topical ($30; $24–36.40) or inhalable ($15.33; $2.12–23.56), we observed that inhalable products are more likely sold within the lower price range (Figure 7A). We found a significant positive correlation between CBD content and price per product when all studied products were analyzed (Figure 7B). A similar positive correlation was found when CBD and price were analyzed by type of product (Figure 8).

Discussion

The major findings of our study are, first, that NC dispensaries advertise their CBD products online using unauthorized medical claims, therefore NC retailers do not comply with FDA regulations; and second, that the online advertised CBD products in NC have a low potency and are expensive, indicating that the NC CBD market does not offer an advantage over the only available FDA approved CBD product, Epidiolex. Notably, the out-of-pocket cost of Epidiolex is $1235[27]

(100 mL of 100 mg/mL), which represents a similar cost of a given CBD product found in the NC market. The low concentration of the NC CBD products contrasts with the consistency and clinically adequate concentration of Epidiolex.

Our results show that the CBD online marketing strategy in NC encompasses the pattern of claims that FDA has identified nationwide in the US,[4] CBD products are offered using unsubstantiated medical and health-related claims. Similarly, this pattern has been uncovered in Canada.[28] It is worth noting that these pervasive violations currently occur in NC despite the historic and increasing FDA pressure through warning letters since 2015.[4] This persistent lack of compliance demonstrates that the current FDA approach has been unsuccessful, and it is insufficient to stop this problem. Notably, therapeutic benefits for pain, inflammation, and anxiety (see bigram medical claim analysis) were the top medical claims in the NC online CBD marketplace. This is consistent with the conditions for which CBD is advertised online in Canada[28] and what FDA warning letters have included as more frequent violations in the US CBD online marketing.[4] Alarmingly, epilepsy, the only conditions for which CBD has been approved to treat,[6,7,22] does not seem to be within the scope of the NC CBD market despite the presence of the NC Epilepsy Alternative Treatment Act.

Our study demonstrates that CBD is marketed with medical and health-related claims for conditions that afflict a large segment of the population (ie, pain, inflammation, and anxiety). Chronic pain affects approximately 10% of the general population, a condition that is often presented and complicated with depression and anxiety that leads to increase disability rates.[29,30] Our study shows that musculoskeletal pain conditions seem paramount as "sore/achy muscles" was among the most frequent in our bigrams. However, the evidence for CBD for treating pain is limited and negative, or derived from sub-quality studies (ie, small sample sizes and lack of prospective, blinded, randomized, placebo control studies).[31–35] Similarly, 11% of adult Americans regularly had feelings of worry, nervousness, or anxiety.[36] Despite the frequency of marketing CBD for the treatment of depression and anxiety, the evidence for CBD treatment anxiety is also mixed.[23] Despite the lack of scientific evidence that CBD could treat pain, inflammation, or anxiety this online marketing strategy seems to be effective as reflected in popular interest and online testimonials about the uses of CBD by the general population that rate these conditions as primary reasons of CBD use.[37] Accordingly, online searches for CBD products have sustainably and pronouncedly increase in all American states during the last decade,[38] indicating that online marketing is an effective strategy to reach out consumers and potentially spur interest and influence their decision on CBD use. In fact, searching and examining online information is associated with positive attitudes towards medicinal cannabis and its legalization.[39] Of note, dispensaries of medical cannabis are rated more favorably than other sources (friend, grower, Health Canada, etc.) in terms of product reliability, quality, and safety.[40] Thus, providing misleading information about CBD products via online dispensaries represents a high risk for public health.

Medical cannabis consumers consider CBD as the most important attribute that influences their willingness to buy cannabis products,[41] signaling they perceive CBD to possess therapeutic benefits. The lack of effective medications for medical conditions, as is the case for pain, chronic inflammation, and anxiety/depression, can encourage patients to seek alternative therapies, including cannabis and CBD.[42] Certainly, a significant portion of consumers state their purpose for CBD use is pain, arthritis, self-perceived mental health problems like anxiety and depression, among others.[43–45] Intriguingly, epilepsy does not appear in the major reasons for CBD use in the available literature. Furthermore, this attitude towards CBD could drive patients to substitute CBD for their prescribed medication,[42] which possesses multiple risks. For example, the major public health risk for non-FDA approved CBD products is the fact that their content and concentration is inaccurately labeled. They might possess undisclosed THC at various intoxicating levels and display lower or larger CBD concentrations than their actual content.[2] Furthermore, CBD products have been reported to be contaminated with synthetic cannabinoids or other substances that caused mass poisonings,[46] or lung injury outbreaks due to CBD e-cigarette or vaping products.[47]

Notably, the concentrations of CBD products advertised in the online NC dispensaries are significantly lower than the known therapeutic doses for CBD and likely not clinically relevant. This apparent low potency together with inaccuracies in content information and the potential of adulterations and contaminants make these products not risk-free, especially when an FDA approved CBD drug is available. Furthermore, and despite their low CBD content, CBD products are expensive, namely $15–30 per 300 mg and the cost increases as CBD content increases.

Our online marketing analysis shows that CBD dispensaries also use language to signal healthy products. The use of words like "organic", "natural", "help", "healthy" indicates that dispensaries also target a non-medical population

interested in general wellbeing. Similarly, the uncovered psychoactive descriptors (ie, relaxing, soothing, enjoy, calm, energy, mind, asleep.) support the interest of retailers in a segment of the population that uses products associated with a healthy lifestyle and reportedly consume CBD products.[37] The taste references related to pleasant flavors or sensations (ie, cool, lavender, delicious, honey, menthol) resemble the strategies used for tobacco, including cigarettes and e-cigarette products designed to attract youth users,[48] one of the most vulnerable demographic groups that notoriously suffers in larger proportions from anxiety and depression.[49]

Our study provides valuable information about how the NC market is promoting CBD products in the context of the local epilepsy program. One of its limitations is that we did not directly compare the NC market with other states or other programs. For example, it is not clear whether the dynamic of the NC program and market extrapolates to states where medical cannabis or recreational cannabis coexist with CBD programs. However, the existing data from Canada and the analysis of the FDA warning letters sent to CBD retailers suggest that our results depict what is happening in other markets regardless of the availability of other cannabis products. Although beyond the scope of this study, another limitation is that we did not study whether this online information is in line with actual products in physical CBD shops. In any case, it is unlikely that retailers offer online products and information that is different from their physical shop menus. Regardless of its accuracy, online information is widely utilized by consumers, which could help form their preferences and perceptions towards CBD.[37–39] We recognize that retailer websites are not the only source of information for CBD consumers seeking therapeutic benefits. In fact, in addition to self-directed research websites, trusted care providers and anecdotal experience of another are also informational sources that form the decision of CBD use for medical purposes.[50]

Conclusions

In conclusion, our study demonstrates that, 1) the NC CBD market promotes products online making unsubstantiated medical claims, a strategy that opposes FDA and NC regulations; 2) NC CBD retailers use their websites to primarily target patients suffering from pain, inflammatory conditions, and anxiety in conjunction with a healthy population interested in general wellness; 3) The products offered online by NC CBD shops do not represent a favorable alternative to the only FDA CBD medication, Epidiolex ($1235 per 100 mL, 100 mg/mL; $37 per 300 mg),[27] as they are labeled with sub-clinical CBD concentrations and a high price. The latter shows a paradoxical disconnect between the NC CBD market and the NC Epilepsy Alternative Treatment Act that is intended to broaden the access of CBD to other epileptic conditions. Altogether, our data highlight the need of a more efficient strategy to enforce FDA and local regulations. The risk of providing online misleading information to vulnerable populations that often seek an alternative therapeutic option for their condition[51] should spur scientific journals to gain online presence for the general population and warrants a change in the current policies to limit the access of non-pharmaceutical grade CBD products and their online promotion. Efforts to educate health-care providers, and, if possible, increase their online activity[52] should also be part of the policy changes that are required to provide a safer environment to patients where CBD or cannabis programs are available.

Abbreviations

CBD, Cannabidiol; FDA, Food and Drug Administration; NC, North Carolina; US, United States; THC, Delta-9-tetrahydrocannabinol.

Data Sharing Statement

Data could be shared upon request to corresponding senior author, Dr. E. Alfonso Romero-Sandoval.

Ethics Approval and Informed Consent

This study is not an animal or human research study.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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