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# Circumvention of COVID-19-related restrictions on tobacco sales by the e-cigarette industry in South Africa and comparative analyses of heated tobacco product vs combustible cigarette volume sales during 2018–2020

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## ABSTRACT

As a public health measure against COVID-19, South Africa restricted the sale of “tobacco, e-cigarettes and related products” for 5 months, ending on August 17, 2020. We examined marketing activities related to novel tobacco products (e-cigarettes and heated tobacco products) during this restriction. Using web scraping, we accessed data for 2661 e-cigarette liquids marketed online by South African vendors in June 2020. We also analyzed heated tobacco product volume sales (kits) using retail scanner data from Nielsen Company. The 2661 e-cigarette liquids assessed online comprised cannabidiol liquids, 28.8%[767/2661], nicotine salts, 10.4%[276/2661], e-cigarette juice concentrates, 14.1%[376/2661], nicotine-free e-liquid, 4.0%[107/2661], and nicotine-containing e-liquid, 42.6%[1135/2661]. Cannabidiol liquids had the highest percentage of fruit (78.4%[601/767]) and tobacco flavors (9.4%[72/767]). During the restriction, many online e-cigarette vendors actively promoted cannabidiol liquid in lieu of regular e-liquid. Nielsen retail scanner data showed that volume of heated tobacco product sales in February 2020, preceding the restriction (7.76 million kits), were higher than in February 2019 (4.52 million kits). The restriction saw decreased sales of heated tobacco products; mean weekly heated tobacco product sales in the 6 weeks following the restriction (772,585 kits/week) were dramatically lower versus the 6 weeks preceding the restriction (2.26 million kits/week). Lifting the restriction saw a 131% spike in sales between the latter half of August 2020 (825,638 kits) and mid-September 2020 sales (1.90 million kits), even though total sales in September 2020 were half of what was observed in the preceding year (3.81 million units in September 2020, vs 6.33 million units, September 2019). The marketing of cannabidiol and other novel products by e-cigarette manufacturers and the tobacco industry may encourage youth use; close monitoring is required.

## 1. Introduction

The COVID-19 pandemic has been one of the most sustained and most destructive public health emergencies in recent times (COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University, 2021; Dong et al., 2020). South Africa has by far, been the most hard-hit country in the African region (COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University, 2021; Roser and Ritchie,

2021). Between March 5, 2020 to April 2, 2021, the country recorded about 1.55 million cases and 52,954 deaths (COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University, 2021; Roser and Ritchie, 2021). Despite accounting for just over 4% of the population of the African continent, South Africa accounts for about 70% of total confirmed COVID-19 cases on the continent (Roser and Ritchie, 2021; Prevent Epidemics, 2020).

To combat this emergency, the government of South Africa declared a national state of disaster on 15 March 2020 and a national lockdown

*Abbreviations:* CI, Confidence interval; AAPC, Average annual percentage change; CBD, Cannabidiol.

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went into effect thereafter (Regulation Gazette No. 43258 of 29-April-2020, 2020; South African Government, 2021; Abdool Karim, 2020). A controversial part of the lockdown was a restriction on sale of tobacco products for health reasons and because of being designated as ‘non-essential goods’ (Egbe and Ngobese, 2020). According to the policy “The sale of tobacco, tobacco products, e-cigarettes and related products to members of the public and to persons including retailers who sell directly to the members of the public, is prohibited”. This restriction lasted about 5 months, ending on August 17, 2020 (Egbe and Ngobese, 2020). The wording of the policy was not explicit in what constituted “tobacco, tobacco products, e-cigarettes and related products”, potentially leaving it open to individual interpretation of what was covered and what was exempt. Both brick-and-mortar points-of-sale and online retailers were however required to comply. Practically though, few options existed for vendors at physical stores than to close till after the restriction because of strict restrictions in movement during the lockdown (Heywood, 2020; Staunton et al., 2020). Online vendors could still receive orders from customers and could ship items deemed exempt under the restriction (i.e., ‘essential items’).

The impact of this restriction has been analyzed in relation to cigarette smoking with data suggesting increased illicit trade during the restriction (Research Unit on the Economics of Excisable Products, 2021). Little information however exists on e-cigarette marketing activities during this restriction, or on how volume sales of novel tobacco products fared before and after the restriction. Examining stealthy industry marketing actions during the restriction can help develop more robust policy interventions in the future. The opportunity to perform a market scan of e-cigarette products on the South African online retail market also allows us to better characterize the types of e-cigarettes in the retail space. The profile of e-cigarette products captured from the online market scan during the shutdown is not likely to be different from what existed prior to the shut-down because the immediacy with which the policy was implemented, coupled with the fact that the restrictions on sales applied not only to consumers but to retailers as well, implied that the inventory before and during the restriction were similar (minus any sales). Knowing how e-cigarette manufacturers, distributors, and vendors adapted their marketing strategy (e.g., promoting certain products over others) to circumvent elements of the restriction during the period it was in effect can alert policy makers to potential loopholes that might attenuate the impact of current and proposed tobacco control policies. Furthermore, comparing volume sales before and after the restriction for cigarettes and other related products can allow us to evaluate the restriction’s impact on consumption.

This study had a three-fold objective. (1) First, we mined web data (web scraping) to characterize e-cigarette products from South African online retailers during the time the restriction was in effect. The rationale of this market scan was to know the range of products on the market and their characteristics, including size, nicotine content, flavors, branding, and packaging. (2) Second, we examined the marketing of substitute products such as cannabidiol (CBD), which like e-liquid, can be consumed by vaping (Grafinger et al., 2020; Wheeler et al., 2020). Besides CBD not being explicitly mentioned among the restricted products, one might expect vape retailers to pivot to CBD given its soaring popularity and increasing uptake (Berg et al., 2020). In the U.S., interest in these products is rivaling interest in e-cigarettes and vape retailers have begun selling CBD products (Leas et al., 2019; Gammon et al., 2020). (3) Our final objective was to analyze long-term trends in volume sales of novel tobacco products (e.g., heated tobacco products) during 2018–2020 using retail scanner data from Nielsen Company, South Africa (Nielsen) and compare with cigarettes. The rationale was to determine whether volume sales for newer tobacco products that are potentially substitute goods for combustible cigarettes, rebound to their original level after the restriction and how this compared with cigarettes.

## 2. Methods

### 2.1. Data sources

#### 2.1.1. Web scraped data of e-cigarette products

During February to May 2020, we compiled a list of 231 South African websites selling e-cigarettes; web scraping of their content occurred during June–July 2020 and was done by author IA. Below, we briefly describe how the list of websites was created, and their data mined.

To create a listing of the websites, we first identified all the physical vape shops in South Africa since we expected most of those stores to also have e-commerce websites. A comprehensive search for vape shops was performed using the Google Places Application Programming Interface. A Text Search (e.g., ‘vape shops’) on this platform returned a list of nearby places, up to 60 at a time. We iteratively searched by provinces, and narrowed down to cities, and towns; duplicate entries were removed. We also searched social media (Face book, Twitter, Instagram) and e-cigarette forums (e.g., [ecigssa.co.za/](http://ecigssa.co.za/)) to identify other online vendors not otherwise captured from our main search.

Next, using web scraping algorithms in Python, we extracted information for e-liquids marketed on all 231 vendor websites identified (on many of the websites, customers could still place orders during the restriction, although some vendors indicated that certain purchases could only be delivered after the restriction). In total, we abstracted data for 2661 unique e-cigarette liquids. Any two identified products were deemed as different (non-duplicative) if at least one of the following attributes was unique: brand name, manufacturer, flavors, packaging volume, and nicotine concentration. We focused on e-liquids in this aspect of the study (vs. devices) because we were interested in exploring how chemosensory properties of e-cigarette liquids (e.g., taste) were being marketed to users and potential consumers.

#### 2.1.2. Nielsen retail scanner data of heated tobacco products and combustible cigarette volume sales

We acquired retail scanner data from Nielsen for the period spanning September 2018 through September 2020 for both combustible cigarettes and heated tobacco products. At the time of the study, Nielsen had no data available on e-cigarette volume sales in South Africa, and we used heated tobacco products as a representative member of the class of battery-operated novel tobacco products that heat a substrate (liquid or solid) to yield nicotine. This period under study (September 2018 through September 2020) can be parsed into 3 parts using the restriction and its end on August 17, 2020 as reference points: a 19-month period preceding the restriction during which Nielsen reported volume sales for each month (September 2018 to March 2020); a 4.5 month period coinciding with the restriction, with no single entry reported by Nielsen for volume sales (April, July, and the first half of August 2020); and a 1.5-month period after the restriction during which Nielsen again reported monthly volume sales (18 August to 30 September 2020). The zero reporting by Nielsen during the intervening period is not to be interpreted that no single tobacco product of interest was sold during the restriction (absence of evidence is not evidence of absence). Rather it reflects the fact that Nielsen gathers information from traditional, select brick-and-mortar retailers (e.g., grocery stores, gas stations, chain stores)—outlets where restrictions are more likely to be enforced (Agaku et al., 2020). Notable points-of-sale not covered by Nielsen include online vendors and specialty shops, both of which are niche points-of-sale for heated tobacco products. Nielsen-derived estimates of volume sale are therefore likely to be more conservative for heated tobacco products than for combustible cigarettes as cigarette sales occur largely in traditional retail outlets which are captured in Nielsen. The two datasets used in our analyses are therefore very complementary; while our web scraping provides context for e-cigarette marketing occurring during the restriction within the online space, the Nielsen data provides context for marketing activities for related emerging tobacco products (e.g., heated

tobacco products) occurring in traditional, brick-and-mortar outlets before and after the restriction. The Nielsen data also allow us to compare long-term trends in volume sales for heated tobacco products versus combustible cigarettes.

Using Universal Product Codes (bar code technology), Nielsen collected information on volume sales within South Africa at the following outlets: grocery, branded or independent forecourts (gas stations), specialist liquor stores, and taverns. Representative data were available nationally and for the following provinces: Gauteng; KwaZulu Natal; Northern Cape/Eastern Cape/Free State; Western Cape; and Mpumalanga.

In the data from Nielsen, the unit of sales for heated tobacco products was a 'kit' whereas cigarette sales were reported in single sticks. Usage of the 'kit' as a standardized unit of heated tobacco product sales was as defined by Nielsen Company to allow for meaningful measurement and comparisons over time and between studies.

## 2.2. Measures

### 2.2.1. Web-scraped data of e-cigarette products

Brand information was used to classify all e-cigarette e-juice into the following non-mutually exclusive categories (Agaku et al., 2020; Kuiper et al., 2018): (1) menthol, when the product description referenced menthol or anything mint-like (e.g., "mint", "menthol", "icy"). (2) Fruit/nut flavor when the product referenced a specific fruit or nut (e.g., "strawberry", "almond", "pecan"). (3) Characteristic flavors for other food, beverage, or spices when the product description referenced a characteristic or primary discernable flavor other than menthol, fruit, or nuts (e.g., "frappe", "candy", "rum"). (4) Tobacco flavor, when the product specifically referenced "tobacco" (e.g., "classic tobacco", "Honey Roasted Tobacco", "Chocolate Tobacco"). (5) Concept (ambiguous) flavors: this was designated in the absence of a characterizing flavor (e.g., "Beast Sunrise", "Harlot", or "SNLV 18") (Gammon et al., 2019; Corey et al., 2015).

### 2.2.2. Nielsen retail scanner data of heated tobacco products and combustible cigarette volume sales

Covariates of interest included the brand, variety, quantity purchased, and province.

## 2.3. Analyses

We analyzed the web scraped market data descriptively (percentages and means) to ascertain common flavor types, flavor combinations (Lex et al., 2014), as well as differences in flavor distribution by type of vape liquids. For the Nielsen data, we converted all combustible cigarette volume sales into 20-stick packs by dividing total sales by 20. Volume sales were expressed both as crude number of standardized sales units (e.g., number of kits for heated tobacco products, or cigarette packs) as well as sales per capita (standardized volume sales divided by the projected population of South African adults aged 15+ years in 2020, 42.57 million people) (Statistics South Africa, 2021).

To evaluate the impact of the restriction on tobacco-related sales, we compared mean volume sales in the 6 weeks after the restriction (last 2 weeks of August and all 4 weeks of September 2020), to last 6 weeks preceding the restriction (half of the volume sales in February 2020 and all of that for March 2020). We also compared volume sales for the full month after the restriction (September 2020) with the same month in the previous (e.g., September 2019). Join point regression using National Cancer Institute's Join point Regression Program (Version 4.3.1.0) was used to estimate trends in monthly volume sales for each tobacco product during the 18 months with uninterrupted data preceding the lockdown, September 2018 to March 2020. Statistical significance for all analyses was defined as  $p < 0.05$ . Statistical procedures were performed with Python 3, R Version 3.6.2, and Stata. Version 14.

## 2.4. Ethical review

The study was approved by the University of Pretoria's Faculty of Health Sciences' Ethics Review (no. 39/2019).

## 3. Results

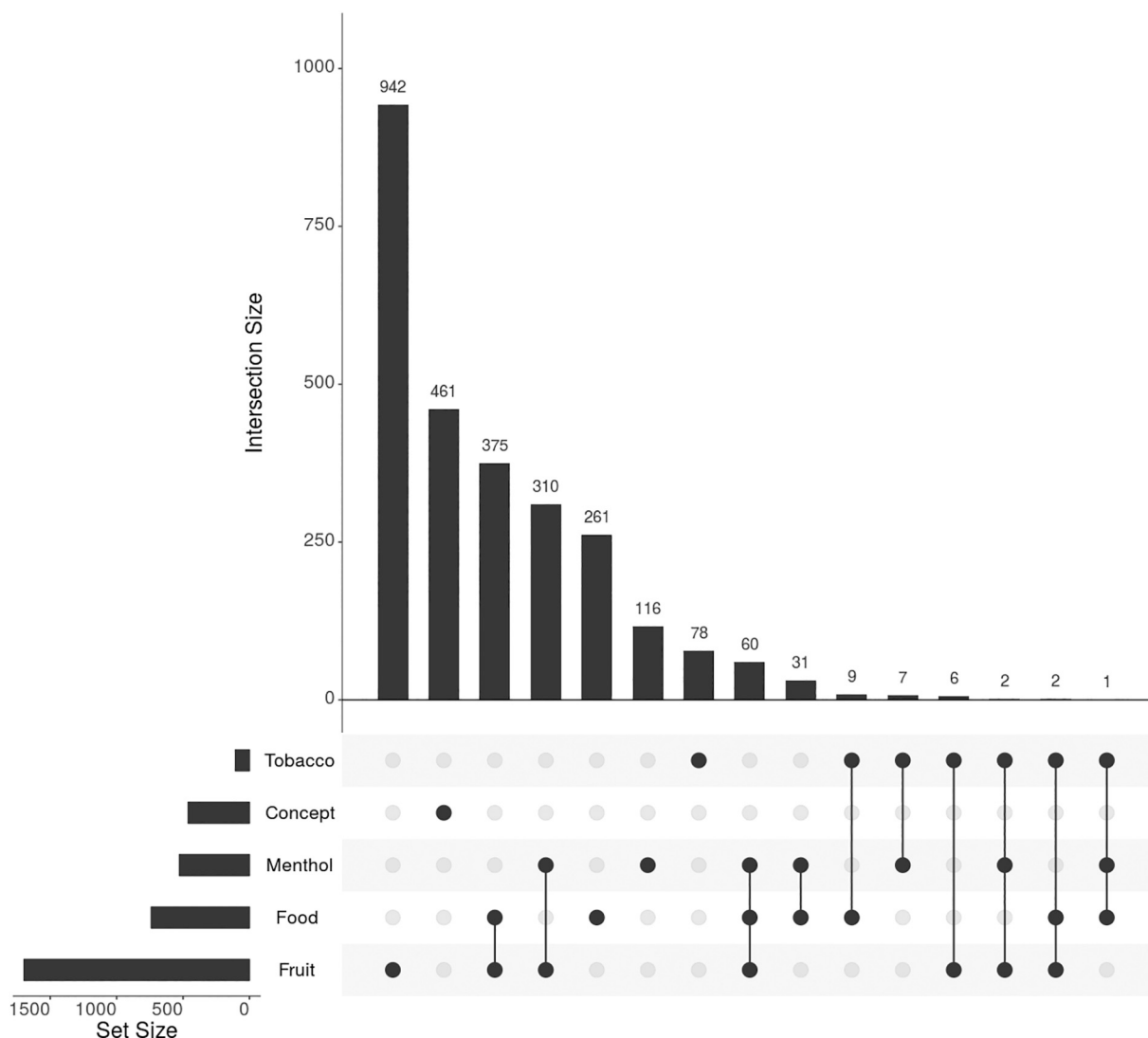
### 3.1. Web-scraped data of e-cigarette products

We identified a plethora of brands, flavors, packaging features, and nicotine concentrations in which e-cigarettes are marketed in South Africa. Of the 2661 unique refill liquids assessed, the following mutually exclusive categories of product type were identified: CBD liquid, 28.82% (767/2661), nicotine salts, 10.37% (276/2661), e-cigarette juice concentrates, 14.13% (376/2661), nicotine-free regular vaping juice, 4.02% (107/2661), and nicotine-containing regular vape juice, 42.65% (1135/2661). The mean (SD) content of CBD in marketed products was 315.9 (182.25) mg. Mean nicotine content for nicotine salts was 27.46 (12.75) mg. Mean nicotine content for regular nicotine-containing vape juice was 3.36 (2.64). The median package size was 60 ml for CBD and regular vape juice, 10 ml for e-cigarette juice concentrates (10 ml), and 30 ml for nicotine salts. Of all liquids assessed, the types of flavors in non-mutually exclusive categories were as follows: fruit, 63.8% (1697/2661), menthol, 19.8% (527/2661), other characteristic food, beverage, spice, or confectionary flavor, 27.8% (739/2661), concept flavor, 17.3% (461/2661), and tobacco flavor, 4.0% (105/2661) (Fig. 1). Within non-mutually exclusive categories as shown in Figs. 1, 69.8% (1858/2661) of products had only one flavor type, 27.7% (738/2661) had two flavor types, while 2.4% (65/2661) had three flavor types combined. Of those with only one flavor type, the most common exclusive flavor type was fruit (942/1858, 50.7%), followed by concept flavors (461/1858, 24.8%), food/beverage flavors (261/1858, 14.0%), menthol flavors (116/1858, 6.2%), and tobacco flavors (78/1858, 4.2%).

The distribution of flavors differed by type of liquid assessed (Fig. 2). Concept flavors were the most common type of flavor for nicotine-free regular vape juice (45.8%, 49/107), whereas for all other product types, it was fruit flavors (CBD: 78.4% [601/767]; nicotine salts: 72.5% [200/276]; e-cigarette juice concentrates: 66.0% [248/376]; and nicotine-containing regular vape juice: 54.2% [615/1135]). The distribution of menthol flavors was highest in the nicotine containing products, including nicotine salts (28.6% [79/276]), and nicotine-containing regular vape juice (27.3% [310/1135]), but lowest in CBD liquids (6.4% [49/767]). The percentage of products that contained tobacco flavor was highest for CBD liquids (9.4% [72/767]), and lowest for nicotine-free regular vape juice (0.9% [1/107]).

E-cigarette online vendors operating during the restriction advertised and sold CBD, including with health claims. Said one vendor: "CBD (Cannabidiol) is classified as a complementary medicine and is, therefore, an essential product available during all stages of the lockdown" (Supplemental Fig. 1). Regarding the purported health benefits of CBD, another stated: "We are not doctors. We do not claim Cannabidiol (CBD) can diagnose, cure, or treat any disease. However, we do believe CBD offers life enhancing benefits and relief for some ailments" (Supplemental Fig. 2). Despite the restriction on nicotine, some vendors appeared to market CBD that contained "pharmaceutical grade nicotine" (Fig. 3).

A wide array of e-cigarette-related products were also deemed 'essential' by some vendors. For example, despite declaring "We will NOT be shipping any Nicotine or Ecig (sic) related items", one vendor went on to exempt propylene glycol, glycerine, flavor concentrates, and batteries/chargers as 'essential items' (Supplemental image 3). Some e-cigarette vendors would only ship e-cigarette hardware if the consumer purchased CBD along with the order (Fig. 3 and Supplemental Figs. 1, 4), others shipped them even without an accompanying CBD order (Supplemental Fig. 5). Furthermore, while some vendors temporarily restricted delivery of any type of e-liquid purchased regardless of its



**Fig. 1.** Distribution of flavor types in e-cigarette refill liquids assessed from online vendors in South Africa, 2020. Note. During February to May 2020, we compiled a list of 231 South African websites selling e-cigarettes. Web scraping of their content occurred during June–July 2020 during the restriction on sales of tobacco and nicotine products in South Africa.

nicotine content (Supplemental Fig. 1), others interpreted the restriction to apply only to “nicotine e-liquids” (Supplemental Fig. 5).

### 3.2. Nielsen retail scanner data of heated tobacco products and combustible cigarette volume sales

The first 12 months of available sales data from Nielsen Company preceded the restriction and covered the period September 2018 to August 2019. During this period, total volume sales was 52,961,817 kits (1.24 kits per capita) for heated tobacco products and 1,733,724,343 packs (40.73 packs per capita) for combustible cigarettes. Western Cape and Gauteng alone accounted for 82.6% of the total volume sales for heated tobacco products in South Africa during September 2018–August 2019 (Table 1). The next 12 months from September 2019 to August 2020, covered the tobacco restriction during which Nielsen did not report any volume sales for 4.5 of the 12 months for both heated tobacco products and cigarettes. Comparisons of the first and second 12-month intervals (September 2018 to August 2019, vs September 2019 to August 2020) revealed reduced volume sales for both heated tobacco products and cigarettes. The decline was however more marked for combustible cigarettes (relative percentage change of –39.8%, from 40.73 packs per capita [1,733,724,343 packs total], to

24.53 packs per capita [1,044,431,057 packs total]) than for heated tobacco products (relative percentage change of –1.30%, from 1.24 kits per capita [52,961,817 kits total] to 1.23 kits per capita [52,275,195 kits total]). In the period following the lifting of the restriction, equivalent comparisons of data for the second half of August 2020 (all available volume sales for that month since the restriction was in place for half of the month) vs half of the volume sales for September 2020 (month of full sale) showed an increase for heated tobacco product sales (relative percentage change of 131%, from 825,638 kits in half of August 2020 to 1.90 million kits for half of September 2020). In contrast, a decrease was seen for combustible cigarettes (relative percentage change of –12%, from 55.27 million packs for half of August 2020 to 48.36 million for half of September 2020).

The mean weekly volume sales of heated tobacco products in the 6 weeks following the restriction (i.e., the second half of the month of August and all of September 2020, mean *weekly* volume sales = 772,585 kits/week) were dramatically lower compared to the 6 weeks preceding the restriction (i.e., second half of February and all of March 2020, *weekly* mean = 2.26 million kits/week). Assessed month-on-month, volume sales of heated tobacco products in February 2020, which almost immediately preceded the restriction (7.76 million kits), were much higher than in the same month of the preceding year (i.e.,

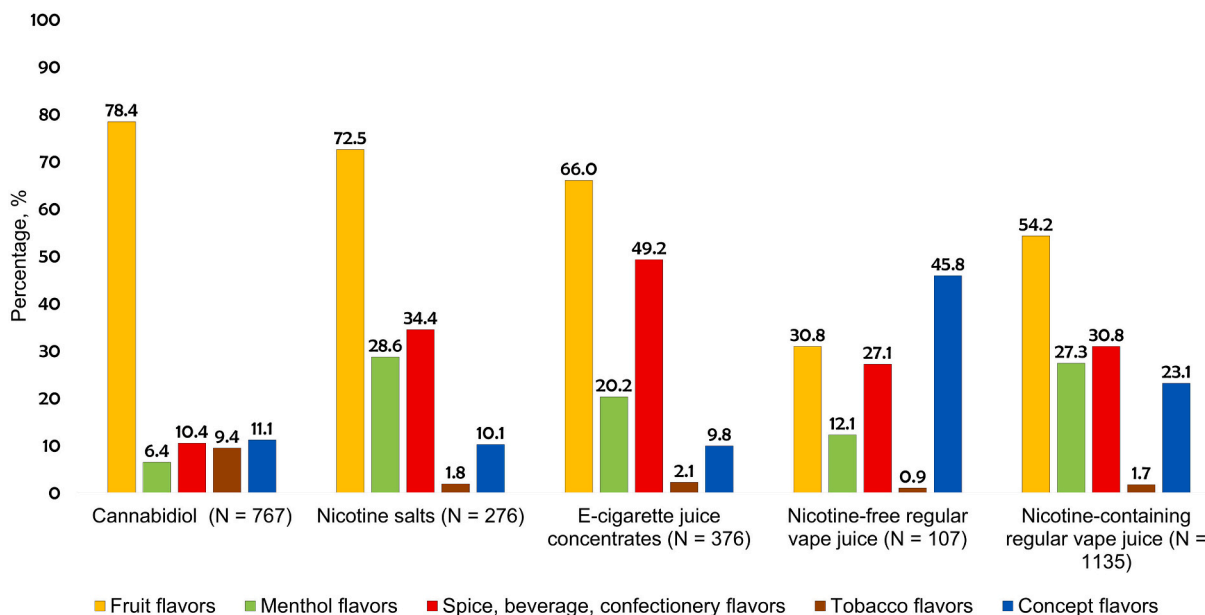


Fig. 2. Distribution of flavors in e-cigarette refill liquids assessed from online vendors in South Africa, by type of refill liquid, 2020. Note. During February to May 2020, we compiled a list of 231 South African websites selling e-cigarettes. Web scraping of their content occurred during June–July 2020 during the restriction on sales of tobacco and nicotine products in South Africa.

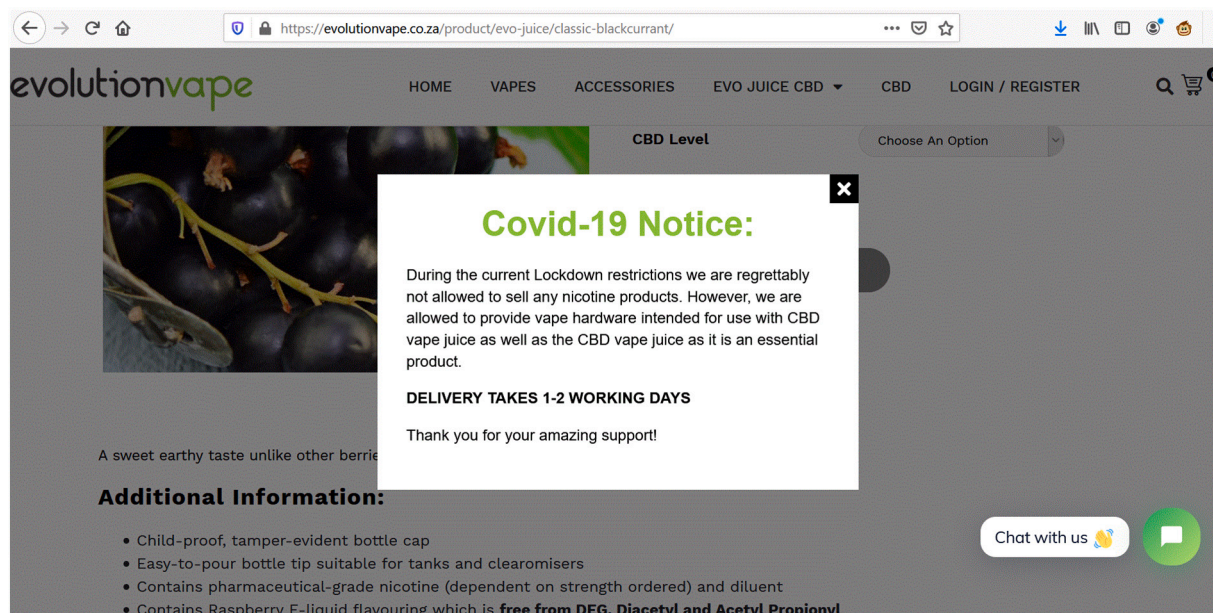


Fig. 3. Marketing of cannabidiol liquid containing “pharmaceutical-grade nicotine” as an additive during the restriction on the sale of “tobacco, e-cigarettes and related products” in South Africa, 2020.

February 2019, 4.52 million kits); the reverse was however seen for the full month immediately following the restriction. Heated tobacco product volume sales in September 2020 (3.81 million kits) were almost half of what was observed for September 2019 (6.33 million kits).

Join point analysis for the uninterrupted 19 months from September 2018— March 2020 showed a significant upward trend for heated tobacco product volume sales (from 2.92 million to 9.69 million kits, relative percentage change = 232%, average annual percentage change (AAPC) = 6.1, 95%CI, 4.6 to 7.7,  $p < 0.001$ ) (Fig. 4). In contrast, no significant change in combustible cigarette volume sales occurred during the same period (AAPC = 0.6, 95%CI, -0.2 to 1.4,  $p = 0.100$ ).

#### 4. Discussion

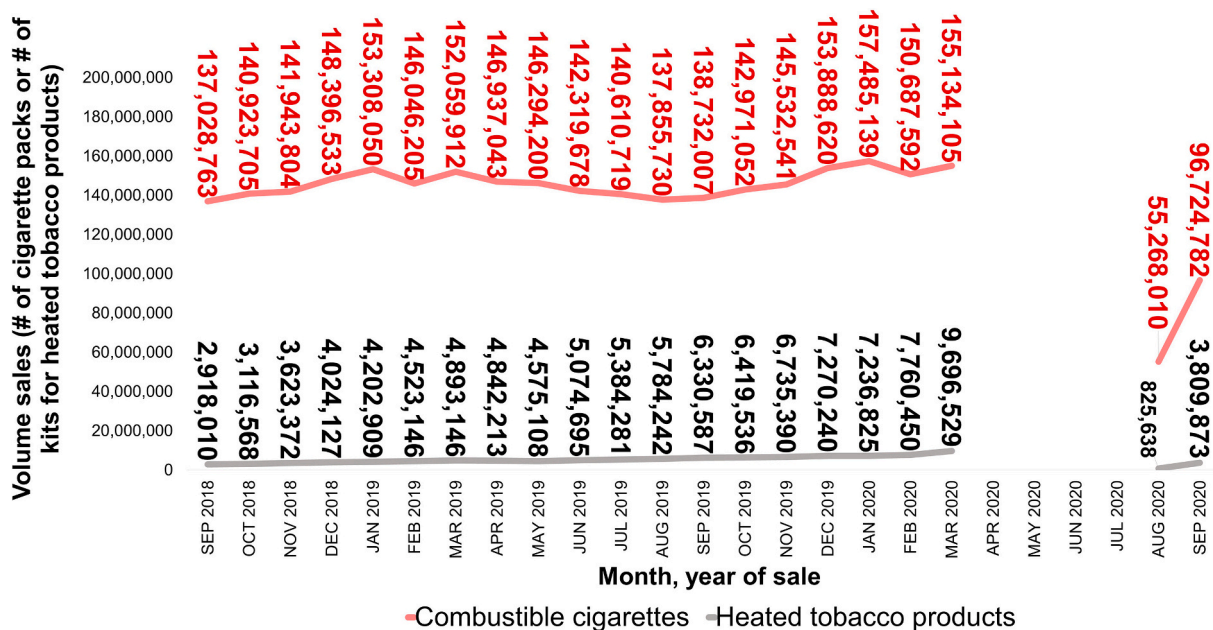
Three major findings from our study were: (1) E-cigarette liquids and CBD are marketed in a plethora of flavors in South Africa. (2) The e-cigarette industry used a variety of tactics to evade the restrictions on the sale of “tobacco, tobacco products, e-cigarettes and related products”. These including promoting CBD as a substitute product (including CBD with “pharmaceutical-grade nicotine”); allowing the sale of restricted items if purchased with CBD; and deeming ingredients for e-liquid and other e-cigarette paraphernalia as ‘essential items’, including glycerin, propylene glycol, and flavor concentrates. (3) The restriction appeared to be associated with a reduction in annualized legal tobacco

**Table 1**  
Total volume sales of heated tobacco products, by month, South Africa overall and in selected provinces, September 2018 to September 2020.

MARKET	South Africa	Gauteng	KwaZulu Natal	Western cape	Mpumalanga	Northern cape/Eastern cape/Free State
SEP 2018	2,918,010	1,359,938	229,698	1,104,391	115,091	113,896
OCT 2018	3,116,568	1,445,392	241,995	1,266,239	141,804	123,861
NOV 2018	3,623,372	1,658,435	305,672	1,354,234	225,923	144,673
DEC 2018	4,024,127	1,805,967	352,804	1,525,710	181,186	171,353
JAN 2019	4,202,909	1,838,533	349,247	1,644,118	182,520	179,389
FEB 2019	4,523,146	2,048,435	355,234	1,721,350	295,196	173,639
MAR 2019	4,893,146	2,213,529	381,882	1,834,631	232,133	203,161
APR 2019	4,842,213	2,150,724	391,395	1,835,378	233,508	229,286
MAY 2019	4,575,108	1,991,576	355,907	1,793,388	130,233	234,744
JUN 2019	5,074,695	2,213,025	416,862	1,962,906	255,695	256,736
JUL 2019	5,384,281	2,357,858	404,018	2,036,249	206,656	265,896
AUG 2019	5,784,242	2,452,987	442,977	2,152,251	251,478	311,041
SEP 2019	6,330,587	2,813,263	490,502	2,263,903	203,008	311,382
OCT 2019	6,419,536	2,924,328	503,174	2,358,027	159,891	291,176
NOV 2019	6,735,390	3,048,872	539,798	2,488,589	264,780	317,026
DEC 2019	7,270,240	3,313,015	558,608	2,664,278	269,305	352,471
JAN 2020	7,236,825	3,060,677	599,680	2,783,716	208,211	411,272
FEB 2020	7,760,450	3,338,831	640,500	3,000,978	258,700	378,923
MAR 2020	9,696,529	4,337,779	729,419	3,632,809	333,001	466,460
AUG 2020 <sup>a</sup>	825,638	292,377	77,513	325,500	256,108	60,530
SEP 2020	3,809,873	1,465,286	326,626	1,480,853	133,159	291,462
SEP 2018 to AUG 2019 <sup>b</sup>	<b>52,961,817</b>	<b>23,536,399</b>	<b>4,227,691</b>	<b>20,230,845</b>	<b>2,451,423</b>	<b>2,407,675</b>
SEP 2019 to AUG 2020 <sup>c</sup>	<b>52,275,195</b>	<b>23,129,142</b>	<b>4,139,194</b>	<b>19,517,800</b>	<b>1,953,004</b>	<b>2,589,240</b>

Note: Unit of sales for heated tobacco products was a “kit”. Only provinces with representative data from Nielsen Company are shown. Sum of volume sales for the provinces shown in the table is therefore less than the national total. The numbers in bold are the column totals for the one-year calendar period spanning September 1 of the one year, to August 31 of the next year.

- <sup>a</sup> Represents only half of the month as the restriction on sales was lifted on August 17, 2020.
- <sup>b</sup> 12 calendar months with 12 months of sales data.
- <sup>c</sup> 12 calendar months with 7.5 months of sales data; the restrictions were in place for 4.5 months.



**Fig. 4.** Total volume sales of heated tobacco products and combustible cigarettes, by month, South Africa overall, September 2018 to September 2020. Note: For heated tobacco products, unit of sales was a “kit”; for combustible cigarettes, it was a pack of 20 cigarettes.

sales; heated tobacco products had a smaller decline from the restriction and enjoyed a larger rebound two months after the restriction. Heated tobacco products also enjoyed a much faster increase in growth over the entire study period although combustible cigarettes had a considerably larger market share.

That the e-cigarette industry circumvented this national restriction by offering CBD as a substitute product is indicative that they have less interest in helping people quit smoking completely than in perpetuating addictive behaviors (Braymiller et al., 2020). Restrictions on tobacco use

in different forms, including smoke-free laws, have been shown in past studies to be effective in helping smokers quit and protecting non-smokers from involuntary exposure to secondhand smoke (Shavers et al., 2006; Monson and Arsenault, 2017; Frazer et al., 2016). In addition, CBD itself is not entirely safe; in the U.S. for example, the Food and Drug Administration has declined to confer GRAS status (Generally Regarded As Safe) on CBD, citing concerns about potential toxicity and some available data suggestive of potential for harm (U.S. Food and Drug Administration, 2021). CBD products had the highest proportion of

tobacco flavors, which raises concerns about perpetuating tobacco use. British American Tobacco recently signaled interest in introducing cannabidiol and cannabis flavorings in their products (ITV News, 2021), underscoring the need for tobacco industry watch on this issue. For example, research is needed to examine nicotine content of CBD vaping liquids on the market, as this has direct implications for addictive behavior.

Policies that are vague in their framing, unenforceable, or simply unenforced are likely to be subjectively interpreted and may have poor compliance. In the case of the temporary restriction of the sales of tobacco products in South Africa, we saw a wide variability in marketing practices regarding what was restricted and what was not. Variability existed from vendor to vendor as to whether e-liquid substitutes such as CBD were sold; whether e-cigarette hardware could be sold only with a CBD purchase, without a CBD purchase, or not at all; whether e-liquids containing 0 mg nicotine were prohibited; as well as the range of what was deemed 'essential goods' and who could make that determination. The observed loopholes around CBD to maintain e-cigarette use behavior during the restriction could also have relevance for other vaping-specific policy (Government Gazette, 2018). Specifically, it raises the specter that tobacco companies, for example, might respond to flavor-restrictions by introducing/promoting analogous flavors in CBD vapes, or might respond to excise taxes on e-liquids by promoting CBD alternatives. Implementing comprehensive policies that address the full range of products, including e-cigarettes, can help reduce aggregate tobacco consumption (King and Graffunder, 2018). The rapid increase in heated tobacco product sales as evident in our study, along with the subterfuge marketing strategies used by the industry warrants implementing comprehensive policy.

This study's strength is its drawing on complementary data sources to answer questions of public health importance, with potential implications for proposed tobacco control regulations in South Africa. Nonetheless, there are limitations. First, online information about product characteristics may not match the actual contents, for example, the advertised nicotine vs actual levels may differ. Second, any online search for retailers is subject to the search strategy and may not be exhaustive of all online retailers. Third, the Nielsen data did not include online sales, specialty shops, or illicit products (e.g., smuggled). Calculated volume sales may therefore underestimate total consumption in South Africa. Furthermore, the pattern of sales and uptake of heated tobacco products which we analyzed volume sales for during the ban, may be very distinct from e-cigarettes for which we had no available data. Finally, sales may not necessarily translate into actual consumption; some purchased products may be unused, damaged, or stolen.

## 5. Conclusion

Market-level data revealed a wide variety of flavors on the e-cigarette market in South Africa, including for CBD which were marketed as a way of circumventing restrictions on sale of e-cigarette liquids and related products in South Africa during the COVID-19 lockdown. The restriction appeared to be associated with a reduction in sales of heated tobacco products. Yet, month-on-month analysis showed a large increase in volume sales following the lifting of the restriction. Regulation of e-cigarettes and other novel tobacco products should pay attention to product design, manufacture, advertising, and distribution (including over the internet) as part of comprehensive tobacco control in South Africa. The marketing of cannabidiol by e-cigarette manufacturers may perpetuate e-cigarette use without net public health gain, especially if it encourages youth use; close monitoring is required.

## Disclosure

The authors have no financial relationships relevant to this article to disclose.

## Author contributions

IA conceptualized and designed the study and drafted the initial manuscript. CO and AA helped conceptualize the study and critically reviewed and revised the manuscript. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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## Declaration of Competing Interest

The authors have no conflicts of interest to disclose.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ypmed.2021.106526>.

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