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Global and regional trends in public interest in cola and energy drinks across English-speaking countries

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ABSTRACT

A Google-linked plugin was used to investigate the trend in the public's interest in cola and energy drinks. Seven English-speaking countries and the global context were studied for the time period between 2004 and 2022. The influence of time, the financial income situation in a given country, and the level of human development were investigated as potential independent variables concerning the population's interest in cola and energy drinks. The results of the current study indicate differences in interest in cola drinks and energy drinks among the populations of the seven English-speaking countries studied here. There are also differences between the country-specific context and the global one concerning the population's interest in cola and energy drinks. Cola drinks are decreasing in significance as a topic of Google searches in Australia, India, South Africa, New Zealand, the United Kingdom, the United States, and Canada. A slightly different trend was observed for energy drinks, where the countries' populations seem to search for specific brand names rather than general information related to energy drinks. The health impacts of energy drinks are of interest to the populations in the studied countries and globally. Therefore, it is likely that the public searching on Google will receive health promotion interventions related to energy drinks positively. Results from this study can form the foundation for public health approaches tackling the risk factors of non-communicable diseases in the studied countries and South Africa. Future studies should focus on a comparative analysis of public health policies and legislation in addressing the consumption of cola and energy drinks as a potential risk factor for non-communicable diseases in the studied countries and in the global context.

Keywords: Google search volumes, Spearman correlation coefficient, cola, energy drinks, public interest

INTRODUCTION

Mphahlele et al. **[1]** reviewed the biological effects and potential negative impacts of consuming energy drinks on adolescents. Manyeneng and Pilusa **[2]** showed that energy drinks are consumed by South African nursing staff during part-time studies, which can lead to fatigue during the nurse's on-the-job duties. Fernandes et al. **[3]** reported an urgent need for public health interventions to address the consumption of energy drinks to the public as a potential health risk. Some authors highlighted the importance of advertising in South Africa as a significant hurdle faced by the public health sector in managing the possible adverse effects of energy drink consumption **[1]**. Soft drink manufacturers have been advertising in various formats over many decades, and the respective advertising campaigns have been adapted to local conditions **[4]**. At the same time, the big players in the soft drinks market have been established in the African continent and South Africa since the 19th century **[5]**. Novel soft drink solutions and socially engaged corporate citizenship have been a staple of the approach of soft drink manufacturers in South Africa, for example, through the launch of the Spar Letta range of products **[6]**. Advertising has moved online, and platforms, such as Google, have become focal points of the marketing of soft drink manufacturers to consumers **[7]**. With a total advertising revenue of $ 209.49 billion in 2021, Google is recognised as one of the most widely used search engines globally **[8]**. Businesses of all sizes have utilised this

platform to promote their goods and services to a large audience. The search engine offers a flexible and efficient way to gauge the general interest of a country's population in a specific topic. It can therefore be a source of significant data about consumer interest in a specific topic, such as cola and energy drinks.

Scientific Hypothesis

The working hypothesis of this article is that the public's interest in cola and energy drinks in the studied countries was a function of time. It is further hypothesised that the public's interest in both groups of drinks is also a function of the financial resources available to the country's population and the level of human development, including the health status and education level of the country's population.

Objectives

Madikizela et al. **[9]** showed that the plugin-assisted data extraction of search volumes from Google can provide reliable and generally representative trends in the search volumes for water, sanitation, and hygiene (WASH) in South Africa. The authors presented a statistical analysis and sample size estimation using Google-derived search volumes to gauge public opinion concerning WASH in South Africa. The study approach was derived in part from the previous article by Pretorius et al. **[10]**. Here the logic is extended to establish whether one can use Keywordseverywhere.com to check the advertising costs paid to Google per click for cola and energy drinks. The same plugin is used here to extract data on monthly, weekly, and daily search volumes about a specific set of keywords **[9]**. The specific subtopics in the current article include the level of public interest in energy drinks and an estimate of the advertising revenue that soft drink producers might pay to Google for the promotion of their products. Qualitative drivers of the public interest are also analysed for the period from January 2004 to August 2022. Data were analysed for the global context and for the following countries: Australia, India, South Africa, New Zealand, the United Kingdom, the United States, and Canada. These countries are all English-speaking, and examining the public interest trends in them will provide an outline of the interest and consumer behaviour concerning cola and energy drinks. At the same time, the authors hope to assess the influence of the level of human development and the financial strength among the countries' populations on the consumer interest in cola and energy drinks.

MATERIAL AND METHODS

Data extraction and variability in the extracted search volumes for cola and energy drinks

The approach employed in this article was partially comparable to that of Madikizela et al. **[9]**, who also utilized the Keywordseverywhere.com plugin to examine the interest of the South African populace in WASH-related topics. In the current study, the authors downloaded and installed the plugin and purchased credits to extract data from Google using the online plugin platform (see https://keywordseverywhere.com/credits.html for details; accessed on 30 October 2024). The search volumes extracted from Google through Keywordseverywhere.com for each month are variable on a sliding time scale. This could potentially result in changes in the extracted values of monthly search volumes if they were to be extracted on multiple occasions. As such, the monthly search volumes for cola and energy drinks were extracted on two separate occasions between August and November 2022. The potential shifts in these extracted volumes were measured by calculating the 'coefficient of variation' (*CV*) using Equation (1).

$$CV = 100 \times \frac{|Extracted\ value\ one - Extracted\ value\ two|}{Extracted\ value\ two} \quad (1)$$

In Equation (1), *CV* represents the percentage of change in search volumes obtained for a specific search term on two different occasions, reflecting the Google search volumes for a particular country during a specific time frame spanning from January 2004 to August 2022. The process of data extraction generated two values, *Extracted value one* and *Extracted value two*, which correspond to the monthly search volume for the cola/energy drinks term extracted on the first and second occasions, respectively, within the time period of January 2004 to August 2022. The numerator of Equation (1) contains the absolute value of the difference between the two extracted values of the search volume for the same month, but from two separate occasions of extraction. The *CV* value as defined in Equation (1) represents an absolute error of the search volume between the values extracted for the same month on two different occasions. The analysis period spanned from January 2004 to August 2022. The individual months were represented by ascending numbers ranging from 1 to 224. The *CV* calculations were conducted for cola and energy drinks globally, and separately for each of the seven English-speakign countries studied.

Statistical testing and correlation analysis of the search volumes for cola and energy drinks

Various statistical tests and distribution parameters were performed/calaculated for the two data extraction events for cola or energy drinks in a given country. The following distribution parameters were calculated for cola and energy drinks monthly search volumes in individual countries using Microsoft Excel 2016: the arithmetic average, the median, and the mode. Any statistically significant differences in the public's interest in cola and energy drinks between the nations, and as a function of time, were investigated using Kruskal-Wallis analysis of variance by ranks at 5 % level of significance **[11]**. Next, the average monthly search volumes were subjected to assessment for any increase or decrease with time. This was done using the Mann-Kendall test at 5% level of significance **[11]**. The monthly search volumes for cola and energy drinks were also analysed for any statistical significant correlation, or a lack thereof, with time using the Spearman coefficient at 5% level of significance (see https://www.socscistatistics.com/tests/spearman/default2.aspx for details; website accessed on 10 July 2022; see Results and Discussion). The logic in using the combination of the Mann-Kendall test and the Spearman correlation coefficient was as follows. Results of the first test would indicate whether a particular temporal trend in the search volumes exists, whether it is increasing or decreasing. Evaluation of the Spearman correlation coefficient can confirm these trends, or a lack thereof. In additon, its second power would indicate the percentage of variance in the dependent variable (monthly search volumes) that is explained by the independent variable (time). This can indicate whether time of the dominant parameter in determining the search volume trend. In other words, if time explains more than 50% of the variability of the search volumes in a given month, than time detemines the search volume. Changes of the information and type of access to it can change over the duration of the study, which in turn could have been a source of the observed trends and correlations between search volumes and time.

For each in the seven English-speaking countries and the global landscape, the monthly search volumes for cola or energy drinks were then summed up across the given calendar year. Then, the yearly search volumes for both search terms (for either cola or energy drinks) were obtained for each country (designated as *YSVC* in the further text of the article). The calculation was based on Equation (2).

$$YSVC = \sum_{1}^{12} Y_{\mathrm{i}} \quad (2)$$

Equation (2) calculates the total search volume for cola or energy drinks in a specific year, represented by *YSVC*. The search volume can be based on the population of one particular English-speaking country being studied, or the global Google users for the overall global landscape. The symbol $\sum$ represents the total amount of searches conducted for either cola or energy drinks by a particular population throughout the 12 months of a given year. The symbol Y_i represents the monthly search volume conducted by the population of a specific country for either cola or energy drinks. Once the *YSVC* values were calculated, a correlation analysis was performed by using Spearman correlation coefficient calculations. *YSVC* was considered the dependent variable, while the independent variables were indicators of the national income and/or level of development for the population in a given country or global community.

To evaluate the income of either the global population or the population of the specific country being studied, the Gross National Income per capita adjusted for purchasing power was utilized (designated as GNI_{adjusted} in further text of this article). The values of GNI_{adjusted} in USD were obtained from the World Bank database for the period between 2004 and 2021 **[12]**. Moreover, the access to the internet and the tendency to search for information online can be impacted by a combination of factors, including the level of education, the health status of the population, and the income level **[13]**. This relationship can be easily quantified by comparing the Human Development Index (HDI) with the yearly search volumes for cola and energy drinks (measured as *YSVC*) for the country under study [13]. To investigate whether this correlation existed for the population in a specific country, the *HDI* values were obtained from United Nations information sources for the period spanning from 2004 to 2021 **[14]**. Google may be used as a feasible means to identify factors that can affect the public's inclination to search for information on the internet **[13]**.

Qualitative and quantitative information related to public interest in cola and energy drinks

The Keywordseverywhere.com plugin provides additional qualitative and quantitative information about Google searches related to cola and energy drinks, as well as those performed by the population of the country in question or globally. These include keywords, the related keywords people searched for, the long-tail keywords and price of advertising revenue/payment per click on a given term. This information was extracted using the

Keywordseverywhere.com plugin and the time of extraction did not influence the nature of the qualitative or the quantitative terms. For the global Google landscape and individual countries, the main keywords and topics were extracted, overlaps and common topics were sought to be identified. Such overlaps would indicate potential drivers of the interest in cola and energy drinks among populations. They could provide indications about the main topics to be addressed in public health awareness campaigns in South Africa and beyond. The average advertising revenues from cola and energy drink searches in a given country per month were calculated using Equation (3).

$$AMAR = AMSV \times CPC \quad (3)$$

In Equation (3), *AMAR* stands for the average monthly advertising revenue in a given country in USD per drink type which has been paid by the advertisers to Google per user click on cola and energy drinks. At the same time, *AMSV* is the median value for the monthly search volume for cola or energy drinks in a given country/globally between January 2004 and August 2022 (see Tables 1 and 3 below for details). Finally, *CPC* is the cost per click paid by advertisers for the searches performed for cola or energy drinks in a given country between January 2004 and August 2022. Finally, the total advertising volume/potential income globally or in the specified country was calculated for cola and energy drinks for the period between 2004 and 2022. This is designated as *TARG* in the text below details are shown in Equation (4).

$$TARG = 19 \times 12 \times AMAR = 228 \times AMAR \quad (4)$$

Definitions of the terms used in Equation (2) and Equation (3) have not changed as they are also used in Equation (4). The computations performed using Equation (4) relied on the assumptions that each click represented one user (search) and that the cost per click remained constant from January 2004 to August 2022. The overall estimated advertising revenue may serve as an indicator of the amount of funding that external advertisers are allocating to promote cola and energy drinks in the Google environment. The amount of advertising revenue generated by Google can provide insight into the extent of the challenge public health authorities may face in addressing the harmful effects of cola and energy drink consumption globally and in the specific country being studied.

Data Access

The Results and Discussion section below presents data in tables and figures. The authors can provide more detailed data upon request.

Statistical Analysis

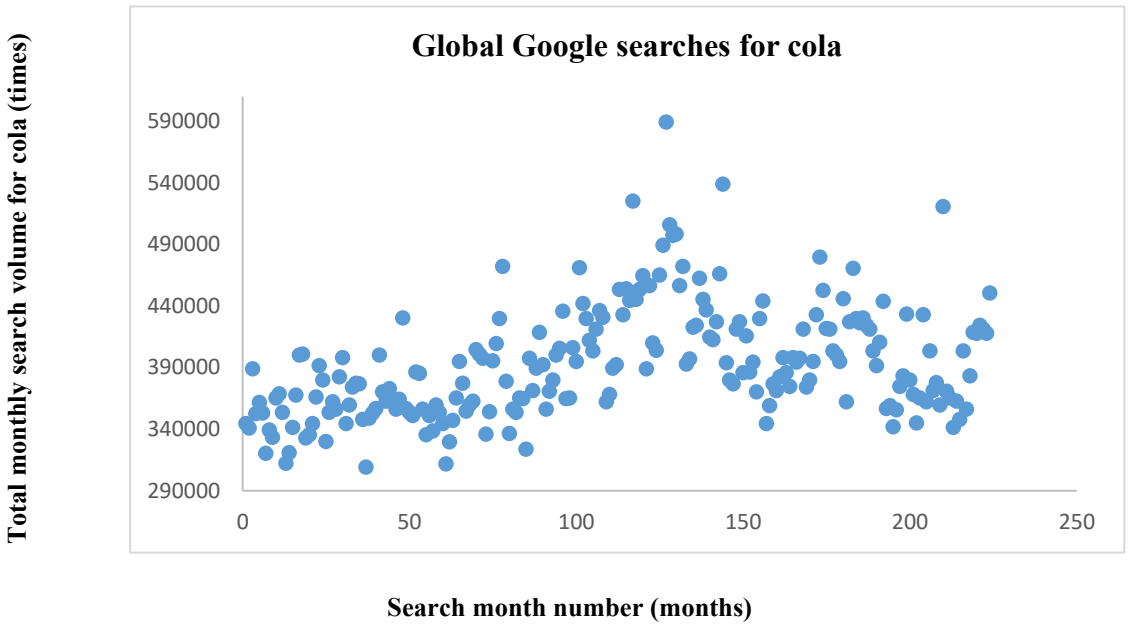
As stated above, the Kruskal-Wallis analysis of variance by ranks and the Mann-Kendall test were performed. All analyses were done using the Past 3.0 software package **[11]**. The Spearman correlation coefficient was calculated using the online calculator as stated above.

RESULTS AND DISCUSSION

Public interest in cola in the English-speaking countries and globally

Examples of the public interest in the search term ‘cola’ as a function of time are shown for the global population and the internet-using public in South Africa in Figure 1. Results of the Kruskal-Wallis analysis of variance by ranks at 5 % level of significance indicated that the monthly search volumes for cola were significantly different among the studied countries, and the global scope of analysis between January 2004 and August 2022 (H_C =1459; p-value < 0.0001). For the individual studied countries, the monthly search volumes ranged from 0 to 83400, with the lowest search volumes observed for New Zealand in January 2004 and the highest in India in March 2019. There was only one monthly search volume, which was equal to zero, i.e., the New Zealand value for January 2004. That value was recorded on the values from both data extractions from the Keywordseverywhere.com plugin. Based on the results of the Mann-Kendall test, public interest in cola drinks declined over time in all seven English-speaking countries, as indicated by Google monthly search volumes between January 2004 and August 2022 (with p-values ≤ 0.01 in all cases). Globally, the values of monthly search volumes ranged from 371400 in January 2005 to 714300 in July 2014. The trend was increasing with time which was based on the resutls of Mann-Kendall test and the results were statistically significant at 5% level of significance (p-value = 0.0113).

a)



b)

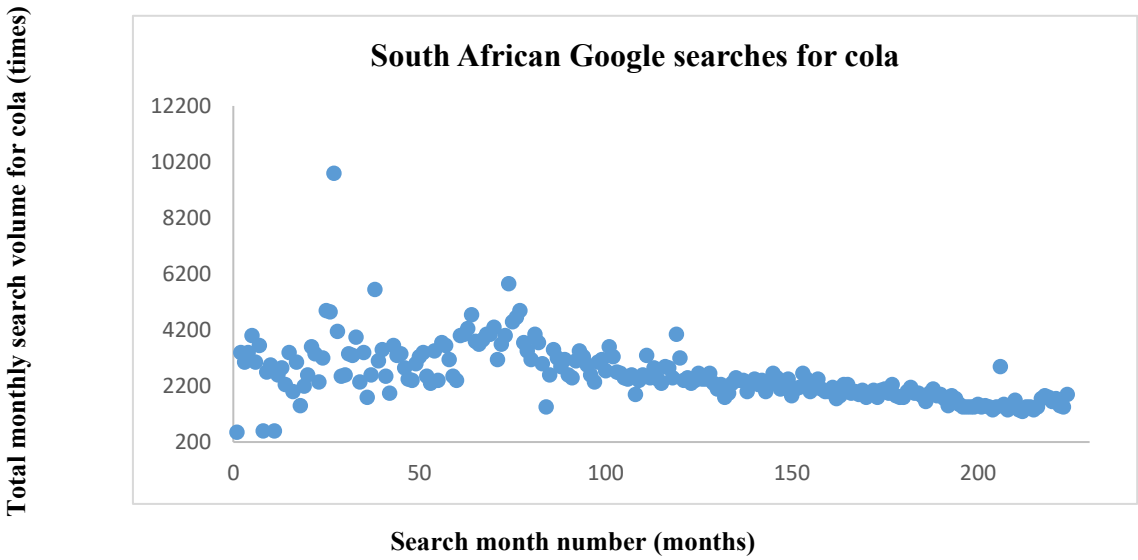


Figure 1 The monthly search volumes for cola for the global Google users (a) and the users from South Africa (b) for the time period from January 2004 until August 2022.

Table 1 displays the statistical measures and average *CV* values of the extracted data for cola in the seven English-speaking countries. If both values are equal to zero, the resulting *CV* value would be infinitely large. However, this is an irrational scenario, and such a large *CV* value can never be observed. Therefore, where a zero was calculated, the variability is logically assumed to be zero as it implies that there was no public interest in cola for that month and hence no variation was recorded. Consequently, the *CV* value for January 2004 was assigned a value of zero for New Zealand. In all seven countries studied, the use of a sliding time scale for extracting monthly search volume data was found to be a contributing factor to the observed range of *CV* values. Those values ranged on average from 4 ± 3 to 21 ± 6%. Upon analyzing the Spearman correlation coefficient results, it was found that the level of public interest in cola decreased over time in all seven English-speaking countries studied. The Spearman correlation coefficients for each country ranged from -0.1676 in Canada to -0.8672 in Australia. Additionally, the global Spearman correlation coefficient was calculated to be 0.4340, and all correlations were deemed statistically significant at 5% level of significance (see *p*-values in Table 1).

By aggregating the monthly search volumes of all seven English-speaking countries for a specific month, it was found that on average, searches for cola from these countries accounted for 21 ± 4% of all worldwide cola searches on Google from January 2004 to August 2022. As a result, the surge in global public interest in cola

drinks was primarily driven by searches conducted in regions outside of Australia, Canada, India, New Zealand, South Africa, the United Kingdom, and the United States.

Table 1 The public interest in cola as the monthly search volumes that were extracted from Google using the Keywordseverywhere.com plugin between January 2004 and August 2022.

	Cola – Australia	Cola – Canada	Cola – India	Cola – New Zealand	Cola – South Africa	Cola – United Kingdom	Cola – United States	Cola – Global
Average	5496	4924	18327	568	2607	14228	35326	445458
STD	1726	753	10237	172	1018	3905	3676	50570
Median	4800	4800	16350	525	2450	12950	34350	436975
Mode	4600	4850	10000	465	1450	10700	33750	390000
Average CV (%)	6 ± 3	4 ± 3	37 ± 5	12 ± 42	17 ± 5	21 ± 6	14 ± 3	8 ± 2
Spearman correlation coefficient	-0.8672	-0.1676	-0.5347	-0.5000	-0.6960	-0.5533	-0.1856	0.4340
Variance percentage[a]	75.2	2.8	28.6	25.0	48.4	30.6	3.4	18.8
***p*-value**	< 0.00001	0.01201	< 0.00001	< 0.00001	< 0.00001	< 0.00001	0.00534	< 0.00001

Note: [a] Percentage of dependent variable (public interest in cola) variance as explained by the independent variable, namely time.

Table 2 The *YSVC* values for cola drinks as a function of $GNI_{adjusted}$ and *HDI* between 2004 and 2021.

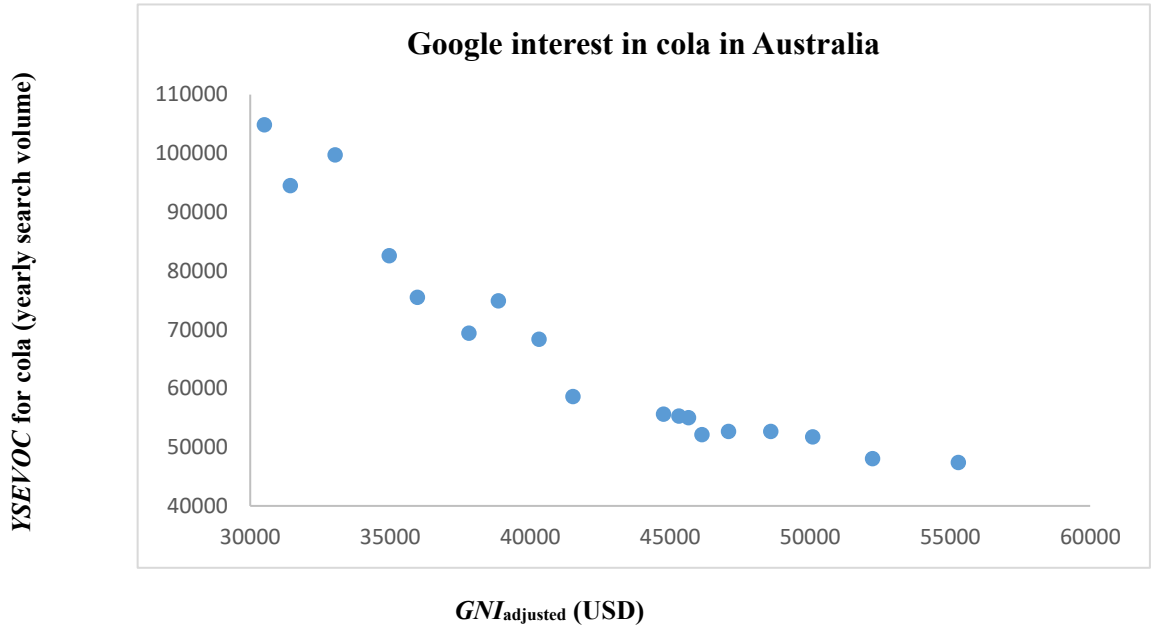
	Cola – Australia	Cola – Canada	Cola – India	Cola – New Zealand	Cola – South Africa	Cola – United Kingdom	Cola – United States	Cola – Global
Spearman correlation coefficient for $GNI_{adjusted}$	-0.9892	-0.2838	-0.4386	-0.9133	-0.7228	-0.8019	-0.3891	0.6471
Variance percentage[a]	97.8	8.1	19.2	83.4	52.2	64.3	15.1	41.8
***p*-value**	< 0.00001	0.25376	0.06864	< 0.00001	0.0007	0.00006	0.11054	0.0037
Spearman correlation coefficient for HDI	-0.9851	-0.2447	-0.4120	-0.9106	-0.7723	-0.7005	-0.3647	NA[c]
Variance percentage[b]	97.0	6.0	17.0	82.9	59.6	49.0	13.3	NA[c]
***p*-value**	< 0.00001	0.32775	0.08936	< 0.00001	0.00017	0.00121	0.13678	NA[c]

Note: [a] Percentage of dependent variable (public interest in cola) variance as explained by the independent variable, namely the gross national income per capita per purchasing parity adjustment.
[b] Percentage of dependent variable (public interest in cola) variance as explained by the independent variable, namely the country's human development index.
[c] Not applicable.

The factor of time explained between 2.8 and 75.2 % of the variance in the monthly search volumes derived from Google, with individual correlations being predominantly weak. Rise in public interest for cola beverages was motivated, at least to some extent, by factors beyond time. Further investigation into these factors were conducted as shown below. An online Spearman correlation coefficient calculator was used to determine the correlations between the *YSVC* values for cola drinks and the $GNI_{adjusted}$/HDI values. The findings of this analysis are presented in Table 2 above. Examples of the relationship between the *YSVC* values and $GNI_{adjusted}$/HDI values for Australia are shown in Figure 2. According to the data gathered for Australia, there is a negative correlation between public interest in cola (measured as annual Google search volumes) and increased human development and income. This trend is consistent with the results observed across all seven countries studied. The Spearman

correlation coefficient analysis revealed that Canada had the minimum correlation level between $GNI_{adjusted}$ and *YVSC*, with a value of -0.2838, which was not statistically significant at 5% level of significance. Australia had the strongest negative correlation between the variables, with a Spearman value of -0.9892. This negative correlation was statistically significant at a 5% significance level (the respective *p*-value < 0.00001).

a)



b)

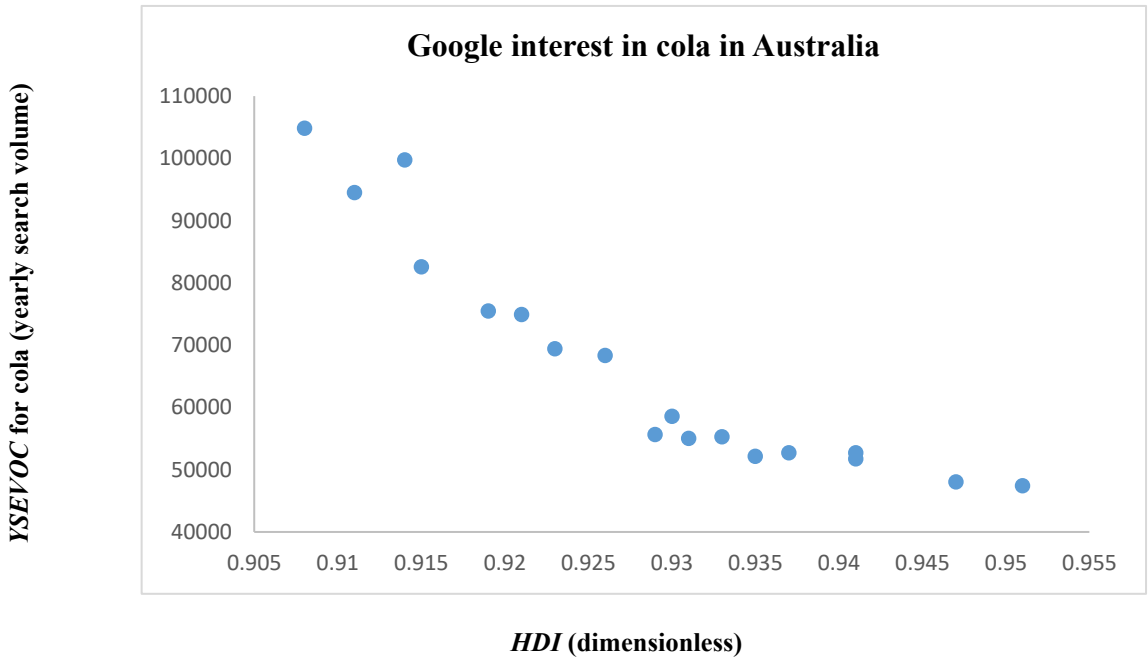


Figure 2 The yearly search volumes for cola for the global Google users in Australia as a function of $GNI_{adjusted}$ in USD (a) and as a function of the *HDI* of Australia (b) between 2004 and 2021.

At the global level, there was a positive correlation between interest in cola and $GNI_{adjusted}$ with a Spearman correlation coefficient of 0.6471. A similar trend was seen in the correlation between *YVSC* and *HDI*, where the Spearman correlation coefficient values ranged from -0.2447 to -0.9851, with Canada and Australia being the countries showing this trend. About 43% of the correlations between *YVSC* and $GNI_{adjusted}$/HDI was not statistically significant at a 5% significance level (see Table 2 for details).

As the level of human development increases, it typically signifies a rise in education and life expectancy among a country's population. Consequently, if Google searches for cola decreased in the seven countries under

study, this may suggest that the people in those countries are making more informed and more health-conscious decisions regarding their consumption of sugary beverages. More specifically, the consumption and interest in cola drinks is declining with increasing level of purchasing power and human development. Such decisions are likely based on improved education and health awareness among the population in a given country. Globally, the interest in cola drinks increased as the income per capita increased between 2004 and 2021. This could indicate that the advertising and consumption of cola/sugary beverages increased in countries outside of the specific seven ones studied here. The yearly search volumes obtained from Googles were influenced to a considerable extent by a $GNI_{adjusted}$ values, accounting for between 8.1 and 97.8% of the variation. The values of *HDI* for the seven countries studied accounted for 6.0% to 97.0% of the variance in *YSVC* values. This suggests that factors other than time were responsible for driving the public interest in cola drinks, and these factors are explored in more detail below. In the next subsection, the same analyses are presented for energy drinks.

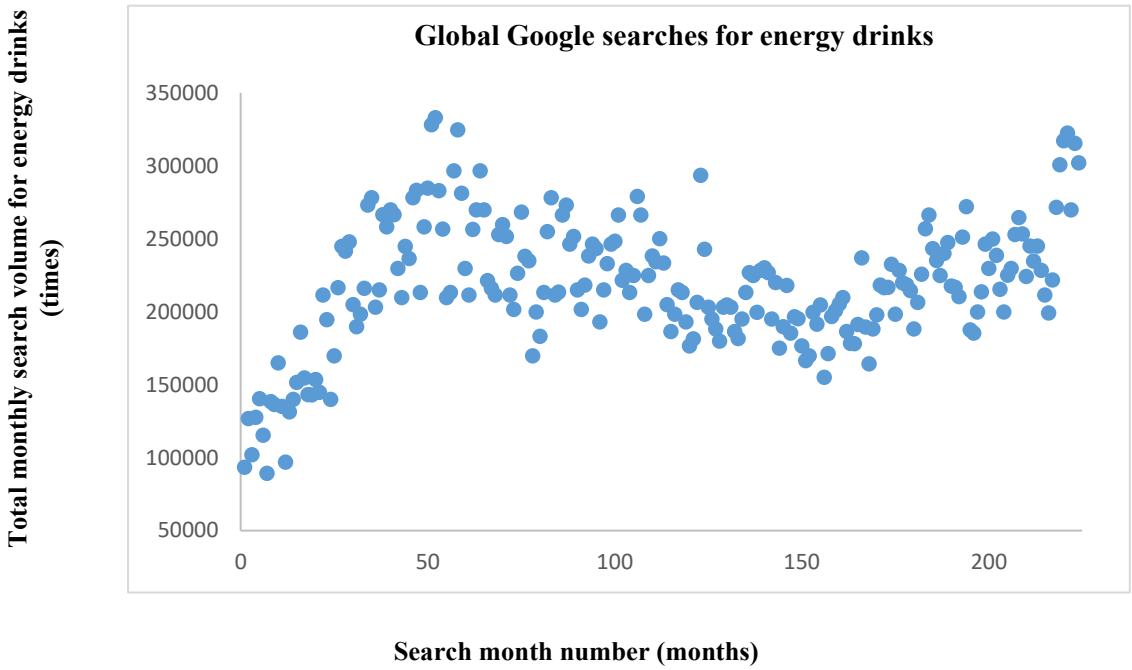
Public interest in energy drinks in the English-speaking countries and globally

Figure 3 displays the level of public interest in energy drinks over time, both globally and among internet users in South Africa. The measures of central tendency and other statistical values related to the monthly search volumes of distribution are presented in Table 3. Results of the Kruskal-Wallis analysis of variance by ranks at 5% level of significance indicated that the monthly search volumes for energy drinks were significantly different among the studied countries and the global scope of analysis, between January 2004 and August 2022 (H_C=1253; p-value < 0.0070). Monthly search volumes for energy drinks varied among individual countries, with some countries, such as Australia and Canada, having search volumes as low as 0 on several occasions between January 2004 and January 2007. On the other hand, the highest search volume of 112000 was observed in India in March 2019, while the lowest search volume was recorded in New Zealand in January 2004. The monthly search volumes for energy drinks in New Zealand were again zero in January 2004, as with the cola drink searches (see above). This was recorded in both data extractions from the Keywordseverywhere.com plugin. Thus, the *CV* value for January 2004 was adjusted to zero, in the same manner as with the cola drink example (see above). Globally, the monthly search volumes for energy drinks ranged from 90350 in July 2004 to 348250 in April 2008. The trend for energy drink searches increased over time, as indicated by the Mann-Kendall test results (p-value = 0.0155).

In all seven countries studied, the time of extraction impacted the monthly search volume data, as the *CV* values ranged from 6 ± 4% to 33 ± 56%. Upon analysis of the Spearman correlation coefficient results, it was found that public interest in energy drinks showed a variable relationship with time in seven English-speaking countries. The Spearman correlation coefficients was equal to -0.0713 for India, which was not statistically significant at 5% level of significance (p-value = 0.28799). At the same time, the search volumes for energy drinks in Canada yielded a Spearman correlation coefficient which was equal to 0.0560. That correlation was not statistically significant at 5% level of significance (p-value = 0.40344). In the remaining cases, the Spearman correlation coefficient showed a direct proportionality with time. The individual Spearman values ranged from 0.3730 for the United States to 0.8971 for the United Kingdom (all correlations were statistically significant, p-values < 0.00001). The global interest in energy drinks increased as the Spearman correlation coefficient was equal to 0.1672 (p-value < 0.00001). By aggregating the monthly search volumes of all seven English-speaking countries for a specific month, it was found that on average, searches for energy drinks from these countries accounted for 80 ± 6% of all worldwide cola searches on Google from January 2004 to August 2022. As a result, global public interest in energy drinks was primarily driven by searches in Australia, Canada, India, New Zealand, South Africa, the United Kingdom, and the United States. The novelty and interest in energy might be a lifestyle choice in the seven studied countries could explain this observation. Advertising could also be a source of difference, i.e., this would mean that energy drink manufacturers are targeting their advertising to consumers in Australia, Canada, India, New Zealand, South Africa, the United Kingdom, and the USA.

As with cola drinks, the Spearman correlation coefficients were calculated for the *YSVC* values for energy drinks and the $GNI_{adjusted}$/HDI values in Australia, Canada, India, New Zealand, South Africa, the United Kingdom, and the USA. The findings of this analysis are presented in Table 4 and Figure 4. According to the data gathered, correlations between the *YSVC* and the $GNI_{adjusted}$ was not statistically significant for five out of the seven studied countries, nor the global settings. The annual income per capita was indirectly proportional and negatively correlated with the yearly interest of the country's population in energy drinks for New Zealand and the United Kingdom. The Spearman correlation coefficients were equal to -0.9133 for New Zealand and to -0.8039 for the United Kingdom. Both correlations were statistically significant at a 5 % significance level, as the respective p-values were ≤ 0.00006. Analogical Spearman correlation coefficients were observed for the *HDI* and *YSVC*, with the value of -0.9106 for New Zealand and to -0.7005 for the United Kingdom. Both correlations were statistically significant at a 5 % significance level, as the respective p-values were ≤ 0.00121.

a)



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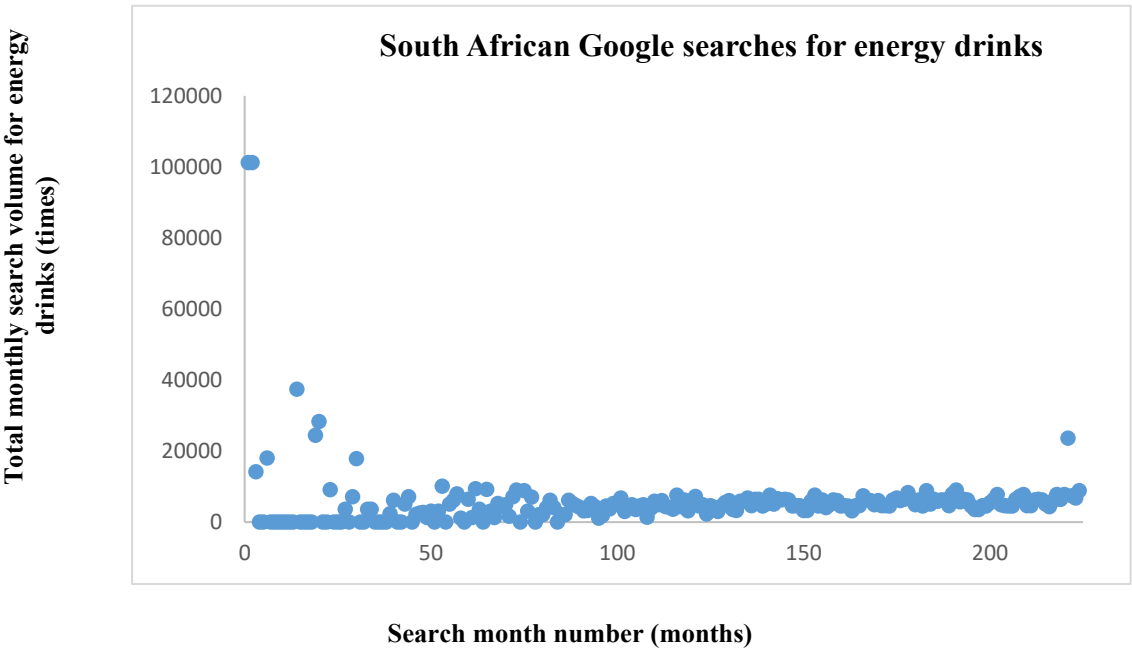


Figure 3 The monthly search volumes for energy drinks for the global Google users (a) and the users from South Africa (b) for the time period from January 2004 until August 2022.

As a result, personal income and level of health/education contribute to the interest in energy drinks, and the extent depends on the location of the person searching for the information. At the same time, these are not the only determining factors of the interest of the populations of seven countries in energy drinks. This trend is also global based on the income correlation results. Advertising might be the cause of these observations and so must be investigated in the futher considerations in this article. This is done in the next subsection of the article.

Table 3 The public interest in energy drinks as the monthly search volumes that were extracted from Google using the Keywordseverywhere.com plugin between January 2004 and August 2022.

	Energy drinks – Australia	Energy drinks – Canada	Energy drinks – India	Energy drinks – New Zealand	Energy drinks – South Africa	Energy drinks – United Kingdom	Energy drinks – United States	Energy drinks – Global
Average	5044	5310	103600	1201	5765	6575	59539	227013
STD	2218	1848	94714	1069	10071	3236	16735	45833
Median	5025	5200	81400	1100	4650	7000	59700	224650
Mode	4850	5400	74000	0	0	6900	52250	221200
Average CV (%)	10 ± 27	18 ± 55	25 ± 41[a]	43 ± 47	33 ± 56	17 ± 24	6 ± 4	8 ± 4
Spearman correlation coefficient	0.3827	0.0560	-0.0713	0.3827	0.4294	0.8971	0.3730	0.1667
Variance percentage[b]	14.6	0.3	0.5	14.6	18.4	80.5	13.9	2.9
***p*-value**	< 0.00001	0.40434	0.28799	< 0.00001	< 0.00001	< 0.00001	< 0.00001	0.01247

Note: [a] This is a relative standard deviation of the extracted data, i.e. 100 times the ratio of the standard deviation and the arithmetic average.
[b] Percentage of dependent variable (public interest in energy drinks) variance as explained by the independent variable, namely time.

Table 4 The *YSVC* values for energy drinks as a function of $GNI_{adjusted}$ and *HDI* between 2004 and 2021.

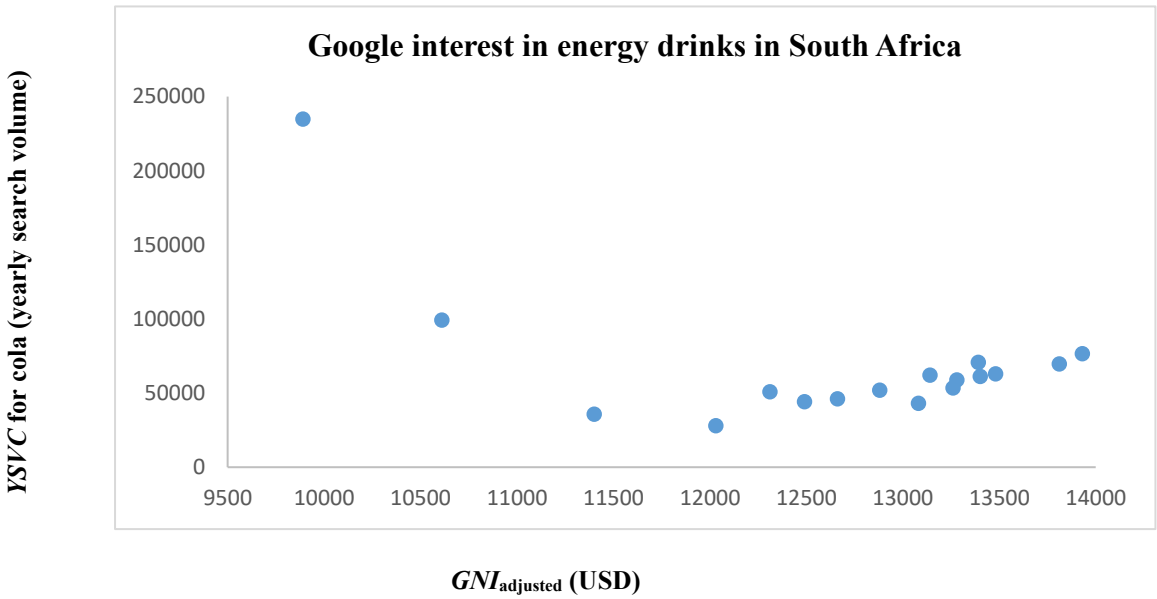
	Energy drinks – Australia	Energy drinks – Canada	Energy drinks – India	Energy drinks – New Zealand	Energy drinks – South Africa	Energy drinks – United Kingdom	Energy drinks – United States	Energy drinks – Global
Spearman correlation coefficient for $GNI_{adjusted}$	0.4448	-0.06295	-0.4386	-0.9133	0.3313	-0.8019	-0.3891	-0.0341
Variance percentage[a]	19.8	0.4	19.2	83.4	11.0	64.3	15.1	0.1
***p*-value**	0.06439	0.80402	0.06864	< 0.00001	0.17932	0.00006	0.11054	0.89328
Spearman correlation coefficient for HDI	0.4430	-0.0795	-0.4120	-0.9106	0.3375	-0.7005	-0.3647	NA[c]
Variance percentage[b]	19.6	0.6	17.0	82.9	11.4	49.0	13.3	NA[c]
***p*-value**	0.06563	0.75383	0.08936	< 0.00001	0.17084	0.00121	0.13678	NA[c]

Note: [a] Percentage of dependent variable (public interest in energy drinks) variance as explained by the independent variable, namely the gross national income per capita per purchasing parity adjustment.
[b] Percentage of dependent variable (public interest in energy) variance as explained by the independent variable, namely the country's human development index.
[c] Not applicable.

Qualitative and quantitative information related to public interest in cola and energy drinks

The keyword searches and the qualitative drivers were found to be of limited value, as the information generated was mostly financial in nature. At the same time, the product information and keywords mainly were related to Coca-Cola, eliminating competition information. For example, Google results for "Coca-Cola stock" provided mostly information on the market standing (share market price, financial-related news of the product, buying and selling of shares etc). This information would generally be searched for by business people who want to invest/buy shares, academics for research purposes or financial institutions to analyse the financial markets of Coca-Cola. It is for these reasons that such keywords are not included further tables and analysis.

a)



b)

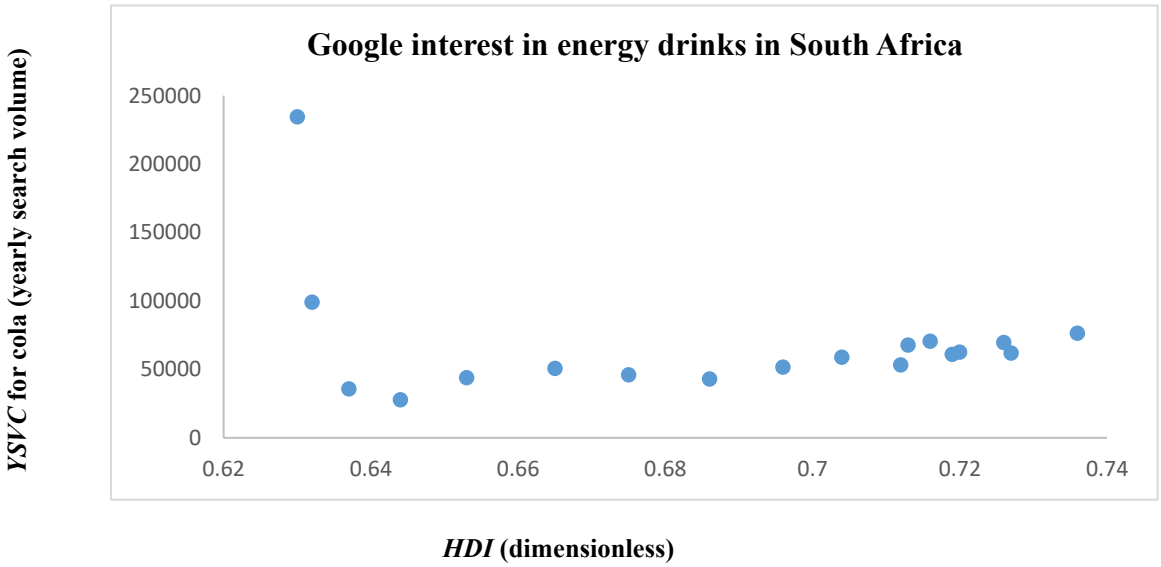


Figure 4 The yearly search volumes for energy drinks for the Google users in South Africa as a function of $GNI_{adjusted}$ in USD (a) and as a function of the *HDI* of South Africa (b) between 2004 and 2021.

The cola plant search volumes are reasonably low, which indicates that a very few people are concerned about the main ingredient used to make this beverage. The Google search results, that appear when this keyword is used, include what cola is and what it can be used for. These results do not cover information on the chemical composition of the plant and its impact on the body upon consumption. Hence, this is information that requires a different keyword search. The average monthly search volumes for keywords and related qualitative interest for cola drinks are shown in Table 5. When the "Coca-Cola recalls" keyword is searched on Google, it shows information/news on the products that have been recalled, usually due to incorrect labelling/packaging, or something is wrong with the product itself, usually relating to a potential health hazard. The highest search volumes for "Coca-Cola recalls" are noted from the United States, Canada and South Africa, respectively. These search results may be the outcomes of the "Coca-Cola recalls" events that have happened in these countries, for example, the coca cola recall that occurred in the United States in 2021 late November was noted by the Commissaries and the Food Safety Network **[15]**, **[16],** whereby Coca-Cola recalled specific batches of their products citing the potential presence foreign objects in them.

Table 5 Search volumes of keywords and related phrases about cola drinks in different countries and globally.

Searched Keywords	Australia	Canada	India	New Zealand	South Africa	United Kingdom	United States	Globally
Coca cola	27 100	40 500	201 000	5 400	18 100	74 000	450 000	2.74 million
Cola plant	170	140	170	30	50	480	880	3 600
Coca cola recalls	2 900	9 900	50	30	4 400	90	74 000	90 500
Cola green	9 900	14 800	8 100	1 900	1 900	18 100	135 000	246 000
Coca cola starlight	880	5 400	260	70	90	1 900	60 500	74 000
CPC (USD)	0.49	0.49	0.05	0.24	0.12	0.84	1.14	0.28
TARG (million USD)	4.57	7.90	2.39	0.41	0.68	18.11	187.24	201.36

According to the Food Safety Network, another recall from the United States recently happened this year, 2023 July, citing reasons for incorrectly labelling products as 'Coca-Cola Ultimate Zero Sugar', which is still ongoing **[17]**. Coca-Cola South Africa has also had a recall of its 'Appletiser' product due to the higher-than-normal levels of patulin toxins found during testing, which happened in 2021 **[18]**. Again, these recalls may drive the search volumes for "Coca-Cola recalls" in these countries. According to the search volumes of "Cola Green", it is evident that there is a great interest on the product across all the investigated countries, except for South Africa and New Zealand with the lowest search volumes when compared to other countries. Cola green is advertised as a healthy carbonated soft drink with natural flavours, Stevia leaf extract sweetener and natural caffeine from green coffee beans **[19]**. The product is believed to contain no sugars, no calories and no preservatives. These high search volumes could indicate good advertising by the cola green company, or people are generally looking for a "healthier" version of Cola drink. As far as health is concerned, the "Coca-Cola recalls" and "Cola green" keywords are the only health related searches found in these countries. The "Coca-Cola Starlight" search volumes are considerably low in New Zealand, South Africa, India, and Australia. However, the search volumes are fairly high, especially in the United States. This product's overall search volumes are low compared to the normal coca cola keyword searches. This could be since this product was only launched earlier on 21 February 2022 and was made available in selected countries globally including the United States. Interesting search results were noted from Canada for the keywords "coca cola logo" with recorded search volumes of 3600. The logo represents the company, and this speaks to the advertising of their products. Other searches from India which relate to advertising include "Coca-Cola distributor" and "Brand ambassador of Coca-Cola" with search volumes of 1900 and 1600, respectively. This information highlights the impact of advertising on different populations. The advertising revenue of Google shows that the most significant investment in by cola makers was made in the USA. This is the birthplace of Coca Cola, but also the largest market for the drink.

Looking at the generated data for energy drinks, results are summarised in Table 6 below. The search results suggest that most keywords people use in their search are related to health. This means that globally, there are general health concerns about the impact of energy drinks on their bodies. It is also interesting to note that people are looking/searching for healthy energy drinks, meaning that they are aware of the fact that energy drinks are unhealthy, hence they also search for their side effects. Considering the qualitative drivers, the United States and New Zealand have the leading searches followed by the United Kingdom. One of the interesting keyword searches for New Zealand was whether one can buy energy drinks with food stamps. These are food stamps, which are given to unemployed people by the government to assist them with purchasing food. The search volumes for South Africa are the lowest when compared to other countries in question. However, it is worth noting that the search volumes for the keywords "side effects of energy drinks" in South Africa is higher than all the other countries except for New Zealand and the United States. Given the high consumption of energy drinks in South Africa, it is concerning to see a very low search volume on energy drinks health-related searches. However, this can be potentially the result of a combination of several factors. Specific information about the health threat from the particular type of energy drinks might not be available in the native tongue of the majority of the South African consumers. This could be the result of the fact that there are twelve official languages in South Africa **[20]**. Information materials for health promotion in South Africa are generally available only in English, and only four other official languages **[21]**. Besides South Africa, the search volumes could have been low for other countries, as people in the studied countries could have searched for brand names of energy drinks and not the phrase 'energy

drink'. Publishing data about specific name brands would pose an ethical and potentially legal problems. As a result, the authors chose to omit those in the current study. As a result, only general energy drinks findings are focused on here. This could be a limitation of the current study, and such a limitation should be considered when interpreting the results obtained.

The overall search results are an indication that people are searching for information about energy drinks. This interest can be harnessed to draft and execute health promotion campaigns which may include but not be limited to the distribution of information leaflets that are easily comprehensible. The pamphlets would and should contain information about the chemical and nutritional composition of energy drinks, which are the most consumed in the particular country. The advertising revenue to be extracted from the Google-related advertising was found to be a negligible portion of the GDP of the countries studied (limited data shown and more information are available from the authors). The Keywordseverywhere.com plugin did not provide reliable figures for all the studied countries. The results in this article do, however, point to potential factors that can impact the public's interest in cola and energy drinks. The observed search volumes varied between the seven English countries for the duration of the study, with New Zealand recording the lowest search volume of zero in January 2004 and India with the highest search volumes observed in March 2019. It is possible that these observations were influenced by the events happening in the country then. For instance, in 2004, the New Zealand government launched a public health campaign to reduce soft drink consumption and promote healthier drink choices. The campaign, called "Water is the Best Choice" **[22]**. It was part of a wider government initiative called "Healthy Eating - Healthy Action," **[23]** which aimed to promote healthy eating and physical activity to prevent chronic diseases, such as diabetes, heart disease, and some forms of cancer. That campaign was an important step in raising awareness about the health risks of soft drink consumption and promoting healthier drink choices in New Zealand. Hence, it can be argued that this campaign influenced the search volume results for this country. Awareness campaigns and education effectively influence the public's lifestyle choices. Results from this study indicate that there are differences in the public's interest in cola drinks and energy drinks among different English-speaking countries. It is therefore imperative for governments to invest in health education of their country's population and to consistently champion health awareness campaigns that specifically focus on energy drinks. The standard and generic campaigns about sugar conusmption and cola drink consumption, along with other government interventions, can make a difference, but more work must be done. Specific health promotion campaigns about particular health impacts of energy drinks must, however, be developed. Such a combinations of strategies is outlined in the next two paragraphs on the example of South Africa.

South Africa has experienced a rise in non-communicable diseases in the last several years **[24]**. One of the risk factors of non-communicable diseases is obesity, e.g. as indicated by the high cholesterol and body mass index in a study by Manning et al. **[25]**. The rise in obesity among South African citizens is highly problematic and results of the current article point to the possibility that it might continue due to consumption of energy drinks. The extent will depend on several factors and so a more nuanced understanding of the South African population's interest in energy drinks is required. It is necessary to understand how consumption of energy drinks with high carbohydrate content and other components, which can contribute to the development of negative impacts of the consumption of energy drinks on the health of adolescents **[1]**, impact the health of the South African population. The more nuanced understanding also pointed to potential challenges in tackling such negative health outomes of enegry drink consumption, as many health effects of energy drinks remain under-researched **[26]**. One of the probable outcomes is likely an increased rate of diabetes and cardiovascular diseases **[27]**. The South African government has already implemented several strategies to tackle risk factors of non-communicable disease. Such strategies have included specialised taxes on sugary drinks, e.g., the Health Promotion Levy **[28]**. Awareness campaigns and baseline data collection on the consumption of specific energy and sugary beverages also play a significant role in this context **[27]**. Recent significance of health promotion efforts, that should target the consumption of cola and energy drinks, was highlighted **[29]**. These efforts must be extended as a public health policy priority in South Africa. Given the findings from this study, it is also necessary to examine various policies and public health approaches to tackle the energy drink consumption among the studied English-speaking countries. Efforts and initiatives from global organisations, such as the World Health Organisation, have been launched and implemented **[30]**. Combining all these methods can help find the optimal solution for managing the public health implications of energy drink consumption and the potential resulting non-communicable disease burden **[31]**.

Based on the results of the current study, health promotion campaigns should be examined from several perspectives. Firstly, they will need to consider the potential impact of cola and energy drink consumption as a risk factor or hazard for the increase in obesity rates in the studied countries. At the same time, the habits and channel of information sourcing by the respective population will be critical to the success of the health promotion campaigns. Public health authorities will deliver health promotion information. They will have to perform several

tasks in relation to the message preparation and channel selection for dispersal of the health promotion information. Filters that would and could block the information from the targeted population about cola or energy drinks consumption will need to be identified. Holistic and comprehensive messaging about the specific brands of cola and energy drinks that are mostly consumed in a given country will need to be created. Therefore, the development of health promotion campaigns should be based on the principles of risk communication **[32]**. The first step should be the processing of big data on cola and energy drink consumption, and the preparation of a message map outlining the potential negative health impacts of consuming these products on the target population **[32]**. Chemical composition and nutritional/health impacts from literature **[1]** should form part of the foundation of such message maps. Points in the message maps should be converted into culturally appropriate messages that align with the health literacy of the target population. This can be achieved through health literacy testing **[33]**.

Table 6 The search volumes of common keywords used to search for information relating to energy drinks by different countries and globally.

Searched Keywords	Australia	Canada	India	New Zealand	South Africa	United Kingdom	United States	Globally
Healthy energy drinks	590	880	1 000	33 100	320	1 300	27 100	33 100
Natural energy drinks	260	320	720	9 900	90	1 000	6 600	9 900
Best energy drinks	480	880	4 400	27 100	260	1 000	18 100	27 100
Are energy drinks bad for you?	480	720	170	12 100	70	1 300	6 600	12 100
Side effects of energy drinks	320	480	590	9 900	880	720	2 900	9 900
What is taurine in energy drinks	390	320	110	4 400	90	1 000	2 400	4 400
CPC (USD)	1.21	1.28	0.09	1.21	0.30	0.28	0.84	0.78
TARG (million USD)	0.70	1.05	0.14	26.62	0.12	0.40	12.20	17.16

The rollout and formalization of health promotion campaigns should be viewed as part of the strategic communication of the South African National Health Department concerning public health. Therefore, the rollout strategies should incorporate the application of the above-mentioned message maps as part of this strategic communication. The stages in the strategic communication and health promotion should follow the model outlined in FEMA **[34]**. Dealing with the potential risk factors from cola and energy drinks consumption should be seen as part of national health policy. This is in line with the Preamble, Chapter 3 Section 21 Subsection 1b and Chapter 4 Section 25 Subsection 3b of the South African National Health Act No. 61 of 2003 **[35]**. Health promotion campaigns should include the findings from the current study and go along the lines of the previously analysed policies on prevention of non-communicable diseases **[36]**. Mukhovha et al. **[36]** stated that 30.1% of all sugary drinks in South Africa, such as cola drinks, should include a warning label for high carbohydrate content, vs. 96.9% of energy drinks. This further indicates the emergency nature of the situation. Health promotion activity will need to be targeted to specific age groups **[37]** and various residential situations **[38]**. Finally, it is essential to try and achieve consensus building in any health promotion strategy to achieve inclusive decision making, e.g. as suggested for meat food safety in Sotuh Africa by Vhiriri et al. **[39]**. Combining strategic communication, prioritizing tackling the risk factors which might arise from the consumption of energy drinks, and the management of the broader societal implications of cola drinks and energy drinks.

Conclusion

Results of the current article are indicative of the need for continued collection of information about the drivers of the public's interest in cola and energy drinks. Cola drinks are generally decreasing in significance as a topic of Google searches in Australia, India, South Africa, New Zealand, the United Kingdom, the United States, and Canada. A slightly different trend was observed for cola globally and for energy drinks in individual countries. Populations in individual countries appear to be searching for specific brand names and not for general information related to energy drinks on Google. Health impacts of energy drinks are of interests to the populations in the studied countries and globally. Drawing on the results from this study can form the foundation of the public health approaches tackling the risk factors of non-communicable diseases in the studied countries and in South Africa.

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