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Article

Public Perception of the Effects of Artificial Sweeteners on Diabetes Based on YouTube Comments

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SUMMARY

Information on artificial sweeteners has been largely spread through social media platforms like YouTube. This study explored the interconnectedness between misleading information in YouTube comments and the potential associated health risks associated with it. We expected that the extensive dissemination of misleading information about artificial sweeteners has led to misguided consumer attitudes towards artificial sweeteners and their potential health risks. Here, a content analysis was performed on a total of 4347 comments from 10 YouTube videos to discern the prevalence of comments describing weight loss and diabetes management. From our research, 18.96% of the comments from the 10 YouTube videos either directly described or suggested achieving weight loss by consuming artificial sweetener beverages. Additionally, among the comments that discussed diabetes, 22% either directly mentioned or suggested that diet soda helped regulate their diabetes. The health benefits and risks of artificial sweeteners have been controversial. The discrepancy between scientifically proven facts and false information from comments demonstrated fallibly shaped consumer attitudes through social media. Therefore, our study highlighted the prevalence of comments heralding positive health outcomes as a result of using artificial sweeteners despite lack of scientific evidence.

INTRODUCTION

Artificial sweeteners (AS) are substances that are used as sugar substitutes to provide a sweet taste to food and beverages without the added calories of sugar (1,2). They are chemically synthesized compounds that can be many times sweeter than natural sugars, such as sucrose (table sugar). AS are particularly appealing to individuals who are looking to reduce their sugar intake, prevent dental cavities, manage their weight, or control blood sugar levels, such as people with diabetes (3). However, with their rising popularity, the risk of artificial sweeteners has been recently re-examined.

The rising popularity of AS is interdependent with the increased calorie intake in America. From the 1950s to 2008, the average calorie intake in the U.S. increased from 1900 kcal to 2661 kcal per capita (4). AS are used as substitutes for nutritive sugar to reduce food's caloric and sugar content. Around the late 20th century and 21st century, AS consumption was estimated to have increased by ~200% in adolescents and 54% in adults, with ~25% of children and 41% of adults consuming AS at least once daily (5). Growing demand for sugar alternatives led to a boom in the consumption of AS, with consumption increasing by 150% between 1975 and 1984 (6). The rising trend of diet soda, which uses AS, has resulted in an influx of advertising for diet soda and competition between companies.

AS are regulated by governmental authorities and underwent rigorous safety testing before being approved for consumption; approved AS are generally considered safe when consumed within recommended amounts (7).

In contrast, some studies revealed that consuming AS continuously can lead to serious health problems. A study by Reuber discovered an increased frequency of urinary bladder cancers in subjects exposed to diets containing saccharin (8). Another study found an association between aspartame exposure and higher rates of lymphoma and leukemia (9). Several epidemiological studies conducted on humans as well as animal models have shown that long-term use of AS may increase the risk of cancer, including brain tumors and leukemia (10,11). Furthermore, a systematic review of the relationship between AS and various cancers revealed significant direct associations between AS consumption and risk for laryngeal, urinary tract, non-Hodgkin lymphoma, and multiple myeloma in men (12). AS are commonly used as substitutes for regular sugars among individuals with obesity or diabetes, however they may also inadvertently lead to increased sugar intake. From a neurobiological perspective, it has been hypothesized that artificial sweeteners fail to activate the food reward pathways in animal models, thus leading to weight gain (13, 14). With scientific evidence of AS causing harmful effects on health, recommendations regarding the consumption of artificial sweeteners should be carefully considered, particularly for patients with metabolic syndrome.

Like any other products, the popularity of AS has been largely spread through social media and platforms like YouTube. The influence of social media extends further, with YouTube influencers playing a significant role in shaping consumer perceptions. With the increasing influence of social media in nearly every aspect of modern life, false information regarding AS may be spread more easily. Conformity—a common social phenomenon referring to the act of changing one's behavior to match others—is a powerful force in social interactions and can influence people's decisions and actions significantly (15). It has been shown that behaviors exhibited by other users in the comment section of fake news articles have a notable effect on the individuals' attitudes towards disinformation and their likelihood to participate by commenting on or sharing false information (16). Accordingly, the reactions of consumers to diet soda can be affected by biased videos or biased comments.

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Extensive research has been conducted on the long-term detrimental effects of AS (8-12). However, no study has been conducted on how social media platforms spread misinformation about AS. This research aimed to investigate the influence of misleading information about AS disseminated by YouTube influencers. By examining this, the study aimed to shed a light on the role of social media in spreading misinformation about artificial sweeteners and diet soda.

RESULTS

In this study, we investigated public opinions about artificially sweetened beverages through YouTube comments. Data from a total sample size of 4347 comments on 10 videos are displayed on a chart with the number of comments that qualified for the criteria (**Figure 1**).

Among the 4347 comments, 18.96% of the comments (n = total of 824 comments) mentioned weight loss and either directly mentioned or suggested weight difference with consuming diet soda (**Table 2**). For instance, the comment from video 1, "I am on a carnivore diet and drink Diet Pepsi, and I have lost 50 pounds," contained a weight unit (50 pounds) and related the weight difference to consuming diet soda. 19.60% of the comments (n = total of 852 comments) complimented or showed a positive opinion toward diet soda (**Table 2**). For example, a comment from video 2, "Love my diet pop…tastes great and allows me to use my calories on something worthwhile…," implicated positive connotations toward diet soda and mentioned the advantage of having low calories. 25.26% of the comments (n = total of 1098 comments) mentioned specific brand names, such as Pepsi, Coke, Mountain Dew, and Sprite (**Table 2**). From the total sample size, 3.91% of the comments (n = total of 170 comments) mentioned diabetes. For example, a comment from video 2, "Diet soda helped me lose 100lb of my weight and regulate my t2 diabetes". Among 170 comments that directly mentioned diabetes, 22.35% of the comments (n = total of 38 comments) said or suggested diet soda helped with diabetes treatment.

Interestingly, comments that complimented diet soda often mentioned their diabetic experiences and weight loss experiences to encourage others to consume diet soda. This can be seen by how analyzed comments often used keywords for multiple criteria (**Table 1**). There was an interesting observation that many of the comments coded "Yes" in Criteria 1 (i.e., mentioning weight difference) were also coded "Yes" in Criteria 2 (i.e., complimenting diet soda).

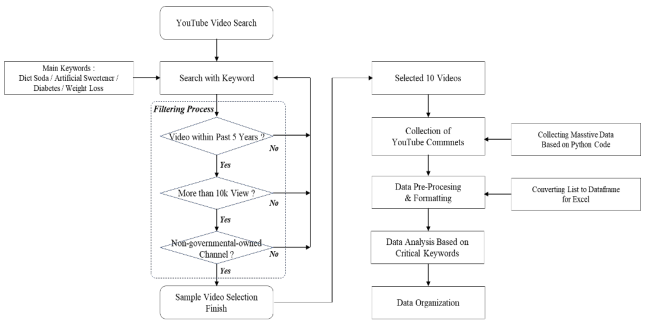

Figure 1. Flow diagram of sample video selection method from YouTube and data organization process.

Comments	C1) Comment mentioning weight loss	C2) Comment complimenting diet soda	C3) Comment mentioning specific brand name	C4) Comment mentioning diabetes	C4-1) Comment mentioning diet soda helped diabetes
Selection	i) Include weight unit (ex. lbs/kg) ii) Describes weight difference	i) Include words with positive connotation (ex. love, like, fan)	i) Mentions specific diet soda brand name	i) Include words: diabetes / diabetic ii) Describe diabetic experiences	i) Support for diet soda of being help for diabetes
I still love my diet iced tea, they helped me a bunch to lose my last 10 kg to finally get into shape, I never noticed any craving increase.	o	o	x	x	x
When that late night snack hits recently I have been grabbing a Fresca and it has really helped me lose weight.	o	o	o	x	x
Diet soda helped me losing 100 lbs of weight and regulated my t2 diabetes.	o	x	x	o	o
Type 1 diabetic since age 12 here. I have zero worries about drinking sugar-free soda… I have yet to hear any convincing argument against drinking Diet Coke or Fresca.	x	o	o	o	x
Coke Zero is soooooo good! It was the first change I made that helped me lose 35 pounds. My arthritic knees feel so much better.	o	o	o	x	x

Table 1. Examples of comments that were coded for multiple categories. Five example comments are shown to demonstrate how comments were considered "Yes (O) /No (X) " in each categories.

For example, the comment from video 1, "I still love my diet iced tea, they helped me a bunch to lose my last 10 kg to finally get into shape, I never noticed any craving increase," qualified for both criteria 1 and 2 by mentioning weight loss and having a positive attitude toward artificially sweetened beverages. On the same line, comments that were coded "Yes" in criteria 4 (i.e., mentioning their diabetic experience) also seem to be coded "Yes" for criteria 4-1 (i.e., diet soda helped with diabetes regulation). For example, a comment from video 3 said: "Diet soda helped me losing 100 lbs of weight and regulated my t2 diabetes," which meets both criteria 4 and sub-criteria 4-1. Therefore, each comments may be considered in multiple categories.

DISCUSSION

The goal of this research was to analyze the YouTube comments of the videos that present AS. From our research, 18.96% of the comments from the ten YouTube videos described achieving weight loss experience with consuming diet soda/artificial sweetener beverages. However, these comments contradict the scientific studies that have shown diet soda does not help diabetic diseases and even stimulates weight gain (13,14,17). A study by Yang Q. suggested a hypothesis of AS: Because they are sweet, they encourage sugar craving and sugar dependence (17). According to this study, the brain receives the signal of sweet intake with AS, but no actual calories are consumed. This stimulates the body to crave and gain calories from other food sources, leading to weight gain (17). Therefore, 18.96% of comments claiming weight loss or suggesting diet soda helping with weight loss contradicts the finding linking AS consumption to weight gain, thereby spreading misleading information via social media.

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	Themes of comments				
	Comment mentioning "weight" (Keyword: weight/lbs/kg)	Comment encourages diet soda intake (Keyword: addicted /like/love)	Comment mentions specific brand name (Pepsi + Coke + Mountain Dew + Sprite)	Comment mentions Diabetes (Key words: Diabetes)	Comment mentions diet soda helped for diabetes
	Number of comments				
Video 1	80	59	248	23	3
Video 2	540	374	72	25	18
Video 3	55	127	270	7	7
Video 4	64	51	199	3	0
Video 5	26	37	27	19	3
Video 6	12	95	208	52	7
Video 7	22	69	30	11	0
Video 8	21	35	15	4	0
Video 9	4	5	27	23	0
Video 10	0	0	2	3	0
Total number of comment in each categories	824	852	1098	170	38
Percentage of comments categorized from the total (4347 comments)	18%	19%	25%	3.9%	0.8%

Table 2. Analysis of 10 YouTube videos related to diet soda consumption. Number of comments each categorized is shown. Each comment may be considered into one or more categories.

Our research showed over 22% of comments that mentioned diabetes (C4) said or suggested diet soda helped regulate their diabetes (C4-1). However, the study from Vikas Purohit et al. suggests artificial sweeteners do not have any beneficial effect on the control of diabetes (18). While artificial sweeteners may reduce caloric intake, they also alter insulin sensitivity, which might lead to uncontrolled blood sugar levels (18). Additionally, Pei Qin's research group evaluated the adverse effects of consuming artificially sweetened beverages on type 2 diabetes, obesity, and all-cause mortality. They observed a linear association between artificially sweetened beverage intake and Type 2 diabetes risk and a positive correlation between artificially sweetened beverages on obesity risk (19). Moreover, the recent research published by the World Health Organization International Agency for Research on Cancer on the artificial sweetener aspartame suggests possible carcinogenic hazards (20). The discrepancy between scientifically proven facts and false information from comments demonstrates fallibly shaped consumer attitudes through social media. The number of misleading comments was not negligible, considering the extensive connection and virality of social media content.

The primary cause of spreading misleading information may be the parasocial relationship between YouTube influencers and audiences. Parasocial interaction is a perceived interpersonal relationship on the part of a viewer with a mass media speaker (21). With YouTube influencers acting like celebrities, viewers trust their words and information without any suspicion. This parasocial interaction might be a factor that amplifies the misinformation delivery and beliefs in false concepts. As YouTube creators are seen as a celebrity, the audiences think information from them is trustworthy and agree with them.

Our study had certain limitations that need to be acknowledged. The first possible limitation in our study was the anonymity of the comments. We could not ensure the comments were written by different people or one individual with multiple accounts. This could have altered our result. Secondly, although these videos were selected based on shared keywords, their content differed substantially, which can contribute to disparate comment representations for each video. Thirdly, due to the nature of YouTube comments being voluntary, the comments collected may not represent the opinions of all viewers. People who feel strongly about a video or topic are likely to comment, leading to a potential bias in the data. This bias can impact the generalizability of our findings to the wider population. Additionally, the act of publishing comments publicly on YouTube may prompt individuals to express and present themselves in a more socially desirable manner. This bias occurs when individuals modify their comments to conform to societal norms or avoid social disapproval. This phenomenon, known as the Hawthorne effect, could impact the authenticity and representativeness of the comments collected in our study (22).

Despite the global research efforts on artificial sweeteners, our study revealed that misleading information that contradicts the scientific evidence can be easily spread through social media, which can consequently endanger the health of many people. In the context of potential health risks associated with disseminating misinformation, individuals should be cautious when taking in information available from an unverified source on the internet. Individuals should talk to licensed health care professionals to discuss health-related information. In addition, it is necessary to establish regulations to combat health misinformation. For example, having videos that were created by licensed health care provider labeled in specific ways will let audience knows that they will get more accurate information.

MATERIALS AND METHODS

In the present study, a content analysis of YouTube comments was performed to examine the prevalence of misleading information related to artificial sweeteners in videos about diet soda. YouTube was chosen as a mode of analysis given it is the most well-known social media site, with more than 2 billion views per day (23). Data were gathered from the existing resources, specifically YouTube influencer videos and their corresponding comments. 10 Videos were selected from YouTube using keywords including diet soda, artificial sweeteners, and diabetes or any combination of those words (**Figure 1**). Videos were screened by following criteria: 1) having total views more than 10,000 2) having over 1000 likes 3) originating from individual or group (rather than government owned channel) 4) published within the last 7 years. Videos were sorted through "rating" and randomly selected based on random number generator,

Video comments were selected from the date uploaded through May 2023. We scraped 4347 comments—encompassing all ten videos' comments— by using Python (Python Software Foundation, Delaware, U.S.). We examined the themes of the comments by identifying keywords in each comment. The segregation of the comments was based on 4 different coding questions. These included 1) Does this comment mention or suggest weight loss experience? 2) Does this comment complement or suggest positivity towards diet soda? 3) Does this comment mention a specific brand of diet

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soda? 4) Does this comment mention the relationship between diabetes and diet soda? 4-1) If yes, does this comment have an optimistic view that diet soda helps diabetes? Comments that adhered to the coding questions were considered, while non-related comments were excluded. Descriptive statistics, such as frequencies and percentages, were calculated through excel.

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