frontiers | Frontiers in Sustainable Food Systems

TYPE Original Research
PUBLISHED 26 June 2024
DOI 10.3389/fsufs.2024.1357896

OPEN ACCESS

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RECEIVED 18 December 2023
ACCEPTED 17 April 2024
PUBLISHED 26 June 2024

CITATION
Kvasnička R, Kvasničková Stanislavská L, Pilař L, Kuralová K, Pilařová L and Čejka M (2024) Exploring twitter discussions on healthy food: inspiring, access to healthy food for young, and nutritional economics in focus.
Front. Sustain. Food Syst. 8:1357896.
doi: 10.3389/fsufs.2024.1357896

Exploring twitter discussions on healthy food: inspiring, access to healthy food for young, and nutritional economics in focus

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Considering that food is a critical factor for a healthy population, social media analysis of discussions about this area is very important to understanding people's behavior. This research aimed to identify the main areas of communication about healthy food, including sentiment identification, on the social network Twitter (now X). We achieved this aim by analyzing 828,963 Tweets posted from 1 April 2018 to 17 April 2023 based on a dataset that included all Tweets containing the hashtag "#healthyfood" or the phrase "healthy food." This study extends previous research that focused only on hashtags and did not include all messages about healthy food. The results identified five main communication areas, namely (1) Inspiring, (2) Access to healthy food for children and youth, (3) Expenditure on healthy food, (4) Homemade food, and (5) Vegan/vegetarian diet, of which the second and third areas were not identified in previous research due to selective analysis focusing only on hashtags. These two communities had the highest negative sentiment of the top 10 communities, suggesting that these issues require attention.

KEYWORDS

healthy food, social media analysis, hashtag, sentiment analysis, expenditure on healthy food

1 Introduction

In the present globalized world, food choice is an increasingly complex process influenced by various internal and external factors. A United Nations report in 2021 showed that 828 million people in the world suffer from hunger, which highlights the urgent need for food system transformation (WHO, 2022). While food is needed for survival, it has become an important lifestyle element for many (Enriquez-Martinez et al., 2021; Habib et al., 2024). The diversity of factors influencing food choices highlights the complexity of individuals' dietary choices. Social factors, including norms and expectations within the community, have a major influence on shaping an individual's eating habits (Basch et al., 2016; Alahmari et al., 2019; Leu et al., 2022). People may be influenced by social pressures from family, friends, or colleagues (Mahmoud et al., 2020), as well as by trends in online communities (Schubert et al., 2021;

Reyes et al., 2022). The opinions and attitudes of others toward food can create certain norms to which an individual tries to conform (Schulze et al., 2021).

Social media plays a key role in shaping individuals' eating habits in the current digital era (Charry and Tessitore, 2021). The development of modern technology has led to new ways of sharing information and interacting with each other, which impacts what we eat and how we approach food (Lakshmi and Milcah Paul, 2022). Therefore, concerns about the negative impact of social media on the eating habits of its users have become the subject of many studies. For example, a study (Rounsefell et al., 2020) pointed out that engaging with social media during mealtimes can distract young adults and predispose them to poorer food choices, while another study (Carthy et al., 2022) highlighted the negative effects of social media, particularly through the marketing of unhealthy foods and beverages, which can affect diet-related outcomes in children. According to another study (Zahid et al., 2021), social media influences eating habits, especially in children and adolescents, leading to eating pathologies.

As is evident from a review of existing studies, current research primarily focuses on identifying the negative impacts of social media on users' eating habits. However, it is worth considering whether social media can also play a constructive role and support the formation of healthier eating habits. This is an unresolved research gap that this study intended to address.

Rather than focusing exclusively on negative aspects, we should recognize that social media can be a vehicle for sharing positive information, motivation, and peer support to form healthy eating habits. This study aimed to comprehensively analyze the content of communication associated with the hashtag "#healthyfood" or the phrase "healthy food" on Twitter. To better understand what topics Twitter users are communicating about in the context of healthy eating, we analyzed global healthy eating communication by assessing the full text of Tweets (including both hashtags and full text) posted in 2018–2023 using a machine learning approach. We were also interested in how communication related to healthy food varies across world regions. To better understand how Twitter users perceive individual topics communicated in the context of healthy food, we performed sentiment analysis. Analysis of discussions associated with the use of the hashtag "#healthyfood" or the phrase "healthy food" provides the context in which opinions and preferences are formed, which is key to understanding the impact of social media on dietary decisions.

1.1 Theoretical background

1.1.1 Definition and history of healthy food

The development of the definition of healthy food and healthy food behavior has been influenced by various factors over time. The concept of healthy food has evolved in response to changing societal, cultural, and economic contexts (Mahmudiono et al., 2022). The history of agriculture has played a significant role in shaping human development and the availability of healthy food options (Devlet, 2020). Additionally, the evolution of human views about nutrition from antiquity to the present time has contributed to the development of nutrition theories and the understanding of healthy eating behaviors (Dydykin et al., 2022).

1.1.2 Cultural differences in food consumption

Culture plays a significant role in shaping food consumption behaviors, as evidenced by various studies. These studies (Fismen et al., 2012; Kamphuis et al., 2018) highlight the impact of cultural capital on food preferences and consumption patterns. Food consumption experiences are influenced by cultural resources, and differences in cultural capital contribute to disparities in dietary habits among various social groups (Fismen et al., 2012). Additionally, the ecological and cultural conditions of a region also play a crucial role in shaping food consumption patterns. The availability of locally grown foods and the degree of modernization within a community influence food choices and nutrient intake (Ohtsuka et al., 1985). Furthermore, considering the cultural context and attitudes toward food consumption is essential when assessing the acceptance of unfamiliar foods within a particular market (Wansink et al., 2002). Cultural competence and experiences with local food consumption contribute to an individual's ability to recognize and interact with different cultures (Lin et al., 2023). Moreover, cultural differences in intercultural service encounters can lead to "cultural shocks," emphasizing the impact of cultural distinctiveness on consumer behavior (Weber et al., 2016).

1.1.3 Challenges in shaping consumer behavior in the context of healthy food

The challenges in shaping consumer behavior in the context of healthy food consumption are multifaceted and influenced by various factors. One significant challenge is reinforcing food preferences, where healthier food options may not be as reinforced as less healthy alternatives, leading to relapse in behavior changes (Epstein et al., 2007). Additionally, demographic and lifestyle characteristics, attitudes, norms, and knowledge of functional foods play a crucial role in influencing consumer behavior toward healthy food choices (De Jong et al., 2003). Furthermore, the traditional patterns of food consumption in different regions may no longer serve as a reference point for shaping healthy and sustainable food behavior due to the growing discrepancies between tradition and sustainable development (Voinea et al., 2020).

Consumer demand for healthy food is also influenced by factors such as health considerations, social and subjective norms, attitudes, and price, particularly in the food service industry (Jie and Bakar, 2023). Moreover, understanding the psychosocial context and the association between contexts and healthier or unhealthier foods is essential because food decisions and eating behaviors are significantly shaped by the context (Turnwald et al., 2022). Other factors that influence consumers' healthy food choice behavior are sensory perception, trust, willingness to pay a higher price, and perceived health and taste ambivalence in food consumption (Luomala et al., 2015; Rahnama et al., 2017; Mirosa and Mangan-Walker, 2018). Additionally, the influence of food bloggers' reviews and recommendations about healthy eating lifestyles and consumer behavioral intentions is an important aspect to consider for shaping consumer behavior toward healthy food consumption (Nathalia et al., 2017).

Shaping consumer behavior in the context of healthy food consumption is a complex process influenced by various factors such as reinforcement of food preferences, demographic and lifestyle characteristics, traditional food consumption patterns, psychosocial context, sensory perceptions, and, in recent years, the influence of

social media and especially food bloggers (De Jong et al., 2003; Nathalia et al., 2017; Jie and Bakar, 2023).

Social media refers to online platforms and technologies that enable individuals and communities to create and share content and participate in social networking. The number of individuals and organizations using social media has increased, leading to the generation of vast amounts of data related to user attributes, social connections, and topics of conversation (Treem et al., 2016). Social media platforms serve various purposes, including providing free information, networking opportunities, entertainment, and business opportunities for users (Manurung et al., 2022). Additionally, social media facilitates the formation and maintenance of social connections, offering opportunities and challenges in information acquisition, cultural intelligence, and creativity development (Hu et al., 2017).

The purpose of social media extends beyond personal use because it has become an integral part of various domains, such as education, journalism, and business (Mendez et al., 2020; Fuchs, 2022). In the business context, social media is used for marketing, communication, and customer engagement, influencing consumer attitudes and behaviors.

1.1.4 Social media analysis

Social media platforms have become influential channels for communicating about healthy eating. A study Bissonnette-Maheux et al. (2015) has shown that social media can influence individuals' perceptions and behaviors regarding food choices and healthy eating. For example, blogs and social media platforms provide an interactive space to engage consumers and health professionals in discussions about healthy eating, thereby facilitating the transfer of healthcare knowledge. In addition, social media campaigns focused on healthy eating, physical activity, and healthy weight, which have the potential to reach a broad audience and positively influence individual behavior (Luo et al., 2024).

A study by Steeves et al. (2016) has shown that social support from friends and family members can influence individuals' eating habits. For example, at least one social network member supports healthy eating as associated with greater motivation to consume fruits and vegetables (Crookes et al., 2016).

However, the influence of social media on healthy eating is not always positive (Wongprawmas et al., 2022). Research Mumber et al. (2022) has suggested that social media use may contribute to body dissatisfaction and reduced quality of life in adolescents, highlighting the need to examine the content shared on these platforms critically. Social media use has also been linked to unhealthy eating behaviors and excess body weight in adolescents (Sampasa-Kanyinga et al., 2015). In addition, depictions of healthy eating in online media can sometimes oversimplify the complexity of eating behaviors, leading to misconceptions about food choices and health (Jelicich and Braun, 2023).

Despite these issues, social media remains valuable for promoting healthy eating behaviors. Social media interventions have effectively improved health beliefs and dietary behaviors, particularly in populations with limited access to traditional health services (Chang et al., 2022). In addition, social media platforms offer opportunities for disseminating accurate health information and engaging diverse audiences on diet-related issues (Lookingbill et al., 2023).

Social media analysis is a valuable method to understand consumer preferences, beliefs, and behaviors. A previous study (Wang et al., 2012) emphasized the increasing relevance of consumption-related peer communications through social media, which significantly influence newcomers' attitudes toward products. Furthermore, another study (Aleti et al., 2018) highlighted the interactive and collaborative nature of social media, which accelerates consumer socialization processes and influences communication between peers, ultimately impacting decision-making processes. Additionally, another study (Parajuli and Budhathoki, 2022) found that consumers' actions are significantly and positively correlated with the degree to which they trust content shared on social media platforms.

Social media provides a platform for organizations to connect with many consumers simultaneously (Lokithasan et al., 2019). Nowadays, social media is recognized as a vital part of integrated marketing communication (Olutade, 2021), can effectively influence consumer perceptions of product images (Kumar et al., 2021), and plays a crucial role in shaping consumer beliefs and behaviors, attitudes, and final consumer behavior (Ziyadin et al., 2019; Chen et al., 2020; Tseng et al., 2022).

To understand the meanings of terms used in the context of healthy eating, a study (Pilař et al., 2021a) analyzed communication of the hashtag "#healthyfood" on Twitter in 2019–2020. It found that Twitter users most frequently communicate the hashtag "#healthyfood" and hashtags related to veganism and homemade and organic food. The authors analyzed a dataset of hashtags and did not include the actual text of each Tweet. Hashtags often provide only limited context (Nasrin and Fisher, 2021). Analysis of the full text of Tweets allows a more comprehensive understanding of the content, which is crucial for accurate interpretation and analysis (Burton, 2019). The text allows users to express their opinions, experiences, and attitudes about topics related to the "#healthyfood" hashtag in more detail. Thus, nuances and details not apparent from hashtag analysis alone can be revealed. For this reason, we aimed to analyze the full-text content of Tweets, including hashtags, associated with the "#healthyfood" hashtag on the social network Twitter.

2 Materials and methods

The data analysis methodology employed in this study was grounded in an enhanced version of the SMAHR framework, as proposed previously (Pilař et al., 2021b). This framework was meticulously expanded to encompass the comprehensive analysis of the entire content of Tweets. The analytical process, underpinned by the SMAHR framework, was methodically structured into four distinct stages, as depicted in Figure 1.

2.1 Data acquisition

The primary objective of this phase was to systematically collect data from Twitter, specifically targeting Tweets containing the hashtag "#healthyfood" or the phrase "healthy food" (not case-sensitive). This endeavor was conducted over an extensive period from 1 April 2018 to 17 April 2023. To facilitate this data harvesting process, we utilized the advanced capabilities of the Twitter API v2 (Platform Developer, 2022). For the practical execution of this task, we employed Tractor software (Graphext 2023b), which proved

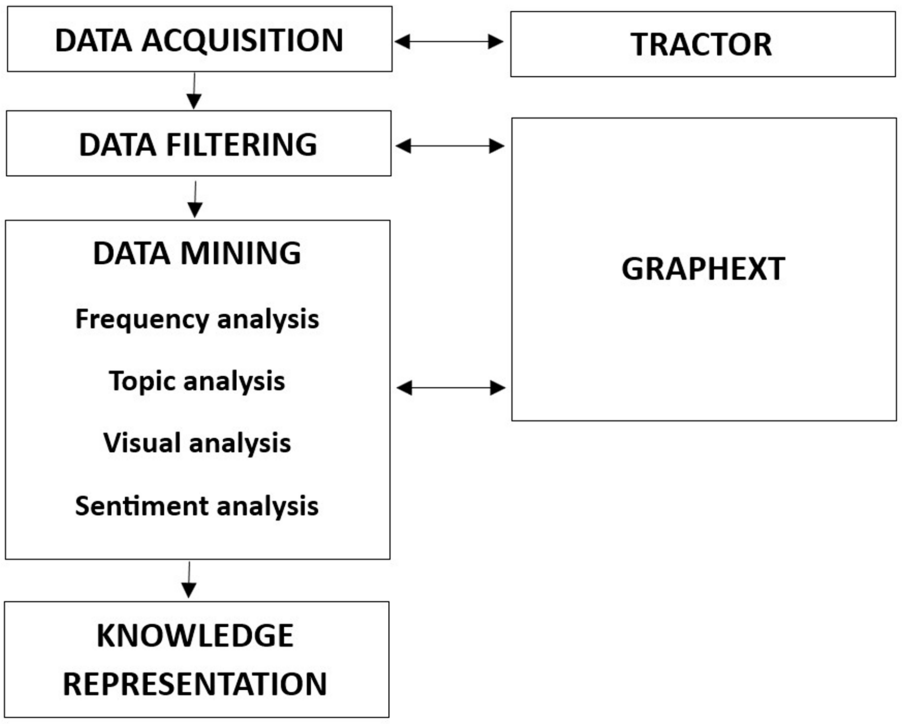

FIGURE 1
The steps of the methodological procedure. The key conceptual steps include (1) data acquisition, (2) data filtering and transforming, (3) data mining, and (4) knowledge representation.

instrumental in efficiently downloading the relevant Tweets. Our thus compiled comprehensive dataset encompassed 828,963 Tweets contributed by 255,662 unique Twitter users. This dataset represented a complete aggregation of all Tweets featuring the hashtag "#healthyfood" or the phrase "healthy food" (not case-sensitive) posted by users on the Twitter platform during the specified observation period.

The name "Twitter" is used throughout the article. This social network was renamed "X" on 24 July 2023. Because the content was downloaded on 25 April 2023, when the network was still called "Twitter," this name is used throughout the article.

2.2 Data filtering

The data filtering phase was a critical component of our methodology and was designed to ensure the integrity and relevance of the dataset. The primary aim of this step was to meticulously scrutinize the collected Tweets for any instances of misleading content or spam. This was imperative to maintain the quality and reliability of our analysis.

To achieve this, we employed a comprehensive filtering process involving manual review techniques to thoroughly examine the dataset. Despite the exhaustive nature of this search, our investigation revealed there were no discernible instances of misleading content or spam within the Tweets collected. This affirmed the overall quality of the data, underscoring their suitability for the subsequent stages of our analysis.

This filtering process encompassed several phases:

- Initially, messages lacking the key phrases "healthy food" or the hashtag "#healthyfood" were filtered out, ensuring the accurate acquisition of pertinent data.
- Subsequently, a roster of Twitter users was compiled, each being attributed a yearly tweet count. This facilitated the identification of profiles engaged in spam activities. Within this bracket, entities were pinpointed for proliferating merchandise advertisements across various platforms under the guise of "healthy food." Out of the 828,963 tweets, the most frequent user has 10,564 tweets, which is only 1.27% of the total set. In the individual topics, the highest representation of a single user is at 0.96% (topic 2). In such a large dataset, one user does not affect the results of the analysis.
- The final step entailed organizing all communications in an alphabetical sequence, thereby enabling a straightforward assessment of whether specific tweets were excessively propagated among Twitter users, potentially signifying a distinct discourse. No such dissemination pattern was observed.

We encountered a unique problem with the uniformity of user location data. On Twitter, users have the option to set their location through the 'user_location' attribute. Unfortunately, there is no consistent format for inputting these data, which leads to a wide range of variations from user to user. For example, a single city like Rome can be listed in numerous ways, such as "Rome, Italy," "Rome (Italy)," "Italy – Rome," or simply "Rome." This inconsistency makes it necessary to standardize location information for thorough analysis of Tweets. To tackle this, we used the 'get_country_code' function. This function gathers location details using the Google Maps API and

assigns a corresponding country code to each location. If a country code is successfully obtained, it is added to a new column labeled 'country_code'. This code adheres to the standardized ISO 3166-2 format, which is a geocoding system for identifying major subdivisions of countries and dependent areas. In situations where a country cannot be pinpointed, the function returns 'NAN'. The 'get_country_code' function was an integral part of our process and was specifically designed for certain programming languages and to work with the Google Maps API. The employment of this method for data cleaning led to a collection rich with uniform ISO 3166-2 codes, which greatly improved our ability to conduct location-based analysis of Twitter data.

2.3 Data mining

The fundamental objective of the data mining phase of our study was to meticulously extract valuable and pertinent information from the extensive corpus of user-generated data on Twitter. This process involved the deployment of sophisticated algorithms and analytical techniques designed to sift through the voluminous data, identify patterns, and distill insights that were not immediately apparent. By doing so, we aimed to uncover underlying trends, sentiments, and behavioral indicators embedded within social media interactions, thereby transforming the raw, unstructured data into a rich source of actionable intelligence. This phase was crucial for converting the expansive quantity of data into meaningful, analyzable, and insightful information that could significantly contribute to our understanding of social media dynamics. The following techniques were used for this step:

2.3.1 Frequency analysis

The initial methodological approach in our study involved conducting a frequency analysis of the various hashtags present within the messages. This analysis was pivotal for quantifying and elucidating the prevalence and distribution of specific hashtags in the dataset. By systematically tallying the occurrence of each hashtag, we were able to identify and rank the most prominently used hashtags within the corpus of Tweets. This quantitative assessment not only offered insights into the most dominant themes and topics resonating with users but also served as an indicator of trending discussions and focal points of interest within the Twitter community. The "Hashtag in text" module of Graphext software (Graphext, 2023a) was used for this process.

2.3.2 Topic analysis

Topic analysis is a methodological cornerstone for discerning the principal themes or topics communicated within extensive datasets, notably in the realm of social media posts. It is particularly pertinent in the context of complex networks, such as those formed on social media platforms, where certain nodes (for instance, hashtags or words) exhibit a higher degree of interconnectedness than others. Focusing on clusters of these interconnected nodes makes it feasible to discern distinct topics.

Our objective was to unravel the topic structure inherent in healthy food-related discussions on Twitter. This step transcended the scope of mere frequency analysis by incorporating the entirety of the content of Tweets, not just hashtags. For this purpose, we employed Graphext software (Graphext, 2023b), which utilized a modified version of the Louvain algorithm (Blondel et al., 2008) to analyze the community structure of our network. This network was constructed based on the interconnections among individual words within Tweets. Through an iterative process, the Louvain algorithm assigns nodes to clusters with the aim of optimizing a key performance metric known as modularity. Modularity essentially measures the concentration of edges within clusters in relation to those between clusters, enabling a more nuanced understanding of topic prevalence and interrelations within the dataset.

$$\Delta Q = \left[\frac{\sum_{in} + 2k_{i,in}}{2m} - \left(\frac{\sum_{tot} + k_i}{2m} \right)^2 \right] - \left[\frac{\sum_{in}}{2m} - \left(\frac{\sum_{tot}}{2m} \right)^2 \right]$$

In this framework, the modularity metric is computed where ∑_in represents the sum of all weighted links internal to the community and ∑_tot denotes the aggregate of weighted connections within the community. The term k_i refers to the sum of all weighted links associated with community hashtags. Additionally, k_i, in signifies the total weighted connections from an individual node to the community hashtags. Furthermore, m serves as a normalization factor, which is calculated based on the total sum of weighted links across the entire graph, as elucidated previously (Blondel et al., 2008).

2.3.3 Sentiment analysis

The sentiment analysis component of our research was pivotal for gauging the prevailing attitudes and opinions articulated in Tweets concerning topics related to healthy food. This analytical process involved classifying textual data into categories of positive, negative, or neutral sentiments. This classification was based on the context and tonal nuances of the language employed in Tweets. The primary aim of this analytical stage was to meticulously identify and quantify the range of sentiments expressed in healthy food-related discussions on Twitter. To achieve this, we utilized the Valence Aware Dictionary and Sentiment Reasoner (VADER) tool, a lexicon and rule-based sentiment analysis framework. VADER is distinguished for its effectiveness in interpreting the nuances of sentiment expressed in social media text, providing a robust mechanism for sentiment categorization (Hutto and a Eric Gilbert., 2014).

2.3.4 Visual analysis

The visual analysis phase of our study leveraged advanced network visualization techniques, specifically the use of force-directed layouts, to illuminate various facets of the network structure. These techniques are particularly adept at highlighting elements such as the density of connections and the polarization of topics within the network. The primary objective of this step was to delineate the polarity of the identified topics. To this end, we employed the ForceAtlas2 layout technique, an enhanced iteration of the original ForceAtlas algorithm optimized for handling large-scale networks. The ForceAtlas2 technique is renowned for its efficacy in visualizing complex networks, enabling the identification of intricate intercommunity connections through graphical representations of network subsets (Jacomy et al., 2014). To execute this visual analysis, we utilized Graphext software

TABLE 1 Frequency analysis of hashtags connected to #healthyfood.

No.	Hashtag	Total count	No.	Hashtag	Total count
1.	#healthyfood	429,524	26	#vegetarian	16,824
2.	#food	100,332	27	#healthylife	16,276
3.	#healthy	99,095	28	#instafood	15,836
4.	#healthylifestyle	83,542	29	#plantbased	14,763
5.	#health	67,524	30	#foodblogger	14,395
6.	#healthyeating	63,707	31	#lunch	14,381
7.	#fitness	47,854	32	#dinner	13,804
8.	#nutrition	45,322	33	#homemade	13,104
9.	#foodie	43,653	34	#cleaneating	12,940
10.	#healthyliving	39,711	35	#fit	12,900
11.	#vegan	38,049	36	#glutenfree	12,853
12.	#diet	37,682	37	#foodphotography	12,505
13.	#weightloss	31,228	38	#lifestyle	12,419
14.	#delicious	29,837	39	#foodlover	12,367
15.	#recipes	26,422	40	#gym	12,042
16.	#cooking	21,694	41	#motivation	11,309
17.	#foodporn	21,568	42	#salad	11,183
18.	#recipe	20,542	43	#fitnessmotivation	11,166
19.	#organic	19,472	44	#veganfood	10,612
20.	#yummy	19,226	45	#exercise	10,575
21.	#breakfast	18,645	46	#tasty	10,432
22.	#wellness	18,551	47	#eatclean	9,709
23.	#healthyrecipes	17,814	48	#recipeoftheday	9,517
24.	#love	17,134	49	#healthcare	9,386
25.	#workout	16,876	50	#eathealthy	9,333

(Graphext, 2023a), which facilitated the generation of a two-dimensional graph, providing a clear and intuitive visualization of the network's structure and the relationships within it.

2.4 Knowledge representation

Knowledge representation constituted a critical phase in our research methodology, where visualization tools were employed to elucidate and interpret the findings derived from data mining. This process played a pivotal role in synthesizing and presenting the aggregated individual values and outputs gleaned from the data evaluation phase. The fundamental aim of knowledge representation is to accentuate and clearly convey the significant insights and conclusions drawn from preceding analyses. It involves transforming complex, multidimensional data into more accessible and comprehensible formats, such as charts, graphs, and other visual aids. This not only aids understanding of the data but also facilitates communication of the key findings and patterns discovered during the course of a study. Through effective knowledge representation, we strive to make the intricate results of our research readily interpretable to both specialists in the field and a broader audience.

3 Results and discussion

We conducted frequency analysis in the initial phase of our content analysis related to the hashtag "#healthyfood" on the social media platform Twitter. This involved examining 828,963 Tweets extracted from Twitter over a specified period. Table 1 presents the 50 most frequently shared hashtags concurrently used with #healthyfood and their respective frequencies.

The frequencies of hashtags indicate relevant and popular topics in a given context. The most frequently used hashtags can reveal users' main interests and preferences. This provides insight into how social media shapes the content and topics that reach and engage the community. Hashtags such as "#healthylifestyle" (fourth), "#fitness" (seventh), "#workout" (twenty-fifth), "#fit" (thirty-fifth), "#gym" (fortieth), "#fitnessmotivation" (forty-third), and "#exercise" (forty-fifth) suggest that Twitter users associate healthy eating with an overall healthy lifestyle and physical fitness. This association is consistent with a broader understanding of eating healthy foods as part of a holistic approach to health and has been confirmed in numerous studies (Michie et al., 2009; Blake et al., 2017; Hazley et al., 2022).

The sharing of hashtags such as "#vegan" (eleventh), "#diet" (twelfth), "#vegetarian" (twenty-sixth), and "#glutenfree"

TABLE 2 Topic analysis.

Topic	Key terms	Selection count	%
1. Inspiring	Foodie, yummy, foodporn, instafood, delicious, foodlover, foodphotographer, foodstagram, healthylive, healthylifestyle	160,966	19.42
2. Access to healthy food for children and youth	Community, school, access, child, support, program, provide, student, help, local, education, policy	77,616	9.36
3. Expenditure on healthy food	Eat, expensive, junk, buy, junk food, unhealthy, cheap, money, choice, fast, like, spend	57,260	6.91
4. Homemade food	Cook, recipe, chef, cooking, kitchen, easy, meal, recipes, home, prepare, ingredient, try, quick, foodblogger, delicious, dinner, lunch, make, simple	20,651	6.68
5. Vegan/vegetarian diet	Salad, green, vegetable, veggie, tomato, vegan, garden, vegetarian, recipe, plantbase, veganfood, plant	50,575	6.1
6. Fruit drinks	Fruit, smoothie, juice, apple, strawberry, banana, mango, vitamin, antioxidant, drink, health benefits, healthyliving, tasty, organic, fresh, coconut	39,959	4.82
7. Healthy breakfast	Breakfast, egg, toast, morning, avocado, yogurt, healthy breakfast, brunch, granola, start, oats, protein, porridge, butter, bread, milk, coffee	21,934	2.65
8. Immunity	Immune, immunity, immune system, system, health, boost, medicine, coronavirus, COVID-19, vitamin, sleep, exercise, rest	21,934	2.65
9. Weight loss	Weight, loss, weight loss, lose, diet, weightlossjourney, fat, keto, fitness, motivation, calorie, nutrition, obesity, exercise, ketodiet, lowcarb	20,564	2.48
10. Seafood	Salmon, fish, tuna, seafood, shrimp, sea, cod, salad, dinner, recipe, delicious, sauce, grill	14,084	1.7

(thirty-sixth) with the hashtag "#healthyfood" shows that Twitter users associate these dietary preferences and diets with healthy eating. Their frequent prevalence on social media suggests that Twitter users have considerable interest in these dietary guidelines, consistent with the results of other studies on Twitter (Pilař et al., 2021c) and Instagram (Pilař et al., 2021a).

The hashtags "#organic" (nineteenth), "#plantbase" (twenty-ninth), and "#cleaneating" (thirty-fourth) reflect the current trend toward organic and plant-based diets without added chemicals. Clean eating is a dietary concept prevalent among younger consumers active on social media and is perceived as a healthy, positive approach (Ambwani et al., 2020). However, when food restrictions are taken to the extreme, clean eating can have negative health consequences such as anorexia nervosa, osteoporosis, amenorrhea, concentration difficulties, and depression (Ambwani et al., 2019).

3.1 Topic analysis

In the next step, we performed a topic analysis. We identified the top 10 topics in global Twitter communication related to the hashtag "#healthyfood." Table 2 shows the results of this analysis.

The largest community was called "Inspiring." This community focused on promoting healthy food with a healthy lifestyle sub-theme. It contained keywords such as "foodie," "yummy," "foodporn," "instafood," "delicious," "foodlover," "foodphotographer," "foodstagram," "healthylive," and "healthylifestyle." This is a critical community from the perspective of those interested in increasing the health of the whole population because communities that focus on promoting healthy foods and healthy lifestyles have a high potential to improve the nutritional composition of the foods consumed by the population exposed to these messages (Love et al., 2018). Overall, it has been shown (Jean et al., 2019) that social media influencers play a crucial role in stimulating positive attitudes among consumers, which can subsequently impact their purchase intentions.

Similarly, other research (Ziyadin et al., 2019) indicated that social media significantly influences consumer behavior, particularly post-purchase activities such as writing reviews and expressing satisfaction or dissatisfaction with products. All of this dramatically impacts the area of food choice for consumption (Ramlan et al., 2023). It is very positive that the largest community associated with healthy food focuses specifically on inspiring healthy eating and healthy lifestyles.

The second largest community was called "Access to healthy food for children and youth." It included key terms such as "community," "school," "access," "child," "support," "program," "provide," "student," "help," "local," "education," and "policy."

Ensuring access to healthy food involves a wide range of stakeholders and factors. Individual stakeholders include local leaders, primary healthcare providers, and district health office staff, who are involved in developing a supportive environment by providing cadre training, ensuring access to healthy food, and delivering local regulation (Fitrina et al., 2020), or policymakers and urban planners, who form strategies for healthy food access (Kuai and Zhao, 2017).

School and family are vital for children and young people's access to healthy food. School plays a primary role in two areas. The first is focused on shaping the social representations of healthy eating for the population, emphasizing the importance of food and nutrition education (Paola Mora Vergara et al., 2020). The second is the actual food that exists in the school, which is related to the quality of school nutrition policies (Khoe et al., 2022). The other crucial area is family. Parental practices play a crucial role in shaping children's food consumption behaviors because parental control of food accessibility significantly influences children's eating habits (Yee et al., 2017).

Regarding individual factors, the social, physical, and economic environments interact to promote or limit access to healthy food

options for children and young people (Hutton and Nalamada, 2020). Differential access to healthy foods may contribute to racial and economic health disparities, emphasizing the importance of addressing environmental influences on food availability, particularly in minority and low-income communities (Franco et al., 2008).

Communities must concentrate on nutritional food to reduce food insecurity and enhance access to fresh food in vulnerable communities (Smith et al., 2013). At the state or national level, strategies include taxes on unhealthy foods, subsidies on healthy foods, and exemptions of healthy foods from certain taxes (Lee et al., 2016). These strategies make healthy foods more convenient and cheaper for the community.

The third largest community was called "Expenditure on healthy food" because it contained the key terms "eat," "expensive," "junk," "buy," "junk food," "unhealthy," "cheap," "money," "choice," "fast," "like," and "spend." This community addresses the issue of the price of healthy versus unhealthy food. Is healthy food more expensive than junk food? This community is highly connected with the previous community "Access to healthy food for children and youth." The question of whether healthy food is more expensive than unhealthy food is of interest due to its potential impact on consumer behavior and public health.

Healthy eating is often perceived as being more expensive, and various studies support this claim. O'Reilly et al. found that higher consumption of fruits, vegetables, meat, and fish, which are promoted as part of healthy eating guidelines, is associated with higher costs (O'Reilly et al., 2017), while another study (Mazzocchi et al., 2015) also highlighted that healthy eating policies involve economic costs to the taxpayer, indicating there are financial implications associated with promoting healthy eating. Furthermore, another study (Daniel, 2016) argued that social class inequities in diet quality and dietary health stem from the prohibitive cost of healthy eating, providing additional evidence to support the notion that healthy eating can be costly.

In addition, another study (Bihan et al., 2010) identified affordability as a determinant of fruit and vegetable consumption, suggesting that a lack of money may hinder individuals from maintaining a healthy diet. Furthermore, another study (Chang and Chatterjee, 2022) found that older age, lower income, and living in certain regions are more likely to lead to a perception of a cost barrier to healthy eating, further highlighting the financial challenges associated with healthy eating. Other studies (Jeong et al., 2019; Chang and Chatterjee, 2022) also highlighted that customers' psychological perception that healthier menu options are more expensive than less healthy ones negatively influences their healthy restaurant dining.

While the abovementioned studies provide substantial evidence to support the claim that eating healthier is more expensive, it is important to note that other factors, such as individual eating behaviors, also shape dietary choices. A study (Chen et al., 2012) suggested that food costs may not be the only reason why low-income individuals have less healthy diets, suggesting there are multifaceted influences on eating behavior. Therefore, the cost of healthy eating is one, but not the only, determinant of dietary choice.

The fourth largest community was called "Homemade food." Many studies have investigated the relationship between homemade food and health. Some studies (Simmons and Chapman, 2012; Mills et al., 2017) showed that regular consumption of home-cooked food affects health not only because the process of food creation is controlled but also because consumption of home-cooked meals is associated with a greater likelihood of average weight and body fat status (Tani et al., 2020).

The main reasons for the positive impact of homemade food include control over the prepared food in terms of the individual ingredients (Fertig et al., 2019) and a greater likelihood of consuming the fruits and vegetables that homemade food contains (Pellegrino et al., 2018).

The fifth largest community was called "Vegan/vegetarian diet" because it contained the key terms "salad," "green," "vegetable," "veggie," "tomato," "vegan," "garden," "vegetarian," "recipe," "plantbase," "veganfood," and "plant." A vegan diet excludes all animal products and is associated with various health benefits. The main difference between a vegan diet and a vegetarian diet is that the former excludes animal products. While both diets emphasize plant-based foods, vegetarians may consume dairy products and eggs, and vegans avoid all animal-derived foods, including dairy products, eggs, and sometimes even honey (Cramer et al., 2017).

Many studies (Key et al., 1999, 2006; Craig, 2009; Glick-Bauer and Yeh, 2014; Le and Sabaté, 2014; Draper et al., 2019; Mahase, 2021) have confirmed that vegan/vegetarian diets have a positive effect on health in terms of reduced occurrence of chronic diseases, lower body mass index, improved cardiovascular health, and decreased mortality from ischemic heart disease. However, it should be noted that research (Dwyer and Loew, 1994; Kiely, 2021; Selinger et al., 2023) also warns of the inevitable consequences of these diets.

Given the results of this research, in which "Vegan/vegetarian diet" was the fifth largest community and the most robust community in the field of diet choices, it is necessary to focus on this diet choice in the future, not only from the perspective of the business environment, where it is possible to find a demand for such foods, but especially from the perspective of parents, institutions, and dietitians, who, given the potential risks of this diet if foods are incorrectly balanced, must focus on providing the correct information to consumers who choose this diet. This is the only way to ensure a healthy population in the future.

The sixth largest community was called "Fruit drinks." The effect of fruit drinks on health has been the subject of considerable scientific investigation. For example, a study (Zheng et al., 2017) identified the ability of fruit and vegetable juices to improve cardiovascular health, which was attributed to their rich composition of polyphenols, vitamins, and minerals. This research is supported by another study (Hussein et al., 2021), which highlighted the nutritional importance of fruit drinks, mainly due to their content of essential vitamins, minerals, and antioxidants, which are crucial to reducing the incidence of various diseases. As with vegan/vegetarian diets, it is necessary to identify the negative side of these products. For example, a study (DeChristopher et al., 2015) described the issue of fruit drinks that are sweetened with high-fructose corn syrup, which may have implications for the exacerbation of coronary artery disease, primarily due to the disproportionate fructose-to-glucose ratio. This result was supported by another study (Verstraeten et al., 2016), which linked excessive consumption of sweetened beverages to an increased risk of obesity and chronic diseases. One solution is to inform consumers that 100% fruit juice should be perceived as a nutritional drink to be consumed with a meal rather than as a thirst quencher to mitigate the risk of overweight and diabetes (Brouns, 2018). The need for

awareness was confirmed by research highlighting that marketing sweetened fruit-flavored drinks to parents leads to potential misperceptions about the benefits for young children (Fleming-Milici et al., 2022). This is concerning because data from the Feeding Infants and Toddlers Study suggested that by 3 years old, half of all children consume sugary drinks such as fruit drinks on any given day (Muth, 2018).

The seventh largest community was called "Healthy breakfast" because it contained the key terms "breakfast," "egg," "toast," "morning," "avocado," "yogurt," "healthy breakfast," "brunch," "granola," "start," "oats," "protein," "porridge," "butter," "bread," "milk," and "coffee."

Eating a healthy breakfast is consistently associated with various aspects of good health. For example, a study (Coulthard et al., 2017) showed that regular breakfast consumption is associated with improved intake of nutrients, including fiber and essential micronutrients. This area can also be linked to adolescent mental health because the consumption of a regular balanced breakfast improves the mental health of adolescents (O'Sullivan et al., 2009). When looking at the different meal splits throughout the day (breakfast, lunch, dinner, and snacks), breakfast is the most communicated event in this area. This result can be used in many areas. From a marketing perspective, it is possible to focus efforts on promoting healthy foods specifically for breakfast.

The goal of interest groups is a healthy society. In the context of research showing that daily breakfast consumption is associated with maintaining a healthy body weight (Dubois et al., 2009), reduces stress and depression in adolescents (Ferrer-Cascales et al., 2018), improves carbohydrate metabolism and insulin levels (Maki et al., 2016; Jeans et al., 2022), and positively correlates with cognitive and emotional engagement (Moller et al., 2022), consumption of a high-quality breakfast plays a critical role in promoting both mental and physical health.

The eighth community was called "Immunity" because it contained the key terms "immune," "immunity," "immune system," "system," "health," "boost," "medicine," "coronavirus," "COVID-19," "vitamin," "sleep," "exercise," and "rest." Nutrients play a vital role in supporting the immune system, and a balanced diet is essential for optimal immune defense against infectious and non-infectious diseases (Chen et al., 2021). Micronutrients such as vitamins, minerals, and fatty acids support the immune system (Calder and Kew, 2002; Calder et al., 2020; Reider et al., 2020). Thus, a balanced diet containing roughage is important for the immune system.

The ninth largest community was called "Weight loss." As alluded to earlier, healthy food and homemade food are associated with weight control. It is necessary to note that terminology related to healthy food, such as "healthy eating," is often confused with dieting for weight loss (Buckton et al., 2015). However, this may only sometimes be true. An example is fast food restaurants that provide "healthy food" and lead consumers to underestimate the caloric content of the main meal, which they supplement with caloric side dishes, desserts, or drinks, making the whole meal calorically unbalanced (Gravel et al., 2012). Here, as in the aforementioned communities, it is necessary to focus on the composition of junk foods. Junk foods typically contain a high number of calories from sugar or fat with little protein, vitamins, or minerals, emphasizing their role in reducing excessive caloric intake (Mohammadbeigi et al., 2019; Karki et al., 2022).

The tenth largest community was called "Seafood" because it contained the key terms "salmon," "fish," "tuna," "seafood," "shrimp," "sea," "cod," "salad," "dinner," "recipe," "delicious," "sauce," and "grill." Generally, seafood is associated with healthy eating because it is a source of nutrients essential for a healthy diet, especially protein, fatty acids, vitamins, and minerals (Hosomi et al., 2012). Seafood also has preventive effects on the risk of congestive heart failure, coronary heart disease, ischemic stroke, and sudden cardiac death (Rimm et al., 2018). The importance of this community is also due to the secondary impact of seafood. It is predicted that seafood will play a key role in improving access to healthy diets that are low in greenhouse gas emissions and thus support environmental sustainability (Farmery et al., 2022; Robinson et al., 2022).

A significant contribution of this research is the extension of previous research that focused on the analysis of communication on the social network Twitter using only the hashtag "#healthyfood" to identify messages. This study expanded the dataset to include messages that also contained the phrase "healthy food," which, compared with previous research (Pilař et al., 2021b), revealed two new and very important communities: "Access to healthy food for children and youth" and "Expenditure on healthy food." These communities were not identified in previous research because the content of the hashtag "#healthyfood" is low in them. Explanations can be found in people's motives for using hashtags (Pilař et al., 2017). "Access to healthy food for children and youth" and "Expenditure on healthy food" are serious topics associated with negative sentiment (Figure 2) and given the limitations of a Tweet, messages in these areas contain more important facts than hashtags.

3.2 Visual analysis

The results of visual analysis indicated that healthy food is not a polarized topic. On the contrary, specific topics overlapped (Figure 3).

Specifically, the largest topic (Topic 1, "Inspiring") was at the center of all topics. Topic 2 ("Access to healthy food for children and youth") and Topic 3 ("Expenditure on healthy food") were next to each other and overlapped significantly. This is supported by the previous text describing that these two topics are connected. Topic 10 ("Seafood") was next to Topic 5 ("Vegetarian/vegan diet"), which supports research showing that seafood is an alternative for vegetarians, especially pesco-vegetarian diets (Rodríguez-Martín et al., 2023).

3.3 Geographic location of tweets

A multitude of factors beyond socioeconomic considerations influence healthy food selection. While socioeconomic status plays a significant role in determining food choices, other factors such as education level, psychological state, community resources, food beliefs, gender, age, emotional states, food labels, cultural factors, home food environment, poverty, ethnic composition, community socioeconomic environment, availability of fresh foods, and transportation also impact selection of healthy food choices (Turrell, 1998; Alkerwi et al., 2015; Provencher and Jacob, 2016; Ares et al., 2017; Benson et al., 2018; Boatemaa et al., 2018; Saygı and Dilistan Shipman, 2021; Zafar et al., 2021).

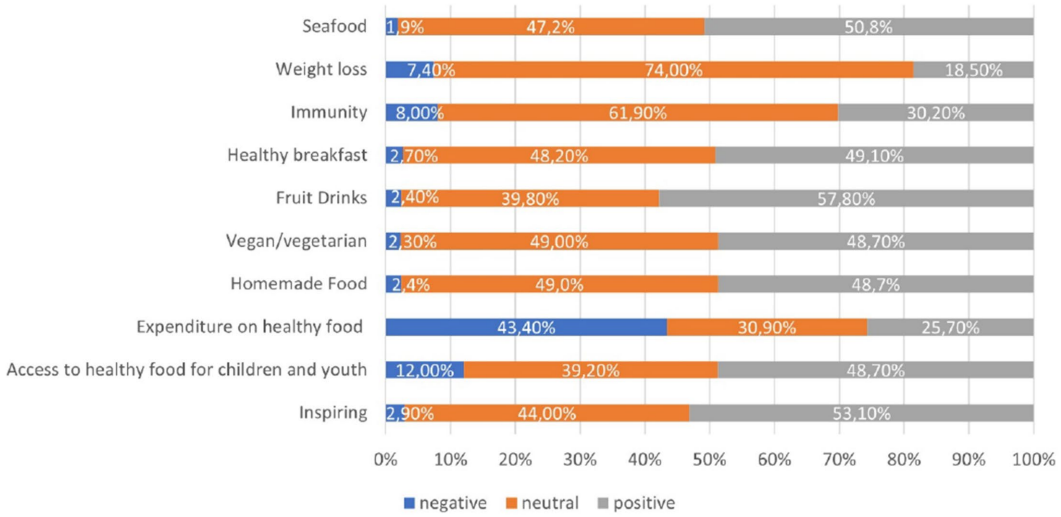

FIGURE 2
Results of sentiment analysis for the identified topics. The results divide the attitudes of Twitter users into negative (blue), neutral (orange), and positive (gray).

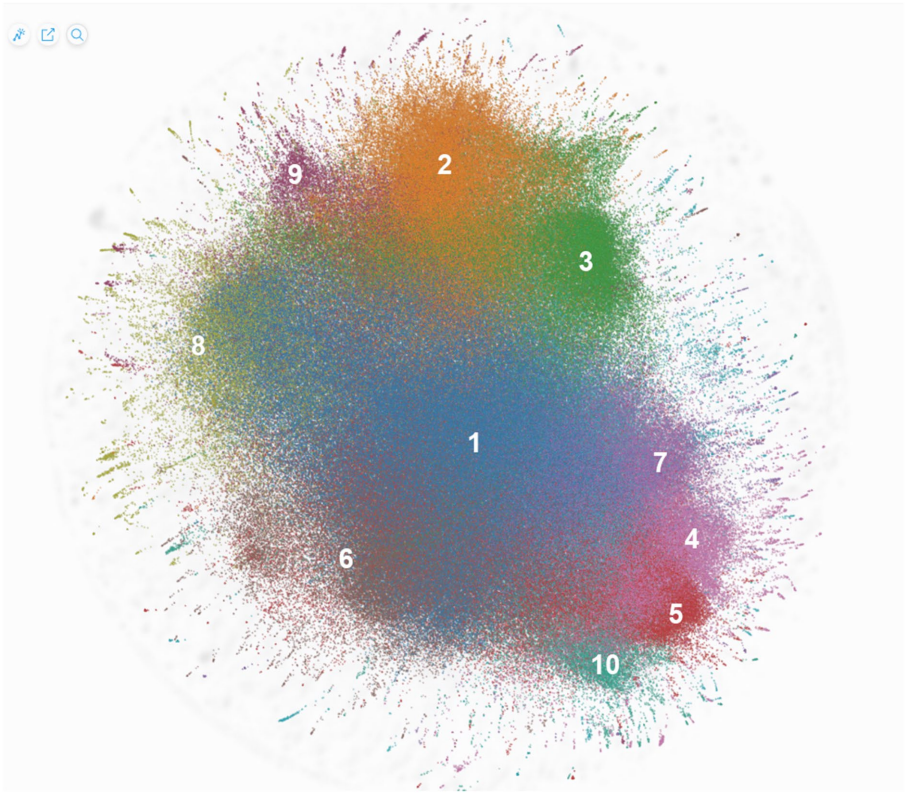

FIGURE 3
Polarization of topics on the social network Twitter in connection with the topic of healthy food. *1—Inspiring, 2—Access to healthy food for children and youth, 3—Expenditure on healthy food, 4—Homemade food, 5—Vegan/vegetarian diet, 6—Fruit drinks, 7—Healthy breakfast, 8—Immunity, 9—Weight loss, 10—Seafood.

These factors differ between locations. Given that it is possible to define the location where a Tweet was sent, an analysis was performed of the communication of each community depending on the country from which the Tweet was sent (Table 3).

The results suggest that in the United States, the discourse was heavily centered around "Access to healthy food for children and youth" (52.4%) and "Expenditure on healthy food" (45.8%), indicating significant public concern and engagement with the economics and

TABLE 3 Comparison of the communication of topics between countries (in %).

	USA	India	Great Britain	Canada	Spain	France	Australia	Nigeria	Italy	South Africa
P**→↓T.N.*	37.5	13.7	12.6	5.3	2.8	1.9	1.8	1.2	1.2	1.1
1	30.5	13.4	13.2	4	**5.3**	**2.9**	1.7	**1.7**	**1.5**	**1.3**
2	**52.4**	6.6	12.5	8.3	0.9	0.8	**2.3**	0.8	0.6	0.9
3	**45.8**	7.8	10.5	4	0.8	1.5	1.8	1.1	0.5	**2**
4	38.8	10.1	18.5	5.3	2.1	1.6	2.2	1.0	1.1	1.1
5	35.8	11.3	13.8	5.3	**4.6**	2.7	1.7	1.1	**1.5**	1.1
6	31.7	11.2	18.7	4.1	4	**2.6**	2.1	1	1.4	1.1
7	39.1	9.3	**19.1**	**5.7**	1.7	1.2	2.2	1.1	0.7	1.3
8	26.4	**28.9**	6.4	**6.2**	0.7	1	0.8	**1.6**	0.5	0.8
9	44.4	**17.8**	11.5	3.3	0.8	1	2	1	0.4	0.9
10	39.3	4.7	**19.0**	4.6	3.4	1.5	**2.2**	1.2	**2.2**	0.9

*TN, Topic number, connected with Table 2. **The proportions of the country in the overall communication. Bold value means the highest values for the selected country.

TABLE 4 Most relevant world sequences in individual categories of sentiment in the topic Expenditure on healthy food.

Sentiment category	Most relevant world sequences
Positive sentiment	Eat, feel, good, eating healthy, buy, like, energy, choice, eat healthy
Neutral sentiment	Eat, junk, eat healthy, need, exercise, diet, good, nutrition, expensive, cheap
Negative sentiment	Expensive, eat, want, buy, junk, unhealthy, shit, bad, junk food, hate, hungry

accessibility of healthy eating for the younger population. Conversely, India showed a predominant focus on "Immunity" (28.9%) and "Weight loss" (17.8%), reflecting a heightened interest in immune health and body weight management.

Twitter users in Great Britain were most vocal about "Healthy breakfast" (19.1%) and "Fruit drinks" (18.7%), suggesting a particular emphasis on the start of the day and beverage choices in their health discussions. Leading topics in Canada were "Access to healthy food for children and youth" (8.3%) and "Healthy breakfast" (5.7%), demonstrating a focus on a nutritional start to the day and food accessibility for the young. In Spain, the dominant themes were "Vegan/vegetarian diet" (4.6%) and "Healthy meat propagation" (4.7%), highlighting a balanced discourse on dietary choices.

Twitter discourse in France was most active about "Inspiring" (2.9%) and "Vegan/vegetarian diet," showing a unique blend of motivation and dietary preferences. In Australia, leading discussions were about "Access to healthy food for children and youth" (2.3%) and "Healthy breakfast" (2.2%), emphasizing the importance of nutrition for children and the first meal of the day. In Nigeria, the most prominent topics were "Immunity" (1.6%) and "Healthy meat propagation" (1.4%), revealing a focus on immune health and meat consumption. In Italy, there was a strong inclination toward "Healthy breakfast" (0.7%) and "Homemade food" (1.7%), reflecting a cultural emphasis on the quality and origin of food. Finally, Twitter conversations in South Africa focused on "Fruit drinks" (1.1%) and "Vegan/vegetarian diet" (1.1%), suggesting a particular interest in beverage choices and plant-based diets. These data provide a fascinating glimpse into the varied priorities and concerns in health-related discussions across different countries on Twitter.

The reasons for these differences are worthy of in-depth investigation in the future.

3.4 Sentimental analysis

Figure 2 shows the results of the sentiment analysis. The highest level of negative sentiment (43.4%) was found for the topic "Expenditure on healthy food," which deals with the cost of healthy food, indicating that Twitter users perceive the cost of healthy eating as an important and sensitive issue. Previous studies (De Mestral et al., 2016; Lima et al., 2021; Wongprawmas et al., 2022) identified the higher cost as one of the most significant barriers to healthy eating. The results of sentiment analysis suggest that Twitter users also perceive this barrier.

A higher level of negative sentiment (12%) was also recorded for "Access to healthy food for children and youth," including discussions about promoting healthy eating to children and young people in schools. Although a previous study (Story et al., 2009) reported that schools play a crucial role in promoting healthy eating and highlighted the need for more robust policies in this area, the results of this sentiment analysis suggest there is controversy around this issue, which may stem from the diverse views and expectations of parents and society.

As this is a topic with a significantly higher proportion of negative sentiment compared to the other identified topics, we identified the most relevant world sequences from the tweets falling into each sentiment category (Table 4). The most relevant world sequences occurring in Tweets with negative sentiment are, e.g., expensive, buy, junk, unhealthy, shit, bad, junk food, and hate. In contrast, the most relevant world sequences occurring in

tweets with positive and neutral sentiment are, e.g., good, healthy eating, energy, choice (positive sentiment), and eat healthy, need, exercise, diet, good, or nutrition (neutral sentiment), respectively.

By contrast, the highest levels of positive sentiment were observed for "Fruit drinks" (57.8%) in the context of healthy food and for "Inspiring" (53.1%), which focuses on promoting healthy eating. The results show that these topics are critical drivers of positive perceptions of healthy food on Twitter.

4 Theoretical and practical implications

It should be noted that this study did not evaluate whether healthier foods are more expensive than unhealthy foods or whether a vegan/vegetarian diet is healthier but only provided insight into global communication on Twitter in relation to the topic of healthy food.

In terms of individual community analysis, this research identified two significant communities that were not previously extracted in relation to healthy food on Twitter and Instagram: "Access to healthy food for children and youth" and "Expenditure on healthy food." The sizes of these communities (Table 2) and the negative sentiment associated with them (Figure 2) suggest the importance of intensively addressing these areas, such as access to and cost of healthy food, at both the individual and national program levels.

Given that schools play a crucial role in shaping children's eating habits, integrating food and nutrition education into curricula, improving school nutrition policies, and focusing on providing healthy food options are essential. Parents should be educated about the importance of healthy eating habits and how to incorporate them into family life. It is important that they understand and effectively manage the financial implications of healthy versus unhealthy food choices. The state should develop policies and strategies to make healthy foods more accessible and affordable, for example, through subsidies or taxes on certain types of food. Implementing national health campaigns to raise awareness of the importance of healthy eating is also crucial.

Given the identification of vegan/vegetarian diets as the most important diet choice in the healthy food sector, it is essential to address the education of consumers who choose this diet. Despite the evidence that vegan/vegetarian diets can have a positive impact on health, it is very important to balance such diets well to avoid a negative impact in the long term, as described above.

Another significant contribution, particularly in the theoretical area, is the recognition that analysis of a dataset based on hashtags alone may be insufficient and thus miss important communities.

5 Conclusion

This research embarked on the journey to elucidate the main areas of communication regarding healthy food on the social network Twitter (now X), with a keen focus on identifying the underlying sentiments. Through the meticulous analysis of 828,963 Tweets encompassing both the hashtag "#healthyfood" and the phrase "healthy food," this study has not only achieved its aim but has also extended the boundaries of our understanding in this domain. The analysis revealed five pivotal communication areas: Inspiring, Access to healthy food for children and youth, Expenditure on healthy food, Homemade food, and Vegan/vegetarian diet. Notably, the study uncovered significant insights into previously underexplored areas of Access to healthy food for children and youth and Expenditure on healthy food, which demonstrated a higher negative sentiment, underscoring the societal concerns regarding these issues.

The sentiment analysis provided an understanding of public perceptions, revealing that discussions around the Expenditure on healthy food bore the highest negative sentiment, highlighting the critical view of the Twitter community on the affordability of healthy diets. Conversely, areas such as Fruit drinks and Inspiring messages evoked markedly positive sentiments, indicating a collective optimism and motivation toward healthier food choices among social media users.

The findings of this research not only contribute to the academic discourse on the role of social media in shaping food-related communications and perceptions but also offer practical implications for policymakers, educators, and health practitioners. By identifying key areas of interest and concern among the public, strategies can be tailored to address these issues, fostering an environment that supports accessible and affordable healthy eating choices for all, especially for children and youth. Furthermore, the insights into sentiment trends underscore the importance of positive messaging in promoting healthier diets and lifestyles.

In conclusion, this research significantly extends the understanding of the discourse surrounding healthy food on the social network Twitter, now known as X. By broadening the scope of analysis beyond the hashtag "#healthyfood" to include the phrase "healthy food," this study has uncovered two previously unidentified but crucial communities: "Access to healthy food for children and youth" and "Expenditure on healthy food." This expansion has enabled a more comprehensive identification of the main areas of communication about healthy food, fulfilling the research aim. Specifically, our findings have delineated five central communities engaging in the discourse on healthy food on Twitter: (1) Inspiring, (2) Access to healthy food for children and youth, (3) Expenditure on healthy food, (4) Vegan/vegetarian diet, and (5) Fruit drinks. A notable aspect of this research is the detection of high levels of negative sentiment within the newly identified communities of "Access to healthy food for children and youth" and "Expenditure on healthy food," highlighting these areas as significant concerns within the Twitter discourse on healthy food. Furthermore, the vegan/vegetarian diet emerges as the most discussed diet choice within the healthy food sector, indicating a sustained interest and engagement with this dietary preference on social media. The geolocation analysis of Tweets reveals variations in community discussions across different countries, suggesting a rich avenue for future research to explore sociocultural influences on healthy food choices more deeply. By expanding the dataset and analyzing sentiment and geographic location, this study not only contributes to the

academic literature by identifying and characterizing the main areas of healthy food communication on Twitter but also offers valuable insights for policymakers, educators, and public health professionals seeking to promote healthier eating habits within the community.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found at: https://zenodo.org/records/10403027.

Author contributions

RK: Writing – original draft, Data curation, Investigation, Validation, Visualization. LK: Conceptualization, Formal analysis, Writing – original draft, Funding acquisition, Project administration, Resources. LaP: Writing – original draft, Conceptualization, Formal analysis, Methodology, Supervision. KK: Formal analysis, Resources, Writing – original draft. LuP: Resources, Writing – original draft. MC: Formal analysis, Resources, Writing – original draft.

Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. This study was supported by the Internal Grant Agency (IGA) of FEM CULS in Prague, registration no. 2022B0009 – Application of artificial intelligence to regional segmentation using Big Data.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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