

“Obesity is the New Major Cause of Cancer”: Connections Between Obesity and Cancer on Facebook and Twitter

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Abstract Social media interactions can inform public health risk perceptions. While research has examined the risk relationships between obesity and cancer, public attitudes about their associations remain largely unknown. We explored how these constructs were discussed together on two social media platforms. Publicly accessible Facebook and Twitter posts from a 2-month period in 2012 containing references to obesity (“obese/obesity,” “overweight,” and “fat”) and cancer-related words were extracted ($N=3702$ posts). Data cleaning yielded a final set of 1382 posts (Facebook: $N=291$; Twitter: $N=1091$). Using a mixed-methods approach, themes were inductively generated, and sentiment valence, structural elements, and epistemic stance were coded. Seven relational themes emerged: obesity is associated with cancer ($n=389$), additional factors are associated with both obesity and cancer

($n=335$), obesity causes cancer ($n=85$), cancer causes obesity ($n=6$), obesity is not linked to cancer ($n=13$), co-occurrence ($n=492$), and obesity is valued differently than cancer ($n=60$). Fifty-nine percent of posts focused on an associative or causal link between obesity and cancer. Thirty-one percent of posts contained positive and/or negative sentiment. Facebook was more likely to contain any sentiment, but Twitter contained proportionately more negative sentiment. Concurrent qualitative analysis revealed a dominance of individual blame for overweight/obese persons and more support and empathy for cancer survivors. Our study reflects wide recognition of the evidence linking obesity to increased risk of cancer, a diverse set of factors perceived to be dually associated with both conditions and differing attribution of responsibility. We demonstrate that social media monitoring can provide an important gauge of public health risk perception.

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Background

Excess body fat is estimated to be responsible for 3–9 % of all incident cancers and 20–33 % of postmenopausal breast, colon, endometrial, kidney, and digestive cancers specifically [1]. Evidence suggests that being overweight or obese is related to poorer quality of life [2], higher rates of cancer recurrence [3, 4], and increased mortality [5]. In addition, some researches suggest that cancer and cancer treatment can lead to weight gain, particularly in breast cancer patients who receive adjuvant chemotherapy [6]. In contrast to the evidence-base linking obesity and cancer, much less is known about public perceptions about this link. A 2015 survey by the American Institute of Cancer Research on public perceptions

of cancer risk demonstrated that although the percentage of Americans that reported awareness of the association between obesity and cancer risk was increasing, still only 52 % correctly identified this link [7].

Examining social media interactions has proven useful for understanding public attitudes and perceptions surrounding health topics [8], such as smokeless tobacco use [9] and vaccinations [10]. Social media is unique from and a complement to other forms of self-reported data, including ecological momentary assessment and national surveys. Studying the discourse surrounding obesity and cancer concurrently can enhance our understanding of lay health beliefs, compare these beliefs with biomedical evidence, and inform health promotion efforts [11].

Our main research question was in what ways do individuals discuss *obesity* and *cancer* concurrently on social media? We examined Facebook and Twitter posts collected over a 2-month period and identified relational themes, grammatical elements, and valence of the sentiments in comments mentioning both conditions.

Methods

Data Source

The original dataset was created using a web-crawling service which mined publicly available English-language posts from blogs, Twitter, Facebook, forums, Flickr, YouTube, and comments (user-generated responses to content on all channels except Twitter) from January 23 to March 23, 2012 containing the words “obesity/obese,” “overweight,” or “fat.” The parent dataset contained approximately 2.2 million posts. A full description of the development of the dataset and broader study findings were published previously [12].

A subset of the dataset was generated for this study by extracting only Facebook and Twitter posts that included the following keywords: benign, cancer, cancers, cancerous, carcinogen, carcinogenic, chemo, chemotherapeutic, chemotherapy, cyst, cysts, growths, leukemia, lymphoma, malignant, metastases, metastasis, metastatic, neoplasm, oncologist, oncology, radiation, radiotherapy, recurrence, tumor, tumors. This key word search yielded a sample of 3702 posts. Duplicative, unintelligible and irrelevant posts (e.g., “cancer” as a zodiac sign) were manually removed, resulting in a final sample of 1382 unique posts. Figure 1 shows a flow diagram of the data selection process.

Mixed Methods Analysis

In order to retain the nuance while capturing the breadth and scope of the data, a mixed methods study design was used. Specifically, a *concurrent embedded* design was chosen, such that a descriptive qualitative analysis was embedded within

the more dominant quantitative approach and used to guide, interpret, and illustrate the patterns revealed [13]. The study team used a 10 % sample of posts from the final data set to generate the coding scheme that was then applied to the rest of the data. Grounded theory was used to guide the generation of the relational themes, grammatical elements, and sentiment valence under investigation [14]. Relational themes characterized the connection made between the two constructs under investigation. An iterative process of review and discussion resulted in seven relational themes:

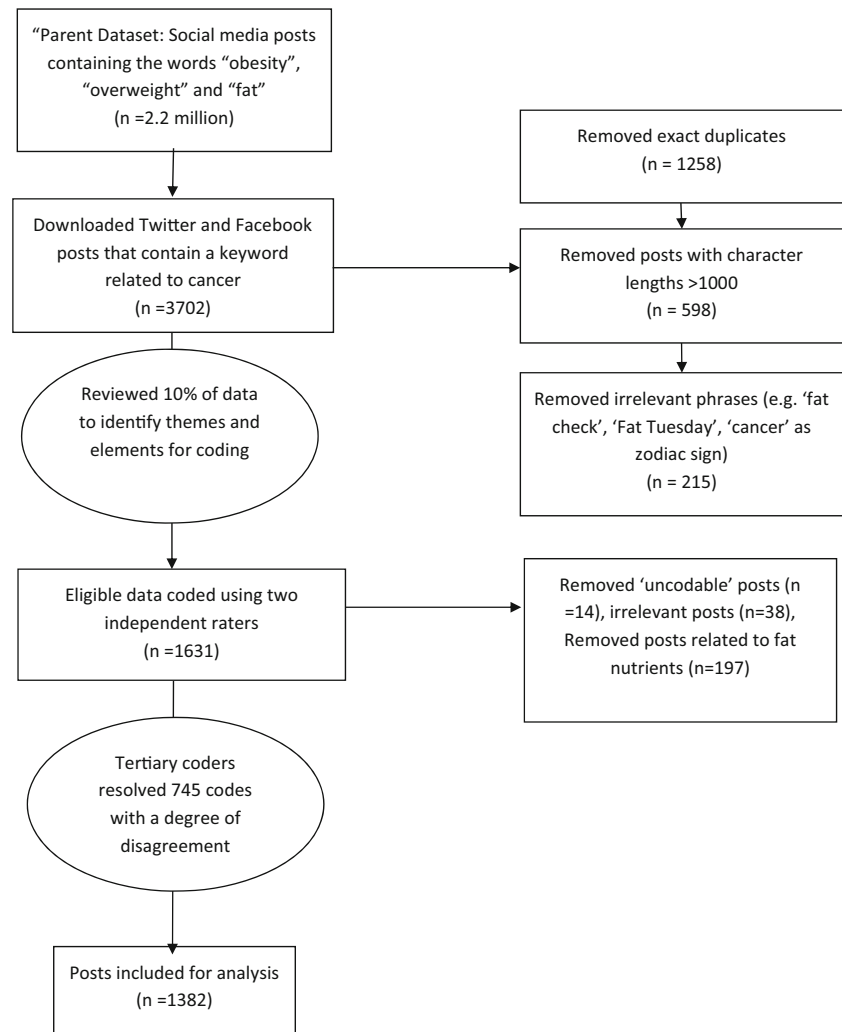
1. Obesity is associated with cancer.
2. An additional factor (s) is associated with both obesity and cancer.
3. Obesity causes cancer.
4. Cancer causes obesity.
5. Obesity is not linked to cancer (explicitly stated).
6. Obesity and cancer co-occur (but are not linked).
7. Obesity and cancer are valued differently.

Given important distinctions and varying public perceptions of the differences between causation and correlation [15], we distinguished between these two concepts (theme 1 vs. 3 and 4). Theme 1 included non-directional relational language such as “linked with” or “associated with,” while themes 3 and 4 included directional causal language such as “causes” or more colloquial wording such as obesity “gives you” cancer, or cancer “makes you” fat. Theme 2 included either associative or causal language, with the emphasis being on the inclusion of an additional factor(s) associated with both obesity and cancer, such as diet soda and chemical additives. For posts coded under theme 2, each additional factor was identified and categorized inductively. For a post to be categorized as corresponding to theme 5, it needed to explicitly state that the two health conditions were not related. Theme 6 included posts that mentioned both obesity and cancer, but did not contain either an endorsement or a denial of an associative/causal link between the two. Finally, theme 7 posts contained a valuation or comparison of the two health conditions (e.g., stating a preference for having one condition rather than the other).

In addition to relational themes, certain grammatical elements of the post, including sentence type (question, imperative/command, or declarative) and epistemic stance (voiced opinion or (re-) stated fact) were recorded. Finally, four categories of sentiment valence were coded: positive (supportive/empathetic statements), negative (direct insults or stigmatizations), both positive and negative (both positive and negative elements), or neither (devoid of explicit sentiments).

The data were independently double-coded by three reviewers (RAR, KG, KG). Fourteen codes were applied to each post (seven relational themes, three elements of sentence structure, and four possible sentiment valences). During the

Fig. 1 Flow diagram of screening and cleaning steps to create the study sample



reconciliation phase, the primary and secondary codes were examined in parallel, and 745 posts were found to have at least one code discrepancy (although over 48 % of the 745 posts contained 1 or 2 discrepancies out of a possible 6 codes per post). Two additional reviewers (WSC and AP) examined and recoded these discrepancies, after which a final reviewer made the final adjudication (EEK). Particularly difficult discrepancies were resolved through a consensus building process among the investigative team.

Frequencies and percentages of codes and comparisons between Facebook and Twitter content were calculated. Analyses comparing sentiment (positive, negative, neither, or both) in posts across social media platform and relational themes were conducted. Bivariate frequency analyses were conducted using chi-square tests with $p=0.05$. All descriptive and analytical analysis was conducted in SAS 9.3 (SAS Institute, Cary, NC).

Qualitative analysis and interpretation within specific relational/sentiment categories was conducted to elucidate the meaning in these posts. Throughout the manuscript, whenever example posts are included, original language, spelling,

grammar, and style was preserved. Note, however, that Twitter handles and other easily identifiable information have been removed or altered to protect privacy.

Results

The final data contained 291 Facebook posts and 1091 Tweets for a total of 1382 codeable units. Table 1 lists the frequencies and percentages of themes and provides sample posts for illustration. A total of 202 (15 %) and 187 (14 %) posts contained an imperative or a question, respectively. A majority of posts ($n=867$, 63.4 %) were presented as statements of fact as opposed to personal opinions.

In terms of relational themes, approximately 59 % of posts focused on an associative or causal link (themes 1–4 from Table 1) between obesity and cancer. Posts in this subset commonly contained the words “risk” ($n=378$, 46.2 %), “link” ($n=115$, 14.1 %), or “cause” ($n=80$, 9.8 %). Significantly,

Table 1 Frequencies of grammatical elements, relational themes, and emotional themes ($N = 1382$)

	Facebook <i>n</i> (%)	Twitter <i>n</i> (%)	Sample posts
Grammatical elements			
Presence of an imperative*	113 (38.8)	89 (8.2)	[Facebook post] Maintain a healthy weight. The weight that's right for you depends on many factors including your sex, height, age and heredity. Excess body fat increases your chances for high blood pressure, heart disease, stroke, diabetes, some types of cancer and other illnesses. But being too thin can increase your risk for osteoporosis, menstrual irregularities and other health problems. If you're constantly losing and regaining weight, a registered dietitian can help you develop sensible eating habits for successful weight management. Regular exercise is also important to maintaining a healthy weight. Tips of The Day Keep Slim - Slimming is good for health, let's do it the healthy way
Presence of a question*	93 (32.0)	94 (8.6)	[Twitter post] RT: They makes shows like 16 & pregnant, teen mom, & I used too be fat. Where's i'm 10 years old & fighting cancer?
Epistemic stance: (opinion vs. fact)*	163 (56.0)	343 (31.4)	Opinion: [Facebook] i have come to a conclusion.... stopping from smoking is causing me to eat more often and substantial amount of food....so i have decided to die from cancer and not become fat.. i have to maintain my 32 waist line @ 48 everything is changing and im not ready for changes..wanna be a sexy grampa Fact: [Facebook]: Sugar is fuelling a global obesity pandemic and should b controlled like alcohol and tobacco, doctors warned. The health effect are so dangerous that it contributes to 35million deaths each yr as a result of diabetes, heart disease and cancer.
Relational themes*			
1. Obesity associated with cancer	19 (6.5)	370 (33.9)	[Twitter post] If you're overweight, your risk for endometrial cancer dramatically rises. Now what do I do about that? Answer http://t.co/vZtRdH9n
2. Additional factors associated with both obesity and cancer	89 (30.6)	246 (22.6)	[Facebook post] Diabetes, pancreatic cancer, obesity, osteo...we've been drinking our way to sickness and death!!! Ditch Colas and Other Soft Drinks Now! Ditch your colas—a new study found that a single can a day increases your risk of heart disease by 43% and can cause liver damage similar to that seen in alcoholics.
3. Obesity causes cancer	9 (3.1)	76 (7.0)	[Twitter post] Obesity may cause cancer.
4. Cancer causes obesity	3 (1.0)	5 (0.5)	[Twitter post] And 9/10 people with serious health conditions that take lots of medicine cause them to be obese. like my cousin with bone marrow cancer
5. Obesity not linked to cancer	0	13 (1.2)	[Twitter post] A study about weight & cancer actually found a NEGATIVE correlation between being overweight & having cancer #ditchingdieting
6. Obesity and cancer co-occur	166 (57.0)	326 (29.9)	[Twitter post] On weight obsession: Singers and hollywood should have a fat strike. They all get fat like when people shave their heads for cancer
7. Obesity valued differently than cancer	5 (1.7)	55 (5.0)	[Facebook post] Young girls are more afraid of becoming fat than they are about of nuclear war, cancer or losing their parents [Twitter Post] Having done the research, I can safely state that Splenda will indeed give you some form of cancer...but it's worth it to not be obese.
Sentiment			
Positive*	102 (35.1)	44 (4.0)	[Twitter] RT: James is strong - He was overweight, had acne, bullied, in a car crash, parents divorced, brother got in a accident & his friend has cancer.
Negative*	116 (39.9)	168 (15.4)	[Twitter] guess it's nice when people say I got real fat and look so disgusting and sickly like I have cancer. #waytokillmyselfesteem
Total	291	1091	

* $p < 0.01$; distributions differed significantly between Facebook and Twitter

more Twitter (70 %) than Facebook (30 %) posts contained an associative/causal link ($p < 0.01$). Posts containing additional factors associated dually with obesity and cancer (theme 2: $n = 159$ beneficial, $n = 166$ harmful) were diverse, with diet/food factors being most common (49 %, $p < 0.01$, Fig. 2). Additional 10 posts that had ambivalent or bidirectional associations were excluded from the figure.

While the associations may be unclear, the language characterizing the additional factors as beneficial or harmful tended to be very explicit and unambiguous. Appendix 2 lists all dietary/food factors that were described as either harmful (e.g., meat, gluten/wheat, “the American Diet”) or beneficial (green tea, eating slowly, “the Paleo Diet”) to risk of both obesity and cancer.

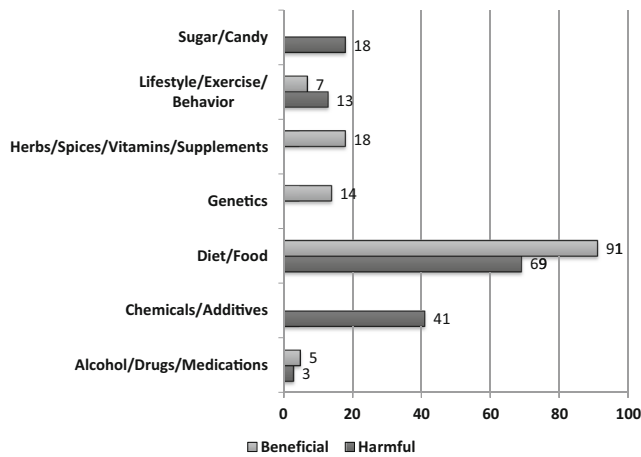


Fig. 2 Number of posts with additional identified factors dually associated with benefit or harm to obesity and cancer. The figure only includes posts classified as including a third factor that could be considered as dually harmful ($n=166$) or dually beneficial ($n=159$). Additional 10 posts which had ambivalent or bidirectional associations were excluded from the figure

A total of 430 posts contained positive, negative, or both positive and negative sentiment. Those that were devoid of sentiment generally contained restated facts as opposed to opinion ($n=851$, 82 %). Posts with positive associative/causal links were less likely to contain sentiment ($n=27$, 3 %) than those without these themes ($n=310$, 55 %) ($p<0.01$). Appendix 2 shows the relative frequency of posts with sentiment on Facebook and Twitter separately. Among posts that did not specify an associative/causal link between obesity and cancer, Facebook posts were more likely to contain either positive and negative elements or neither, while Tweets were more likely to contain no or negative sentiment ($p<0.01$).

Qualitative analysis of posts containing negative sentiment revealed some recurrent themes: self-deprecation, direct insults, stigmatization of overweight/obese persons, and reactions to stigmatization. Self-deprecation often took on a humorous yet dark tone, as exemplified here:

A. [Facebook] They say the best thing to do for a woman is to make her laugh. I'd feel better if I actually spoke before she started laughing. Being a middle aged bald fat man on chemo doesn't hold the sex appeal that one might imagine. I had hoped the look would catch on but no-one seems to be following along in my one man battle against trendy physically appealing aesthetics.

Direct insults are common, with references to “fat [person]”:

B. [Twitter] in class sitting next to some fat kid who smells like someone put mint Axe and tobacco inside of a dead animal #smoker=cancer #ciggsaregross

Less common was the use of “cancer” as an insult:

C. [Twitter] (@[REDACTED] cause dwight just finds something negative in every situation. He's like a cancer to this town. Bald, fat cancer.

Similarly, stigmatization was common, and the majority of posts stigmatizing overweight individuals ($n=18$) as compared to individuals with cancer ($n=4$).

D. [Twitter] Obesity might be a disease, but so is cancer... But at least people with cancer are trying to do something about it #lazyasses

Posts that contained both positive and negative sentiments often framed overweight persons and cancer patients differently. Many posts implied that obesity was the result of personal responsibility, unlike cancer, which was beyond individual control:

E. [Twitter] cancer patients are brave, obese people have no one else to blame but themselves

Positive posts often evoked support for individuals with weight problems and/or cancer. One post that was frequently reposted on Facebook ($n=33$) illustrates resistance to the derogatory sentiment leveled at overweight/obese individuals, individuals with cancer, and other individuals experiencing challenging life circumstances:

F. [Facebook] A 15 year old girl holds hands with her 1 year old son. People call her a slut, no one knows she was raped at 13. People call another Guy fat. No one knows he has a serious disease causing him to be overweight . People call an old man ugly. No one knew he had a serious injury to his face while fighting for our country in the war. People call a women bald but they don't know she has cancer Re-post this if you are against bullying and stereotyping. I bet 95 % of you won't do it.

In aggregate, review of post sentiment indicated strong reactions to both obesity and cancer and a mixture of positive and negative perspectives, with a dominance of negative framing around obesity and a more supportive view of individuals with cancer.

Discussion

Our study demonstrates a complex interplay between cancer risk perceptions, obesity, and overall sentiment of the discourse about obesity and cancer. Widespread acknowledgment of the association between obesity and cancer risk as

well as heterogeneity in information accuracy was apparent. Three specific findings warrant further discussion.

Wide Recognition of a Causal Link Between Obesity and Cancer

The most dominant relational themes included association/causation, and many posts imply that obesity increases risk of cancer (themes 1 and 3, $n=474$, 34.3 %). This finding is consistent with results from a national survey showing prevalent beliefs of the association between lifestyle behaviors and obesity [16]. Indeed, this recognized link reflects a large body of scientific evidence. Furthermore, more posts contain associative, as opposed to directly causal language, indicating recognition of a more probabilistic rather than deterministic model of risk [17]. This preference is more in line with the goals of public health, which are to empower rather than force individuals to adopt healthier choices and communities to enact more comprehensive policies of health promotion [15].

Health Myths and Quick Fixes

One of the most interesting findings from the relational themes was the high number of posts ($n=335$) that identified additional factors that were dually associated with cancer and obesity, as well as the diversity of those factors. Many posts that mentioned an additional element related to both obesity and cancer suggested that adoption/avoidance of a particular factor would lead to prevention or remediation of both health outcomes, often very quickly. Although a few of these factors have some evidence-base supporting their relationship to cancer and obesity (e.g., exercise), most of them do not—particularly singular dietary factors like genetically modified foods or wheat/gluten. As Internet health information seeking continues to increase [18], these types of statements have the potential of misleading users into subscribing to myths about health and behavior change.

Differential Attribution of Responsibility

Consistent with earlier findings and other prior research on weight bias [19], the posts were overwhelmingly negative toward overweight individuals. Many posts alluded to obesity as a result of individual failing. A review of highly viewed YouTube videos containing the word “fat” found that most depictions of obesity were linked to lack of individual discipline rather than social/environmental factors [20]. A report from a nationally representative household survey of American adults ($n=1101$) and found that 52 % of respondents reported that maintaining healthy weight is something that individuals should deal with on their own (as opposed to something that whole communities need to deal with or both individuals and communities together) [21]. Research on

attribution theory suggests that believing health is largely within a person’s own control is associated with a lower likelihood of helping individuals with health problems [22]. This implies that individuals who post derogatory sentiments about overweight/obese persons on social media may be more likely to exhibit other stigmatizing behaviors, although more research on this topic is needed.

In contrast, a more supportive view of people with cancer was observed, and this is reflected in research reporting cancer survivors receiving positive emotional support through social media [23]. Positive and supportive attitudes toward cancer survivors are relatively recent phenomena, born largely out of the cancer survivor advocacy movement which grew in response to high levels of stigma surrounding cancer and improvements in cancer screening and treatment [24].

Strengths and Limitations

Our study made use of a large dataset of social media interactions and provided an authentic view of the online discourse connecting the topics of obesity and cancer. Using a mixed methods approach allowed us to report the relative frequencies of certain post attributes in addition to providing qualitative analysis of the sentiments of these posts.

Several limitations warrant mention, including the we have no additional sociodemographic information about posters and that our dataset is limited to only publicly accessible posts, which thus limits our ability to generalize to users that restrict access to their content. There are inherent challenges that accompany trying to characterize, in real-time, features of social media interactions in a rapidly changing communication landscape. Posters are likely influenced, either explicitly or implicitly, by current events. Our study capitalizes on scale, measurement, and behavioral fidelity, but the ability to replicate findings may be limited due to time-period specific effects [8]. In addition, social media posts are a form of expression, but how closely they track with user’s actual knowledge, attitudes, and behaviors is largely unknown and may vary across several user characteristics, including personality traits, generational, and sociocultural factors [25]. Nevertheless, once posted, content becomes externalized from and often propagates without further input or curation from the original creator, asserting influence perhaps beyond what was originally intended and creating discourse that warrants close attention from public health professionals.

Conclusions

Though social media is already used to offer support and information to individuals suffering from chronic health conditions, we also need to understand public health risk perceptions to tailor health promotion interventions. Social media

analyses augment traditional research methods and data sources, reveal authentic public discourse on health topics, and are poised to inform current public health practice.

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Conflict of Interest Findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the National Cancer Institute. There are no financial disclosures. Findings were presented at the 35th Annual Meeting and Scientific Sessions of the Society for Behavioral Medicine, April 23–26, 2014, in Philadelphia, PA.

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