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Cancer-Prevention Messages on Chinese Social Media: A Content Analysis Grounded in the Extended Parallel Process Model and Attribution Theory

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To elucidate the Chinese public's awareness of cancer and its possible prevention, we investigated cancer-prevention messages presented on Weibo, a Twitter-like Chinese social media platform, with reference to the extended parallel process model (EPPM) and attribution theory. With a sample of 16,654 cancer-related messages, we analyzed whether the messages acknowledged cancer's threat, indicated collective or individual efficacy in preventing cancer, and attributed cancer to known causes. Results revealed that 4,545 of the messages (27.3%) mentioned cancer prevention, 127 (2.8%) described the severity of the threat of cancer, and 1,622 (35.7%) emphasized people's susceptibility to cancer. Relative to messages indicating collective efficacy in cancer prevention ($n = 523$, 11.5%) and environmental causes of cancer ($n = 34$, 0.75%), messages indicating individual efficacy ($n = 3,647$, 79.8%) and individual causes ($n = 1,505$, 33.3%) were far more prevalent. Our findings illuminate Chinese people's beliefs about cancer prevention as well as indicate potential effects of social media messages on individuals' cancer-prevention beliefs and behaviors according to the premises of the EPPM and attribution theory. In closing, we discuss what our findings imply for theory construction and cancer-prevention campaigns.

Keywords: extended parallel process model, attribution theory, cancer-prevention messages, social media, Weibo

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Cancer is a major threat to public health, especially in Asian countries, where half of the global burden of cancer occurs (American Cancer Society, 2017). In the digital age, individuals and organizations generate and circulate abundant cancer-related information on social media. Via social media, such ample information can reach a massive audience and, in turn, shape collective and individual beliefs about cancer (e.g., Chen, Wang, & Peng, 2018; Himelboim & Han, 2014; Xu et al., 2016). Examining cancer-related information on social media can therefore help health professionals to understand the general public's awareness of cancer and conduct more effective cancer-prevention campaigns.

With the world's largest national population, China contributes to roughly a quarter of the global cancer burden, including 22% of new cases of cancer worldwide and 27% of all deaths because of cancer (American Cancer Society, 2017; Chen et al., 2016). In 2015, approximately 4,292,000 Chinese people were newly diagnosed with invasive cancer, and 2,814,000 Chinese people died from cancer (Chen et al., 2016). However, according to the World Health Organization (WHO, 2018), cancer is preventable if people avoid risk factors, including tobacco use and unhealthy diets. By reducing exposure to those risk factors, nearly 60% of deaths in China because of cancer could be avoided (Wang et al., 2012). To elucidate the Chinese public's awareness of cancer and its possible prevention, we conducted a theoretically based content analysis of cancer-prevention messages presented on Weibo, a Chinese social media platform.

Weibo is a Twitter-like microblogging site in China on which users can like, comment on, and share others' posts. With more than 600 million registered users and more than 190 million daily active users, Weibo ranks among the most popular social media sites in China (Smith, 2018). It also serves as a virtual community for Chinese people to access, share, and discuss health-related information (e.g., Shi & Salmon, 2018; Shi, Wang, Peng, & Chen, 2017). Furthermore, a recent study has found that Chinese people shared and discussed the prevention, diagnosis, and treatment of breast and cervical cancers on Weibo (Chen et al., 2018). To analyze how Chinese people have presented their beliefs about cancer prevention on social media and the nature of messages conveying such information, we selected Weibo as the site of our investigation into cancer-prevention messages on social media.

We sought to analyze cancer-prevention messages on Weibo according to two theories. One is the extended parallel process model (EPPM; Witte, 1992, 1994), a message design theory that elaborates how threat- and efficacy-related information in health messages can facilitate preventive behavior or induce defensive avoidance. The other is attribution theory (Heider, 1958; Jones & Davis, 1965; Kelley, 1967), which addresses how laypeople explain causes of and perceive responsibility for events. Though distinct, the theoretical frameworks share conceptualizations of locus of control and efficacy. By integrating the frameworks for the purposes of our content analysis, we expected that our findings could provide useful information about Chinese people's beliefs about cancer prevention as well as insights into ways of tailoring effective, theoretically driven communication strategies for promoting cancer prevention on Chinese social media.

Cancer-Related Information on Social Media

Researchers have recently examined cancer-related information on social media as resourceful platforms for understanding the general public's beliefs about cancer and powerful tools for shaping those beliefs (Himelboim & Han, 2014; Xu et al., 2016). In research addressing cancer communication on social

media, scholars have often focused on two dimensions: the content of cancer-related information and its diffusion on social media. For instance, in some studies on cancer-information content, researchers have investigated information about the diagnosis and treatment of cancer (Chen et al., 2018), topics of discussions about cancer (Rodrigues, das Dores, Camilo-Junior, & Rosa, 2016), and forms of social support shared by patients with cancer and their caregivers (Myrick, Holton, Himmelboim, & Love, 2016; Shi, Chen, Su, & Chen, 2018). By contrast, in other studies, researchers have employed informatics-based approaches to investigate the formation of communities and cliques in discussions about cancer (Himmelboim & Han, 2014), paths of diffusing cancer-related information (Kim, Hou, Han, & Himmelboim, 2016), and even cancer surveillance from real-time Twitter data (Lee, Agrawal, & Choudhary, 2013).

Nevertheless, research specifically addressing cancer-prevention messages on social media remains scarce, despite its potential to provide a means to understand lay beliefs about cancer prevention and, in turn, guide future efforts to that end. However, social media's unprecedented influence on social and individual life today could mean that cancer-prevention messages on such media can shape lay beliefs about cancer prevention and cancer-preventing behaviors. Moreover, as health-communication scholars have argued, theoretically based content analyses of user-generated online information about health could clarify the nature of health-related messages and inform the planning of campaigns to improve health (Lapinski, 2006).

The EPPM and Cancer Prevention

Inducing fear has been a widely employed strategy in designing cancer-prevention messages (e.g., Shi & Smith, 2016; Kline & Mattson, 2000). The most recent theoretical framework employed in designing fear-appeal messages is the EPPM (Witte, 1992, 1994), which suggests that an effective fear-appeal message should first induce a perceived threat by inducing perceptions of the susceptibility and severity of the threat. Susceptibility refers to the perceived risk of acquiring a certain condition, whereas severity refers to the perceived seriousness or significance of the condition's threat. In a fear-appeal message, the level of perceived threat needs to be high enough to motivate individuals to process information. At the same time, a fear-appeal message needs to induce perceived efficacy to motivate audiences to perform recommended behaviors that can counter the threat. Perceived efficacy encompasses both perceived self-efficacy (i.e., belief in the ability to perform recommended behaviors) and perceived response efficacy (i.e., belief that recommended behaviors can effectively avert threats). The outcome of processing a fear-appeal message could be either a danger-control or a fear-control process (Witte, 1992, 1994). Fear control means that the individual perceives a higher level of threat over efficacy and is likely to avoid the message, deny the risk, or perform a maladaptive behavior. Alternatively, a person who engages in a danger-control process perceives a higher level of efficacy than threat and intends to adopt the recommended behavior in the message. Aside from being a framework for designing messages, the EPPM has also been employed as a framework to understand information about cancer prevention presented in media.

The threat of cancer has long been a popular topic covered by newspapers, magazines, and television outlets. In their EPPM-informed analysis of news stories about cancer in South Korean mass media, Shim, Kim, Kye, and Park (2016) found that information about the threat of cancer appeared in approximately 80% of the stories. As a threat, cancer has often been characterized as lethal or hopeless and associated with death in

media (Clarke, 2009; Shim et al., 2016). Information about personal risk of cancer has also been a critical element in cancer communication. Kline and Mattson's (2000) analysis on pamphlets addressing breast cancer, for instance, revealed that information about individuals' risk of cancer appeared in two thirds of the pamphlets analyzed, 19 of which contained 139 messages about susceptibility to the disease.

Although scholars have thoroughly documented the prevalence of threat-focused information in mass media and campaign materials, research on lay communication about health-related issues has revealed findings to the contrary. For example, using the EPPM, Lapinski (2006) performed a content analysis of user-generated online information promoting eating disorders and found that threat-related information appeared far less often than efficacy-related information, given that the audience might have harbored preexisting fears of weight gain. However, to date, studies on threat-related information in laypeople's cancer communication on social media have been few and far between, especially in the Chinese cultural context. In response, we aimed to determine the extent to which laypeople address the threat of cancer in their discussions on Weibo by asking:

RQ1: How frequently do cancer-prevention messages on Weibo include susceptibility-related information and severity-related information?

Once aware of personal risk to a threat, individuals need to perceive their ability to avert the threat and learn skills to protect themselves (Witte, 1992, 1994). Although the initial EPPM conceptualized efficacy at the individual level, researchers who have since applied the EPPM have suggested including collective efficacy in the framework as well (Roberto, Goodall, & Witte, 2009). The collective-level efficacy refers to the ability and efforts of groups (e.g., families, organizations, and populations) in solving problems, which is especially critical in countering large-scale risks (Bandura, 1998; Roberto et al., 2009). With reference to the concept of collective efficacy, Goodall, Sabo, Cline, and Egbert (2012) investigated whether or not news stories about the H1N1 virus presented actions taken by communities, organizations, and societies in controlling the epidemic. Similar to H1N1, cancer poses both individual and social risks that require concerted efforts, including support from family members, actions by healthcare professionals, and progress in scientific research, to counter (Chen et al., 2016). In fact, researchers have shown that collective efficacy can be as efficacious as, if not more efficacious than, individual efficacy for people with collective cultural backgrounds, including the Chinese (Bandura, 1998; Klassen, 2004).

Using the EPPM, some scholars have analyzed the content of news reports highlighting individual efficacy, though not collectively efficacy (e.g., Moriarty & Stryker, 2008; Niederdeppe et al., 2014; Shim et al., 2016). Although variously termed, efficacy-related information in previous content analyses on cancer messages generally refers to any statement indicating that performing a specific behavior can reduce one's risk of cancer. Referring to the idea as self-efficacy, Moriarty and Stryker (2008) argued that efficacy-related information teaches people specific skills to avoid risks of cancer, which enhances their self-efficacy. By contrast, Niederdeppe et al. (2014) termed it "response efficacy" and contended that such information underscores the effectiveness of behaviors recommended to counter the risk of cancer. Taken together, such studies suggest that information stressing self-efficacy and response efficacy integrate with each other in the context of cancer prevention. Indeed, the statement that "avoiding UV exposure reduces the risk of skin cancer" can engender self-efficacy, for it alerts audiences to ways of reducing their risk of skin cancer (i.e., avoiding

UV exposure), as well as response efficacy, for it informs them that avoiding UV exposure can effectively prevent skin cancer. Therefore, in our analysis, we identified any statement suggesting that performing a specific behavior can reduce the risk of cancer as efficacy-related information. If such information suggested efforts requiring individual agency, then we identified the corresponding statements as promoting individual efficacy; however, if it suggested efforts requiring collective agency, then we identified the statements as promoting collective efficacy. In sum, with reference to the EPPM and previous findings, we sought to analyze individual as well as collective efficacy-related information in cancer-prevention messages on Weibo by asking:

RQ2: How frequently do cancer-prevention messages on Weibo include individual efficacy-related information and collective efficacy-related information?

Attribution Theory and Cancer Prevention

Efficacy is not only a critical concept in the EPPM, as well as in other theories of behavioral change, but also a factor thoroughly documented to induce preventive health behavior. By extension, according to attribution theory, messages that promote efficacy highlight responsibility to prevent certain risks that will lead to the attribution of their causes. Briefly, attribution theory holds that laypeople are inherently interested in making causal attributions to understand why events occur (Heider, 1958; Jones & Davis, 1965; Kelley, 1967) and are likelier to make causal inferences for negative outcomes and events (e.g., developing cancer) than positive ones. In individual assessments of the causes of events and the responsibility for them, the causal locus can be either internal or external; internal factors derive from an individual's disposition or characteristics, whereas external ones derive from the environment.

In the context of enacting preventive behaviors, researchers have found that attributing causes to internal factors have motivated behavioral changes such as smoking cessation (Fisher, Levenkron, Lowe, Loro, & Green, 1982) and breast cancer screening (Rothman, Salovey, Turvey, & Fishkin, 1993). Attributing causes to external factors, however, has been less likely to prompt recommended behaviors to prevent risks to health and people's adherence to them (Rothman et al., 1993). In a sense, the concepts of internal and external locus control in attribution theory therefore relate to the concepts of individual and collective efficacy in the EPPM. Information about individual efficacy that emphasizes personal ability to prevent cancer can justify attributions of internal causes to the disease. By contrast, collective efficacy-related information that emphasizes group-level efforts to prevent cancer can justify attributions of external causes. At the same time, information about the attribution of causes may appear alongside efficacy-related information in prevention messages, especially in lay communication about cancer prevention. To explore whether efficacy- and attribution-related information both emerge in laypeople's discussions of cancer prevention, we asked:

RQ3: How frequently do cancer-prevention messages on Weibo include both individual causes of cancer and individual efficacy-related information?

RQ4: How frequently do cancer-prevention messages on Weibo include both environmental causes of cancer and collective efficacy-related information?

Method

Data Collection

To locate cancer-related messages on Weibo, we searched for "cancer" and terms representing 27 types of cancer.¹ We first randomly selected seven weeks from a year—from June 2015 to June 2016—and then collected all the cancer-related messages published in that selected seven weeks. After extracting all messages from Weibo with Python Web Crawler in July 2016, we manually cleaned the dataset and removed all advertisements and messages not related to cancer, such as messages with "lazy cancer" (i.e., referring to people who are exceptionally lazy) and "cancer fans" (i.e., enthusiastic fans of a celebrity). After we eliminated 2,038 such messages, the final dataset consisted of 14,616 cancer-related messages.

Coding Scheme and Procedure

First, we coded all messages in the sample as either cancer-prevention messages, which indicate an objective of decreasing the likelihood of developing cancer, or other messages. This coding category is mutually exclusive. Next, all cancer-prevention messages were coded according to the following variables: (a) severity, (b) susceptibility, (c) individual efficacy, (d) collective efficacy, (e) individual causes, and (f) environmental causes (See Table 1). Each variable was coded as being present or absent. Last, we coded the type of user who posted the messages as nonmedical individuals, nonmedical organizations, or medical individuals or organizations (Harris, Moreland-Russell, Tabak, Ruhr, & Maier, 2014; Shi & Salmon, 2018).

To establish intercoder reliability, two trained coders who were native Chinese speakers coded 1,726 of the messages (10.36%). Krippendorff's alpha tests (2007) revealed acceptable levels of intercoder reliability: 0.89 for cancer-prevention messages, 0.87 for severity of cancer, 0.90 for susceptibility to cancer, 0.90 for individual efficacy in preventing cancer, 0.92 for collective efficacy in preventing cancer, 0.83 for individual causes of cancer, 0.87 for environmental causes of cancer, and 0.98 for user types. After resolving all discrepancies, we established coding rules via discussion to avoid ambiguities in meanings of words, definitions of categories, and coding instructions. We next split the remaining messages in half, and two coders separately coded them.

¹ The types of cancer were oral, pharyngeal, nasopharyngeal, esophageal, stomach, colon, rectal, liver, gallbladder, pancreatic, throat, lung, bone, skin, melanoma, breast, cervical, uterine, ovarian, prostate, testicular, kidney, bladder, brain, thyroid, lymphoma, and leukemia. We searched for terms representing those types of cancer given cancer incidence and mortality rates in China (Chen et al., 2016).

Table 1. Theoretical Variables, Definitions Derived from the Extended Parallel Process Model and Attribution Theory, and Sample Messages on Weibo.

Variable	Definition	Example
Severity	Messages promoting the seriousness of cancer	"Skin cancer is one of the major causes of death among young women."
Susceptibility	Messages promoting the likelihood that individuals will develop cancer	"Residents in Jiangsu Province are more likely to get esophageal cancer."
Individual efficacy	Messages promoting individuals' ability to engage in cancer prevention	"Eating five servings of vegetables and fruits every day prevents cancer."
Collective efficacy	Messages promoting collective efforts to engage in cancer prevention	"Beijing Union Medical College Hospital is collaborating with Baidu [a Chinese Internet company] on a research project to use big data for the prevention and early detection of esophageal cancer."
Individual causes	Messages promoting individual and behavioral causes of cancer	"Heavy smoking causes lung cancer."
Environmental causes	Messages promoting environmental causes of cancer	"Chemicals and smoke in the workplace environment can result in cancer."

Results

Our sample consisted of 4,545 cancer-prevention messages posted by 3,395 nonmedical individuals, 744 nonmedical organizations, and 404 medical professionals or organizations.

Threat of Cancer

To answer RQ1, we examined messages in the sample to determine whether they described the severity of or susceptibility to cancer. As shown in Table 2, 127 messages (2.8%) described severity, 1,622 (35.7%) described susceptibility, and only 42 (0.9%) described both. Messages indicating the severity of cancer often presented mortality rates of cancer (e.g., "Annually, around 600,000 people die from lung cancer, which is the deadliest cancer for Chinese people" and "Approximately 50,000 Chinese die from cervical cancer") or examples or narratives of its severity (e.g., "Recently, several celebrities lost their lives

to breast cancer"). In messages indicating the audience's susceptibility to cancer, statements often reported the incidence of cancer in China, some of which highlighted specific segments of the population who were highly susceptible to the disease. For instance, one message stated, "In the past 30 years, the incidence of melanoma increased by 50% among young women," while another stated, "People with obesity are more susceptible to cancer."

Table 2. Threat-, Efficacy-, and Attribution-Related Information about Cancer Prevention in Cancer-Prevention Messages on Weibo.

	<i>n</i>	%
Severity	127	2.8
Susceptibility	1,622	35.7
Individual efficacy	3,647	79.8
Collective efficacy	523	11.5
Individual causes	1,505	33.3
Environmental causes	34	0.8
Individual causes and individual efficacy	1,163	25.6
Environmental causes and collective efficacy	0	0.0

The total is not 100% because the coding scheme was not mutually exclusive.

Efficacy in Preventing Cancer

To answer RQ2, we analyzed the prevalence of messages addressing individual and collective efficacy in preventing cancer and identified recommended behaviors in response to the risk of developing cancer. Of the 3,647 (79.8%) messages indicating individual efficacy that recommended specific behaviors in response to the risk, some promoted behaviors recommended by WHO (2018), including quitting smoking, avoiding ultraviolet radiation, and increasing vegetable and fruit intake, whereas other recommended unverified cancer-prevention methods, including eating superfoods, maintaining a positive mood, and using traditional Chinese medicine. By contrast, only 523 messages (11.5%) indicated collective efficacy in preventing cancer, some of which mentioned how recent advances in medical research can help to prevent cancer. Others emphasized the role of for-profit and nonprofit organizations in cancer prevention, while still others presented examples of cancer-prevention education, especially in rural China. However, the cancer-prevention messages rarely mentioned other collective efforts toward controlling environmental causes of cancer (e.g., controlling air pollution and reducing water and soil contamination). Recommended cancer-preventing behaviors that emerged more than 10 times in the sample appear in Table 3.

Table 3. Recommended Behaviors to Prevent Cancer in Cancer-Prevention Messages on Weibo.

Category	Frequency
Superfood and traditional Chinese medicine consumption	1,319
Healthy eating	807
Regular physical examination	459
Conducting scientific research on cancer	352
Maintaining a generally healthy lifestyle	276
Exercising	258
Smoking cessation	246
Alcohol withdrawal	208
Public service for cancer	110
Cancer-prevention campaigns and education	109
Sun protection	106
Sunbathing	82
Vaccination	41
Breastfeeding	30
Using feminine hygiene products	62
Reducing cell phone radiation	58
Taking herbal medicine	56
Wearing comfortable bras	50
Maintaining a positive mood	26
Receiving music therapy	34
Fund-raising for cancer	33
Purchasing health insurance	10

A message may include more than one recommended behavior.

In sum, although 4,371 cancer-related messages contained at least one variable of the EPPM, few messages indicated both the threat of cancer and efficacy-related information about cancer prevention. Only a third of the cancer-prevention messages ($n = 1,505$, 33.1%) indicated at least one threat-related variable (i.e., susceptibility to cancer or severity of cancer) and at least one efficacy-related variable (i.e., individual efficacy or collective efficacy).

Attribution of Causes of Cancer

RQ3 and RQ4 respectively addressed how often cancer-related messages on Weibo indicated both individual efficacy in preventing cancer and the internal attribution of causes of cancer, as well as both collective efficacy in preventing cancer and the external attribution of causes of cancer. Although 1,505 messages (33.3%) indicated individual causes of cancer (e.g., alcohol consumption and tobacco use), many other behaviors whose role in developing cancer remains scientifically unproven also appeared as causes of cancer in the messages (e.g., taking painkillers, using shower gel, and eating genetically modified foods). Among messages indicating individual and behavioral causes of cancer, 1,163 (77.3%) also indicated individual efficacy in preventing the disease. Conversely, environmental causes of cancer seldom appeared in the

messages ($n = 34$, 0.75%); such causes that did appear included air pollution and the presence of smoke or radiation in the workplace. Furthermore, none of the cancer-prevention messages indicated both environmental causes of cancer and collective efficacy in preventing it.

Threat, Efficacy, and Attribution Information by User Types

We also analyzed the content of cancer-related messages by the type of users who posted the messages (i.e., nonmedical individuals, nonmedical organizations, and medical professionals or organizations). According to our results (Table 4), nonmedical individuals posted roughly three fourths of the cancer-prevention messages ($n = 3,395$, 74.7%). Although medical professionals and organizations are thought to be knowledgeable about cancer prevention, they did not contribute much to discussions on Weibo about preventing cancer ($n = 404$, 8.9%). Moreover, consistent with the general trend, individual efficacy in preventing cancer, susceptibility to cancer, and individual causes of cancer were the top three categories of information posted by all types of users.

Table 4. Threat of Cancer, Efficacy in Preventing Cancer, and Attribution of Causes of Cancer by Weibo User Types.

Variable	Nonmedical individuals (%)	Nonmedical organizations (%)	Medical professionals and organizations (%)
Severity	85 (2.5)	22 (3.0)	20 (5.0)
Susceptibility	1,237 (36.4)	254 (34.1)	131 (32.4)
Individual efficacy	2,908 (85.7)	477 (64.1)	262 (64.9)
Collective efficacy	285 (8.4)	157 (21.1)	81 (20.0)
Individual causes	984 (29.0)	211 (28.4)	113 (28.0)
Environmental causes	22 (0.6)	8 (1.1)	4 (1.0)
Individual causes and Individual efficacy	926 (27.3)	142 (19.1)	72 (17.8)
Total	3,395	744	404

Note: No messages in the sample presented both environmental causes of cancer and collective efficacy in preventing cancer. Because our coding scheme was not mutually exclusive, the total number did not equal the sum of all types of information, and the sum of percentages in the columns does not equal 100%.

Discussion

We analyzed the content of cancer-prevention messages on Weibo with reference to a framework that integrated the EPPM and attribution theory. Our findings show that information about the threat of cancer, efficacy in cancer prevention, and the attribution of causes of cancer has all appeared on Weibo. However, only a third of the messages indicated both threat- and efficacy-related information, despite recommendations by the EPPM. Moreover, compared with statements about individual efficacy in preventing cancer and individual causes of the disease, most of which appeared together in messages, statements about collective efficacy in preventing cancer and its environmental causes seldom appeared in the messages.

Threat of Cancer

Our findings show that, contrary to professional cancer communication and campaigns, cancer communication on social media has not highlighted the threat of cancer. A close examination of threat-related information revealed that, compared with mentions of susceptibility to cancer, mentions of its severity were far less prevalent. However, the relative infrequency of severity-related information is not surprising. Scholars have shown that the general public is fully aware of the seriousness of cancer and is likely to conceive the disease as lethal compared with other diseases, such as diabetes and emphysema (Henley & Donovan, 2003). Indeed, results of a recent nationwide survey conducted in the United States revealed that 61.6% of the respondents believed that cancer is a death sentence (Moser et al., 2014). In that sense, it is possible that merely presenting the word *cancer* in a message is threat enough for audiences, which would explain why more messages on Weibo emphasized individuals' susceptibility to cancer instead of its seriousness.

According to the EPPM (Witte, 1992, 1994), an effective fear-appeal message needs to indicate the severity of the threat as well as the audience's susceptibility to it. Our findings revealed that, in most cases, severity- and susceptibility-related information did not appear together in cancer-prevention messages on Weibo. If both elements are necessary to induce a high level of perceived threat and cognitive as well as behavioral changes, as suggested by the EPPM, then cancer-prevention messages with only one element may be poorly designed. However, since cancer's seriousness has been thoroughly recognized, whether emphasizing its severity in cancer-prevention messages is necessary warrants additional consideration. After all, the EPPM also predicts that messages indicated an extremely high level of threat with little acknowledgment of people's efficacy in response can prompt message avoidance and maladaptive behaviors. Possibly, providing or discussing severity-related information about cancer to a greater extent could increase defensive avoidance among individuals who already fear cancer. To advance the EPPM, researchers should therefore examine whether an individual's baseline perceived threat of a disease interacts with the threat-related information in health messages to influence his or her adoption of recommended preventive behaviors.

Efficacy in Preventing Cancer

Our findings on efficacy in preventing cancer and the attribution of causes of cancer are consistent with each other. Information on individual efficacy and behavioral causes was prevalent on Weibo, whereas information on collective efficacy and environmental causes was rare. Furthermore, individual causes and efficacy appeared together in most messages, which suggests that many cancer-related messages on Weibo convey the belief that cancer is preventable, at least to some extent. Such messages encourage audiences to avert the threat of cancer by highlighting the internal locus of control over personal health and teaching them preventive behaviors. In addition, information about individual efficacy in preventing cancer can challenge fatalistic beliefs about the disease, such as "There's not much people can do to lower their chances of getting cancer" (Niederdeppe & Levy, 2007, p. 998). Researchers have found that fatalism was negatively associated with the adoption of cancer-preventing behaviors, including taking hepatitis B and Human Papillomavirus (HPV) vaccines (Wardle & Steptoe, 2003). Given the influence of cultural beliefs, Chinese individuals have demonstrated greater fatalism toward cancer than people in Western populations (Straughan & Seow, 1998).

Thus, messages on Weibo that describe individual efficacy in cancer prevention could challenge fatalistic thoughts about cancer among Chinese people and motivate their cancer-preventing behaviors.

Nevertheless, over presenting individual causes and efficacy may lead to some unintended effects. According to the premise of attribution theory, over discussing personal responsibility in preventing cancer may prompt a public stigma of cancer or self-blame among patients with cancer. These potential unintended effects of efficacy-related messages have been suggested by the literature on health communication campaigns (Cho & Salmon, 2007; Guttman & Salmon, 2004) and cancer prevention (Marlow, Waller, & Wardle, 2010). Thus, according to some scholars (Roberto et al., 2009), when a threat is a social problem, collective efficacy in averting the threat is an important element of the message. Theoretical advancement of the EPPM could therefore concentrate on understanding how individual and collective efficacy in fear-appeal messages affect the attribution of blame among audiences, which could be another unintended effect of such messages.

Individual Versus Environmental Causes of Cancer

Although environmental pollution represents a major cause of cancer (Cohen & Cantor, 2014; WHO, 2018), the cancer-prevention messages on Weibo largely ignored it. Likewise, individual causes of cancer are often overrepresented in media, as recent studies have extensively documented. Early research on cancer-related news in US newspapers revealed that news stories in the late 1970s and 1980s overemphasized environmental causes of cancer (e.g., carcinogens and chemicals in the workplace and in homes). Nevertheless, as findings about the behavioral causes of cancer mounted, researchers began to show that individual causes, not environmental ones, have dominated media coverage on cancer (Russell, 1999). Several scholars have observed that news media have not paid much attention to environmental causes of breast cancer but instead focused on behavioral causes and the personal responsibility of women to avert the threat of the disease (Atkin, Smith, McFeters, & Ferguson, 2008; Brown, Zvestoski, McCormick, Mandelbaum, & Luebke, 1910). Therefore, our results for cancer-prevention messages on Weibo are consistent with findings on cancer messages on US media platforms.

The setting of our study, China, suffers from some of the worst environmental pollution in the world (Goss et al., 2014). The country contains 459 so-called "cancer villages," where the extremely high incidence and mortality of cancer have been strongly associated with environmental factors such as air quality, water contamination, and concentrations of heavy metals (Goss et al., 2014). Although such environmental causes are prominent in China, society's collective efficacy in reducing such pollution has rarely appeared or been discussed on Chinese social media. One reason could be that, since individual Weibo users posted roughly 80% of the messages in our sample, information about individual efficacy, instead of collective efforts, might be more relevant and applicable to Weibo users in general, who therefore focused on individual aspects of the risk of cancer and its prevention in their messages. Furthermore, because extremely few messages indicating environmental causes of cancer surfaced in our sample, none of the messages in the sample simultaneously presented environmental causes of cancer and collective efficacy in preventing it. Another reason why cancer-prevention messages on Weibo focused almost entirely on individual causes and efficacy could be that because Chinese mass media rarely cover the possibility of reducing environmental pollution to prevent cancer, public discussions on social media that follow rarely present the topic. However, that explanation requires further examination.

Practical Implications

Our findings can help health professionals to understand how messages on Chinese social media present the risk and causes of cancer, as well as people's ability to prevent it, and provide information for future anticancer campaign planning. For one, health professionals need to improve the public's awareness of environmental risk factors of cancer and the collective responsibility to prevent cancer among Chinese people, given that cancer-preventing messages on social media rarely address the external causes of the disease and collective efficacy in preventing it. By improving awareness, reducing the potential unintended effects indicated by cancer-prevention messages that overstate individual responsibility for averting the risk of cancer and preventing the disease can become possible. In addition, although some WHO-recommended cancer-preventing behaviors have appeared on Weibo, information on unverified cancer-preventing behavior has also abundantly appeared on the social media platform. Therefore, identifying and correcting misinformation about cancer prevention on social media is a pressing public health task. By extension, education programs are also needed to improve the general public's e-health literacy to enable people to access high-quality health-related information on social media.

Limitations and Future Research

Future examinations of cancer-prevention messages on social media can improve research on the topic in several ways. Although we examined the content of such messages in terms of threat-, efficacy-, and attribution-related information about cancer prevention, we did not investigate its potential intended or unintended effects according to the EPPM and attribution theory. Thus, researchers should explore the effects of user-generated cancer-prevention messages on social media to determine, for instance, whether information about individual causes and efficacy motivates intentions to prevent cancer or prompts the stigmatization of patients with cancer. Moreover, in recent studies, scholars have found that some online health information presenting threats and guiding efficacy beliefs emerged in narratives such as personal stories (Holton, Lee, & Coleman, 2014) and that such narratives, when addressing death, affected individuals' efficacy beliefs and perceived barriers to perform recommended healthy behaviors (Krakow, Yale, Torres, Christy, & Jensen, 2017). In the future, researchers should therefore update the EPPM with narrative typologies to analyze cancer-prevention information on social media and its effects.

Second, not all cancer-prevention messages on social media receive the same amount of attention. Research has shown that whereas some messages on social media may reach thousands of users, most languish in obscurity (Goel, Anderson, Hofman & Watts, 2015). Thus, scholars should employ computational methods and social network analysis to investigate how cancer-prevention messages with verbal and visual content spread on social media, who plays a critical role in their diffusion, and whether certain message elements (e.g., susceptibility-related or individual efficacy-related information) contribute to their dissemination.

Third, our findings indicate that, aside from cancer-preventing behaviors recommended by medical professionals and organizations, other unverified preventive behaviors and causes of cancer often circulate on social media. Future research on cancer-prevention messages on social media should therefore employ expert coding to identify misinformation, which will enhance the understanding of cancer-related information on social media and provide valuable recommendations for future cancer-prevention education and campaigns.

Conclusion

We analyzed the content of cancer-prevention messages on the Chinese social media platform Weibo with reference to a framework that integrated the EPPM and attribution theory. Our results revealed that such messages focused on the behavioral causes of cancer and promoted individual efforts to avert the risk of developing the disease. However, environmental causes of cancer and collective efficacy in cancer prevention were rare on the social media platform.

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