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Is Coffee the Cause or the Cure? Conflicting Nutrition Messages in Two Decades of Online *New York Times'* Nutrition News Coverage

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ABSTRACT

Two-thirds of US adults report hearing news stories about diet and health relationships daily or a few times a week. These stories have often been labeled as conflicting. While public opinion suggests conflicting nutrition messages are widespread, there has been limited empirical research to support this belief. This study examined the prevalence of conflicting information in online *New York Times'* news articles discussing published nutrition research between 1996–2016. It also examined the contextual differences that existed between conflicting studies. The final sample included 375 news articles discussing 416 diet and health relationships (228 distinct relationships). The most popular dietary items discussed were alcoholic beverages (n = 51), vitamin D (n = 26), and B vitamins (n = 23). Over the 20-year study period, 12.7% of the 228 diet and health relationships had conflicting reports. Just under three-fourths of the conflicting reports involved changes in study design, 79% involved changes in study population, and 31% involved changes in industry funding. Conflicting nutrition messages can have negative cognitive and behavioral consequences for individuals. To help effectively address conflicting nutrition news coverage, a multi-pronged approach involving journalists, researchers, and news audiences is needed.

Introduction

Health news coverage has become an important source of health information among the general public. It can help democratize access to information that in previous decades was only accessible through academic institutions or physician-patient interactions. Health news stories alert society to outbreaks and other public health emergencies, inform them of advances in clinical research, publicize updates in federal health guidelines (e.g., cancer screenings and dietary recommendations), and promote strategies to improve individual- and population-level health outcomes (Russell, 1999; Southwell et al., 2013).

Studies of health information-seeking behaviors have found an increase in online searches for health topics like diet and nutrition over the past few decades (Goldberg & Sliwa, 2011). Increased interest in health information coupled with the demands of a 24-hour news cycle have led to increased publishing of certain types of health news stories (Schwitzer, 2009). Frequent publishing of select health news can create an information environment that is rife with conflict.

To better understand what topics are likely to become health news and why conflicting messages may result from this coverage, it is important to understand the priorities of health news producers (i.e., health journalists and news editors). "Newsworthiness" is a term that is used to describe how fit something is to become news (Shoemaker & Cohen, 2006). Newsworthy criteria are a set of criteria used by news producers to evaluate a topic's newsworthiness. While the list of criteria has evolved over time, it often includes factors like relevance, novelty, surprise, conflict, and impact, among others (pp. 49–82). In addition to influencing what becomes news, newsworthy criteria can also impact how information is framed for news audiences such that whatever makes information newsworthy will be emphasized in coverage (McCauley et al., 2013).

Public health research studies are promising candidates for news stories because they tend to meet multiple newsworthy criteria (Chang, 2015; Wallington et al., 2010). The findings are often of interest to (i.e., relevance) or carry implications for (i.e., impact) a significant portion of the population. Additionally, most if not all journals expect that any research submitted for publication will make some novel contribution to its respective field (i.e., novelty or surprise).

A Kaiser report on the state of health journalism described an increased emphasis on research studies in health news coverage (Schwitzer, 2009). Reductions in health news staff in newsrooms nationwide have put news producers under greater strain. Fewer staff means an increased workload for remaining journalists, and when coupled with budget cuts, it becomes difficult to do in-depth reporting. Individual research studies, referred to as "quick-hit stories," are appealing because they take less time to research and develop. With a research study, journalists don't have to determine what the "storyline" is because the findings provide the storyline. Additionally, existing resources like press releases can be used to develop the story. While quick hit-stories fill a need, they are problematic because they can oversimplify complex health information, which the general public is increasingly seeking out, and lead to more conflicting messages (Russell, 1999; Wellman et al.,

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2011). The purpose of this study was to determine the prevalence of conflicting messages in online news coverage of nutrition research.

Literature review

Nutrition-related topics are among the most commonly searched for health topics (Bianco et al., 2013; Ghweeba et al., 2017) with nearly half of participants in a national survey reporting that they had searched for this type of information (American Dietetic Association, 2011). The Internet and mass media, including news media, are popular sources of nutrition information (Borra & Bouchoux, 2009; Greiner et al., 2010; Wilson, 2007). According to a 2016 Pew survey, two-thirds of US adults read or hear news stories about the health effects of dietary choices daily or a few times a week.

Nutrition news reporting

By reporting on "quick-hit" nutrition stories (i.e., nutrition research), news producers can meet the demands of news organizations while covering topics that will interest the public. This has prompted criticism that nutrition news coverage focuses too heavily on individual studies (Goldberg & Hellwig, 1997; Stahl, 2000; Wellman et al., 2011). Reporting on a single study gives an incomplete picture of a diet and health relationship. It also creates more opportunities to spread conflicting messages (Webb & Byrd-Bredbenner, 2015; Wilson, 2007). When findings from a new study conflict with findings from an older study, the public is expected to make sense of these findings. In order for them to do so effectively, however, they need context.

News media and researchers have a responsibility to help put conflicting nutrition research into context for news audiences by offering explanations for what may have caused the conflicting findings (Russell, 1999; Schwitzer et al., 2005). While two studies may examine the same diet and health relationship, they may do so using different study designs or populations. These choices can impact study outcomes and the limitations associated with these findings (Jensen et al., 2011). For example, regardless of population size or follow-up period, a prospective cohort study is an observational study and can therefore only suggest causal relationships, not prove them.

Identifying contextual differences, when they exist, can help readers make sense of conflicting findings and the conclusions that can be drawn from them. In an experimental study, Jensen et al. (2011) manipulated cancer news articles to include or omit these details, and then looked at the effects this had on factors central to cancer control including cancer fatalism and nutritional backlash. They found that participants were less fatalistic about cancer and less prone to nutrition backlash when they read news articles that included these details. Alternatively, if there are no clear contextual differences between conflicting studies, researchers should offer some insight as to why their findings differ from prior research. Without providing these details the news article is incomplete and leaves news audiences ill-equipped to parse out these distinctions.

A majority of the general public has reported exposure to conflicting nutrition messages. Survey estimates range from 51 to nearly 75% of individuals being exposed to conflicting messages (C-J. Lee et al., 2018; Nagler, 2014; Pew Research Center, 2016). Exposure to conflicting nutrition information can have negative cognitive and behavioral consequences. Cognitively, individuals have rated conflicting health news coverage as less credible and expressed that it caused more uncertainty during decision-making (Chang, 2015). When faced with conflicting messages, news audiences may rely on heuristics to process this information, including ignoring information that does not support previously held beliefs (Vardeman & Aldoory, 2008). Conflicting messages can also lead to nutrition backlash (i.e., believing all dietary advice should be taken lightly because scientists do not know what they are talking about; Nagler, 2014).

Conflicting nutrition information can disrupt the decision-making process because individuals must determine which statement is false and proceed accordingly. This could lead to increased information seeking in an attempt to find answers (Weeks et al., 2012). If individuals are unable to make a determination about which statement is true, they could delay decision-making or choose to do nothing. It could also lower self-efficacy to act on the information. Marshall and Comello (2019) found that showing participants conflicting cancer screening messages reduced self-efficacy and response efficacy to get cancer screenings.

Behaviorally, individuals may be less willing to eat healthfully if they feel dietary recommendations are constantly changing (Chang, 2015; Clark et al., 2019; Patterson et al., 2001). Based on the relationship between intention and behavior, exposure to conflicting nutrition messages could undermine healthy eating behaviors (Azjen, 1991; McEachan et al., 2011). Furthermore, reduced motivation to eat a healthy diet could increase risk for chronic disease since poor dietary habits have been linked to the development of several chronic conditions (Schulze et al., 2018).

Defining conflicting health information

A small but growing body of research has examined conflicting health information focusing on nutrition (Nagler & LoRusso, 2018; Nickoloff et al., 2008; Vardeman & Aldoory, 2008), cancer screenings (Gibson et al., 2016), and medication adherence (Carpenter et al., 2010; Elstad et al., 2012). Across these studies, conflicting information has been defined in different ways. Cancer screening research has largely defined conflicting information as disagreements on the timing, frequency, and even necessity of cancer screenings (Gibson et al., 2016). Nutrition-related research has defined conflicting information as risk-benefit information regarding the consumption of specific foods (e.g., red meat promotes muscle growth but also increases heart disease risk; Nickoloff et al., 2008; Regan et al., 2014). Finally, medication adherence research has defined conflicting information as disagreements on dosing, timing, duration, and medication side effects (Carpenter et al., 2010; Elstad et al., 2012).

Within these studies, researchers have used the terms "conflicting" and "contradictory" interchangeably at times (Nagler

& LoRusso, 2018). For example, Nagler (2014) defined contradictory information as a single behavior producing two distinct outcomes but later used the term conflicting to describe the same information. Other research has labeled as conflicting what could be considered contradictory based on the above definition (Chang, 2015; Elstad et al., 2012; Vardeman & Aldoory, 2008). For example, Regan et al. (2014) referred to risk and benefit information about a dietary item as "conflicting" information, but this could be labeled as "contradictory" information based on Nagler's definition (Nagler, 2014).

As defined in nutrition-focused studies, conflicting statements do not have to be logically inconsistent (i.e., a person can believe both statements are true at the same time). Carpenter's et al. (2016) definition differs from this definition in that their definition is based on logical inconsistency. They define conflicting information as statements that are in direct opposition with each other such that a person cannot simultaneously believe both statements are true. For example, if one study reports that coffee increases the risk for heart disease while another study reports that coffee reduces heart disease risk, a person cannot believe that both statements are true at the same time. Using this definition, conflicting information can also emerge in the case of null findings. If one study finds that coffee has no effect on heart disease risk while another study finds that coffee increases heart disease risk, this is also conflicting information since a person cannot simultaneously believe that coffee has an effect and no effect on heart disease.

This definition of conflicting information aligns with the definitions used in cancer screening and medications adherence research because logical inconsistency is central to it. While research suggests there are negative consequences when a person makes a health decision with distinctly positive and negative outcomes, making a decision when there are two diametrically opposed outcomes is a presumably much more challenging task. Consequently, this study chose to use Carpenter's et al. (2016) definition of conflicting information to explore the pervasiveness of this particular phenomenon.

Research Questions

Since conflicting nutrition messages can negatively impact decision-making, it is important to determine how prevalent these types of messages are to identify the magnitude of the problem and develop appropriate solutions. Our current knowledge of the prevalence of conflicting nutrition information is largely informed by public perception surveys (Carpenter et al., 2016; Chang, 2015; Nagler, 2014). Largely absent from the literature are objective measurements of the prevalence of conflicting nutrition messages in news media, particularly online news. While there has been some research studying diet and health-related news coverage, a limited number of these studies have included findings about conflicting information. In the few studies that have included this information, the findings were anecdotal and not the primary focus of the research (Houn et al., 1995), used a different definition of conflicting information, or focused on a specific dietary item or category (Greiner et al., 2010).

This study sought to address these gaps in the literature. In order to determine the prevalence of conflicting nutrition messages, I first needed to identify the specific diet and health relationships discussed in news coverage and the nature of each relationship (i.e., whether an item increased the risk, decreased the risk, or had no effect on a health outcome; Caufield et al., 2014), so I could record whether these relationships changed across the study period. This led to the study's first research question:

> RQ1: What is the nature of diet and health relationships reported in online *New York Times'* nutrition news coverage between 1996-2016?

Using the conflicting information definition offered by Carpenter et al. (2016), this study then asked the following question:

> RQ2: What is the prevalence of conflicting nutrition messages in online *New York Times'* nutrition news coverage between 1996-2016?

With the impact that contextual details can have on study outcomes, this study also examined what contextual differences existed when a diet and health relationship had conflicting reports:

> RQ3: What contextual differences exist when conflicting research findings are reported for diet and health relationships in online *New York Times'* nutrition news coverage between 1996-2016?

Finally, when evaluating conflicting findings it may be useful to consider the amount of time that has elapsed between conflicting reports, something Carpenter et al. (2016) referred to as "temporal inconsistency." They suggest that information may be seen as less volatile among the general public if a greater amount of time has passed between conflicting studies. This led to the study's final research question:

> RQ4: How much time elapsed between conflicting reports of diet and health relationships in online *New York Times'* nutrition news coverage between 1996-2016?

Methods

Content analysis is a useful tool to study news coverage because it reveals patterns and trends in news over time (Riffe et al., 2014). This information can help account for public perceptions, refute potential misperceptions, and highlight areas for improvement in news coverage. Prior content analyses have focused on nutrition news coverage in print sources (Hackman & Moe, 1999; Kininmonth et al., 2017), but online news publishing has become a common practice over the past couple of decades with online sources of health information becoming increasingly popular (Fox & Duggan, 2013).

Eligibility criteria

There were four eligibility criteria for news articles to be included in the study. First, the article had to discuss published nutrition research examining one or more diet and health relationships. The relationship could involve a single dietary item (e.g., coffee), nutrient (e.g., dietary fats), or diet type (e.g., the Mediterranean Diet). Second, the research

study and the diet and health relationship(s) it discussed needed to be the sole focus of the news article. If a news article talked about diet as one of multiple lifestyle factors impacting a health outcome then it was excluded. Third, the article needed to be originally published by the *New York Times*. Wire stores, such as those from the Associated Press or Reuters, were excluded.

Since the main objective of this study was to determine the prevalence of conflicting nutrition information from the inception of online news publishing, I identified which major newspapers maintained a comprehensive archive of their online news articles since they began publishing online. The *New York Times* was chosen as the focus for this study because it was the only newspaper of the top ten major US newspapers to maintain a comprehensive archive of its online news articles since it began publishing online in 1996 (The New York Times, n.d.). The trade-off in this decision is that no claims of representativeness can be made regarding the trends that appear in other major newspapers. Finally, the article must have been published on the *Times'* website between January 22, 1996 and January 22, 2016. January 22, 1996 was the day the *New York Times* launched its website (Lewis, 1996).

Article search

The search for news articles was conducted using ProQuest U. S. Newsstream, a digital database that allows users to search current and archival news content from several newspapers across the US. Since the *Times'* website does not offer advanced search features, the initial search and first round of screening were conducted through the ProQuest database. The second round of screening involved retrieving the full text of the remaining news articles directly from the *Times'* website.

The search phrase consisted of two parts: diet and health terms. The "diet" search terms included: diet, nutrition, food, beverage, drink* (to also capture drinking), eat* (to also capture eaten or eating), consum* (to capture consume, consuming, and consumption), vitamin, nutrient, and supplement. Diet-related terms were kept largely broad (i.e., "drink") because broad terms are likely to co-appear with specific terms. For example, if "wine" appears in an article "drink" or some variation of it will likely appear as well. The exception was dietary supplements which were specifically listed in the search terms.

The "health" search terms included: health* (to also capture healthy), disease, heart, cancer, diabetes, stroke, obes* (to capture obese and obesity), weight, kidney, brain, neuro* (to capture neurological or neurodegenerative), cholesterol, and blood pressure. The exact search phrase is shown below:

> *(diet OR nutrition OR food OR nutrient OR vitamin OR supplement OR beverage OR drink* OR eat* OR consum*) AND (health* OR disease OR heart OR cancer OR diabetes OR stroke OR obes* OR weight OR kidney OR brain OR neuro* OR cholesterol OR blood pressure)*

The health-related terms included both general and specific terms because the link between these terms is more tenuous. If any combination of the two-part search phrase appeared in the headline or article, it was retrieved. The search phrase returned 110,059 articles. An initial screening of these articles was conducted based on the headlines only. All news articles that were clearly irrelevant were excluded (e.g., "Eat, Sleep, and Breathe Politics on the Internet,"; "Things to Do on Long Island, Jan. 23 Through Jan. 31"; "Weakened at Bernie's"), which left 815 news articles remaining (see Figure 1). A keyword search would have yielded more precise results but could have omitted potentially relevant articles. An additional twenty-one articles were excluded because they could not be located through the *Times'* website or through general search engines. The 794 full text news articles that could be retrieved were read and 419 articles were subsequently excluded based on the exclusion criteria.

Articles that were excluded after the full text review included: personal accounts about nutrition and health (e.g., "Connecticut Q&A: Polly Fitz"; "Taking Food and Nutrition More Seriously"); articles discussing dietary trends with no research mentioned (e.g., "A New Goal Beyond Organic: 'Clean Food'"); articles that didn't focus on any specific dietary item, diet type, or food group (e.g., "Snacking Your Way to Better Health"); articles that addressed diet as one of multiple lifestyle factors to improve health (e.g., "Treating Childhood Obesity: From Healthy Eating to Working Out"; "For Mild Hypertension, Healthier Life and Diet May Be Good Medicine"); recipes (e.g., "A Cheesecake That's Good and Good For You"); and food policy articles (e.g., "Groups debate role of milk in building a better pyramid"; "Experts Disagree on Adding Fatty Acids to Infant Formula).

Coder training

A health communication masters' student served as my second coder. During three training sessions we reviewed the coding protocol that I developed and completed several practice rounds of coding. These sessions helped ensure we were interpreting and coding items consistently. For the initial reliability test we coded 10 news articles. The reliability coefficients were calculated using the KALPHA macro developed for SPSS (Hayes & Krippendorf, 2007). Each item was found to meet the cutoff for good reliability (0.8) before coding commenced. For the final reliability test we coded 10% of the sample (n = 38), a standard percentage used to calculate reliability in content analyses (Riffe et al., 2014). All final reliability coefficients met the cutoff for good reliability ranging from 0.87–0.97.

Nature of diet and health relationships

We recorded the nature of each diet and health relationship (i.e., positive and negative) discussed within a news article. "Positive" diet and health relationships were those where consumption of the item or adherence to the diet type was linked to a reduced risk of a negative health outcome (e.g., heart disease) or a greater likelihood of a positive outcome (e.g., cognitive function). "Negative" diet and health relationships were those where consumption of the item or adherence to the diet type was linked to an increased risk of a negative health outcome or a lower likelihood of a positive outcome. We also recorded the number of instances when no effect or association was found between a diet category and health outcome.

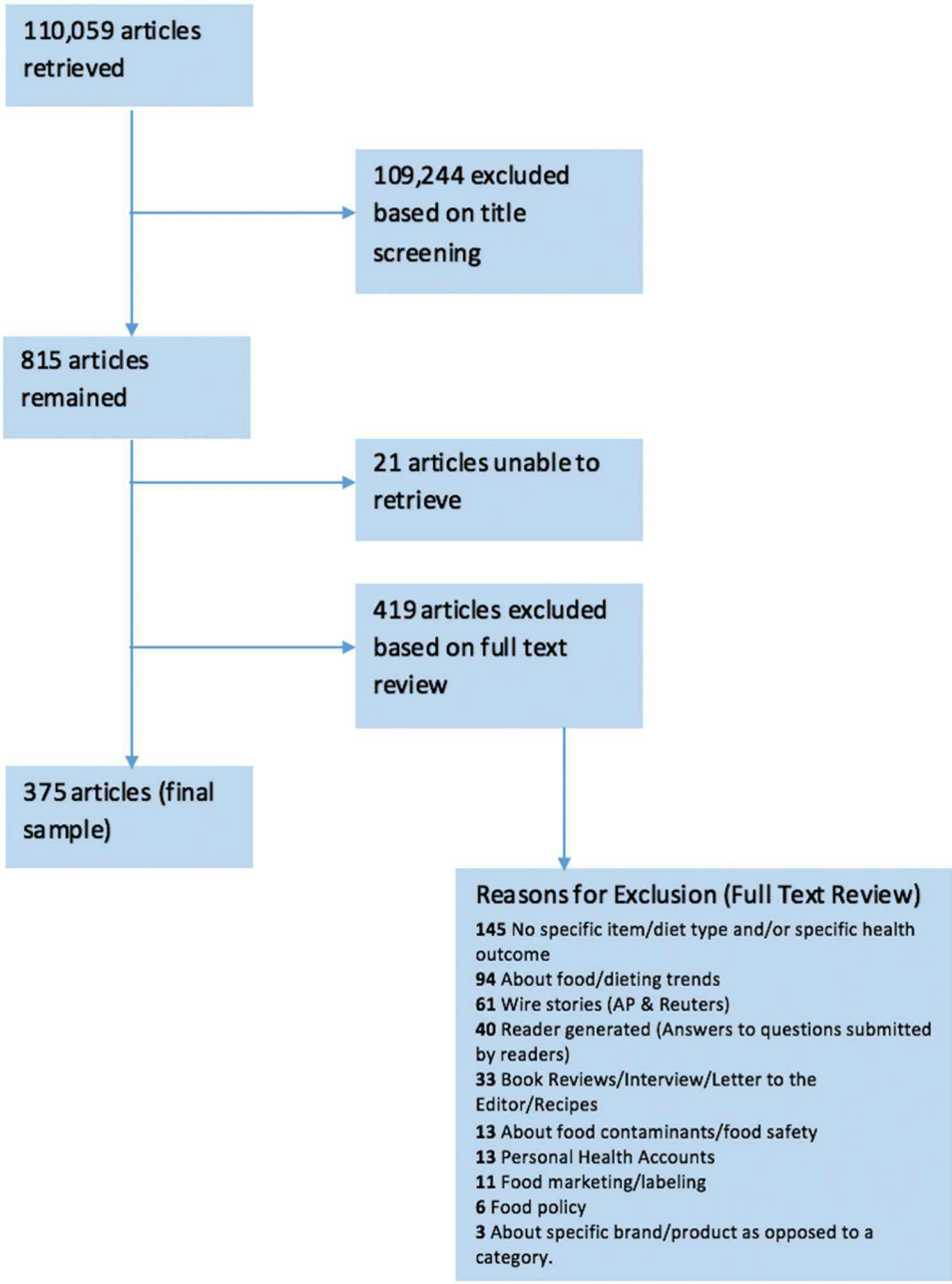

Figure 1. Screening of Online *New York Times'* Nutrition News Articles, January 1996 – January 2016.

For each dietary item or diet type, the total number of times it was linked to positive health outcomes and negative health outcomes was recorded. Items were marked as "exclusively positive" if there were no instances of a negative relationship reported, "predominantly positive" if 75–99% of the relationships reported were positive, and "skewed positive but mixed" if 51–74% of the relationships reported were positive. The same scale was used to classify items as "exclusively negative," "predominately negative," and "skewed negative but mixed." Finally, items were marked as "evenly split" if there were an equal number of positive and negative relationships reported over the study period.

Conflicting messages and time between conflicting reports

After the nature of each diet and health relationship was recorded, all relationships were examined to see if this changed across the study period (e.g., was calcium reported as improving bone health in one news article and later reported to have no impact or a negative impact on bone health). When an item was dually linked to a single health outcome (i.e., positively and negatively, neutrally and positively, or neutrally and negatively) across the study period, this was recorded as conflicting information. When conflicting reports were observed, the published journal articles of the studies involved were retrieved and reviewed. The publication month and year for each study were recorded to capture the time that elapsed between conflicting reports.

Contextual information

The contextual differences between conflicting studies were also recorded including changes in study design (e.g.,

randomized control trial vs. meta-analysis), study population (i.e., average age, gender, racial/ethnic composition, and health status of participants), and industry funding/support. To determine if there was a change in age, I chose age brackets used to analyze data in large scale clinical trials (<18 years; 18–44 years; 45–64 years; and ≥65 years; Goding-Sauer et al., 2017; Ward & Schiller, 2013), and we recorded whether the average age in the two conflicting studies fell in the same or different brackets. To determine if there was a difference in the other three study population variables, we looked at homogeneity and composition. For example, if one study used a homogenous population (i.e., all women) and the other used a mixed population or a population of all men, this was recorded as a change. If there were changes in any of these four variables, the study population was recorded as changing.

Results

A total of 375 news articles met the eligibility criteria during the study period, all of which were included in the final sample. Among these articles, 416 diet and health relationships were discussed with 228 of these being distinct diet and health relationships. The total number of diet and health relationships exceeded the number of news articles because some studies examined multiple relationships. There were six diet categories discussed: food items (e.g., eggs)/food groups (e.g., dairy), beverages, nutrients (e.g., salt), vitamins/supplements, diet types (e.g., Mediterranean diet), and other. Each category is shown in Table 1 along with the individual items that fell under these categories and the frequency with which they appeared in news coverage. The most popular dietary items discussed were alcoholic beverages (n = 51), followed by vitamin D (n = 26), and B vitamins (n = 23).

RQ1

Table 2 shows which dietary categories were consistently linked to positive health outcomes, negative health outcomes, or mixed with respect to health outcomes. Diet categories exclusively or predominantly linked to positive outcomes included chocolate, nuts, fish/seafood, fruits, vegetables, and the Mediterranean diet. Categories that were exclusively or predominantly linked to negative outcomes included sugar-sweetened beverages, red meat, processed meat, artificial sweeteners, and salt. Items that were skewed in one direction but mixed included dietary fats (e.g., trans fats, saturated fats, and unsaturated fats), alcohol, caffeine, soy, calcium, and fish oil/omega 3's. Evenly split items included beta-carotene, multivitamins, and a high-fat diet.

RQ2

Table 3 shows which diet and health relationships had conflicting reports during the study period. Over the 20-year study period, 29 out of 228 diet and health relationships (12.7%) had conflicting reports. Across these 29 relationships there were a total of 44 instances when the nature of the relationship changed, translating to an average of 1.52 times that the nature of each diet and health relationship changed.

Approximately half (51.7%) of the diet and health relationships with conflicting reports involved vitamins and/or supplements. These included B vitamins, vitamins C, D, and E, calcium, vitamin D, fish oil/omega-3's, antioxidants, and multivitamins. Vitamin E had the single greatest number of conflicting relationships out of all diet categories (n = 4). Conversely, wine/alcohol had the single most volatile relationship with breast cancer with the nature of this relationship changing four times over the study period.

RQ3

Of the 29 diet and health relationships with conflicting reports, approximately 90% of them (n = 26) had changes in one of the three contextual details recorded. Just under three-fourths of the diet and health relationships with conflicting reports (n = 21) involved changes in study design, 79% involved changes in study population (n = 23), and 31% (n = 9) involved changes in industry funding. Approximately 73% (n = 21) of the diet and health relationships with conflicting reports had changes in at least two of the contextual details and 21% (n = 6) had changes in all three contextual details. The three diet-health relationships with conflicting reports that had no changes in the contextual details recorded were fish oil/omega-3's and pregnancy/fetal health outcomes, low-carb diet and cardiovascular outcomes, and low/reduced calorie diet and aging. Tables S1-S3 (found in the supplemental information) report specific study details for each publication listed in Table 3.

RQ4

The average time between conflicting reports was 53.24 months ranging from three to 198 months.

Discussion

Several conflicting diet and health relationships emerged across the 20-year study period. Diet categories such as alcohol, dietary fats, and certain vitamins like vitamin E were involved in multiple conflicting reports. Some diet and health relationships were volatile in nature with positive, negative, and neutral associations reported between a given diet category and health outcome. For example, the relationship between alcohol and breast cancer changed several times over the study period with some changes occurring within a few months. On average, however, several years passed between conflicting reports. When more time elapses between conflicting findings, it may be cognitively easier for news audiences to accept the new findings than if they occurred in a shorter time span (Carpenter et al., 2016). The reason for this is that when conflicting findings emerge in a short period of time, it may give the impression that a mistake was made which can negatively impact trust in researchers.

This study also examined the nature of diet and health relationships across the study period. Items like nuts, fruits, and chocolate were consistently linked to positive health outcomes, while sugar-sweetened beverages and a high-carb diet were consistently linked to negative health outcomes. Items like alcohol and vitamin E were mixed with respect to health

Table 1. Diet Categories in Online *New York Times'* Nutrition News Coverage, 1996–2016.

Dietary Categories	Number of Instances Item Appeared in Coverage (N = 416)
Food Items/Food Groups	
Fruits	15
Fish/seafood	14
Dairy products	13
Chocolate	11
Nuts	9
Vegetables/legumes	5
Red meat	4
Junk food (e.g., soft drinks, candy, potato chips)	1
Instant noodles	1
Processed meat	1
Beverages	
Wine/alcohol	51
Coffee/Caffeinated Beverages	21
Sugar-sweetened beverages	19
Tea	3
Water	1
Nutrients	
Salt	15
Dietary fats	11
Fiber and whole grains	10
Artificial Sweeteners	5
Spices	2
Vitamins/Supplements	
Vitamin D	26
B Vitamins	23
Fish oil/omega-3's	18
Vitamin E	14
Calcium + Vitamin D	10
Vitamin C	6
Antioxidants	6
Lycopene	6
Calcium	5
Multivitamin	5
Soy	5
Probiotics	4
Iron	3
Resveratrol	3
Beta carotene	2
Vitamin A	2
Selenium	2
Zinc	1
Potassium	1
Copper	1
Glucosamine & Chondroitin	1
Red yeast rice	1
Diet Types	
Low/reduced-calorie diet	12
Mediterranean diet	11
Low or no-fat diet	6
Low-carb diet	5
High-carb diet	4
High fat diet	4
DASH diet	4
High protein diet	3
Western diet	3
Meat-free diets	3
Gluten-free diet	2
Low protein diet	1
Other	
Chewing gum	1

Table 2. The Nature of Diet and Health Relationships in Online *New York Times'* Nutrition News Coverage, 1996–2016.

Relationship to Health Outcomes*	Dietary Items, Nutrients, and Diet Types
Exclusively positive	Chocolate, nuts, tea, spices, vitamin A, resveratrol, iron, Mediterranean diet, low or no-fat diet, DASH diet, Meat-free diets, Gluten-free diet, Probiotics, Red yeast rice, chewing gum, zinc, water
Predominantly positive	Fish/seafood, fruits, vegetables/legumes, dairy products, fiber & whole grains, B vitamins, Calcium & Vitamin D, low/reduced calorie diet, low-carb diet
Skewed positive but mixed	Coffee, wine/alcohol, vitamin C, fish oil and omega-3s, antioxidants, soy
Exclusively negative	Sugar-sweetened beverages, salt, high-carb diet, "Western" diet, low-protein diet, instant noodles, selenium, potassium, processed meat, copper
Predominantly negative	Red meat, artificial sweeteners
Skewed negative but mixed	Dietary fats, vitamin D, vitamin E, calcium, high protein diet
Evenly split	Beta carotene, multivitamins, high fat diet

*Two items were not linked to any positive or negative health outcomes (i.e., exclusively neutral): glucosamine & chondroitin, "junk food"

outcomes. When items are consistently linked to positive or negative health outcomes, decisions about whether to consume them are cognitively easier to make because the evidence for or against consumption points in the same direction.

On the other hand, when an item is linked to positive and negative health outcomes or its relationship with a specific health outcome changes (i.e., conflicting messages), decisions about whether to incorporate it into one's diet prove more challenging. This can lead to nutrition backlash which is more likely to occur among those with low science knowledge (Nagler, 2014; Pew Research Center, 2016, 2017). While a majority of Americans have reported that conflicting nutrition information is indicative of scientific progress and helps improve understanding of diet and health relationships, individuals with low science knowledge tend to be less trusting of conflicting nutrition messages and more likely to dismiss such information (Pew Research Center, 2016, 2017). Additionally, these individuals are more likely to report difficulty with deciding what to eat due to these conflicting messages.

While interpreting conflicting nutrition messages can be challenging, conflicting nutrition information is not inherently problematic. Our knowledge of diet and health relationships will undoubtedly evolve as more nutrition research is conducted. This understanding was built into the National Nutrition Monitoring and Related Research Act (1990) which mandates that federal dietary guidelines be updated every five years to reflect current scientific knowledge.

When nutrition experts convene to make these updates, they have access to a larger body of evidence than was available when previous guidelines were established. Consequently, if a conflicting recommendation emerges from one iteration to the next, the public can be assured that the new recommendation is based on more information and a better understanding of a diet and health relationship than the one it replaced.

Conflicting nutrition information in media coverage can become problematic, however, because of how nutrition research tends to be reported (Russell, 1999; Wellman et al., 2011). Media coverage of nutrition research can be compared to coverage of a tennis match that reports on every serve rather than waiting for the final score. Audiences may get whiplash keeping up with the back and forth conclusions drawn from individual studies when they would be better served just knowing the recommendations these studies collectively informed.

Nutrition research studies have become a popular topic of news coverage in increasingly strained newsrooms because these studies tend to be of great interest to the general public,

Table 3. Diet and Health Relationships with Conflicting Reports in Online *New York Times'* Nutrition News Coverage, 1996–2016.

Diet and health relationship	Research Studies*	Outcome Change	Study Design Changes? Y/N	Study Population Changes? Y/N	Funding Type Changes? Y/N
Fish and cardiovascular outcomes	Daviglus et al., 1997; Mozaffarian et al., 2004; Mozaffarian & Rimm, 2006	(+) → (±) → (+)	Y	Y	N
Fish and pregnancy/fetal health outcomes	Olsen & Secher, 2002; Myers et al., 2003; Rogers et al., 2004	(+) → 0 → (+)	Y	N	N
Dairy products and cardiovascular outcomes	Alonso et al., 2005; Rong et al., 2013; Tang et al., 2013	(+) → 0 → (-)	Y	Y	N
Coffee/caffeinated beverages and pregnancy/fetal health outcomes	Wisborg et al., 2003; Bech et al., 2007; Weng et al., 2008	(-) → (0) → (-)	Y	N	Y
Coffee/caffeinated beverages and general/overall health	Andersen et al., 2006; Seifert et al., 2011	(+) → (-)	Y	Y	N
Wine/alcohol and breast cancer	Smith-Warner et al., 1998; Y. Zhang et al., 1999; Chen et al., 2011; Newcomb et al., 2013; Liu et al., 2013	(-) → (+) → (-) → (+) →(-)	Y	Y	N
Wine/alcohol and bone/joint health	Choi et al., 2004; Di Giuseppe et al., 2012	(-) → (+)	N	Y	N
Wine/alcohol and cognitive function	Dent et al., 1997; Mukamal et al., 2001; Stampfer et al., 2005	(0) → (-) → (+)	Y	Y	N
Dietary fats and cardiovascular outcomes	Hu et al., 1997; Beauchamp et al., 2005; Chowdhury et al., 2014	(±) → (+) → (0)	Y	Y	N
Dietary fats and breast cancer	Kohlmeier et al., 1997; Wolk et al., 1998	(-) → (±/0)	Y	N	N
Salt and cardiovascular outcomes	Midgley et al., 1996; Adler et al., 2014; O'Donnell et al., 2011	(-/0) → (-) → (0)	Y	Y	Y
Vitamin C and cardiovascular outcomes	Duffy et al., 1999; Sesso et al., 2008	(+) → (0)	N	Y	Y
Vitamin D and cardiovascular outcomes	Amer & Qayyum, 2012; Wood et al., 2012: Forman et al., 2013	(+) → (0) → (+)	Y	Y	Y
Vitamin D and bone/joint health	T. E. McAlindon et al., 1996; T. McAlindon et al., 2013	(+) → (0)	Y	Y	N
Vitamin E and overall cancer risk	Bairati et al., 2005; I-M. Lee et al., 2005	(-) → (0)	N	Y	N
Vitamin E and Alzheimer's disease	Petersen et al., 2005; Dysken et al., 2014	(0) → (+)	N	Y	Y
Vitamin E and aging/lifespan	Poulin et al., 1996; Miller et al., 2005	(+) → (-)	Y	Y	N
Vitamin E and general/overall health	Institute of Medicine, 2000; Meagher et al., 2001	(-) → (0)	Y	Y	Y
B vitamins and cardiovascular outcomes	Rimm et al., 1998; Clarke et al., 2002	(+) → (0)	Y	Y	N
B vitamins and overall cancer risk	S. M. Zhang et al., 2008; Ebbing et al., 2009; Andreeva et al., 2012; Linabery et al., 2012	(0) → (-) → (0) → (+)	Y	Y	N
B vitamins and cognitive function	Morris et al., 2005; Durga et al., 2007;	(-) → (+)	Y	Y	N
Fish oil/omega-3's and cardiovascular outcomes	Raitt et al., 2005; Bosch et al., 2012; Mozaffarian et al., 2013; Grey & Bolland, 2014	(-) → (0) → (+) → (0)	Y	Y	Y
Fish oil/omega-3's and pregnancy/fetal health outcomes	Dunstan et al., 2008; Makrides et al., 2010	(+) → (0)	N	N	N
Antioxidants and aging/lifespan	Bjelakovic et al., 2007; Li et al., 2011	(-) → (+)	Y	Y	Y
Lycopene and prostate cancer	Giovannucci et al., 2002; Peters et al., 2007	(+) → (0)	Y	Y	N
Multivitamins and overall cancer risk	Neuhouser et al., 2009; Gaziano et al., 2012	(0) → (+)	Y	Y	Y
Low-carb diet and cardiovascular outcomes	Foster et al., 2003; Sacks et al., 2014	(+) → (0)	N	N	N
Low-calorie diet and aging/lifespan	Verdery et al., 1997; Mattison et al., 2012	(+) → (0)	N	N	N
Calcium + vitamin D and bone/joint health	Grant et al., 2005; Lappe et al., 2008	(0) → (+)	N	Y	N

*Full reference citations can be found in the supplemental information.
(+) = positive relationship was found between item/diet type and health outcome (i.e., item was associated with a decreased risk for negative health outcomes or increased the likelihood of positive outcomes)
(-) = negative relationship was found between item/diet type and health outcome (i.e., item was associated with an increased risk for negative health outcomes or decreased the likelihood of positive outcomes).
(0) = no association found between item/diet type and health outcome.
Y = change occurred; N = change did not occur

offer novel information, and can quickly be turned into news stories (Schwitzer, 2009). However, one of the factors that contributes to a study's newsworthiness, novelty, can also lead to conflicting information. If a study is chosen for news coverage because it has novel findings, the novelty may stem from the fact that its findings conflict with findings from previous research (Nagler & LoRusso, 2018; Stryker, 2002). With novelty as a newsworthy criterion, the public can get a distorted image of the scientific literature from news media with a bias toward publishing conflicting findings.

This is why when conflicting nutrition information emerges within a short time span, media coverage of individual studies is a common culprit. Conflicting findings reported during shorter timeframes should primarily be viewed as noise because a single study is only a single data point. Nutrition experts tasked with updating federal guidelines examine these data points collectively and draw new conclusions based on what they find. News audiences should be attuned to if and how dietary guidelines change over five, 10, and 20-year periods. Conflicting information that emerges

in shorter timeframes often lacks enough substance to be informative on its own.

With news media being a popular source of health information for the general public, calls for improvements in health news reporting have been made by several parties. A leading voice among these has been Health News Review (HNR), an independent organization with a cadre of medical, public health, and communications experts who review and rate the quality of health news. Over its 13-year run, HNR contributors reviewed and rated thousands of articles based on a set of ten criteria (e.g., does the story grasp the quality of the evidence; does the story include independent sources and identify conflicts of interest).

HNR has urged news media, including the *New York Times*, to stop publishing incomplete news stories on what is often inconclusive research (Joyce, 2017). Gary Schwitzer, founder of Health News Review, has pointed out that contextual details are a critical component of health news coverage. Factors like study population, study period, and limitations help readers understand the quality of the findings presented and the conclusions that can be drawn from them. In the case of conflicting findings, these details can help readers compare studies and decide which study presents stronger evidence.

A majority of the conflicting studies that I found differed on at least two of the three contextual details. Study characteristics like study design and study population impact study findings because these choices shape what conclusions can be drawn from a study and to whom the findings apply (Nagler & LoRusso, 2018). For example, the comparison of a randomized controlled trial with obese participants to a prospective cohort study with participants in a healthy weight range is not one of apples to apples. A randomized controlled trial can demonstrate that A led to B while a prospective cohort study can only show that A and B are associated. Additionally, study population characteristics such as participants' average weight or their racial/ethnic group can moderate the relationship between diet and health outcomes (Albain et al., 2009; Miller et al., 2018). In these instances, it is more likely that differences in study design or study population led to the conflicting findings rather than any ambiguous nature of the item itself.

While not examined in this study, differences in the self-reported measures used for dietary intake (e.g., food frequency questionnaires and food diaries) can also impact study findings. These measures are used to study diet and health relationships but they are plagued by issues of recall bias (Ioannidis, 2018). Asking people to remember what and how much they ate and drank over a span of days, weeks, sometimes even a year or more is a challenging task. If people have difficulty remembering this information, it can impact the association observed between a dietary item and health outcome (Archer et al., 2013). Additionally, these measures are not comparable. Some self-report measures may ask participants to provide a detailed list of all the foods they consumed over a short period of time (e.g., list everything you ate in the last 24 hours) while other measures may focus on general consumption habits over a longer period of time (e.g., over the past year, on average, how many times a week did you eat fish?). If two studies use different dietary intake measures to study the same diet and health relationship, conflicting findings between the studies may be partly attributed to this difference. All of these contextual factors are important to consider when comparing the results from conflicting studies and should be discussed in nutrition news reporting.

Minimizing the impact of conflicting nutrition information

It would be impractical to try to eliminate all conflicting nutrition news coverage. For reasons that include public interest, limited resources, and time constraints, nutrition research studies will likely remain a popular choice for health news. A more practical solution to effectively address conflicting nutrition news coverage should involve: 1) facilitating connections between journalists and researchers, 2) ensuring that journalists have the best possible information on which they can base health news stories (i.e., improving the quality of journal articles and press releases), and 3) improving the health literacy of the public. With this solution journalists, news audiences, and researchers each play important roles which are briefly outlined below.

Role of journalists

In the bylaws of the Association of Healthcare Journalists, it states that journalists have a "special responsibility in covering health and medical news." Since few people frequently interact with healthcare providers, news media may act as a surrogate source of information when individuals need to make healthcare decisions. If health news is used for decision-making, it's critical that coverage is comprehensive so news audiences can accurately interpret research findings and the significance of these findings. In addition to details about the study, a comprehensive nutrition news article should discuss how the findings fit within the existing body of research (Chang, 2015; Pellechia, 1997; Russell, 1999). If research findings differ significantly from previous research, news audiences should be informed. It may signify that the study is an outlier, in which case the findings should be interpreted with caution.

Journalists may be unable to provide this context because they lack this technical knowledge. That is why it is important for journalists to have established relationships with researchers who they can call upon to provide this expertise. A journalist's ability to provide contextual information, however, greatly depends on the accessibility of researchers. This highlights a responsibility that researchers have in addressing conflicting nutrition news coverage.

Role of researchers

Researchers should make themselves accessible to health journalists. In addition to explaining how a study's findings fit within the larger scope of existing research, researchers can also help interpret findings and point out study limitations. It is especially important for researchers who are unaffiliated with a study to weigh in because they can provide a more critical, objective assessment of the research. Social media can be helpful in facilitating connections between researchers and journalists by providing a platform through which discussions can be had (Southwell, 2013). To further facilitate these discussions, researchers should receive media training so they have the

skills to effectively communicate with journalists and general audiences about their research.

Before journalists begin developing news stories, researchers and their institutions have an opportunity to shape news stories with their press releases. Press releases are a significant resource for journalists (Schwitzer, 2009). Press releases often include a summarized, less technical version of a research study. In some cases, the press release can be a helpful primer before a journalist starts writing a story. In other cases, it may become the story (Boivin et al., 2016). Researchers and their institutions should ensure that key takeaways and appropriate interpretations are included in press releases to aid journalists in the writing process.

Role of news audiences/general public

Lastly, news audiences are responsible for critically evaluating health news. In order to successfully do this, they need comprehensive information to interpret the research findings and sufficient health literacy to make accurate interpretations from that information. Interpreting findings from nutrition research requires a basic understanding of epidemiology. Schools should offer curriculum in health and media literacy at the primary, secondary, and post-secondary levels so students are equipped to evaluate health messages they encounter in the media.

In addition to this, federal public health agencies and research institutions should create primers for how to read and interpret research studies. These primers can be published on their organizations' websites and made available to the press. Primers should, at a minimum, explain the difference between different types of study designs (e.g., randomized clinical trials, case control studies, and prospective cohort studies), how to interpret odds ratios, and the difference between absolute vs. relative risk. News outlets can share these resources on their website for news audiences or, depending on available resources, develop their own.

Strengths

This study makes an important contribution to the literature by being the first, to my knowledge, to empirically examine the prevalence of conflicting nutrition messages in online news media, capturing a broad range of dietary items. Additionally, it examined conflicting nutrition messages over a 20-year study period beginning with the inception of online news publication for a major US newspaper. Since our previous knowledge of conflicting nutrition messages relied heavily on public perception and experimental studies with few studies of actual news coverage and even fewer still that addressed conflicting information, this study helps fill a gap by providing a more objective assessment of the amount of conflicting nutrition messages circulating in online news media (Chang, 2015; Nagler, 2014).

Limitations

There are a few considerations to keep in mind when interpreting the findings. First, to capture the broad range of items and health outcomes studied, broad categories were used in some instances (e.g., "fruits" instead of separate categories for different types of fruit, and "cardiovascular outcomes" instead of specific categories for high blood pressure or heart attack). Where applicable, differences between items within the same diet or health category were recorded in the supplemental tables to address this limitation and provide further details about conflicting studies (e.g., recording when studies looked at saturated vs., trans fats).

Next, there is no consensus in the literature on a definition for conflicting information. Some researchers have defined conflicting nutrition information as providing risk-benefit information about a single dietary item (Regan et al., 2014). When Greiner et al. (2010) examined risk-benefit information about fish, this would be considered conflicting information based on that definition. This study chose a different definition that focused on logical inconsistency. Consequently, the findings cannot be compared to studies that used another definition of conflicting information, or studies that examined whether journalists labeled conflicting information as such in news coverage.

Finally, this study focused exclusively on news coverage from a single source, the *New York Times'* website. There are a vast number of online sources of nutrition information available to the public. As noted earlier, the trade-off in focusing exclusively on the *New York Times* is that no claims of representativeness can be made regarding the trends that may appear in other major newspapers. Additionally, the people exposed to these articles (i.e., *New York Times'* readers and subscribers) are likely different from the general public with respect to sociodemographic variables such as education and income.

While the *Times'* online readership may not be reflective of the general US population, according to its most recent digital media kit it receives 122 million unique visitors each month (The New York Times, 2020). This translates to a wide potential reach of these messages. Consequently, the findings are still informative as they reveal the prevalence of conflicting messages in a widely circulated, major newspaper over a 20-year period. Future studies can build on this research by focusing on other newspapers, looking at conflicting nutrition information in different types of media, such as television, and examining other characteristics of news coverage including how often study authors and independent sources are quoted.

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