UNIVERSITY OF CALIFORNIA SAN DIEGO

SAN DIEGO STATE UNIVERSITY

Instagram for diet and weight loss research

A dissertation submitted in partial satisfaction of the
requirements for the degree Doctor of Philosophy

in

Public Health (Health Behavior)

by

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2019

The Dissertation of Jessica Rachel Hawks is approved, and it is acceptable in quality and form for publication on microfilm and electronically:

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2019

DEDICATION

This work is dedicated to my parents, Steve and Jaylyn Hawks, for teaching me the values of hard work and lifelong learning, for multiple long phone conversations, and for continuing to support my habit of perpetual studenthood. I am finally finished! It is also dedicated to my partner, Adam Klatt, for unending and unwavering love, support, and listening as I toiled away at this massive project. Thank you for always reminding me that I can do and be anything.

EPIGRAPH

The single greatest lesson the garden teaches is that our relationship to the planet need not be zero-sum, and that as long as the sun still shines and people still can plan and plant, think and do, we can, if we bother to try, find ways to provide for ourselves without diminishing the world."

Michael Pollan, *The Omnivore's Dilemma: A Natural History of Four Meals*

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LIST OF ABBREVIATIONS

SCT	Social Cognitive Theory
DALY	Disability-Adjusted Life Years
PRISMA	Preferred reporting items for systematic reviews and meta-analyses
ACM	Association for Computing Machinery
JH	Jessica Hawks
CLEAR	Clearinghouse for Labor Evaluation and Research
BMI	Body Mass Index
PSA	Public Service Announcements
API	Application Programming Interface
SSB	Sugar-sweetened beverages
NHANES	National Health and Nutrition Examination Survey

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ACKNOWLEDGEMENTS

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I would like to thank my committee members, Dr. Atsushi Nara, Dr. David Strong, Dr. Cheryl Anderson, and Dr. Sheri Hartman, for dedicating their time and expertise to this work. All of you have helped me throughout the dissertation process and throughout my PhD program as a whole. Thank you, Dr. Nara, for allowing me to use your dataset for this work and for taking the time to help me with keyword searches and checking Instagram posts for public availability. Thank you to Dr. Jiue-An Yang of the Qualcomm Institute and The California Institute for Telecommunications and Information Technology (CALIT2) at University of California San Diego for collecting Instagram posts using Instagram API. Thank you to Dr. Lourdes Martinez for assisting with calculating Gwet's coefficient during the piloting and inter-rater reliability testing portion of this dissertation.

I would like to thank Dr. Andrea Mendoza-Vasconez for her friendship and support throughout this program. Thank you for always encouraging me, for lending a listening ear and a helping hand, and for sharing your family and Ecuador with me. Thank you for inspiring me to be better, to demand more from our leaders, and to contribute to a better world.

Thank you to my partner, Adam, for making me laugh, pushing me to work harder, listening to the minutiae of academic life, and helping me to believe that I can do whatever I set my mind to. Thank you to my mom, Jaylyn, for encouraging me to chase my dreams, no matter how wild. Thank you for earning your master's degree (as a mother of 6!), for being the executive director of the local women's shelter, and for becoming a county councilwoman. You have shown me how to be a fierce advocate for the powerless and a champion of my community. Thank you to my dad, Steve, for exposing me early to public health and international travel. Thank you for showing me that it is never too late to become a rock star, for teaching me the importance of developing and sharing my talents, and for mentoring me throughout my education. Thank you to both of my parents for instilling in me the values of learning and perseverance. Thank you to my family for their endless love and support.

Chapter 2, in full, is being prepared for submission for publication of the material. Co-authors include Madanat, Hala; Walsh-Buhi, Eric R.; Hartman, Sheri; Strong, David; Nara, Atsushi; and Anderson, Cheryl. The dissertation author was the primary author of this paper.

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VITA

EDUCATION

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2014 Master of Public Health
University of Utah, Department of Family and Preventive Medicine
Major: Public Health
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Academic Appointments

Instructor of Public Health, 2016-present
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San Diego State University, School of Public Health
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San Diego State University

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PH 101: Introduction to Public Health, 3 units
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FPMU 110: Health Behavior and Chronic Disease, 4 units
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Winter 2016, 99 students
FPMU 101B: Epidemiology & Biostatistics B, 4 units
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FPMU 110: Health Behavior and Chronic Disease (Community Interventions), 4 units
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2018	**Best Teaching Assistant of the Year,** University of California, San Diego
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2015-2019	**Chancellor's Doctoral Incentives Program, California State University,** San Diego State University
2014	**Meghan Arnold Memorial Scholarship**, University of Utah.
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8. **Hawks, J.R.,** Madanat, H., Walsh-Buhi, E.R., Nara, A., Hartman, S., Strong, D., & Anderson, C. (In preparation). Summer bodies are made in winter: Season and gender identity trends among diet-related Instagram posts. Will be submitted to *Computers in Human Behavior*.
7. **Hawks, J.R.,** Walsh-Buhi, E.R., Madanat, H., Nara, A., Hartman, S., Strong, D., & Anderson, C. (Submitted). Dieting for weight loss on Instagram: A content analysis guided by Ideation Theory. Submitted to *Social Media + Society*.
6. **Hawks, J.R.,** Madanat, H., Walsh-Buhi, E.R., Hartman, S., Strong, D., Nara, A., & Anderson, C. (Under review). Systematic review of social media as a research tool for diet and weight loss. *Journal of Health Communication.*
5. Walsh-Buhi, E.R., **Hawks, J.R.**, Nara, A., & Wells, K.J. (In preparation). #Gardasil on Twitter: A content mining study examining message, context, and source characteristics of human papillomavirus (HPV) vaccine-related tweets.
4. **Hawks, J.R.**, & Madanat, H. (In preparation). Self-reported weight loss strategies and metabolic health among US Latinos: A cross-sectional analysis of 2011-2012 NHANES data. To be submitted to *Family and Community Health*.
3. **Hawks, J.R.**, & Madanat, H. (In preparation). Validity and reliability of the IES-2 in *Valorando Nuestros Cuerpos*: An intuitive eating intervention for Latinas. To be submitted to *Journal of Counseling Psychology*.

2. Madanat, H., **Hawks, J.R.**, Gonzales, A., Shapiro, E., & Buhi, E. (In preparation). Assessing evidence of validity for the Intuitive Eating Scale-2 among adult Latina women. To be submitted to *Journal of Latina/o Psychology*.
1. **Hawks, J.R.**, Molina, M., & Madanat, H. (In preparation). Assessing the role of food security and acculturation on body mass index among Latinos. To be submitted to *Family and Community Health*.

REFEREED PRESENTATIONS

11. **Hawks, J.R.**, Mendoza-Vasconez, A., Nara, A., Walsh-Bushi, E.R., & Madanat, H. (Accepted). Diet on Instagram: A case study of what people post when trying to lose weight. Society for Behavioral Medicine 40th Annual Meeting. Washington, D.C. (Will be presented in March 2019).
10. Walsh-Buhi, E.R., **Hawks, J.R.**, Willis, L., Carson, L., & Dao, B. (2018, August). Message and source characteristics of #GetYourselfTested and GYT-related Twitter posts: Implications for STD prevention. 2018 STD Prevention Conference. Atlanta, GA.
9. **Hawks, J.R.**, Walsh-Buhi, E.R., & Madanat, H. (2018, April). Systematic review of social media as a research tool for diet and weight loss. Society for Behavioral Medicine 39th Annual Meeting. New Orleans, LA.
8. **Hawks, J.R.**, & Madanat, H. (2016, November). Self-reported weight loss strategies and metabolic health among US Latinos: A cross-sectional analysis of 2011-2012 NHANES data. 144th American Public Health Association Annual Meeting. Denver, CO.
   ***2016 Best Doctoral Student Abstract**, APHA Community Health Planning and Policy Development
7. **Hawks, J.R.**, & Madanat, H. (2016, March). Validity and reliability of the IES-2 in *Valorando Nuestros Cuerpos*: An intuitive eating intervention for Latinas. Student Research Symposium. San Diego State University, San Diego, CA.
6. Buhi, E., **Hawks, J.R.**, Lewis, M., Sabzi, P., & Austin, C. (2016, February). Sentiment toward the HPV vaccine on Twitter: Implications for health behavior research. American Academy of Health Behavior Annual Meeting. Ponte Verde Beach, FL.
5. Buhi, E. R., **Hawks, J.R.**, Rezai, R., Dorsey, K., Salgin, L., Nara, A., & Wells, K. (2015, November). Expanding boundaries in sexual health research: A case study of sentiment toward the HPV vaccine on Twitter. Society for the Scientific Study of Sexuality Annual Meeting. Albuquerque, NM.
3. **Hawks, J.R.**, Molina, M., & Madanat, H. (2015, April). Assessing the role of food security and acculturation on body mass index among Latinos. 25th Annual Art & Science of Health Promotion Conference, San Diego, CA.
2. **Hawks, J.R.**, Molina, M., & Madanat, H. (2015, March). The relationship between food security and acculturation in predicting obesity among Latino immigrants. Student Research Symposium, San Diego State University, San Diego, CA.
2. **Hawks, J.R.** (2011, April). The benefits of exposure to nature for survivors of domestic violence. Westminster College Undergraduate Research Fair, Salt Lake City, UT.
1. **Hawks, J.R.** (2011, April). Singing in the dark: A representation of Argentina during the sixties. Céfiro 12th Annual Conference in Latin American and Iberian Languages, Literatures, and Cultures, Texas Tech University, Lubbock, TX.

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SERVICE

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2017 **Dean's Search Committee.** San Diego State University, College of Health and Human Services. October 2017-April 2018.
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<u>Community</u>
2013 **Utah Goat Project Needs Assessment.** International Rescue Committee and University of Utah.
2013 **Cardiovascular Disease Risk Assessment.** University of Utah and Universidad de Cesar Vallejo, Trujillo, Peru.

PROFESSIONAL EXPERIENCE

2013 **Social Work MSW Intern.** Cancer Wellness House. August 2012 – April 2013.
*Compiled and analyzed member usage data, conducted individual therapy with members diagnosed with cancer, completed screening assessments, assisted members with developing wellness goals.
2012 **Social Work MSW Intern.** ACES: Assessment, Counseling, and Education Services. August 2011 – April 2012.
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2009 **Health Promotion Specialist.** Seekhaven Family Crisis and Resource Center. June 2008 – August 2009.

***** Wrote the Rape Prevention and Education Grant (R-PEG) funded through the Utah Department of Health for $19,000; developed community education programming consistent with R-PEG funding, interpreted for Spanish-speaking clients.

RESEARCH INTERESTS

Public health nutrition – obesity prevention and management
Dietary behavior and health outcomes
Food security and nutrition
Social media for dietary and health behavior interventions
Community gardening for health promotion

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ABSTRACT OF THE DISSERTATION

Instagram for diet and weight loss research

by

Jessica Rachel Hawks

Doctor of Philosophy in Public Health (Health Behavior)

University of California San Diego, 2019

San Diego State University, 2019

Professor Hala Madanat, Co-Chair

Professor Eric R. Walsh-Buhi, Co-Chair

This dissertation research was undertaken to better understand how individuals use photo-based social media to post about diet and weight loss. Understanding this will help public health professionals to develop more appropriate interventions and communication campaigns when using photo-based social media. The following objectives were addressed by this research: **Objective 1.** To systematically review dietary behavior and social media literature in order to develop a framework for studying dietary behavior on photo-based social media platforms such

as Instagram. **Objective 2.** To collect and analyze a set of dieting for weight loss Instagram posts following the framework developed in Objective 1. **Objective 3.** To evaluate gender identity and seasonal trends within dieting for weight loss-related Instagram content. For objective one, a systematic review was conducted. For objectives 2 and 3, content analysis methods guided by Ideation Theory and the systematic review were used to evaluate a set of dieting for weight loss Instagram posts and to evaluate seasonal and gender identity trends. Most diet/weight loss-related social media studies focus on either Facebook or Twitter (67%), were non-experimental (41%), and were atheoretical (54%). Over half (55%) of Instagram profiles in our sample belonged to females, and most posts (57%) contained an image of food, with vegetables being the most commonly depicted food (38% of posts). Recipes and motivating language were common in the most popular posts. Females were more likely to be portrayed as thin than males, and males were more likely to be portrayed as muscular than females. Posts mentioning a specific holiday were more likely to describe the holiday as a reason for celebratory eating than a reason to restrict eating. Posts published in spring and summer were more likely to contain red meat and sugar-sweetened beverages than posts published in fall and winter. This dissertation was a preliminary step in investigating the relationship between interaction with photo-based social media and influences on dieting for weight loss. Additional research should rigorously quantify how specifically interaction with dieting/weight loss social media content is related to actual dieting for weight loss behavior.

CHAPTER 1

INTRODUCTION

Social media use has become widespread over the last several years. Social media includes websites and applications that feature user-generated content including photos, writing, status updates, and video (Cann, Dimitriou, & Hooley, 2011). Since 2005, social media use has increased nearly tenfold, from 7% of all adults in 2005 to 69% in 2018 (Pew Research Center, 2018). Data shows that adults use one-fifth of their time online to interact with social media (more than the time spent other activities like streaming videos) (comScore, 2017). The most popular social media applications/websites are Facebook, YouTube, Instagram, and Pinterest (Smith, Anderson, & Caiazza, 2018).

Instagram is an increasingly popular social media platform. It is the third most popular social media platform after YouTube and Facebook, and 35% of online adults reported using Instagram (Smith et al., 2018). Each day, one billion active monthly Instagram users upload more than 500 million photos, videos, and stories per day (Instagram, 2019). Approximately 70% of internet-using adults ages 18-24 and teens aged 13-17 years use Instagram, as do 55% of adults aged 25-29 years, and 40% of adults aged 30-49 years (Anderson, Smith, & Caiazza, 2018; Smith et al., 2018). It is also an excellent platform for reaching a diverse population, since 32% of white (non-Hispanic), 43% of black (non-Hispanic), and 38% of Hispanic internet-using adults use Instagram (Pew Research Center, 2018). Given photo-based social media's high use, it is important to understand what effect exposure to diet for weight loss-related photos and messages may have on users and how it might relate to their diet for weight loss behavior.

Diet plays an important role in weight management (National Heart Lung and Blood Institute, 2014; US Department of Health and Human Services & US Department of Agriculture,

2015). Consuming foods low in calories but high in nutrients is associated with weight loss and healthy weight management, whereas consuming foods high in calories but low in nutrients is associated with weight gain (Rolls, Drewnowski, & Ledikwe, 2005). Diets high in fruits and vegetables, fat free/low fat dairy products, whole grains, a variety of lean protein, and oils are associated with healthy weight management (HHS & USDA, 2015). Dietary behavior (behaviors surrounding food choices, food preparation, and how much/often people eat) has multiple influences, including gender, advertising, and season. For this dissertation, I focused on dieting for weight loss as one aspect of dietary behavior. I define dieting for weight loss as any dietary strategies (e.g. restricting calories, eating more fiber) intended to help a person to lose weight, including a person's adherence to a particular diet's (e.g. Atkins diet) recommendations (Montani, Schutz, & Dulloo, 2015).

Research has demonstrated that eating behavior and influences on eating choices vary according to a person's gender identity. For example, women are more likely to go on diets or use specific dietary strategies like eating more fruits and vegetables to lose weight than men (Davy, Benes, & Driskell, 2006; Markey & Markey, 2005; Oakes & Slotterback, 2002; Slof-Op 't Landt et al., 2017; Tsai, Lv, Xiao, & Ma, 2016). In addition, fitness and health magazine advertising targeted towards women emphasizes thinness and dieting as a weight loss strategy, whereas health and fitness advertising content marketed towards men is more likely to emphasize muscularity and exercise (Bazzini, Pepper, Swofford, & Cochran, 2015; Mishra & Kern, 2015).

Another consideration in this dissertation is the influence of season on eating choices and dieting for weight loss behavior. Evidence is mixed on whether and how eating choices change across seasons and during holidays. Some research has shown that fresh produce intake is

highest in the seasons in which it is locally available like spring and summer (Jahns et al., 2016). Other research has found that meat intake is higher in spring and summer than in fall and winter (Stelmach-Mardas et al., 2016) and that protein intake is highest in spring (Marti-Soler et al., 2017). Other research has shown that individuals spend more on unhealthy food items both during and after the Thanksgiving-New Year's holidays compared to the period before the holidays (Pope, Hanks, Just, & Wansink, 2014). Twitter data showed that there were more weight loss-related Tweets during and after the holidays compared to before the holidays (Turner-McGrievy & Beets, 2015). Understanding how individuals' dieting for weight loss posting behavior is related to season and holidays may help researchers understand how to better time weight loss interventions or messaging on social media to reach a greater number of people and be maximally effective.

Research shows that photos of food and fitness imagery (e.g., fitness models in magazines) are correlated with food preferences and intention to lose weight (Mills, Tanner, & Adams, 2013; Vukmirovic, 2015). Food advertising appears to more strongly influence unhealthy eating in individuals who are already overweight or obese (Mills et al., 2013). The increasing use of photo-based social media platforms (such as Instagram and Pinterest) may provide greater exposure to dieting for weight loss-related content. Understanding the type of dieting for weight loss content available on photo-based social media and how people respond to this type of content may provide an opportunity to develop more effective healthy weight management interventions.

This dissertation focused on how people represent dieting for weight loss on Instagram because Instagram offers users the opportunity to share diet and weight management content with one another by posting recipes, cooking demonstration videos, and other advice. Sharing

diet and weight management content on Instagram is important because social media users often use social media to search for information and support when trying to change their health behaviors (Dahl, Hales, & Turner-McGrievy, 2016; Vaterlaus, Patten, Roche, & Young, 2015). In addition, Instagram is a photo-based platform. Photos related to dieting for weight loss (e.g., pictures of food, before and after photos of people trying to lose weight) may provide more motivation for people to change their dieting for weight loss behavior than text alone (Dahl et al., 2016; Vaterlaus et al., 2015).

Researching health behaviors through social media is a recent development within health sciences research. The most heavily-researched social media platforms are Twitter and Facebook (Highfield & Leaver, 2015; Patel, Chang, Greysen, & Chopra, 2015), but few studies have focused on Instagram. Thus, the overarching *goals* of this study were to systematically examine the literature on social media-based dietary behavior research and to develop and utilize a framework for conducting dietary behavior research using Instagram data based on the systematic literature review.

This dissertation consisted of five chapters, three of which address the three objectives of this dissertation. Chapter 1 begins on page 1 and contains an overall introduction to the dissertation. Chapter 2 (*Systematic Review of Social Media as a Research Tool for Diet and Weight Loss*) begins on page 9 and addresses objective 1. Chapter 3 (*Dieting for Weight Loss on Instagram: A Content Analysis Guided by Ideation Theory*) begins on page 48 and addresses objective 2. Chapter 4 (*Summer Bodies are Made in Winter: Season and Gender Identity Trends Among Diet-Related Instagram Posts*) begins on page 84 and addresses objective 3. Chapter 5 begins on page 117 and contains an overall conclusion to the dissertation, including implications for future public health research. References for each chapter can be found immediately

following the text of each chapter. Figures and tables for each chapter can be found immediately following the references for each chapter. A full table of contents is included on page vi, and lists of figures and tables are included on pages x and xi, respectively.

This dissertation addressed three main objectives, corresponding with Chapters 2-4 of the dissertation. The first objective (addressed in Chapter 2) was to systematically review dietary behavior and social media literature in order to develop a framework for studying dietary behavior on photo-based social media platforms such as Instagram. The second objective (addressed in Chapter 3) was to collect and analyze a set of dieting for weight loss Instagram posts following the framework developed in objective 1. The third objective (addressed in Chapter 4) was to evaluate gender identity and seasonal trends within dieting for weight loss-related Instagram content. Understanding how dieting for weight loss posts vary by gender may help researchers to understand who is most responsive to different types of dietary content posted on social media. Understanding how dieting for weight loss posts vary across seasons may help researchers understand the most effective times to deliver healthy weight management interventions for individuals using social media for weight management support.

REFERENCES

Anderson, M., Smith, A., & Caiazza, T. (2018). *Teens, social media, & technology 2018*. Washington, DC. Retrieved from https://www.pewinternet.org/2018/05/31/teens-social-media-technology-2018/

Bazzini, D. G., Pepper, A., Swofford, R., & Cochran, K. (2015). How healthy are health magazines? A comparative content analysis of cover captions and images of Women's and Men's Health magazine. *Sex Roles, 72*, 198–210. http://doi.org/10.1007/s11199-015-0456-2

Cann, A., Dimitriou, K., & Hooley, T. (2011). Social Media: A guide for researchers. *History, 89*(February), 48.

comScore. (2017). *The 2017 U.S. cross-platform future in focus*. Reston, VA.

Dahl, A. A., Hales, S. B., & Turner-McGrievy, G. M. (2016). Integrating social media into weight loss interventions. *Current Opinion in Psychology, 9*, 11–15. http://doi.org/10.1016/j.copsyc.2015.09.018

Davy, S. R., Benes, B. A., & Driskell, J. A. (2006). Sex differences in dieting trends, eating habits, and nutrition beliefs of a group of Midwestern college students. *Journal of the American Dietetic Association*, 1673–1677. http://doi.org/10.1016/j.jada.2006.07.017

Highfield, T., & Leaver, T. (2015). A methodology for mapping Instagram hashtags. *First Monday*, *20*(1), 1–12. http://doi.org/http://dx.doi.org/10.5210/fm.v20i1.5563

Instagram. (2019). Our Story. Retrieved April 2, 2019, from https://instagram-press.com/our-story/#news-filter-2019

Jahns, L., Johnson, L. A. K., Scheett, A. J., Stote, K.S., Raatz, S. K., Subar, A.F., & Tande, D. (2016). Measures of diet quality across calendar and winter holiday seasons among midlife women: A 1-year longitudinal study using the automated self-administered 24-hour recall. *Journal of the Academy of Nutrition and Dietetics, 116*(12), 1961–1969. http://doi.org/10.1016/j.jand.2016.07.013

Markey, C. N., & Markey, P. M. (2005). Relations between body image and dieting behaviors: An examination of gender differences. *Sex Roles, 53*(7/8), 519–530. http://doi.org/10.1007/s11199-005-7139-3

Marti-Soler, H., Guessous, I., Gaspoz, J., Metcalf, P., Deschamps, V., Castetbon, K., … Marques-Vidal, P. (2017). Seasonality of nutrient intake - An analysis including over 44,000 participants in 4 countries. *Clinical Nutrition ESPEN, 21*, 66–71. http://doi.org/10.1016/j.clnesp.2017.05.003

Mills, S., Tanner, L., & Adams, J. (2013). Systematic literature review of the effects of food and drink advertising on food and drink-related behaviour, attitudes and beliefs in adult populations. *Obesity Reviews, 14*, 303–314. http://doi.org/10.1111/obr.12012

Mishra, S., & Kern, R. (2015). Persuading the public to lose weight: An analysis of a decade (2001-2011) of magazine advertisements. *Journal of Magazine and New Media Research*, *16*(1), 1–21.

Montani, J. P., Schutz, Y., & Dulloo, A. G. (2015). Dieting and weight cycling as risk factors for cardiometabolic diseases: Who is really at risk? *Obesity Reviews*, *16*(1), 7–18. http://doi.org/10.1111/obr.12251

National Heart Lung and Blood Institute. (2014). *Managing overweight and obesity in adults: Systematic evidence review from the Obesity Expert Panel, 2013* (Vol. 22).

Oakes, M. E., & Slotterback, C. S. (2002). The good, the bad, and the ugly: Characteristics used by young, middle-aged, and older men and women, dieters and non-dieters to judge healthfulness of foods. *Appetite*, *38*, 91–97. http://doi.org/10.1006/appe.2001.0444

Patel, R., Chang, T., Greysen, S. R., & Chopra, V. (2015). Social media use in chronic disease: A systematic review and novel taxonomy. *American Journal of Medicine*, *128*(12), 1335–1350. http://doi.org/10.1016/j.amjmed.2015.06.015

Pew Research Center. (2018). Social Media Fact Sheet. Retrieved April 2, 2019, from https://www.pewinternet.org/fact-sheet/social-media/

Pope, L., Hanks, A. S., Just, D. R., & Wansink, B. (2014). New year's res-illusions: Food shopping in the new year competes with healthy intentions. *PLoS ONE*, *9*(12). http://doi.org/10.1371/journal.pone.0110561

Rolls, B. J., Drewnowski, A., & Ledikwe, J. H. (2005). Changing the energy density of the diet as a strategy for weight management. *Journal of the American Dietetic Association*, *105*(5 SUPPL.), 98–103. http://doi.org/10.1016/j.jada.2005.02.033

Slof-Op 't Landt, M. C. T., van Furth, E. F., van Beijsterveldt, C. E. M., Bartels, M., Willemsen, G., de Geus, E. J., … Boomsma, D. I. (2017). Prevalence of dieting and fear of weight gain across ages: A community sample from adolescents to the elderly. *International Journal of Public Health*, *62*(8), 911–919. http://doi.org/10.1007/s00038-017-0948-7

Smith, A., Anderson, M., & Caiazza, T. (2018). *Social Media Use in 2018*. Washington, DC. Retrieved from https://www.pewinternet.org/2018/03/01/social-media-use-in-2018/

Stelmach-Mardas, M., Kleiser, C., Uzhova, I., Peñalvo, J. L., La Torre, G., Palys, W., … Boeing, H. (2016). Seasonality of food groups and total energy intake: A systematic review and meta-analysis. *European Journal of Clinical Nutrition*, *70*, 700–708. http://doi.org/10.1038/ejcn.2015.224

Tsai, S. A., Lv, N., Xiao, L., & Ma, J. (2016). Gender differences in weight-related attitudes and behaviors among overweight and obese adults in the United States. *American Journal of Men's Health*, *10*(5), 389–398. http://doi.org/10.1177/1557988314567223

Turner-McGrievy, G. M., & Beets, M. W. (2015). Tweet for health: Using an online social

network to examine temporal trends in weight loss-related posts. *Translational Behavioral Medicine*, *5*(2), 160–166. http://doi.org/10.1007/s13142-015-0308-1

US Department of Health and Human Services, & US Department of Agriculture. (2015). *2015-2020 Dietary Guidelines for Americans, 8th Edition*.

Vaterlaus, J. M., Patten, E. V., Roche, C., & Young, J. A. (2015). #Gettinghealthy: The perceived influence of social media on young adult health behaviors. *Computers in Human Behavior*, *45*, 151–157. http://doi.org/10.1016/j.chb.2014.12.013

Vukmirovic, M. (2015). The effects of food advertising on food-related behaviours and perceptions in adults: A review. *Food Research International*, *75*, 13–19. http://doi.org/10.1016/j.foodres.2015.05.011

CHAPTER 2

SYSTEMATIC REVIEW OF SOCIAL MEDIA AS A RESEARCH TOOL FOR DIET AND WEIGHT LOSS

Abstract

This systematic review examined the following research questions: 1) How is social media being used as a research tool for diet and weight loss? 2) What methodologies are used in diet for weight loss studies that use social media as a research tool? 3) What research gaps exist among diet for weight loss studies that use social media as a research tool? We conducted a systematic review of studies related to diet, weight loss, and social media. Out of 37 included articles, most focused exclusively on Facebook (n=13, 35%) or Twitter (n=12, 32%). Of 20 studies (54%) analyzing social media content, most analyzed textual content (n=13, 65%). About half of studies (n=20, 54%) had no guiding theoretical framework, and about one-quarter used Social Cognitive Theory (SCT) (n=10, 27%). Studies designs used were non-experimental (n=15, 41%), experimental (n=12, 32%), qualitative (n=8, 22%), and mixed methods (n=2, 5%). Intervention research thus far has consisted mostly of inadequately controlled and powered pilot studies. More rigorous randomized controlled trials should be conducted that build on data gathered from pilot research. Further research on how exposure to/interaction with diet/weight loss social media translates to individual behavior change will aid in addressing the US's obesity epidemic.

Introduction

The average American ate 23% more calories in 2010 than in 1970 and a greater proportion of those calories came from fats and refined grains (Desilver, 2016). Diets high in fruits and vegetables, low- or nonfat dairy products, whole grains, lean protein, and oils are associated with healthy weight management (US Department of Health and Human Services & US Department of Agriculture, 2015). Poor diet is related to increased risk of overweight and obesity. Obesity puts individuals at increased risk of several chronic diseases, including obesity, diabetes, heart disease and stroke, and certain cancers (Guh et al., 2009). In 2017, dietary factors such as high sodium intake and low whole grain and fruit intake contributed to 11 million deaths (approximately one fifth of all deaths) and 255 million disability-adjusted life years (DALYs) globally (GBD 2017 Diet Collaborators, 2019). Dietary behavior (behaviors surrounding food choices, food preparation, and how much/often people eat) has many different influences, including gender, advertising, and season. Less research has been conducted on how social media use might influence diet.

Kaplan and Haenlein (2010) defined social media as "a group of internet-based applications that build on the ideological and technological foundations of Web 2.0 and that allow the creation and exchange of User Generated Content" (p. 61). Social media applications emphasize relationship building, creation of groups or communities, and exchanging of user-created content (Kietzmann, Hermkens, McCarthy, & Silvestre, 2011). Adults spend one-fifth of their digital time on social media (comScore, 2017) and use social media for health information and support when trying to change health behaviors (Dahl, Hales, & Turner-McGrievy, 2016).

Social media communication surrounding diet may influence people's diet and weight loss behavior. Visual cues of foods (e.g., images, video) increase likelihood of eating and weight

gain (Boswell & Kober, 2016). Research has shown the increased marketing potential for unhealthy foods and beverages via social media (Freeman et al., 2014; Vassallo et al., 2018). Viewing photos of food and fitness imagery, such as fitness models in magazines, is correlated with food preferences and intention to lose weight (Mills, Tanner, & Adams, 2013; Vukmirovic, 2015). Fitspiration ─ content intended to motivate healthy behaviors ─ can be motivating but may negatively affect emotional wellbeing due to unrealistic content (Easton, Morton, Tappy, Francis, & Dennison, 2018).

Three recent reviews examined weight loss interventions with a social media component (Balatsoukas, Kennedy, Buchan, Powell, & Ainsworth, 2015; Elaheebocus, Weal, Morrison, & Yardley, 2018; Maher et al., 2014), and one review examined nutrition outcomes among young adults (Klassen, Douglass, Brennan, Truby, & Lim, 2018). These reviews focused mainly on interventions' overall efficacy, but the contribution of social media content and features to intervention outcomes was unclear. We conducted a systematic review of interventions and other types of studies (e.g., content analyses, big data studies) to better understand social media's contribution to diet and weight loss. The purpose of this review was to summarize the research being conducted on social media surrounding diet and weight loss, identify methodological strengths and limitations of the existing literature, and discuss implications for diet/weight loss communication via social media. Specifically, we sought to answer the following research questions:

1) How is social media being used as a research tool for diet/weight loss?
2) What methodologies are used in social media-based diet/weight loss studies?
3) What research strengths and limitations exist among social media-based diet/weight loss studies?

Methods

Search Strategy

This review followed PRISMA Guidelines for Systematic Reviews (Liberati et al., 2009) and was registered with PROSPERO: International Prospective Register of Systematic Reviews (CRD42017069684). Five experts in systematic review methodology, social media, dietary behavior, and weight loss interventions provided feedback on the search strategy detailed in Figure 2.1. From July 4-8, 2017, we searched 7 databases yielding 2,728 potential articles (CINAHL, Cochrane, Communication and Mass Media Complete, Health Source: Nursing/Academic Edition, PsycINFO, PubMed, and Web of Science); 3 grey literature sources yielding 1,405 articles (Association for Computing Machinery (ACM) Digital library (http://dl.acm.org/), Google Scholar, and ProQuest Dissertations & Theses Global); and reference lists of 37 included studies for empirical, peer-reviewed research published between 2003-17. For articles retrieved during the database searches, both titles and abstracts were searched for keywords. After searching databases, Google Scholar was searched using the same search string used for Cochrane, CINAHL, etc. The first 100 results were reviewed to identify any additional relevant articles that may have been missed in the other database searches. No additional unique and relevant articles resulted from the Google Scholar search.

Inclusion and Exclusion Criteria

Included articles must have been published since 2003 (the launch date of the first included social media platform, Myspace), identified using at least one diet/weight loss-related search term (weight loss, weight management, diet, eating, nutrition, food, and food porn) and one social media-related search term (social media, Twitter, Instagram, Facebook, Pinterest, Tumblr, Vine, Flickr, and Myspace), and examined a social media platform. We used Medical

Subject Headings (MeSH) terms to search PubMed and the plus operator and parentheses to search ACM Digital Library. The search strings used are provided in Figure 2.1. We excluded opinion pieces, book reviews, papers with no original research, and papers written in a language other than English. Articles were also excluded if they did not focus on diet/weight loss (n=17), did not use social media as a key study component (n=12), focused on a population with specific dietary needs (n=4), if the dissertation was either inaccessible or duplicated articles already included in the review (n=2), and if the full paper from a conference abstract was inaccessible (n=1).

Study Identification, Screening, and Coding

Figure 2.2 presents the PRISMA flow diagram for study selection. Studies were downloaded to Mendeley Desktop software, and duplicates were removed first using Mendeley and then manually. Using Mendeley to remove duplicates has been recommended by previous researchers (Kwon, Lemieux, McTavish, & Wathen, 2015). JH screened titles/abstracts of 3,414 non-duplicate citations by reading the title and abstract and applying inclusion and exclusion criteria. When an article was identified for inclusion, it was evaluated for several characteristics determined before the screening was conducted. These characteristics include its topical relevance (i.e. did it include both social media and diet/weight loss as key study components), whether it presented original empirical research, whether the study was written in English, and whether full text was available. Most articles were excluded during title/abstract screening because they were not topically relevant to the research questions addressed in this systematic review (n=3,341). JH assessed 73 full text articles for potential inclusion by reading through each article and applying inclusion and exclusion criteria. Of these, 37 met inclusion criteria.

Quality Assessment

We used a piloted matrix based on the Matrix Method (Garrard, 2017) to extract and synthesize data. Sample extracted information, including key study findings, strengths, and limitations, can be found in Table 2.1. The Clearinghouse for Labor Evaluation and Research (CLEAR) Guidelines for Reviewing Quantitative Descriptive Studies were used to assess study quality (Clearinghouse for Labor Education and Research, 2014). CLEAR guidelines include yes/no questions in six domains that assess study quality and methodological rigor (e.g., "Are findings fully supported by the data and analysis?"). Low quality studies had limitations in at least three CLEAR domains that posed serious threats to study validity, reliability, and conclusions. Medium quality studies had limitations in two or three CLEAR domains that were concerning but did not pose major threats to study validity, reliability, and conclusions. High quality studies had minor limitations in one or none of the CLEAR domains.

JH and a research assistant independently coded approximately 10% (n=4) of studies to pilot the systematic review matrix and CLEAR quality assessment tool, ensure accuracy, and then met to resolve discrepancies. Interrater reliability was calculated as percent agreement for the systematic review matrix and study quality data. The review matrix contained 76 possible categories and 8 cases of disagreement (89.5% agreement). The study quality matrix contained 88 categories and 5 cases of disagreement (94.3% agreement).

Analysis and Synthesis

The following information was extracted from each study: Author (Year), Software Used, Recruitment Strategies, Sample Characteristics, Independent and Dependent Variables, Outcomes of Interest, Findings, Strengths, and Limitations. Study outcomes were analyzed based on whether the primary focus of the study was on individual behavior or social media content.

To be grouped as a study that focused on *individual behavior*, the topic of the study had to focus on individual behaviors or knowledge/attitudes (e.g., diet/nutrition knowledge, diet/nutrition attitudes, changes in adherence to a diet/weight loss intervention). To be grouped as a study that focused on *social media content*, the primary focus of the study had to be characteristics of posts, pages, images, and videos posted to a social media platform. Study characteristics were discussed narratively to describe how social media is being used as a research tool for diet/weight loss, methodologies used in social media-based diet/weight loss studies, and strengths/limitations that exist among social media-based diet/weight loss studies.

Results

Results are presented by research question. The first section discusses how social media is being used as a research tool in diet/weight loss studies, the next section describes methodologies and study quality, and the following section presents selected study outcomes in aggregate and by the primary focus of the study. Finally, strengths and limitations of studies that use social media as a research tool in diet/weight loss studies are discussed.

Social Media Uses in Diet/Weight Loss Studies

General study characteristics are presented in Table 2.2. Out of 37 studies, most examined diet/weight loss through Facebook (n=13) or Twitter (n=12). Over half of studies (n=20) analyzed social media content, and most focused only on textual content. Twenty studies had no guiding theoretical framework. Approximately one-quarter used Social Cognitive Theory (SCT) (n=10) and four used multiple guiding theories. Although most studies that examined social media content examined social media content (e.g., posts, comments, images, videos) characteristics descriptively, nearly one third of social media content studies compared social media content characteristics to population health outcomes such as rates of obesity and diabetes.

As many of the studies that examined individual behavior were pilot studies, half examined intervention acceptability and 39% examined engagement and how it was related to weight loss or other weight-related health outcomes (e.g., waist circumference, body fat percentage). Just over one quarter (28%) of individual behavior studies used social media as a means of enhancing social support available to intervention participants. Individual behavior studies tended to focus on improving diet knowledge, awareness, and attitudes (44%) and/or weight/body mass index (BMI) reduction (39%).

Sample Characteristics: Social Media Content Studies. Table 2.3a shows sample characteristics of social media content studies. Studies that focused on social media content (n=19) assessed single posts on platforms such as Instagram, Twitter, Pinterest, YouTube, and blogs and entire pages or ad content on Facebook. Sample sizes of social media content analyzed ranged from 4 Facebook pages to 503 million Tweets (Twitter posts).

Sample Characteristics: Individual Behavior Studies. Table 2.3b shows sample characteristics of individual behavior studies. Of 18 studies focused on individual behavior, sample sizes ranged from 12-1041 participants with an average sample size of 156.6 (SD=247.3). Twelve studies had sample sizes composed of at least two-thirds females. Half of studies focused on individual behavior (n=9) included a majority of white participants, and four included a majority of racial/ethnic minority participants. Average BMI across studies was 30.1 kg/m^2 (SD=4.8). Participants' average age was 33 years old (SD=10.9). One third of studies each focused on college students or individuals 40 years or older. Nine of ten studies included participants with at least some college and one included participants with a high school education or less.

Methodological Characteristics and Study Quality

Table 2.4 shows methodological study characteristics. Most studies were quantitative and used non-probability sampling. Fourteen studies were high quality (38%), thirteen were medium quality (35%), and ten were low quality (28%).

Outcomes of Interest

Study outcomes are presented by study focus in Table 2.5. Across all studies, social media content characteristics were the most common study outcome (n=20). Individual health outcomes (e.g., change in blood pressure) were the least studied outcomes.

Post Characteristics. Out of 20 studies that examined social media post characteristics, the most commonly studied post characteristic was foods portrayed (n=9, 45%). Other commonly studied post characteristics were: timing of post (n=7, 35%), nutritional content of post and population health outcomes (n=6, 30%), sentiment (n=5, 25%), source of post, (n=5, 25%), and communication strategies were least commonly studied (n=2, 10%). Since most studies examined multiple post characteristics, numbers do not add up to a total of 20 studies and percentages do not add up to 100%.

Foods portrayed. The most frequently mentioned and portrayed foods were unhealthy (e.g., pizza, cookies, and ice cream) (Holmberg, Chaplin, Hillman, & Berg, 2016; Mejova, Haddadi, Noulas, & Weber, 2015; Pila, Mond, Griffiths, Mitchison, & Murray, 2017). Frequently mentioned beverages included beer, wine, coffee, and tea. Fruits and vegetables were infrequently mentioned and portrayed across studies.

Timing of post. Although popular posting times ranged from 2 PM to 6 AM, several studies concluded that evenings are the most popular times to post about food (Abbar, Mejova, & Weber, 2015; Chen & Yang, 2014; Hales, Davidson, & Turner-McGrievy, 2014; Vidal, Ares,

Machin, & Jaeger, 2015). Unhealthy choices and snacking were clustered around evening and late-night eating times (Chen & Yang, 2014; Vidal et al., 2015). Spikes in food-related Tweets and social media advertising occurred on holidays (e.g., Valentine's Day, Thanksgiving) (Abbar et al., 2015; Freeman et al., 2014), and weight loss Tweets were more common during and after the Thanksgiving-New Year's holidays compared to pre-holidays (Turner-McGrievy & Beets, 2015). Schneider, McGovern, Lynch, and Brown (2013) found no differences in blog recipes' calorie and fat content across seasons, although recipes from December to May contained 30% more sodium than recipes from June-November.

Nutritional content of post and population health outcomes. Caloric estimates depicted in a single social media post ranged from 214 to 9,120 calories across studies. The caloric value of foods in social media posts was statistically positively correlated with obesity and diabetes rates (Abbar et al., 2015; Alajajian et al., 2017), high blood pressure prevalence, and the percentage of those who eat fruits and vegetables less than once per day (Alajajian et al., 2017).

Sentiment. Three quarters of posts in Holmberg et al.'s (2016) sample were positive. Nguyen et al. (2016) and Widener and Li (2014) found that tweets about healthy foods were more positive than tweets about unhealthy foods.

Source of post. Abbar et al. (2015) found that men were more likely to Tweet about higher calorie foods than women, and 60% of #cheatmeal Instagram posts came from men (Pila et al., 2017). However, Widener and Li (2014) found that men were more likely to tweet about healthy foods compared with women.

Communication strategies. Wilkinson et al. (2016) found that most diet-related Pinterest infographics were presented with little text and vibrant colors. Zhang, Baker, Pember, and

Bissell (2017) found that the top five most popular healthy eating public service announcements (PSAs) on YouTube used a humor message appeal to improve healthy eating self-efficacy.

Acceptability. Three studies reported that most participants felt satisfied with and would recommend the intervention to others. Reasons participants liked interventions were that they liked the content and felt supported by staff and group members. Participants did not like interventions because they disliked logging food through an app, did not receive enough information on how to improve diet, and disliked sharing weight loss information on social media (Hingle et al., 2013; Turner-McGrievy & Tate, 2011).

Engagement. Engagement measures varied by study but commonly included number of likes and comments per intervention post. Total number of participant posts ranged from 98 Facebook posts to 2,630 Tweets. Number of comments per person ranged from an average of 2 comments on a blog per month (Caplette et al., 2017) to a median of 15 Tweets per participant (Turner-McGrievy & Tate, 2013). Polls resulted in the most participant engagement (Hales et al., 2014; Merchant et al., 2014). Most studies described a decline in engagement over time. Two studies reported that the most engaged users tended to lose the most weight (Hales et al., 2014; Turner-McGrievy & Tate, 2013).

Diet-Related Behavior, Knowledge, or Attitudes. Studies varied in how they measured diet-related behavior, knowledge, and attitudes. Two studies showed improved weight-related behavior, such as paying more attention to nutrition/calories and self-weighing (Dagan, Beskin, Brezis, & Reis, 2015; West et al., 2016). However, Turner-McGrievy and Tate (2011) found no difference in weight-related behavior at three or six months. Two studies found that participants improved nutrition knowledge and attitudes (Barragan et al., 2014; Dagan et al., 2015). Among four studies that found increased fruit and vegetable intake, changes ranged from an additional

half serving per day (Cavallo et al., 2016) to 2.5 more servings per day (Chung, Skinner, Hasty, & Perrin, 2017). Neither Jane et al. (2017) nor Turner-McGrievy and Tate (2011) found any difference between groups in energy or food intake at 3 or 6 months.

Weight/BMI. Three studies found no statistically significant changes in weight/BMI due to social media-based interventions. Two studies reported weight loss but no statistical significance testing (Cavallo et al., 2016; Chung et al., 2017).

Attrition/Retention. Two studies each retained above 90% of participants, from 51-89% of participants, and below 50% of participants. Turner-McGrievy and Tate (2011) reported that non-completers at 6 months were younger (average age 31 compared to 44) and nearly 5 times less likely to be white.

Individual Health Outcomes. Ashton et al. (2017) showed significant differences in body fat mass and improved cholesterol between control group and HEYMAN intervention group participants. Jane et al. (2017) found that Facebook group participants had reduced waist circumference compared to control group participants at weeks 18 and 24, but there were no differences in blood sugar, blood pressure, and hip circumference.

Strengths and Limitations of Studies

Strengths. Many of the studies that examined social media content had large sample sizes and were able to correlate social media post characteristics with population level health outcomes like obesity and diabetes rates. They also focused on a larger variety of social media platforms than individual behavior studies. Studies that examined individual behavior contributed knowledge on culturally relevant social media-based dietary behavior intervention designs. They also provided information on social media intervention components that enhance intervention feasibility, acceptability, engagement, and effectiveness, including sending out

email reminders to participants and providing additional opportunities for social support via social media platforms. Although most studies were pilots with methodological limitations, several utilized a randomized experimental design.

Limitations. The most common limitations were sample restrictions, measurement limitations, and keywords used. Common sample restrictions were small sample size or participants that were not representative of the general population (e.g., mostly young, white, high socioeconomic status, female participants). Studies that focused on the nutritional content of social media posts were limited because of limited serving size measurements or the exclusion of certain types of food. Studies focused on individual behavior used self-report rather than objective measurements. Twelve studies mentioned the difficulty of measuring actual behavior rather than a social media proxy. Keyword searches that used hashtags may have missed posts that contained the keyword but not the hashtagged keyword (e.g., "on a diet" vs. #onadiet). Other studies limited keyword searches to certain keywords and may have missed posts that did not contain the keyword (e.g., searching for "on diet" rather than by diet name).

Discussion

Most studies focused on individual behavior change had small sample sizes because their focus was on feasibility and acceptability. Two thirds of studies that focused on individual behavior change had sample sizes composed of at least two-thirds females, while only one study had a sample composed of 100% males. This lack of male participation mirrors what others have found in systematic reviews of diet and weight loss interventions (Maher et al., 2014; Neve, Morgan, Jones, & Collins, 2010), even though males have a higher prevalence of overweight and obesity than females (73% compared to 66%) (National Center for Health Statistics, 2017).

Although overweight and obesity are more prevalent among Hispanics (78%) and blacks (76%) than whites (67%) (National Center for Health Statistics, 2017), half of the reviewed studies included a majority of white participants and only four had a majority of racial/ethnic minority participants. This may reflect the demographic makeup of the locations in which studies were performed. For example, most studies with majority white participants were conducted in areas where whites make up a majority of the population (e.g., Quebec, North Carolina). Studies with a higher percentage of minority participants came from San Diego and Los Angeles, California, which have a higher percentage of Asian Americans and Hispanics and a lower percentage of whites. The low participation of minorities in the reviewed studies is unfortunate, especially given social media's potential for engaging racial/ethnic minorities (especially blacks and Hispanics) due to high use among these groups (Duggan, Ellison, Lampe, Lenhart, & Madden, 2015). For pilot studies that showed healthy eating behavior change (e.g. increased fruit/vegetable consumption), larger randomized controlled trials with diverse participants should be conducted.

Nine studies examined engagement and concluded that engagement declined over time. This is similar to findings from other systematic reviews of health promotion interventions conducted online or with a social media component (Balatsoukas et al., 2015; Maher et al., 2014). Definitions of engagement varied across studies and were limited to quantitative measures (e.g. number of likes, comments, and posts). Klassen et al. (2018) reported varied definitions of engagement that did not capture all potential value that engaging with social media might provide.

Social media allows users to engage with and support each other on the platform when trying to lose weight (Dahl et al., 2016). Social support was a component of three studies focused

on individual behavior. However, it was not clear how social media had been harnessed to provide additional social support. More recent studies have improved both engagement and social support by including social media as one component of a multi-pronged intervention with both in-person and online activities (Andrade, Evans, Barrett, Edberg, & Cleary, in press; Silfee et al., 2018). Future research should focus on how social media can be used for social support for diet and weight loss since social support is important for successful weight loss (Nestle et al., 2009).

High calorie, unhealthy foods were both the most posted and the most liked type of foods, while fruits and vegetables appeared less often. Other research has found that exposure to food advertising on television (especially unhealthy or snack food advertising) increases participants' likelihood of snacking on unhealthy food while viewing television (Vukmirovic, 2015). Exposure to unhealthy foods on social media platforms in photo or video format may encourage unhealthy eating behavior. However, almost one third of studies focused on social media content mentioned the potential discrepancy between a person's social media behavior and their actual eating behavior. Posts about food may not be representative of what a person normally eats. None of the studies that analyzed social media posts connected the content of the post to individual diet and weight loss behavior. However, they did show the potential for using social media data to measure population health problems like obesity, diabetes, and high blood pressure. Large social media datasets correlated with population health outcomes may not be applicable to individuals' health outcomes. Other studies have shown that individuals active in online weight loss communities have successfully lost weight (Pappa et al., 2017). More research should be conducted on how a person's social media behavior and exposure to unhealthy and healthy foods via social media is related to individual diet and weight loss behavior.

The studies reviewed suggested that there may be some relationship between timing of social media posts and post content. In a pilot study of an in-person intervention (Fresh Start Trial) adapted for Facebook, participants indicated that posts at certain times of day were most likely to reach them (Silfee et al., 2018). Health communication campaigns should be implemented when there is public interest in and excitement about a health topic like diet and exercise (Backer, Rogers, & Sopory, 1992). For example, a social media-based diet/weight loss intervention may be more effective if implemented during New Year's due to the popularity of diet- and weight loss-related New Year's resolutions than if the intervention were implemented at another time of year.

Findings regarding the source of social media posts were mixed; some showed that men were more likely to post high calorie foods and others showed that women were more likely. More research is needed to discern the differences between what males and females are likely to post. This information can help researchers to design effective diet-related health communication campaigns by tailoring messages to specific audiences. It may also help researchers to understand differences in actual dietary behavior reflected in individuals' posting behavior.

Limitations

This review should be understood within the context of its limitations. For this review, the first author was primarily responsible for screening, abstracting, and managing data. To improve objectivity, the matrix form used to abstract data was piloted using a random sample of approximately 10% of studies and agreement between JH and the other trained research assistant was high. Given the heterogeneity of findings, a meta-analysis could not be performed for study outcomes and instead a narrative approach was used. This review synthesized results of studies that focus both on social media content and individual behavior, giving greater insight into how

social media might be better used for diet and weight loss research. Since study of social media for health communication and interventions is a rapidly growing field (Müller et al., 2018), this systematic review likely missed new research published while the review was being conducted. Future systematic reviews will be able to expound on the findings presented in this review as new research continues to emerge.

Conclusion

This review is one of the first to include studies focused both on individual behavior and those focused on social media content. This inclusion allows for comparison and synthesis of data on individual behavior change with population-level insights that can be gained from social media and big data analysis. It also includes findings from qualitative and mixed methods studies to provide greater understanding of diet and weight loss on social media. This review highlights the need for more research dedicated to diet and weight loss on social media, particularly rigorous, well-controlled and sufficiently powered intervention trials that build on the pilot data highlighted in this review. More rigorous randomized controlled trials will also allow researchers to better assess the social media's contribution to diet and weight loss intervention effects. Additional research will provide a better understanding of what strategies and messages would be most effective for diet/weight loss social media campaigns. Further research on how interaction with diet/weight loss social media campaigns translates to individual behavior change will help to address the obesity epidemic in the US.

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REFERENCES

Abbar, S., Mejova, Y., & Weber, I. (2015). You Tweet what you eat: Studying food consumption through Twitter. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (pp. 3197–3206). New York, NY, USA: ACM. http://doi.org/10.1145/2702123.2702153

Alajajian, S. E., Williams, J. R., Reagan, A. J., Alajajian, S. C., Frank, M. R., Mitchell, L., … Dodds, P. S. (2017). The Lexicocalorimeter: Gauging public health through caloric input and output on social media. *PLOS ONE*, *12*(2). http://doi.org/10.1371/journal.pone.0168893

Andrade, E., Evans, W., Barrett, N., Edberg, M., & Cleary, S. (in press). Exploring strategies to increase Latino immigrant youth engagement in health promotion using social media (in press). *JMIR Public Health and Surveillance*. http://doi.org/10.2196/publichealth.9332

Ashton, L. M., Morgan, P. J., Hutchesson, M. J., Rollo, M. E., & Collins, C. E. (2017). *Nutrition Journal*, *16*(2). http://doi.org/10.1186/s12937-017-0227-8

Backer, T. E., Rogers, E., & Sopory, P. (1992). *Designing health communication campaigns: What works?* Thousand Oaks, CA: Sage Publications.

Balatsoukas, P., Kennedy, C. M., Buchan, I., Powell, J., & Ainsworth, J. (2015). The role of social network technologies in online health promotion: A narrative review of theoretical and empirical factors influencing intervention effectiveness. *Journal of Medical Internet Research*, *17*(6), e141. http://doi.org/10.2196/jmir.3662

Barragan, N. C., Noller, A. J., Robles, B., Gase, L. N., Leighs, M. S., Bogert, S., … Kuo, T. (2014). The "sugar pack" health marketing campaign in Los Angeles County, 2011-2012. *Health Promotion Practice*, *15*(2), 208–216. http://doi.org/10.1177/1524839913507280

Boswell, R. G., & Kober, H. (2016). Food cue reactivity and craving predict eating and weight gain: A meta-analytic review. *Obesity Reviews*, *17*(2), 159–177. http://doi.org/10.1111/obr.12354

Caplette, M. E., Provencher, V. V., Bissonnette-Maheux, V. V., Dugrenier, M., Lapointe, A., Gagnon, M. P., … Desroches, S. (2017). Increasing fruit and vegetable consumption through a healthy eating blog: A feasibility study. *JMIR Research Protocols*, *6*(4), e59. http://doi.org/10.2196/resprot.6622

Cavallo, D. N., Sisneros, J. A., Ronay, A. A., Robbins, C. L., Jilcott Pitts, S. B., Keyserling, T. C., … Samuel-Hodge, C. D. (2016). Assessing the feasibility of a web-based weight loss intervention for low-income women of reproductive age: A pilot study. *JMIR Research Protocols*, *5*(1), e30. http://doi.org/10.2196/resprot.4865

Chen, X., & Yang, X. (2014). Does food environment influence food choices? A geographical analysis through "tweets." *Applied Geography*, *51*, 82–89. http://doi.org/10.1016/j.apgeog.2014.04.003

Chung, A. E., Skinner, A. C., Hasty, S. E., & Perrin, E. M. (2017). Tweeting to health: A novel mHealth intervention using Fitbits and Twitter to foster healthy lifestyles. *Clinical Pediatrics*, *56*(1), 26–32. http://doi.org/10.1177/0009922816653385

Clearinghouse for Labor Education and Research. (2014). *Guidelines for reviewing quantitative descriptive studies*. Washington, DC.

comScore. (2017). *The 2017 U.S. cross-platform future in focus*. Reston, VA.

Dagan, N., Beskin, D., Brezis, M., & Reis, B. Y. (2015). Effects of social network exposure on nutritional learning: Development of an online educational platform. *JMIR Serious Games*, *3*(2), e7. http://doi.org/10.2196/games.4002

Dahl, A. A., Hales, S. B., & Turner-McGrievy, G. M. (2016). Integrating social media into weight loss interventions. *Current Opinion in Psychology*, *9*, 11–15. http://doi.org/10.1016/j.copsyc.2015.09.018

Desilver, D. (2016). *What's on your table? How America's diet has changed over the decades*. Washington, DC, USA.

Duggan, M., Ellison, N. B., Lampe, C., Lenhart, A., & Madden, M. (2015). *Social Media Update 2014*.

Easton, S., Morton, K., Tappy, Z., Francis, D., & Dennison, L. (2018). Young people's experiences of viewing the fitspiration social media trend: Qualitative study. *Journal of Medical Internet Research*, *20*(6), e219. http://doi.org/10.2196/jmir.9156

Elaheebocus, S. M. R. A., Weal, M., Morrison, L., & Yardley, L. (2018). Peer-based social media features in behavior change interventions: Systematic review. *Journal of Medical Internet Research*, *20*(2), e20. http://doi.org/10.2196/jmir.8342

Freeman, B., Kelly, B., Baur, L., Chapman, K., Chapman, S., Gill, T., & King, L. (2014). Digital junk: Food and beverage marketing on Facebook. *American Journal of Public Health*, *104*(12), e56-64. http://doi.org/10.2105/AJPH.2014.302167

Garrard, J. (2017). *Health sciences literature reviews made easy: The matrix method* (5th editio). Sudbury, MA: Jones & Bartlett Learning.

GBD 2017 Diet Collaborators. (2019). Health effects of dietary risks in 195 countries, 1990–2017: A systematic analysis for the Global Burden of Disease Study 2017. *Lancet*, *393*, 1958–72. http://doi.org/10.1016/S0140-6736(19)30041-8

Guh, D. P., Zhang, W., Bansback, N., Amarsi, Z., Birmingham, C. L., & Anis, A. H. (2009). The incidence of co-morbidities related to obesity and overweight: A systematic review and meta-analysis. *BMC Public Health*, *9*(88), 1–20. http://doi.org/10.1186/1471-2458-9-88

Hales, S. B., Davidson, C., & Turner-McGrievy, G. M. (2014). Varying social media post types differentially impacts engagement in a behavioral weight loss intervention. *Translational*

Behavioral Medicine, *4*(4), 355–362. http://doi.org/10.1007/s13142-014-0274-z

Hingle, M., Yoon, D., Fowler, J., Kobourov, S., Schneider, M. L., Falk, D., & Burd, R. (2013). Collection and visualization of dietary behavior and reasons for eating using twitter. *Journal of Medical Internet Research*, *15*(6), e125–e125. http://doi.org/10.2196/jmir.2613

Holmberg, C., Chaplin, J. E., Hillman, T., & Berg, C. (2016). Adolescents' presentation of food in social media: An explorative study. *Appetite*, *99*, 121–129. http://doi.org/10.1016/j.appet.2016.01.009

Jane, M., Hagger, M., Foster, J., Ho, S., Kane, R., & Pal, S. (2017). Effects of a weight management program delivered by social media on weight and metabolic syndrome risk factors in overweight and obese adults: A randomised controlled trial. *PloS One*, *12*(6), e0178326. http://doi.org/10.1371/journal.pone.0178326

Kaplan, A. M., & Haenlein, M. (2010). Users of the world, unite! The challenges and opportunities of social media. *Business Horizons*, *53*(1), 59–68. http://doi.org/10.1016/j.bushor.2009.09.003

Kietzmann, J. H., Hermkens, K., McCarthy, I. P., & Silvestre, B. S. (2011). Social media? Get serious! Understanding the functional building blocks of social media. *Business Horizons*, *54*(3), 241–251. http://doi.org/10.1016/j.bushor.2011.01.005

Klassen, K. M., Douglass, C. H., Brennan, L., Truby, H., & Lim, M. S. C. (2018). Social media use for nutrition outcomes in young adults: A mixed-methods systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, *15*(70). http://doi.org/10.1186/s12966018-0696-y

Kwon, Y., Lemieux, M., McTavish, J., & Wathen, N. (2015). Identifying and removing duplicate records from systematic review searches. *Journal of the Medical Library Association*, *103*(4), 184–188. http://doi.org/10.3163/1536-5050.103.4.004

Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., & John, P. A., … Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: Explanation and elaboration. *BMJ Online*, *233*. http://doi.org/10.1136/bmj.b2700

Maher, C. A., Lewis, L. K., Ferrar, K., Marshall, S., De Bourdeaudhuij, I., & Vandelanotte, C. (2014). Are health behavior change interventions that use online social networks effective? A systematic review. *Journal of Medical Internet Research*, *16*(2). http://doi.org/10.2196/jmir.2952

Mejova, Y., Haddadi, H., Noulas, A., & Weber, I. (2015). #FoodPorn: Obesity patterns in culinary interactions. In *Proceedings of the 5th International Conference on Digital Health 2015* (pp. 51–58). New York, NY, USA: ACM. http://doi.org/10.1145/2750511.2750524

Merchant, G., Weibel, N., Patrick, K., Fowler, J. H., Norman, G. J., Gupta, A., … Marshall, S. (2014). Click "like" to change your behavior: A mixed methods study of college students' exposure to and engagement with Facebook content designed for weight loss. *Journal of Medical Internet Research*, *16*(6), e158–e158. http://doi.org/10.2196/jmir.3267

Mills, S., Tanner, L., & Adams, J. (2013). Systematic literature review of the effects of food and drink advertising on food and drink-related behaviour, attitudes and beliefs in adult populations. *Obesity Reviews*, *14*, 303–314. http://doi.org/10.1111/obr.12012

Müller, A. M., Maher, C. A., Vandelanotte, C., Hingle, M., Middelweerd, A., Lopez, M. L., … Wark, P. A. (2018). Physical activity, sedentary behavior, and diet-related ehealth and mhealth research: Bibliometric analysis. *Journal of Medical Internet Research*, *20*(4). http://doi.org/10.2196/jmir.8954

National Center for Health Statistics. (2017). *Health, United States, 2016: With chartbook on long-term trends in health*. Retrieved from https://www.cdc.gov/nchs/data/hus/hus16.pdf#019%0Ahttps://www.cdc.gov/nchs/data/hus/hus16.pdf%23056%0Ahttps://www.cdc.gov/nchs/data/hus/hus16.pdf%23listtables%0Ahttps://www.cdc.gov/nchs/data/hus/hus16.pdf%23019

Nestle, M., Wing, R., Birch, L., DiSogra, L., Drewnowski, A., Middleton, S., … Economos, C. (2009). Behavioral and social influences on food choice. *Nutrition Reviews*, *56*(5), 50–64. http://doi.org/10.1111/j.1753-4887.1998.tb01732.x

Neve, M., Morgan, P. J., Jones, P. R., & Collins, C. E. (2010). Effectiveness of web-based interventions in achieving weight loss and weight loss maintenance in overweight and obese adults: A systematic review with meta-analysis. *Obesity Reviews*, *11*(4), 306–321. http://doi.org/10.1111/j.1467-789X.2009.00646.x

Nguyen, Q. C., Kath, S., Meng, H.-W., Li, D., Smith, K. R., VanDerslice, J. A., … Li, F. (2016). Leveraging geotagged Twitter data to examine neighborhood happiness, diet, and physical activity. *Applied Geography*, *73*, 77–88. http://doi.org/10.1016/j.apgeog.2016.06.003

Pappa, G. L., Cunha, T. O., Bicalho, P. V., Ribeiro, A., Couto Silva, A. P., Meira, W., & Beleigoli, A. M. R. (2017). Factors associated with weight change in online weight management communities: A case study in the loseit reddit community. *Journal of Medical Internet Research*, *19*(1). http://doi.org/10.2196/jmir.5816

Pila, E., Mond, J. M., Griffiths, S., Mitchison, D., & Murray, S. B. (2017). A thematic content analysis of #cheatmeal images on social media: Characterizing an emerging dietary trend. *International Journal of Eating Disorders*, *50*(6), 698–706. http://doi.org/10.1002/eat.22671

Schneider, E. P., McGovern, E. E., Lynch, C. L., & Brown, L. S. (2013). Do food blogs serve as a source of nutritionally balanced recipes? An analysis of 6 popular food blogs. *Journal of Nutrition Education & Behavior*, *45*(6), 696–700. Retrieved from

http://10.0.3.248/j.jneb.2013.07.002

Silfee, V. J., Lopez-Cepero, A., Lemon, S. C., Estabrook, B., Nguyen, O., Wang, M. L., & Rosal, M. C. (2018). Adapting a behavioral weight loss intervention for delivery via Facebook: A pilot series among low-income postpartum women. *JMIR Formative Research*, *2*(2), e18. http://doi.org/10.2196/formative.9597

Turner-McGrievy, G. M., & Beets, M. W. (2015). Tweet for health: Using an online social network to examine temporal trends in weight loss-related posts. *Translational Behavioral Medicine*, *5*(2), 160–166. http://doi.org/10.1007/s13142-015-0308-1

Turner-McGrievy, G. M., & Tate, D. F. (2011). Tweets, apps, and pods: Results of the 6-month Mobile Pounds Off Digitally (Mobile POD) randomized weight-loss intervention among adults. *Journal of Medical Internet Research*, *13*(4). http://doi.org/10.2196/jmir.1841

Turner-McGrievy, G. M., & Tate, D. F. (2013). Weight loss social support in 140 characters or less: Use of an online social network in a remotely delivered weight loss intervention. *Translational Behavioral Medicine*, *3*(3), 287–294. http://doi.org/10.1007/s13142-012-0183-y

US Department of Health and Human Services, & US Department of Agriculture. (2015). *2015-2020 Dietary Guidelines for Americans, 8th Edition*.

Vassallo, A. J., Kelly, B., Zhang, L., Wang, Z., Young, S., & Freeman, B. (2018). Junk food marketing on Instagram: Content analysis. *JMIR Public Health and Surveillance*, *4*(2), e54. http://doi.org/10.2196/publichealth.9594

Vidal, L., Ares, G., Machin, L., & Jaeger, S. R. (2015). Using Twitter data for food-related consumer research: A case study on what people say when tweeting about different eating situations. *Food Quality and Preference*, *45*, 58–69. http://doi.org/10.1016/j.foodqual.2015.05.006

Vukmirovic, M. (2015). The effects of food advertising on food-related behaviours and perceptions in adults: A review. *Food Research International*, *75*, 13–19. http://doi.org/10.1016/j.foodres.2015.05.011

West, D. S., Monroe, C. M., Turner-McGrievy, G., Sundstrom, B., Larsen, C., Magradey, K., … Brandt, H. M. (2016). A technology-mediated behavioral weight gain prevention intervention for college students: A controlled, quasi-experimental study. *Journal of Medical Internet Research*, *18*(6), 61. http://doi.org/10.2196/jmir.5474

Widener, M. J., & Li, W. (2014). Using geolocated Twitter data to monitor the prevalence of healthy and unhealthy food references across the US. *Applied Geography*, *54*(SI), 189–197. http://doi.org/10.1016/j.apgeog.2014.07.017

Wilkinson, J. L., Strickling, K., Payne, H. E., Jensen, K. C., West, J. H., & Eysenbach, G. (2016). Evaluation of diet-related infographics on Pinterest for use of behavior change theories: A content analysis. *Journal of Medical Internet Research, 18*(12), 1.

http://doi.org/10.2196/mhealth.6367

Zhang, X., Baker, K., Pember, S., & Bissell, K. (2017). Persuading me to eat healthy: A content analysis of YouTube public service announcements grounded in the Health Belief Model. *Southern Communication Journal*, *82*(1), 38–51. http://doi.org/10.1080/1041794X.2016.1278259

Databases: Cochrane, CINAHL, Communication and Mass Media Complete, PsycInfo, Health Source: Nursing/Academic Edition, Web of Science, ProQuest Dissertations*
Limiters applied: 2003-, English only
Search string: ("Social Media" OR "Twitter" OR "Instagram" OR "Facebook" OR "Pinterest" OR "Tumblr" OR "Vine" OR "Flickr" OR "MySpace") AND ("Weight Loss" OR “weight management” OR "Diet" OR "Eating" OR “nutrition” OR "Food" OR “food porn”)

Database: PubMed
Limiters applied: 2003-, English only
Search string: (("Social Media"[Mesh]) OR "Twitter" OR "Instagram" OR "Facebook" OR "Pinterest" OR "Tumblr" OR "Vine" OR "Flickr" OR "MySpace") AND (("Weight Loss"[Mesh]) OR “weight management” OR ("Diet"[Mesh]) OR ("Eating"[Mesh]) OR ("Nutritional Sciences"[Mesh]) OR ("Food"[Mesh]) OR “food porn”)

Database: Association for Computing Machinery (ACM) Digital Library
Limiters applied: 2003-, English only
Search string: +("Social Media" Twitter Instagram Facebook Pinterest Tumblr Vine Flickr MySpace) +(diet eating nutrition food "Weight Loss" “weight management” “food porn”)

*Additional limiters applied to dissertation search were to include doctoral dissertations only.

Figure 2.1. Search Strategy

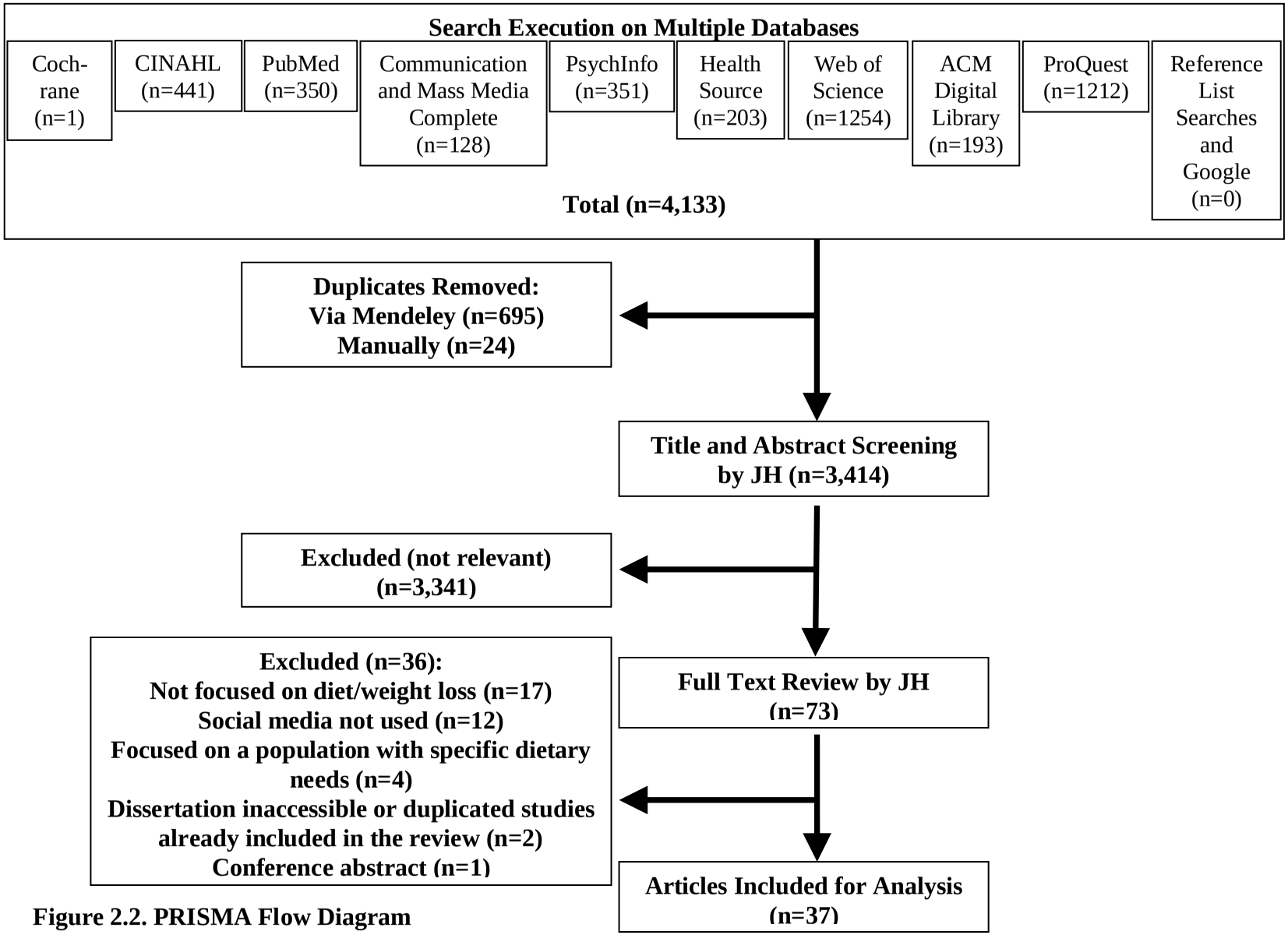

Figure 2.2. PRISMA Flow Diagram

Table 2.1. Summary of Included Articles' Key Findings, Strengths, and Limitations

Author (Year)	Platform	Study Design	Key Findings, Strengths, and Limitations
Abbar et al. (2015)	Twitter	Non-experimental	**Findings:** Men tweet higher calorie foods than women Frequently mentioned foods: pizza, chocolate, chicken, ice cream, apple; drinks: coffee, beer, wine, tea Obesity and caloric value of foods correlated **Strengths:** large sample size, correlation between caloric values of foods and obesity assessed **Limitations:** data come from high socioeconomic status (SES) areas, posting behavior may not represent actual behavior
Alajajian et al. (2017)	Twitter	Non-experimental	**Findings:** Pizza and ice cream accounted for the highest caloric input items across US At the state level, calories eaten (i.e. talked about being eaten in tweets) were correlated with high blood pressure prevalence, diabetes rate, and overweight/obesity rate **Strengths:** large sample size, correlation between caloric value of Tweets and health outcomes assessed **Limitations:** posting behavior may not represent actual behavior, limitations in assessing calories per Tweet
Ballantine & Stephenson (2011)	Facebook	Non-experimental	**Findings:** Types of Facebook weight loss page users: passive (47%), active supporters (32%), casual browsers (21%) Active supporters were longest members, passive recipients were most positive about level of satisfaction **Strengths:** development of a measurement tool to assess online social support **Limitations:** sample composed of almost entirely female Weight Watcher participants, limitations in recruitment/sampling strategy
Barragan et al. (2014)	Facebook Twitter Youtube	Non-experimental	**Findings:** 1.5 million Twitter impressions; 15,000 Youtube views; 60,000 sugar calculator uses via Twitter and Facebook 30% of individuals had accurate knowledge of sugar content in sugar-sweetened beverages (SSB) 62% were likely/very likely to reduce SSB consumption **Strengths:** large sample size, multi-faceted health communication campaign **Limitations:** self-report measures, limited generalizability
Bissonnette-Maheux et al. (2015)	Blogs	Qualitative	**Findings:** 75% of participants thought blogs were a good place to learn about nutrition 83% said that weekly emails and new content weekly would help them to remain engaged with the blog Barriers to using a registered dietician's healthy eating blog were lengthy posts, presence of advertising, and lack of time **Strengths:** provided in-depth information on how blogs could serve as a source of nutrition information **Limitations:** Participants not representative of general population due to high SES, results limited to blogs written by dieticians but not general recipe bloggers

Table 2.1 Cont. Summary of Included Articles' Key Findings, Strengths, and Limitations

Author (Year)	Platform	Study Design	Key Findings, Strengths, and Limitations
Caplette et al. (2017)	Blogs	Experimental	**Findings:** Healthy eating group increased fruit/vegetable (FV) intake at 6 months from 2.4 FV/day to 4.2 FV/day **Strengths:** provided information on how to design and implement a blog-based diet/weight loss intervention, provided preliminary evidence of potential effectiveness of blog-based interventions **Limitations:** did not assess how blog engagement was related to dietary behavior change, mostly white and high SES sample not representative of general population
Carrotte et al. (2017)	Instagram, Facebook, Twitter, & Tumblr	Qualitative	**Findings:** Most posts related to exercise/fitness; 1/6 related to food Females were more likely to appear thinner and less muscular than males **Strengths:** examined multiple social media platforms, contributed to knowledge of fitspiration content **Limitations:** limited keyword search, search limited to 30 minutes
Cavallo et al. (2016)	Facebook	Mixed Methods	**Findings:** 7 participants lost weight with average -1.3 kilograms (kg) lost, range of weight change of -9 to 5 kg Change in FV/day was on average 0.5 servings/day, range -2 to 3 FV/day **Strengths:** provided information on enhancing intervention for participants, diverse sample **Limitations:** High attrition, low engagement, small sample, no statistical testing
Chen & Yang (2014)	Twitter	Non-experimental	**Findings:** There were more green retailers for healthy Tweets (mean = 1.3) than unhealthy Tweets (mean = 0.5) Fast food choices prevalent from 2 PM to 12 AM and grocery choices prevalent from 5-9:30 PM **Strengths:** used real-time Twitter data to examine healthfulness of tweets based on location, provided additional information on how the food environment may influence food choices **Limitations:** no way to assess individual's actual behavior vs posting behavior, did not consider SES variables that may contribute to food choices
Chung et al. (2017)	Twitter	Experimental	**Findings:** F/V consumption increases ranged from 0.5 to 2.5 servings per day SSB consumption decreases ranged from -0.3 to -1.2 servings per day Participants lost between 0.2-7 pounds and 0.5-14% body fat **Strengths:** assessed a variety of behavioral and weight-related outcomes, multi-faceted intervention **Limitations:** small sample size, no control group, little information on how participants used Twitter

Table 2.1 Cont. Summary of Included Articles' Key Findings, Strengths, and Limitations

Author (Year)	Platform	Study Design	Key Findings, Strengths, and Limitations
Dagan et al. (2015)	Facebook	Experimental	**Findings:** No difference between groups (social vs not social) in nutrition knowledge 43% wanted to improve eating behavior, 32% reported high eating behavior improvement, and 73% said they pay more attention to food composition and calories due to Facebook game **Strengths:** examined social competition through Facebook to enhance a diet intervention, experimental design **Limitations:** Low engagement, high attrition, limited use of Facebook as an intervention tool, self-report measures
De Choudhury et al. (2016)	Instagram	Non-experimental	**Findings:** Food desert posts feature foods higher in fat, cholesterol, and sugar by 5-17% compared to matched non-food desert communities Food deserts have lower proportion of fruit/vegetable posts than non-food deserts **Strengths:** large sample size, correlation of posts' nutritional content in food deserts and non-food deserts **Limitations:** posting behavior may not represent actual behavior, limitations in assessing calories per post
de la Peña & Quintanilla (2015)	Facebook	Qualitative	**Findings:** In Facebook weight loss discussion threads, support providers are either experts or regular members Support seekers fall into 7 different categories: anxious/fearful, opportunistic, app users, searching for quality of life, body image, always on a diet, and lurkers/sharers **Strengths:** provides in-depth information on social support in the context of Facebook-based weight loss communities **Limitations:** results not generalizable
Freeman et al. (2014)	Facebook	Qualitative	**Findings:** Most pages posted links to outside apps including other social media platforms All brands used special promotions related to particular holidays (e.g., Valentine's Day) **Strengths:** quantified Facebook marketing reach and exposure, contributes evidence that young adults are likely exposed to social media marketing for energy-dense, nutrient-poor foods **Limitations:** did not examine users' reactions to page content, did not assess paid ads
Godino et al. (2016)	Facebook	Experimental	**Findings:** Significantly lower weight in SMART intervention group compared with the control group at 6 and 12 months Decline in Facebook engagement over time **Strengths:** Large and diverse sample, long intervention and follow-up period, randomized design **Limitations:** did not assess relationship between engagement and weight loss, high chance of contamination between groups

Table 2.1 Cont. Summary of Included Articles' Key Findings, Strengths, and Limitations

Author (Year)	Platform	Study Design	Key Findings, Strengths, and Limitations
Gore et al. (2015)	Twitter	Non-experimental	**Findings:** Tweets about wine were most negatively correlated with obesity, while Tweets about chicken nuggets were most positively correlated Higher frequency of fruit/vegetable-related tweets was negatively correlated with obesity rate. **Strengths:** large sample size, correlation of Tweet content with health outcomes **Limitations:** correlational study; geotagged Tweets may not be generalizable; does not assess Tweet as a whole, only individual words
Hales et al. (2014)	Facebook	Experimental	**Findings:** Polls were the most engaging type of post Facebook engagement was significantly associated with weight loss during four month maintenance period **Strengths:** assessed relationship between engagement and weight loss, objective weight measurements **Limitations:** low engagement, Facebook use was voluntary, participants mostly white and high SES
Hingle et al. (2013)	Twitter	Experimental	**Findings:** Participants Tweeted 773 times using 2,862 food-related and reasons for eating hashtags Most frequent food-related hashtags: #grains, #protein, #dairy Most frequent reasons for eating hashtags: #convenience, #taste, #social **Strengths:** used real-time data to provide visualizations of the relationship between foods eaten and reasons for eating, evaluated feasibility/acceptability of using Twitter as a dietary data collection tool **Limitations:** small number of Tweets, small sample limited to those with prior Twitter experience
Holmberg et al. (2016)	Instagram	Qualitative	**Findings:** Most popular foods/beverages were: cookies/pastries, soda/lemonade, and chocolate High calorie low nutrient foods shown in 68% of images **Strengths:** systematic selection of one image per account for analysis, wide variety of images analyzed **Limitations:** sample accounts belonged to mostly teenaged girls, posting behavior may not represent actual behavior
Jane et al. (2017)	Facebook	Experimental	**Findings:** Compared to control group, Facebook group lost significantly more weight at weeks 6, 18, and 24 and had significant reductions in waist circumference at weeks 18 and 24 **Strengths:** randomized experimental design, long study duration **Limitations:** intervention occurred over Thanksgiving-New Year's holidays, and eating during this period may not be indicative of general eating behavior; did not measure Facebook engagement and how that may have affected the Facebook group's outcomes

Table 2.1 Cont. Summary of Included Articles' Key Findings, Strengths, and Limitations

Author (Year)	Platform	Study Design	Key Findings, Strengths, and Limitations
Kinard (2016)	Instagram	Experimental	**Findings:** Obese participants were more likely to like, share, and comment on the food-related post and to follow the restaurant and view other social media posts by the restaurant when post activity is low (few likes/comments) compared to high (many likes/comments) **Strengths:** randomized experimental design, assessed how weight status interacts with likelihood of engaging with a social media post depicting healthy food **Limitations:** self-reported BMI, not possible to assess generalizability due to missing demographic information, does not assess the relationship between engagement with a post and actual behavior
Mejova et al. (2015)	Instagram	Non-experimental	**Findings:** Correlation of 0.3 between number of fast food restaurants and county obesity rates Posts at non-fast food restaurants had higher number of emotion, healthy, social, and foodporn-related hashtags, whereas posts at fast food restaurants had more unhealthy hashtags Pictures of dessert were most liked, followed by macaroni and cheese, burgers, and French food **Strengths:** large sample size, assessed type of restaurant and relationship to obesity rates **Limitations:** unable to assess relationship of individuals' BMIs to posts from each type of restaurant, only assessed restaurants that were visited by people who posted to social media which limited generalizability
Merchant et al. (2014)	Facebook	Mixed Methods	**Findings:** 40% of interview participants described lurking on Facebook Highest post interaction came from polls and photos, and engagement declined over time **Strengths:** provided additional information on lurking behavior, racially/ethnically diverse sample **Limitations:** results have limited generalizability to college students, did not assess type of engagement and relationship to weight loss outcomes
Merchant et al. (2017)	Facebook	Qualitative	**Findings:** Liked 3-2-Me because it included timeline reminders and information they could access at their leisure Treatment group found Facebook page to be motivating and fun, texting useful, and apps difficult to use Making goals public, social accountability and comparison were helpful in a social media context **Strengths:** in-depth qualitative data about intervention acceptability, transparent coding using grounded theory principles **Limitations:** high contamination between groups, convenience sample of larger intervention

Table 2.1 Cont. Summary of Included Articles' Key Findings, Strengths, and Limitations

Author (Year)	Platform	Study Design	Key Findings, Strengths, and Limitations
Nguyen et al. (2013)	Twitter	Non-experimental	**Findings:** Mean caloric density of food references was 250 calories (per 100 g) Food tweets that did not include fast food had a happier sentiment than those with fast food references Top food terms were coffee, beer, tea, wine, pizza, burger, ice cream, chocolate, cake **Strengths:** large sample size, assessed sentiment surrounding food/diet-related Tweets **Limitations:** posting behavior may not represent actual behavior, limitations in assessing calories per Tweet
Pila et al. (2017)	Instagram	Qualitative	**Findings:** 55% of images represented volume of food consistent with a binge episode Caloric estimates per post ranged from 214 (slice of cheese with tablespoon of jam) to 9120 (2 dozen donuts) 71% of images portrayed calorically dense, high fat, low nutrient foods **Strengths:** assessed an important dietary trend in dieting/pro-muscularity communities, transparent coding approach **Limitations:** posting behavior may not represent actual behavior, limited keyword search
Schneider et al. (2013)	Blogs	Non-experimental	**Findings:** Recipes from December-May contained 30% more sodium than recipes from June-November Average calories per serving (516) were within recommended dietary guidelines Sodium (855 milligrams (mg)) and saturated fat (9.4 grams (g)) per serving exceeded recommendations **Strengths:** assessed popular and active recipe blogs for nutritional content, assessed seasonal differences **Limitations:** only examined entrees but didn't account for additional calories from desserts and sides, did not assess people's actual behavior when interacting with recipe blogs
Turner-McGrievy et al. (2011)	Twitter	Experimental	**Findings:** Non-completers (n = 10) were younger (mean age of 31 vs 44 years) and were 5 times less likely to be white No difference between groups in weight loss, energy expenditure, energy/fat intake, or eating behavior at 3 or 6 months Decline in engagement over time **Strengths:** measured differences between non-completers and completers, randomized design **Limitations:** most participants were high SES white women, examined short term weight loss but not maintenance
Turner-McGrievy et al. (2013)	Twitter	Experimental	**Findings:** There were 2,630 total Twitter posts over 6 months; posts per participant ranged from 0-385 Number of Tweets predicted weight loss at 6 months: for every 10 additional Tweets, there was -0.5% weight loss **Strengths:** assessed relationship between engagement and weight loss, randomized design **Limitations:** most participants were high SES white women, small sample size

Table 2.1 Cont. Summary of Included Articles' Key Findings, Strengths, and Limitations

Author (Year)	Platform	Study Design	Key Findings, Strengths, and Limitations
Turner-McGrievy et al. (2015)	Twitter	Non-experimental	**Findings:** There were more weight loss-related Tweets during and after the Thanksgiving-New Year holidays than before the holidays There were fewer #diet Tweets after and during the holidays than before the holidays **Strengths:** examined temporal trends related to diet and weight loss on Twitter, provided information that could be used to time weight loss intervention delivery **Limitations:** post content not assessed so relevance of Tweets is unclear, limited keyword search strategy
Vidal et al. (2015)	Twitter	Non-experimental	**Findings:** Main themes identified: context of food purchase, preparation, consumption; individual foods/beverages, and other associations with foods or consequences of consumption Celebratory eating was most frequently referenced during dinner **Strengths:** examined temporal trends and relationship to eating behaviors discussed in Tweets, examined context of food/diet-related Tweets **Limitations:** Tweet character limit may prevent people from fully expressing themselves about their food choices, limited keyword search
Villiard & Moreno (2012)	Facebook	Experimental	**Findings:** 40% of first 40 fitness-related ads were related to fitness, 30% to charity runs, 24% to fitness apparel/equipment, and 10% to fad dieting Non-fitness related ads were for sweets and desserts **Strengths:** analyzed the ad content displayed in response to status updates, experimental design **Limitations:** no assessment of whether demographic characteristics affected types of ads displayed, no evaluation of whether the type of status update influenced the type of ad displayed
West et al. (2016)	Facebook	Experimental	**Findings:** No significant difference in weight change between healthy weight information (HW) and Human Papilloma Virus vaccine information (HPV) groups HW group participants increased the number of appropriate weight control strategies by an average of 2.1 compared to a reduction of -1.1 among HPV group participants **Strengths:** randomized design, high retention, multifaceted intervention to prevent weight gain **Limitations:** self-reported measures, small sample of mostly white females, contamination between groups, short intervention duration

Table 2.1 Cont. Summary of Included Articles' Key Findings, Strengths, and Limitations

Author (Year)	Platform	Study Design	Key Findings, Strengths, and Limitations
Widener & Li (2014)	Twitter	Non-experimental	**Findings:** Tweets from low income low access (LILA) tracts were less likely to contain healthy food content than tweets from non-LILA tracts Higher proportion of tweets with unhealthy food content in LILA tracts than non-LILA tracts **Strengths:** examined food environment's relationship to healthfulness of Tweet, large sample size **Limitations:** data is time sensitive and temporal trends were not assessed, posting behavior may not represent actual behavior
Wilkinson et al. (2016)	Pinterest	Qualitative	**Findings:** Pins addressed: macronutrients, micronutrients, and portion control/weight management Health Belief Model and Social Cognitive Theory elements presented in Pins: perceived benefits, perceived barriers, perceived susceptibility, perceived severity, self-efficacy, self-regulation/control, behavioral capability, observational learning/modeling, subjective norms **Strengths:** examined theoretical elements present in Pins, assessed if Pins would be recommended by a professional **Limitations:** over half of initial target sample size was removed due to duplicate Pins, limited sampling method does not account for possible temporal trends
Zhang et al. (2017)	YouTube	Qualitative	**Findings:** 50% of YouTube public service announcements (PSAs) presented cost of not eating healthy 58% presented benefits of healthy eating, including: nutrition, psychological benefits, and taste 85% provided guidance to eat healthy (enhancing self-efficacy for healthy eating) **Strengths:** examined theoretical elements present in YouTube PSAs, examined a less frequently studied but important social media platform **Limitations:** limited keyword search, number of shares was not included as an indicator of success in the analysis

Table 2.2. Characteristics of Included Studies Separated by Focus of Study

	All Studies (n=37)		Focus of Study: Individual Behavior (n=18)		Focus of Study: Social Media Content (n=19)	
	N	%*	n	%*	n	%*
Platform						
Facebook	13	35.1	10	55.5	3	15.8
Twitter	12	32.4	4	22.2	8	42.1
Instagram	5	13.5	1	5.6	4	21.1
Blogs	3	8.1	2	11.1	1	5.3
YouTube	1	2.7	0	0	1	5.3
Pinterest	1	2.7	0	0	1	5.3
Multiple platforms	2	5.4	1	5.6	1	5.3
Image, Video, or Text Analysis						
Text only	13	35.1	2	11.1	11	57.9
Image and text	6	16.2	0	0	6	31.6
Video	1	2.7	0	0	1	5.3
None	17	45.9	16	88.9	1	5.3
Theory**						
Social Cognitive Theory	10	27.0	8	44.4	2	10.5
Theory of Reasoned Action	4	10.8	3	16.7	1	5.3
Social Support/Networks/Comparison	3	8.1	3	16.7	0	0
Control Theory	3	8.1	3	16.7	0	0
Health Belief Model	2	5.4	0	0	2	10.5
Other***	6	16.2	4	22.2	2	10.5
None	20	54.1	7	38.9	13	68.4

*Rounded percentages may not add up to 100.

**Some studies used multiple theories, so the number of studies do not add up to 37, and the percentages do not add up to 100%.

***Other theories used in one study each: Social Learning Theory, Transtheoretical Model, Ecological Theory, Objectification Theory, Integrative Model of Behavior Prediction, and Self Determination Theory.

Table 2.3a. Sample Characteristics of Social Media Content Studies

Author (Year)	Platform	Sample Size
Abbar et al. (2015)	Twitter	503,000,000 Tweets
Alajajian et al. (2017)	Twitter	50,000,000 Tweets
Carrotte et al. (2017)	Instagram, Facebook, Twitter, & Tumblr	415 social media posts
Chen & Yang (2014)	Twitter	357 Tweets
De Choudhury et al. (2016)	Instagram	14,000,000 Tweets
de la Peña & Quintanilla (2015)	Facebook	4 Facebook discussion threads
Freeman et al. (2014)	Facebook	27 Facebook pages
Gore et al. (2015)	Twitter	25,000,000 Tweets
Holmberg et al. (2016)	Instagram	1,001 Instagram images
Mejova et al. (2015)	Instagram	20,848,210 Instagram posts
Nguyen et al. (2013)	Twitter	2,848,900 Tweets
Pila et al. (2017)	Instagram	600 Instagram posts
Schneider et al. (2013)	Blogs	96 blog recipes
Turner-McGrievy et al. (2015)	Twitter	406,863 Tweets
Vidal et al. (2015)	Twitter	12,260 Tweets
Villiard & Moreno (2012)	Facebook	800 Facebook ads
Widener & Li (2014)	Twitter	128,914 Tweets
Wilkinson et al. (2016)	Pinterest	238 Pinterest Pins
Zhang et al. (2017)	YouTube	341 YouTube videos

Table 2.3b. Sample Characteristics of Individual Behavior Studies

Author (Year)	Platform	Sample Size	BMI Mean (SD)	% Overweight and/or Obese**	Age in Years* Mean (SD)	%** Female	%** White
Ashton et al. (2017)	Facebook	50	25.5 (4.6)	46%	22.1 (2.0)	0%	NR
Ballantine & Stephenson (2011)	Facebook	145	NR	NR	37% aged 31-40	98%	NR
Barragan et al. (2014)	Facebook Twitter Youtube	1041	NR	34%	39% aged 25-44	46%	14%
Bissonnette-Maheux et al. (2015)	Blogs	29	NR	NR	44.0 (17.0)	100%	100%
Caplette et al. (2017)	Blogs	80	27.5 (4.6)	31%	42.0 (14.0)	100%	92%
Cavallo et al. (2016)	Facebook	12	39 (8.5)	100%	30 (6.5)	100%	25%
Chung et al. (2017)	Twitter	12	NR	58%	19.7 (NR)	66%	50%
Dagan et al. (2015)	Facebook	63	22.6 (NR)	NR	30.2 (NR)	62%	NR
Godino et al. (2016)	Facebook	404	28.9 (2.8)	NR	22.7 (3.8)	71%	42%
Hales et al. (2014)	Facebook	63	35.2 (5.3)	NR	48.5 (8.3)	73%	79%
Hingle et al. (2013)	Twitter	50	NR	NR	NR	NR	NR
Jane et al. (2017)	Facebook	67	32.9 (NR)	NR	50.4	85%	NR
Kinard (2016)	Instagram	364	NR	45%	32.1 (9.5)	50%	79%
Merchant et al. (2014)	Facebook	199	28.7 (3.5)	NR	22.0 (3.8)	70%	43%
Merchant et al. (2017)	Facebook	38	29.8 (2.9)	NR	25 (4.5)	55%	53%
Turner-McGrievy et al. (2011)	Twitter	96	32.6 (4.7)	NR	42.9 (10.2)	75%	77%
Turner-McGrievy et al. (2013)	Twitter	47	32.9 (4.8)	NR	42.6 (10.7)	77%	75%
West et al. (2016)	Facebook	58	24 (5.1)	22%	21.6 (2.2)	81%	90%

NR=not reported

*In studies that provided the percentage of participants in various age categories in lieu of mean and standard deviation, the age category that was most common is reported in this table.

**Percentages rounded to the nearest whole number.

Table 2.4. Methodological Characteristics of Included Studies Separated by Focus of Study

	All Studies (n=37)		Focus of Study: Individual Behavior (n=18)		Focus of Study: Social Media Content (n=19)	
	n	%*	n	%*	n	%*
Study Methodology						
Non-Experimental	13	35.1	2	11.1	11	57.9
Experimental	13	35.1	12	66.7	1	5.3
Qualitative	9	24.3	2	11.1	7	36.8
Mixed Methods	2	5.4	2	11.1	0	0
Sampling						
Probability	4	10.8	0	0	4	21.1
Non-Probability	33	89.2	19	100	15	78.9
Study Quality						
Low	10	27.7	7	38.9	3	15.8
Medium	13	35.1	5	27.8	8	42.1
High	14	37.8	6	33.3	8	42.1
Study Limitations						
Restricted sample	31	83.7	16	88.9	15	73.7
Measurement limitations	22	59.5	12	66.7	10	52.6
Keywords used	8	21.6	1	5.6	7	36.8

*Percentages are rounded and may not add up to 100%.

Table 2.5. Study Outcomes Presented by Focus of Study

	All Studies (n=37)		Focus of Study			
			Individual Behavior (n=18)		Social Media Content (n=19)	
Outcomes of Interest	**n**	**%**	**n**	**%**	**n**	**%**
Social Media Post Characteristics	20	54.1	1	5.5	19	100
Acceptability	9	24.3	9	50	0	0
Engagement	9	24.3	7	38.8	2	10.5
Diet-Related Behavior, Knowledge, or Attitudes	8	21.6	8	44.4	0	0
Social Support/Networks	7	18.9	5	27.8	2	10.5
Weight/BMI Change	7	18.9	7	38.8	0	0
Attrition/Retention	6	16.2	6	33.3	0	0
Population Health Outcomes	6	16.2	0	0	6	31.6
Presence of Theoretical Constructs	3	8.1	1	5.5	2	10.5
Individual Health Outcomes	2	5.4	2	11.1	0	0

Most studies reported on multiple outcomes of interest, so the number of studies reported in column 2 adds up to more than 37.

CHAPTER 3

DIETING FOR WEIGHT LOSS ON INSTAGRAM: A CONTENT ANALYSIS GUIDED BY IDEATION THEORY

Abstract

Photo-based social media, such as Instagram, are popular for sharing diet and weight management content. The study employed Ideation Theory, which proposes that behavior change is more likely when more ideation factors such as knowledge, beliefs, and social influence and norms are present. Ideation Theory was used to explore how people represent dieting for weight loss through their postings on Instagram and how this information might be used to inform photo-based social media health communication campaigns. One thousand publicly available diet/weight loss-related Instagram posts were randomly selected via keyword search from January 1, 2014-June 3, 2015. The Instagram posts were coded on 50 characteristics to assess post content. Of the 1,000 posts, nearly 80% of accounts belonged to individuals and 55% belonged to females. Over half of posts (57%) contained an image of food, and vegetables were the most commonly pictured food item (38%). Less than 20% of posts contained food items that US Dietary Guidelines recommend limiting, such as red meat. When posts included images of people (33%), more pictured females than males (16% vs 10%), and muscularity was emphasized more often than thinness (12% vs 7%). Over 60% of posts had a positive sentiment, and #healthy was the most commonly used hashtag. This exploratory study provided information on users' interaction with photo-based social media related to dieting for weight loss.

Introduction

Social media use has become widespread over the last several years. Social media includes websites and applications that feature user-generated content including photos, writing, status updates, and video (Cann, Dimitriou, & Hooley, 2011). Since 2005, social media use has increased more than tenfold, from 5% of all adults in 2005 to 69% in 2018 (Pew Research Center, 2018). Data shows that adults spend 20% of their time online interacting with social media, which is more than the amount of time spent for any other leisure time activity (e.g., viewing videos, listening to music) (comScore, 2017). The most used social media applications/websites are YouTube, Facebook, Instagram, and Pinterest (Smith, Anderson, & Caiazza, 2018). Photo-based social media platforms such as Instagram and Pinterest are becoming increasingly popular for sharing diet and weight management content.

Instagram

Instagram's 1 billion active monthly users post a variety of photos and stories (a combination of videos, text, and photos) in part to reflect their current thoughts and experiences (Instagram, 2019). Sixty percent of users access Instagram daily while nearly one-third use Instagram weekly (Smith et al., 2018). Each day, Instagram users upload more than 500 million photos and stories (Instagram, 2019). As the third most popular social media platform after YouTube and Facebook (Smith et al., 2018), over two-thirds (71%) of Internet-using adults aged 18-24 years use Instagram, as do 55% of adults aged 25-29 years and 40% of adults aged 30-49 years (Smith et al., 2018). Among teens aged 13-17 years, almost three-quarters (71%) use Instagram (Anderson, Smith, & Caiazza, 2018). Instagram provides an excellent platform for reaching people of color, as 43% of non-Hispanic black, 38% of Hispanic, and 32% of non-Hispanic white internet-using adults use Instagram (Pew Research Center, 2018). Similar

percentages of non-Hispanic white (73%), Hispanic (72%), and non-Hispanic black (72%) teenagers report using Instagram (Anderson et al., 2018).

Instagram offers users the opportunity to share diet and weight management content. With the 2,200-character limit on Instagram as compared to the 280-character limit on Twitter, Instagram's photo- and short video-based platform enables more detailed posts of tips, advice, and recipes related to dieting for weight loss. The ability to share diet and weight loss-related information is important because social media users often use social media instrumentally: to search for information and support when trying to change their health behaviors (Dahl, Hales, & Turner-McGrievy, 2016). Vaterlaus, Patten, Roche, and Young (2015) indicated that 80% of college students reported that social media use expanded their food choices by providing them with ideas on what to eat and new ways to prepare food. Instagram also represented a venue for sharing pictures of their own food experiences (Vaterlaus et al., 2015). Photos related to dieting for weight loss (e.g., pictures of food, before and after photos of people trying to lose weight) may provide more motivation for people to change their dieting for weight loss behavior than text alone (Dahl et al., 2016; Vaterlaus et al., 2015).

Food and Dieting for Weight Loss on Instagram

Food and dieting for weight loss posts are very popular on Instagram. For example, since Instagram's launch in 2010, a hashtag[1] search on Instagram that was conducted by JH at the time of writing revealed that "#food" was attached to over 330 million public posts, #diet to 57 million public posts, #eatclean to 57 million public posts, #weightloss to 55 million public posts, #fruit to 21 million public posts, #fat to 12 million public posts, and #vegetables to 10 million public posts. The numbers above likely underestimate the number of food-related and weight

[1] A hashtag is a word or phrase preceded by a hash sign (#), used on social media websites and applications to identify messages on a specific topic

loss-related posts on Instagram, given omission of private accounts and posts related to food and weight loss (e.g., a picture of a person eating an apple) that did not include a food-related hashtag.

The most frequently posted food images on Instagram are typically unhealthy (e.g., burgers, macaroni and cheese) (Mejova, Haddadi, Noulas, & Weber, 2015). Only 9% of Instagram images displayed fruits and vegetables (Holmberg, Chaplin, Hillman, & Berg, 2016). A study that examined posts featuring the #cheatmeal hashtag (a hashtag commonly associated with diet and weight loss posts) found that 71% of those posts displayed low-nutrient, high-calorie foods such as pizza, fries, and ice cream (Pila, Mond, Griffiths, Mitchison, & Murray, 2017). Over half of #cheatmeal Instagram posts (55%) featured an amount of food similar to a binge episode (e.g., a dozen donuts), while 14% showed an amount of food that would be appropriate for an individual to eat in a single sitting (Pila et al., 2017). Since young adults may use Instagram and other photo-based social media to support diet for weight loss efforts, it is crucial to understand whether the findings in previous research showing high amounts of unhealthy foods holds true in posts from people who indicate in their post captions that they are interested in weight loss. Thus, the current study focused on how people represent dieting for weight loss through their Instagram posts and profiles.

Ideation Theory

This study was guided by Ideation Theory, which proposes that behavior change is more likely when knowledge, beliefs, social support and influence, social norms, and self-image factors align with goals (Kincaid & Figueroa, 2004). Figure 3.1 illustrates how dieting for weight loss may be applied through Ideation Theory.

According to Ideation Theory, communication for the purpose of instruction can lead to changes in knowledge and skills related to dieting for weight loss. Food preparation skills, general nutrition knowledge, knowledge about healthy eating guidelines (US Department of Health and Human Services & US Department of Agriculture, 2015), knowledge about macronutrients, and knowledge of specific diets (e.g., Weight Watchers) and strategies (e.g., eating low carb) might facilitate dieting for weight loss. Increased knowledge and skills may motivate a person's intention and subsequent efforts to support weight loss which in turn reinforces skills/knowledge in that area.

Ideation factors involved in dieting for weight loss may include beliefs and attitudes regarding dieting, the ideal body, and beliefs about different foods or macronutrients (e.g., fat and carbs are "bad"). Prior research has shown that different types of content on Instagram (e.g. "Fitspiration" content) may lead to unhealthy ideation surrounding ideal body and food beliefs (Carrotte, Prichard, & Cheng Lim, 2017; and Pila et al., 2017). Subjective norms (e.g., a person thinks that others think they should lose weight) and social norms (e.g., a person believes that everyone else is dieting) may contribute to a person's dieting for weight loss behavior. For example, Instagram posts that advocate unhealthy dietary practices such as skipping meals or taking laxatives to lose weight may encourage beliefs that these practices are normal and acceptable. Finally, social factors such as social support (from friends and an Instagram user's Instagram network) and influence (from celebrities, diet enthusiasts, and/or experts) may motivate a person dieting for weight loss. This study focused on beliefs/values surrounding diet, different food groups and macronutrients portrayed via Instagram.

Purpose of the Study

Few studies have examined postings of dietary behavior on photo-based social media platforms such as Instagram (Hawks et al., n.d.) or conducted searches using a guiding theoretical framework (Hawks et al., n.d.). This preliminary and exploratory study aimed to: 1) Add to existing research by applying a theoretical framework to better contextualize dieting for weight loss-related content on Instagram; 2) Provide information on how people ─ who indicate their interest in dieting for weight loss in their post captions ─ discuss diet and weight loss with other photo-based social media users; and 3) Explore how content differed between the most frequently liked posts and less frequently liked posts.

Methods

Data Source

Data were collected from an existing dataset of 7,500,725 Instagram posts that were collected via Instagram's public application programming interface (API) between January 1, 2014 and June 3, 2015 and geo-tagged within Western San Diego County (California, USA). Figure 3.2 shows how the publicly available posts were geographically distributed throughout Western San Diego County. The use of these data for the purposes of this study was reviewed and approved by San Diego State University's Institutional Review Board.

Dataset for current study

We searched the existing data set of 7,500,725 Instagram posts for posts containing the following keywords: dieting tips, diet tips, diet, diet food, dieting, diet life, diet motivation, diet diary, diet journey, healthy eating, healthy food, and weight loss. Of 54,651 posts containing at least one keyword, 36,119 (66.1%) of the dataset were publicly available. Out of the publicly available posts containing at least one keyword, 1,000 unique posts were randomly selected

using Excel's random number function for inclusion in the study. To be included in the study dataset, the post had to contain at least one keyword and be written in English. Multiple posts from the same user were included. There were 720 unique users total. Posts were excluded if they were not publicly available, did not contain any relevant keywords, or were written in a language other than English.

Codebook Development

Of the publicly available posts that contained at least one relevant keyword, 120 posts were randomly selected for coding using a codebook developed based on Ideation Theory (Kincaid & Figueroa, 2004) and existing literature (Ghaznavi & Taylor, 2015; Holmberg et al., 2016; Hu, Manikonda, & Kambhampati, 2014; Jahns et al., 2016; Pila et al., 2017; Schneider, McGovern, Lynch, & Brown, 2013; Turner-McGrievy & Beets, 2015; US Department of Health and Human Services & US Department of Agriculture, 2015; Vidal, Ares, & Jaeger, 2016; Zhang, Baker, Pember, & Bissell, 2017). These posts were not included in the dataset of 1,000 posts used for this study. Codebook development followed a deductive approach (Kondracki, Wellman, & Amundson, 2002). The first author and a trained research assistant independently coded the posts on 50 different variables (e.g., did the post contain text describing or an image of lean protein? did the post emphasize muscularity? did the post reference a specific commercial weight loss diet like Weight Watchers?). The coders met to resolve coding disagreements and revised the codebook accordingly after every 20 posts. They repeated this process iteratively over four months until an inter-rater reliability of 0.8-1.0 was achieved for all variables using Krippendorff's alpha (Hayes & Krippendorff, 2007) for most variables and Gwet's coefficient (Gwet, 2008) for variables with low prevalence.

Coding

The first author manually coded all 1,000 posts in the dataset according to the codebook described above. Categories were not mutually exclusive because they were designed to assess different aspects of the image and caption. We categorized data according to Ideation Theory variables including social influence; skills and knowledge; and beliefs, attitudes, and values. Detailed descriptions of coded elements analyzed for this study can be found in Table 3.1. For social influence, profile information was screenshotted and saved with in conjunction with the screenshotted post. Each of the coded elements in Table 3.1 for social influence came from information extracted from the profile (account type, gender identity, profile location, and food interest) and was based on information in the profile including profile caption, profile picture, and profile username.

For skills and knowledge, we categorized food items identified in the photos, captions, and hashtags. For example, if a picture showed a smoothie and used the hashtags #kale and #banana, the image would be coded as a beverage, fruit, and vegetable. For images that showed meals or complex food items, the items that were clearly visible and/or mentioned in the caption description were coded. For example, if a hamburger with a bun, lettuce, and tomato was pictured, the image was coded as grains, vegetables, and red meat. Diets and dietary strategies were coded if they were mentioned in the post caption.

For beliefs, attitudes, and values, we coded post sentiment using the tone of the language and emojis used in the caption. A caption that contained positive language and emojis was coded as positive. A caption that contained negative language and emojis was coded as negative. A caption that contained both positive and negative language and emojis was coded as ambiguous. A caption that contained language that was neither negative nor positive was coded as neutral.

Table 3.1 contains examples of language and emojis that were coded as positive, negative, neutral, and ambiguous.

Data Analysis

After manually coding the captions and images of 1,000 posts, posts were ranked according to the number of likes received. For posts with the same number of likes, the number of comments was used as a tiebreaker, and the post with more comments was ranked higher. We split the data set into the top 100 most liked posts and the 900 least liked posts. "Liking" a post has been used as a measure of post engagement across several studies (Ashton, Morgan, Hutchesson, Rollo, & Collins, 2017; Hales, Davidson, & Turner-McGrievy, 2014; Kinard, 2016; Mejova et al., 2015; Merchant et al., 2014; West et al., 2016; Wilkinson et al., 2016). More likes indicate more active engagement with a post. However, likes do not account for "lurking," behavior characterized by a person seeing a post but not interacting with it by commenting on or liking it (Merchant et al., 2017). As little research exists in the area of dieting for weight loss posts on photo-based social media, we chose to use "likes" to assess the most engaging posts. The cutoff of the most popular 100 posts versus the least popular 900 posts was chosen because the top 100 posts showed the highest levels of engagement and potential for higher reach and exposure, thus greater potential for influence. In addition, the 100 most liked posts had more variation than the 900 least liked posts.

SPSS Version 25 (IBM Corp., 2017) was used for descriptive statistics to characterize the data. Chi-square tests were used to assess differences in categorical variables between the top 100 and bottom 900 posts according to the number of likes received. Linear regressions were performed to analyze the relationship between coded variables and number of likes and comments. NVivo Version 12 (QSR International, 2018) was used to analyze the frequency of

hashtags and keywords. The map of Instagram posts throughout San Diego county (Figure 3.2) was created using ArcGIS software by Esri (2017).

Results

General Characteristics of Instagram Posts

The average number of followers and accounts followed, and the number of likes, comments, hashtags, and handles (e.g., @johndoe) per post is displayed in Table 3.2. Since the data are skewed, range is also reported. The number of followers ranged from 4 to 1.2 million, while the number of accounts followed ranged from 1 to 15,351. The median number of likes per post was 32 with a range of 0 to 5,464. Comments were less frequent, with a median of 2 per post and a range of 0 to 247. An average of 12.7 hashtags (e.g., #paleo) were used in each post caption. Each post caption contained and average of 0.5 Instagram handles (e.g., @johndoe).

Table 3.3 shows the results of a linear regression analyzing the relationship between coded study variables and number of likes. The number of followers was most strongly positively correlated with the number of likes. Posts displaying a person's full body, endorsing eating restriction, using motivating language, and containing dairy products were positively associated with the number of likes. Posts mentioning a specific diet or containing a captioned photo (i.e., meme) were negatively associated with number of likes.

Table 3.3 shows the results of a linear regression analyzing the relationship between coded variables and number of comments. The number of followers was most strongly positively associated with the number of comments. Posts from an organization and posts mentioning achievement, eating restriction, motivation, and food interest were all positively correlated with number of comments. Posts containing the image of a person were negatively correlated with the number of likes.

Source Characteristics

Table 3.4 displays the source characteristics of the entire dataset. Most accounts belonged to individuals (78.8%). A higher number of individual accounts belonged to females than to males (55% compared to 22.9%). Over half of Instagram accounts did not state the location of the account in the profile. Of those profiles that stated the account location, most stated a location in San Diego. Just under half of profiles (47.2%) stated that they had an explicit interest in or expertise in food and/or diet. Compared to organizations, individuals were significantly more likely to post pictures featuring males (12.1% compared to 3.8%, chi-square=12.403, $p<0.001$, Phi=0.111) and emphasize muscularity (13.6% compared to 7.1%, chi-square=6.596, p=0.010, Phi=0.081). Organizations were significantly more likely to mention health or healthy in the posts than individuals (77.4% compared to 69.7%, chi-square=4.826, p=0.028, Phi=0.069).

Characteristics of Food/Beverage Images

The majority of posts (57.2%) contained an image of food, while less than 20% contained an image of a beverage (see Table 3.5). The percentage of posts that contained images of or text describing foods that the dietary guidelines recommend ranged from 2.7% (unprocessed oils) to 38.4% (vegetables). The percentage of posts that contained images of or text describing foods that the dietary guidelines recommend limiting ranged from 3.8% (alcoholic beverages) to 12.1% (added sugar). The top 100 and bottom 900 posts (based on the number of likes) did not differ among most food categories, apart from vegetables and added sugar. A lower proportion of the 100 most liked posts contained images of or text describing vegetables than the 900 least liked posts (26.0% compared to 39.8%, $\chi^2 = 7.2$, p-value = 0.007, Phi = 0.085). A higher proportion of the 100 most liked posts contained images of or text describing foods with added sugar (e.g.,

candy, cakes, and ice cream) compared to the 900 least liked posts (19% compared to 11.3%, χ^2 = 5.0, p-value = 0.026, Phi = 0.071).

Characteristics of People Portrayed

One third of images contained an image of a person or multiple people. Females (16.3%) were more commonly depicted than males (see Table 3.6; 10.3%) overall, and males were significantly more likely to be featured in the top 100 posts compared to the least liked 900 posts (18% compared to 9.4%, χ^2 = 7.1, p-value = 0.008, Phi = 0.084). A small percentage of images contained both males and females (5.1%). People were more commonly portrayed in the most liked 100 posts than the least liked 900 posts (45% compared to 31.7%, χ^2 = 7.2, p-value = 0.007, Phi = 0.085). Depictions of full bodies (defined as showing from low thigh to shoulders) were more common among the most liked 100 posts than the least liked 900 posts (30% compared to 17.7%, χ^2 = 8.9, p-value = 0.003, Phi = 0.095). The most liked 100 posts were also more likely to emphasize muscularity (22% compared to 11.1%, χ^2 = 10.0, p-value = 0.002, Phi = 0.10) and thinness (12% compared to 6%, χ^2 = 5.3, p-value = 0.022, Phi = 0.072) than the least liked 900 posts.

Skills, Knowledge, Beliefs, and Values Portrayed

Table 3.7 shows the coded variables related to skills, knowledge, beliefs, and values portrayed in Instagram posts. Although a relatively small proportion (11.1%) of all posts mentioned specific diets (e.g., Paleo, Weight Watchers;), almost half (41.3%) mentioned specific dietary strategies (e.g., eating clean, vegan, low/no carb). A small percentage of posts (2.9%) mentioned weight loss surgery, supplements, or medications. Most posts were positive (62.7%), about a quarter (27.9%) were neutral, and less than 10% were either ambiguous or negative. Most posts that mentioned a specific diet or dietary strategy were either positive (64.9-68.8%) or

neutral (24-27.9%), fewer than 10% were ambiguous and less than 1% were negative. The most liked 100 posts included more recipes (10% compared to 2.2%, $\chi^2 = 18.7$, p-value < 0.001, Phi = 0.137) and mentions of motivation or use of motivational language (21% compared to 8.9%, $\chi^2 = 14.5$, p-value < 0.001, Phi = 0.121) than the least liked 900 posts.

Most Frequent Hashtags

Table 3.8 displays the top 20 most frequently used hashtags, across all 1,000 posts. Figure 3.3 shows the top 100 most mentioned words (including hashtags) within the dataset. Hashtags related to health and fitness were the most frequently mentioned.

Discussion

Social media and Instagram use are widespread, especially among teens, young adults, and non-Hispanic blacks and Hispanics (Anderson et al., 2018; Pew Research Center, 2018; Smith et al., 2018). Social media use may influence health behaviors, particularly diet and weight loss behavior (Easton, Morton, Tappy, Francis, & Dennison, 2018; Vaterlaus et al., 2015). Social media can be a facilitator for improving diet by providing new ideas, knowledge, and motivation but may also promote potentially harmful weight loss practices (Easton et al., 2018; Vaterlaus et al., 2015). This study used Ideation Theory to better understand dieting for weight loss posts and examine how people post about dieting for weight loss on Instagram, the popular photo- and short video-based social media platform. Results are discussed in terms of source characteristics (social influence); characteristics of foods/beverages portrayed (skills/knowledge); characteristics of people portrayed (ideal body); skills, knowledge, beliefs, and values portrayed; and most frequent hashtags used (skills, knowledge, beliefs, and values).

Source Characteristics

There were a higher proportion of female-owned accounts than male-owned accounts in our sample of 1,000 diet/weight loss Instagram posts. More female-owned accounts is consistent with the higher proportion of females who use social media compared to males (73% compared to 65%), and the higher percentage of females who report using Instagram compared to males (39% compared to 30%) (Pew Research Center, 2018). More female-owned accounts in our study is also consistent with two studies of Instagram data and food/diet/fitness showing a higher proportion of posts coming from female accounts (Abbar, Mejova, & Weber, 2015; Holmberg et al., 2016). However, Pila et al. (2017) found that among Instagram posts specifically tagged with the hashtag #cheatmeal, most posts came from males. Although #cheatmeal was not one of our primary search keywords, "cheat meals" and "cheat days" were frequently mentioned diet/weight loss strategies among our sample. The higher proportion of female-owned accounts in our study versus Pila et al.'s (2017) study may be due to our study's focus on dieting for weight loss, whereas cheat meals may be more common among pro-muscularity communities (which are dominated by men, though women are becoming more involved in pro-muscularity communities) (Bozsik, Whisenhunt, Hudson, Bennett, & Lundren, 2018). According to Ideation Theory (Kincaid & Figueroa, 2004), the gender identity of the account owner may be important because a social media consumer of the same gender identity as the account owner may find that account owner more relatable and a better role model than an account owner of a different gender identity.

A higher percentage of the most liked posts in our sample came from organizations than in the entire dataset. Organizations may have more followers in general and thus more opportunities for other Instagram users to see and like their posts than individual users. Similar to

Spitzberg's Multilevel Model of Meme Diffusion (Spitzberg, 2014), we found that the number of followers was most predictive of the number of likes each post received. According to Ideation Theory (Kincaid & Figueroa, 2004), organizational and individual accounts with a lot of followers may have more influence when trying to get their followers to adopt certain dieting behaviors. In addition, those accounts identifying themselves as having an interest in food on their profile may have more influence, which may explain the higher proportion of accounts that indicate an interest in diet/food among the top 100 posts than the entire dataset.

Foods and Beverages Portrayed

The most frequently liked posts had a lower proportion of vegetables and a higher proportion of foods with added sugar, like cookies and ice cream, than the least liked posts. In addition, the proportion of foods pictured that should be limited according to the 2015 U.S. Dietary Guidelines was relatively low. The relatively low proportion of unhealthy food items in our sample conflicts with findings from prior research examining food and diet on Instagram, which reported that unhealthy foods are more commonly posted than healthy foods (Holmberg et al., 2016; Mejova et al., 2015; Pila et al., 2017). One explanation for this finding may be that our study focused on posts that were identified by keywords related to dieting for weight loss and healthy eating. However, it is promising that posts indicating some interest in diet for weight loss or healthy eating in our sample are more likely to mention foods recommended by the 2015 Dietary Guidelines than foods that the Dietary Guidelines recommend limiting. This would indicate that people posting about dieting for weight loss have knowledge of the role that healthy eating plays in weight loss.

Skills, Knowledge, Attitudes, and Values

The percentages of posts that mentioned specific diets, dietary strategies, and surgery/medications/supplements were similar between the 100 most liked and the 900 least liked posts. However, recipes were more common among the most liked 100 posts than the least liked 900 posts, indicating that the most popular posts are geared towards providing instruction to improve knowledge and skills related to food preparation. The 100 most liked posts were also more likely to be motivating to other Instagram users than the least liked 900 posts. Our finding regarding the use of motivating language in the most popular posts aligns with research on how young adults use social media for help in changing their health behaviors, both for motivation and to learn new skills and acquire knowledge related to the behavior they are attempting to change (Dahl et al., 2016; Easton et al., 2018; Vaterlaus et al., 2015). Ideation theory also indicates that increases in knowledge regarding improving diet through healthier recipes would increase a person's intention to prepare healthier foods in order to lose or maintain weight.

Approximately 62% of the least liked 900 posts used positive language and emojis (i.e., sentiment) compared to 71% of the top 100 most liked posts. The percentage of posts with positive sentiment in our sample is lower than the percentage of positive-sentiment posts in prior research. For example, in Holmberg et al.'s (2016) study of adolescent Instagram posts, three quarters of posts used positive language. The lower percentage of positive posts in our sample compared to Holmberg et al.'s (2016) sample may be explained by the search strategy employed by Holmberg et al. They identified teenager-owned accounts for analysis by using the hashtag #14år (Norwegian, Swedish, and Danish for "14 years"), then selecting the first food image posted prior to use of the tag. The search strategy may have made the selected posts more likely to be positive, as the hashtag may have been used close to the account owner's 14th birthday. The

lower proportion of posts with positive language in our sample may also be related to the fact that our sample was collected in the US, while Holmberg et al.'s sample came from Scandinavian countries, which are consistently ranked higher in happiness than the US according the United Nation's World Happiness Report (Helliwell, Layard, & Sachs, 2019). It is possible that posts coming from the US are less happy in general, and not due to differences in search strategies or the topic of interest (dieting for weight loss). Conveying a positive tone may be important for helping to increase positive attitudes surrounding dieting for weight loss.

Hashtags

With the exception of the hashtag #sandiego, the top 20 most frequently used hashtags could be separated into the following categories: health and overall fitness (#healthy, #fitness, #health, #fitfam, #fit), motivation (#motivation, #fitspo), exercise (#workout, #gym), body shape change (#weightloss, #bodybuilding), diet/specific diet strategies (#eatclean, #diet, #cleaneating, #nutrition, #organic, #vegan), and food more generally (#foodporn, #food). Mejova et al. (2015) examined the most frequent categories of hashtags used in their research on how Instagram posts at fast food and non-fast food restaurants were correlated with population level health indicators like obesity rates. They found that the most frequently used hashtags related to emotion (e.g., #love), followed by social-related hashtags (e.g., #friends), hashtags related to unhealthiness, foodporn hashtags, and hashtags related to healthiness were least commonly used (Mejova et al., 2015). Our findings may indicate that people who indicate interest in diet and weight loss in their captions may be more likely to identify the content of their posts as health, exercise, or diet-related than 'food' more generally.

Strengths and Limitations

This study should be understood within the context of its limitations. First, our data came from posts that were geotagged in Western San Diego County (California, USA), so these findings may not be generalizable to diet/weight loss-related Instagram posts coming from other areas of the U.S. and world. For example, San Diego is a relatively health-conscious community, which may have contributed to our sample having more healthy foods pictured or mentioned in the caption than posts from other areas. Our sample size is also small in relation to the available number of posts from the existing dataset. However, using a small sample size enabled in-depth content analysis of our data. In addition, we were able to code information from both the images and captions, which we may not have been able to accomplish using a different methodology, like machine learning. We did not exclude multiple posts from the same user, thus posts may have been biased towards accounts that posted multiple times. Other social media studies have included multiple posts from the same user (Moreno, Ton, Selkie, & Evans, 2016; Ofli, Aytar, Weber, al Hammouri, & Torralba, 2017; Pila et al., 2017; Sharma & de Choudhury, 2015). The most posts from any single account was 21, and most users who posted multiple times posted 5 times or less. In addition, including multiple posts from the same user mimics what users would actually see while using Instagram. The keywords we used for our search strategy may have led us to miss important diet/weight loss-related posts. However, as this is one of the preliminary, exploratory studies examining diet/weight loss-related content on photo-based social media, our future research will include additional keywords (e.g., #physique was often used in posts directed towards male weight loss and/or body building and may be an important keyword to study). In addition, since our data come from 2014-2015, we expect that some of the commonly mentioned diets and dietary strategies may change if more recent data were used. Finally, it is unclear to

what extent interaction with social media influences actual dieting for weight loss *behavior*. Future research should explore this connection in greater depth.

Despite the limitations, this study also has several notable strengths. Whereas prior studies have used hashtags to search for relevant Instagram posts, our study included both hashtags and keywords (e.g., #weightloss and weight loss) to identify relevant posts. In addition, prior studies have limited their search period to a few days. Our study is one of the first to examine Instagram posts over a year, which may provide additional insight into diet/weight loss-related posts and provide greater generalizability. Our study also provided some insight into how Ideation Theory could be used to better understand dieting for weight loss communication via photo-based social media. This research is also timely, and the Instagram API initially used to gather the posts for this study is now closed an inaccessible.

Conclusions

This exploratory study is a preliminary step in investigating the relationship between interaction with photo-based social media and influences on dieting for weight loss. It adds meaningful knowledge to how dieting for weight loss Instagram posts can be understood within the context of Ideation Theory, and how the ideation factors under study in this paper (e.g., diet for weight loss skills/knowledge; beliefs, values, and attitudes; and social influence) may be related to a person's intention to diet for weight loss. One important finding is that the most popular posts used motivating language and provided the foundation for skills and knowledge related to dieting for weight loss in the form of recipes. Health promotion campaigns that aim to help people with diet and weight loss should consider using motivating language and providing recipes and other information to support those trying to change their eating behaviors. In addition, using motivating language may be used to help enhance messaging surrounding healthy

foods in order to increase their appeal to more people. Future research should examine how interaction with diet/weight loss-related content on social media influences dieting for weight loss behavior. Although most social media research has shown that unhealthy foods are most frequently posted and most frequently liked, our results offer promising preliminary evidence that people who are actively posting about diet and weight loss are in general posting more often about healthy foods than unhealthy foods.

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Chapter 3, in full, is being prepared for submission for publication of the material. Co-authors include Walsh-Buhi, Eric R.; Madanat, Hala; Nara, Atsushi; Hartman, Sheri; Strong, David; and Anderson, Cheryl. The dissertation author was the primary author of this paper.

REFERENCES

Abbar, S., Mejova, Y., & Weber, I. (2015). You Tweet what you eat: Studying food consumption through Twitter. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (pp. 3197–3206). New York, NY, USA: ACM. http://doi.org/10.1145/2702123.2702153

Anderson, M., Smith, A., & Caiazza, T. (2018). *Teens, social media, & technology 2018*. Washington, DC. Retrieved from https://www.pewinternet.org/2018/05/31/teens-social-media-technology-2018/

Ashton, L. M., Morgan, P. J., Hutchesson, M. J., Rollo, M. E., & Collins, C. E. (2017). Feasibility and preliminary efficacy of the "HEYMAN" healthy lifestyle program for young men: a pilot randomised controlled trial. *Nutrition Journal*, *16*, 1–17. http://doi.org/10.1186/s12937-017-0227-8

Bozsik, F., Whisenhunt, B. L., Hudson, D. L., Bennett, B., & Lundren, J. D. (2018). Thin is in? Think again: The rising importance of muscularity in the thin ideal female body. *Sex Roles, 79*, 609-615. http://doi.org/10.1007/s11199-017-0886-0

Cann, A., Dimitriou, K., & Hooley, T. (2011). *Social Media: A Guide for Researchers*. London, UK.

Carrotte, E., Prichard, I., & Cheng Lim, M. S. (2017). "Fitspiration" on social media: A content analysis of gendered images. *Journal of Medical Internet Research, 19*(3). 10.2196/jmir.6368

comScore. (2017). *The 2017 U.S. Cross-Platform Future in Focus*. Reston, VA.

Dahl, A. A., Hales, S. B., & Turner-McGrievy, G. M. (2016). Integrating social media into weight loss interventions. *Current Opinion in Psychology, 9*, 11–15. http://doi.org/10.1016/j.copsyc.2015.09.018

Easton, S., Morton, K., Tappy, Z., Francis, D., & Dennison, L. (2018). Young people's experiences of viewing the fitspiration social media trend: Qualitative study. *Journal of Medical Internet Research, 20*(6), e219. http://doi.org/10.2196/jmir.9156

Esri Inc. (2017). ArcGIS Desktop 10.6.1. Esri Inc.

Ghaznavi, J., & Taylor, L. D. (2015). Bones, body parts, and sex appeal: An analysis of #thinspiration images on popular social media. *Body Image*, *14*, 54–61. http://doi.org/10.1016/j.bodyim.2015.03.006

Gwet, K. L. (2008). Computing inter-rater reliability and its variance in the presence of high agreement. *British Journal of Mathematical and Statistical Psychology, 61*, 29–48. http://doi.org/10.1348/000711006X126600

Hales, S. B., Davidson, C., & Turner-McGrievy, G. M. (2014). Varying social media post types

differentially impacts engagement in a behavioral weight loss intervention. *Translational Behavioral Medicine*, *4*(4), 355–362. http://doi.org/10.1007/s13142-014-0274-z

Hawks, J. R., Madanat, H., Walsh-Buhi, E. R., Hartman, S., Strong, D., Nara, A., & Anderson, C. (n.d.). Systematic review of social media as a research tool for diet and weight loss. Unpublished manuscript.

Hayes, A. F., & Krippendorff, K. (2007). Answering the call for a standard reliability measure for coding data. *Communication Methods and Measures*, *1*(1), 77–89. http://doi.org/10.1080/19312450709336664

Helliwell, J. F., Layard, R., & Sachs, J. D. (2019). *2019 World Happiness Report*. New York, NY.

Holmberg, C., Chaplin, J. E., Hillman, T., & Berg, C. (2016). Adolescents' presentation of food in social media: An explorative study. *Appetite*, *99*, 121–129. http://doi.org/10.1016/j.appet.2016.01.009

Hu, Y., Manikonda, L., & Kambhampati, S. (2014). What we Instagram: A first analysis of Instagram photo content and user types. In *8th International Conference on Weblogs and Social Media, ICWSM 2014* (pp. 595–598). Ann Arbor, MI: The AAAI Press.

Instagram. (2019). Our Story. Retrieved April 2, 2019, from https://instagram-press.com/our-story/#news-filter-2019

Jahns, L., Johnson, L. A. K., Scheett, A. J., Stote, K. S., Raatz, S. K., Subar, A. F., & Tande, D. (2016). Measures of diet quality across calendar and winter holiday seasons among midlife women: A 1-year longitudinal study using the automated self-administered 24-hour recall. *Journal of the Academy of Nutrition and Dietetics*, *116*(12), 1961–1969. http://doi.org/10.1016/j.jand.2016.07.013

Kinard, B. R. (2016). Insta-grams: The effect of consumer weight on reactions to healthy food posts. *Cyberpsychology, Behavior, and Social Networking*, *19*(8), 481–486. http://doi.org/10.1089/cyber.2016.0085

Kincaid, D. L., & Figueroa, M. E. (2004). Ideation and individual behavior change.

Kondracki, N. L., Wellman, N. S., & Amundson, D. R. (2002). Content analysis: Review of methods and their applications in nutrition education. *Journal of Nutrition Education and Behavior*, *34*(4), 224–230. http://doi.org/10.1016/S1499-4046(06)60097-3

Mejova, Y., Haddadi, H., Noulas, A., & Weber, I. (2015). #Foodporn: Obesity patterns in culinary interactions. In *Proceedings of the 5th International Conference on Digital Health 2015* (pp. 51–58). New York, NY, USA: ACM. http://doi.org/10.1145/2750511.2750524

Merchant, G., Weibel, N., Patrick, K., Fowler, J. H., Norman, G. J., Gupta, A., … Marshall, S. (2014). Click "like" to change your behavior: A mixed methods study of college

students' exposure to and engagement with Facebook content designed for weight loss. *Journal of Medical Internet Research*, *16*(6), e158–e158. http://doi.org/10.2196/jmir.3267

Merchant, G., Weibel, N., Pina, L., Griswold, W. G., Fowler, J. H., Ayala, G. X., … Patrick, K. (2017). Face-to-face and online networks: College students' experiences in a weight-loss trial. *Journal of Health Communication*, *22*(1), 75–83. http://doi.org/10.1080/10810730.2016.1250847

Moreno, M., Ton, A., Selkie, E., & Evans, Y. (2016) Secret society 123: Understanding the language of self-harm on Instagram. *Journal of Adolescent Health, 58,* 78-84. 10.1016/j.jadohealth.2015.09.015

Ofli, F., Aytar, Y., Weber, I., al Hammouri, R., & Torralba, A. (2017). Is saki #delicious?: The food perception gap on Instagram and its relation to health. In *Proceedings of the 26th International Conference on World Wide Web* (pp. 509-518). Geneva, Switzerland: WWW. https://doi.org/10.1145/3038912.3052663

Pew Research Center. (2018). Social Media Fact Sheet. Retrieved April 2, 2019, from https://www.pewinternet.org/fact-sheet/social-media/

Pila, E., Mond, J. M., Griffiths, S., Mitchison, D., & Murray, S. B. (2017). A thematic content analysis of #cheatmeal images on social media: Characterizing an emerging dietary trend. *International Journal of Eating Disorders*, *50*(6), 698–706. http://doi.org/10.1002/eat.22671

QSR International. (2018). NVivo qualitative data analysis software. QSR International Pty Ltd.

Schneider, E. P., McGovern, E. E., Lynch, C. L., & Brown, L. S. (2013). Do food blogs serve as a source of nutritionally balanced recipes? An analysis of 6 popular food blogs. *Journal of Nutrition Education & Behavior*, *45*(6), 696–700. Retrieved from http://10.0.3.248/j.jneb.2013.07.002

Sharma, S. S., & De Choudhury, M. (2015). Measuring and characterizing nutritional information of food and ingestion content in Instagram. In *Proceedings of the 24th International Conference on World Wide Web* (pp.115-116). New York, NY, USA: WWW. http://doi.acm.org/10.1145/2740908.2742754

Smith, A., Anderson, M., & Caiazza, T. (2018). *Social Media Use in 2018*. Washington, DC. Retrieved from https://www.pewinternet.org/2018/03/01/social-media-use-in-2018/

Spitzberg, B. H. (2014). Toward a model of meme diffusion (M^3D). *Communication Theory, 24,* 311-339.

SPSS Version 25 for Windows. (2017). Armonk, NY: IBM Corp.

Turner-McGrievy, G. M., & Beets, M. W. (2015). Tweet for health: Using an online social network to examine temporal trends in weight loss-related posts. *Translational*

Behavioral Medicine, *5*(2), 160–166. http://doi.org/10.1007/s13142-015-0308-1

US Department of Health and Human Services, & US Department of Agriculture. (2015). *2015-2020 Dietary Guidelines for Americans, 8th Edition*. Retrieved from http://health.gov/dietaryguidelines/2015/guidelines/

Vaterlaus, J. M., Patten, E. V., Roche, C., & Young, J. A. (2015). #Gettinghealthy: The perceived influence of social media on young adult health behaviors. *Computers in Human Behavior*, *45*(January 2015), 151–157. http://doi.org/10.1016/j.chb.2014.12.013

Vidal, L., Ares, G., & Jaeger, S. R. (2016). Use of emoticon and emoji in tweets for food-related emotional expression. *Food Quality and Preference*, *49*, 119–128. http://doi.org/10.1016/j.foodqual.2015.12.002

West, D. S., Monroe, C. M., Turner-McGrievy, G., Sundstrom, B., Larsen, C., Magradey, K., … Brandt, H. M. (2016). A technology-mediated behavioral weight gain prevention intervention for college students: A controlled, quasi-experimental study. *Journal of Medical Internet Research*, *18*(6), 61. http://doi.org/10.2196/jmir.5474

Wilkinson, J. L., Strickling, K., Payne, H. E., Jensen, K. C., West, J. H., & Eysenbach, G. (2016). Evaluation of diet-related infographics on Pinterest for use of behavior change theories: A content analysis. *Journal of Medical Internet Research*, *18*(12), 1. http://doi.org/10.2196/mhealth.6367

Zhang, X., Baker, K., Pember, S., & Bissell, K. (2017). Persuading me to eat healthy: A content analysis of YouTube public service announcements grounded in the Health Belief Model. *Southern Communication Journal*, *82*(1), 38–51. http://doi.org/10.1080/1041794X.2016.1278259

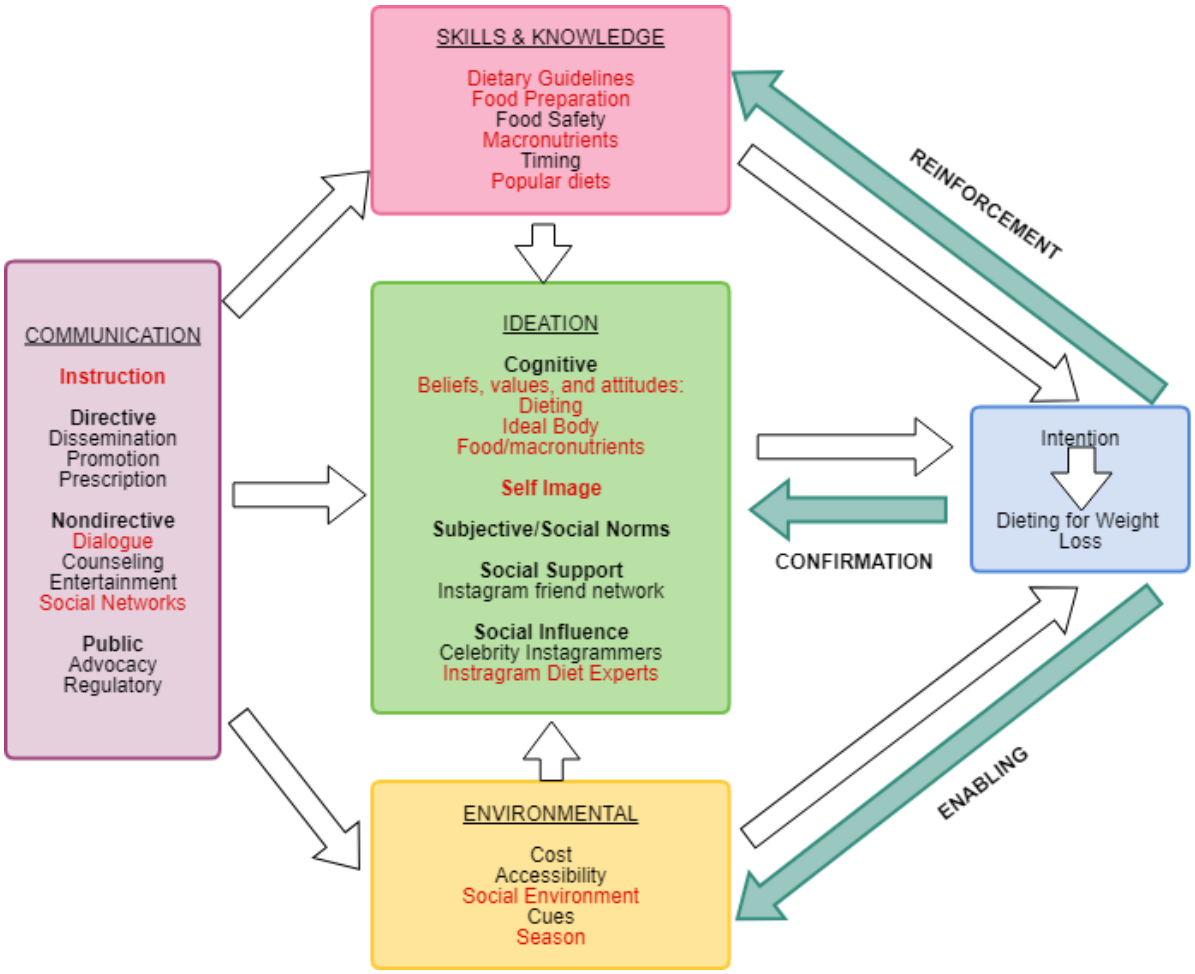

Figure 3.1. Ideation Theory Applied to Dieting for Weight Loss

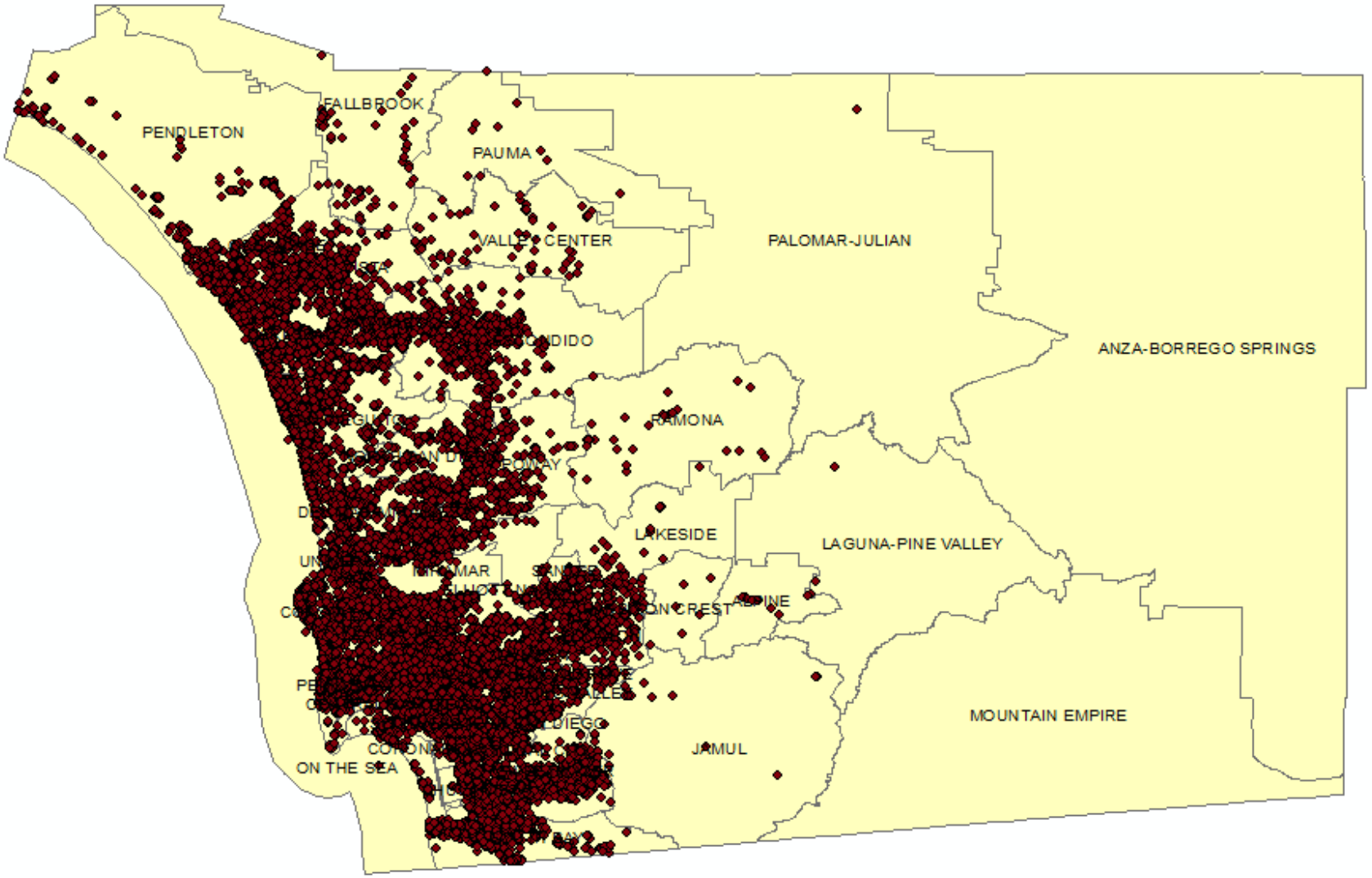

Figure 3.2. Post Location of Publicly Available Posts Containing at Least 1 Diet/Weight-Loss Related Keyword

Figure 3.3. Most Frequently Used Keywords (Including Hashtags)

Table 3.1. Research Questions and Related Ideation Theory Constructs, Coded Elements, and Definitions		
Ideation Theory Construct	**Research Question**	**Coded Element and Definition**
Social Influence	**What are the general source characteristics of individuals who post dieting for weight loss-related content on Instagram?**	**Account Type:** Does the post originate from an individual person's or an organization's Instagram Account? **Gender Identity:** For posts originating from an individual person's account, does the post originate from a male's, female's, transgendered person's, or both male and female's account? **Profile Location:** What specific location is mentioned in the user's profile? **Food Interest:** Does the individual's or organization's profile explicitly mention an interest in food or diet?
Skills/knowledge	**What types of food are most frequently posted?**	**Recommended Foods:** Does the image show or text mention the following types of foods that the US Dietary Guidelines recommend for a healthy diet?: Vegetable Fruit Lean Protein Grains Dairy Oils **Foods that Should Be Limited:** Does the image show or text mention the following types of foods that the US Dietary Guidelines recommends limiting for a healthy diet?: Added sugar Red meat Fried food Sugar-sweetened beverages Alcoholic beverages
Beliefs, values, and attitudes	**What types of sentiment are most frequently posted?**	**Sentiment:** Does the post caption contain negative, positive, ambiguous, or neutral language or emojis? Positive word examples: good, excited, yummy Positive emoji examples:  Negative word examples: bad, hate, shame Negative emoji examples:  Neutral: the post did not contain negative or positive language Neutral emoji example:  Ambiguous: the post contained both positive and negative language Ambiguous emoji example: 

Table 3.1 Cont. Research Questions and Related Ideation Theory Constructs, Coded Elements, and Definitions		
Ideation Theory Construct	**Research Question**	**Coded Element and Definition**
Beliefs, values, and attitudes **Skills/knowledge**	**What are the most frequently used hashtags in diet-for-weight-loss Instagram posts?**	**Hashtags:** Words or phrases preceded by the pound (#) symbol (e.g., #paleo, #healthy, #weight loss) found in the original post caption
Skills/knowledge **Ideal body**	**What is the content of dieting for weight loss Instagram posts that are most popular according to number of likes received, and how is it different from less popular posts?**	**Specific diet, dietary strategy, recommended foods, foods that should be limited*** **Full body:** Does the post contain an image of a person's (people's) body(ies) from low-thigh to shoulders? **Muscularity emphasized:** Does the image depict defined or clearly visible muscles, or does the language of the caption emphasize muscularity? Examples: clearly defined abdomen muscles in image, text that mentions a "six pack," toned abs, muscles, etc. **Thinness emphasized:** Does the image feature an excessively thin body/body parts, or does the language of the caption emphasize thinness? Examples: protruding hip or collar bones in image, text that mentions thinness, skinny, skinny is sexy, etc. *(See above for descriptions)

Table 3.2. Sample Characteristics of 1000 Instagram Posts

	Mean (SD)	Median	Range
Number of followers	11,965.5 (61,612.5)	1,235	4-1,200,000
Number of accounts followed	1,293.6 (1482.8)	801	1-15,351
Number of likes	67.7 (210.4)	32	0-5,464
Number of comments	4.8 (12.0)	2	0-247
Number of hashtags	12.7 (9.2)	11	0-32
Number of handles	0.5 (1.2)	0	0-14

Table 3.3. Regressions of Relationship Among Study Variables and Number of Likes and Comments

	Number of Likes		Number of Comments	
	Beta (SE)	**P-Value**	**Beta (SE)**	**P-Value**
Followers Cubed	$1.532*10^{14}$ (0.000	<0.001	-	-
Followers Squared	$-1.965*10^{8}$ (0.000)	<0.001	-	-
Full Body	23.041 (7.876)	0.004	-	-
Specific Diet	-21.226 (9.056)	0.019	-	-
Captioned Photo	-16.877 (7.250)	0.020	-	-
Dairy	15.114 (7.432)	0.042	-	-
Followers	0.006 (0.00)	<0.001	$7.135*10^{5}$ (0.000)	<0.001
Motivation	17.960 (6.935)	0.010	1.760 (0.832)	0.035
Eating Restriction	18.010 (8.788)	0.041	2.435 (1.054)	0.021
Organization	-	-	2.957 (0.866)	0.001
Person pictured	-	-	-.888 (0.254)	0.001
Achievement	-	-	2.711 (1.242)	0.026
Food Interest	-	-	1.411 (0.714)	0.048
Adjusted R-Squared	0.819		0.192	

Table 3.4. Source Characteristics of 1,000 Instagram Posts

	n (%)
Account Type	
Individual	788 (78.8%)
Organization	212 (21.2%)
Gender Identity	
Female	550 (55.0%)
Male	229 (22.9%)
Not Applicable	219 (21.9%)
Other	2 (0.2%)
Profile Location	
San Diego	265 (26.5%)
Southern California	44 (4.4%)
California	33 (3.3%)
United States	59 (5.9%)
International	25 (2.5%)
Not Stated	574 (57.4%)
Food Interest	
Yes	472 (47.2%)
No	528 (52.8%)

Table 3.5. Characteristics of Images of Food/beverages in All 1,000 and Top 100 Instagram Posts

Type of food or beverage pictured	Overall n=1,000 n (%)*	Top 100 Posts n=100 n (%)*	Bottom 900 Posts n=900 n (%)*
Image of food	572 (57.2%)	50 (50%)	522 (58%)
Image of beverage	189 (18.9%)	17 (17%)	172 (19.1%)
Dietary guidelines recommend:			
Vegetable	384 (38.4%)	26 (26%)**	358 (39.8%)**
Fruit	301 (30.1%)	28 (28%)	273 (30.3%)
Lean protein	271 (27.1%)	23 (23%)	248 (27.6%)
Grains	262 (26.2%)	31 (31%)	231 (25.7%)
Dairy	202 (20.2%)	27 (27%)	175 (19.4%)
Oils	27 (2.7%)	2 (2%)	25 (2.8%)
Dietary guidelines recommend limiting:			
Added sugar	121 (12.1%)	19 (19%)**	102 (11.3%)**
Red meat	99 (9.9%)	9 (9%)	90 (10%)
Fried food	65 (6.5%)	8 (8%)	57 (6.3%)
Sugar-sweetened beverage	62 (6.2%)	5 (5%)	57 (6.3%)
Alcoholic beverage	38 (3.8%)	4 (4%)	34 (3.8%)

*Frequencies and percentages do not add up to 1000 or 100 because an Instagram post may have contained multiple different types of foods and beverages.
**p-value < 0.05

Table 3.6. Characteristics of People Portrayed in All 1,000 and Top 100 Instagram Posts

	Overall n=1,000 n (%)	Top 100 Posts n=100 n (%)	Bottom 900 Posts n=100 n (%)
Person pictured	330 (33%)	45 (45%)*	285 (31.7%)*
Sex of person pictured			
Female	163 (16.3%)	21 (21%)	142 (15.8%)
Male	103 (10.3%)	18 (18%)*	85 (9.4%)*
Both male and female	51 (5.1%)	5 (5%)	46 (5.1%)
Unknown	10 (1%)	1 (1%)	9 (1.0%)
Full body pictured	189 (18.9%)	30 (30%)*	159 (17.7%)*
Muscularity emphasized	122 (12.2%)	22 (22%)*	100 (11.1%)*
Thinness emphasized	66 (6.6%)	12 (12%)*	54 (6.0%)*

*p-value < 0.05

Table 3.7. Skills, Knowledge, Beliefs, and Values Among 1,000 Instagram Posts

	Overall n=1,000 *n (%)*	**Top 100 Posts n=100** *n (%)*	**Bottom 900 Posts n=900** *n (%)*
Dietary strategy	413 (41.3%)	44 (44%)	369 (41.0%)
Specific diet	111 (11.1%)	16 (16%)	95 (10.6%)
Surgery/medication	29 (2.9%)	1 (1%)	28 (3.1%)
Recipe	30 (3.0%)	10 (10%)*	20 (2.2%)*
Sentiment			
Positive	627 (62.7%)	71 (71%)	556 (61.8%)
Neutral	279 (27.9%)	23 (23%)	256 (28.4%)
Ambiguous	75 (7.5%)	5 (5%)	70 (7.8%)
Negative	19 (1.9%)	1 (1%)	18 (2%)
Mentions "healthy"	713 (71.3%)	63 (63%)	650 (72.2%)
Mentions motivation	303 (30.3%)	45 (45%)*	258 (28.7%)*

*p-value < 0.05

Table 3.8. Most Frequently Used Hashtags

Hashtag	n	Hashtag	N
#healthy	256	#fitspo	103
#fitness	193	#diet	101
#health	154	#cleaneating	95
#sandiego	153	#bodybuilding	86
#fitfam	134	#gym	85
#eatclean	113	#nutrition	83
#motivation	113	#foodporn	79
#workout	111	#organic	77
#weightloss	109	#vegan	73
#fit	103	#food	71

CHAPTER 4

SUMMER BODIES ARE MADE IN WINTER: SEASON AND GENDER IDENTITY TRENDS AMONG DIET-RELATED INSTAGRAM POSTS

Abstract

The use of photo-based social media platforms such as Instagram has become increasingly popular for sharing weight management and diet content. The current study used Ideation Theory to characterize seasonal and gender identity trends among dieting for weight loss posts on Instagram. One thousand publicly available weight loss/diet-related Instagram posts were randomly selected via keyword search from 7.5 million Instagram posts geotagged within Western San Diego County and posted between January 1, 2014-June 3, 2015. The Instagram posts were manually coded on 50 different characteristics (e.g., did the post contain vegetables?). There were no statistical differences among posts posted in different seasons. Posts including females were significantly more likely to emphasize thinness than posts including males (1.9% vs 33.1%, $\chi^2 = 36.9$, p-value < 0.001, Phi = 0.373). Posts featuring males were significantly more likely to emphasize muscularity than posts featuring females (62.1% vs 25.8%, $\chi^2 = 34.8$, p-value < 0.001, Phi = 0.362). This study provided insight into how gender identity and season are related to dieting for weight loss content on Instagram. This information could be used to tailor future social media-based diet/weight loss communication campaigns. Future research should examine how posting behavior is related to actual behavior. In addition, further diet/photo-based social media research should be conducted among sexual and gender minority populations.

Introduction

Social media may be an important avenue for communication about health behaviors. Although definitions vary, Cann, Dimitriou, and Hooley (2011) assert that social media includes applications and websites featuring user-generated content (e.g., writing, status updates, photos, and video). Adults spend approximately one fifth of their online time engaging with social media (comScore, 2017). Social media is a popular place for young adults to find support and new information when trying to change a variety of behaviors, particularly diet and exercise behaviors (Dahl, Hales, & Turner-McGrievy, 2016). Instagram, a photo- and short video-based social media platform, is one of the most popular social media platforms used in the US, and over one third of adults use Instagram (Smith, Anderson, & Caiazza, 2018). Instagram may be a promising avenue for reaching youth and young adults, since 71% of teens aged 13-17 years and young adults aged 18-24 use Instagram (Anderson, Smith, & Caiazza, 2018; Smith et al., 2018).

Gender Identity and Dietary Behavior

Evidence suggests that eating patterns and influences on food decisions vary by a person's gender identity. For example, there may be differences in seasonal variation between males' and females' dietary intake (i.e., foods, nutrients, and calories consumed) (Ma et al., 2006; Marti-Soler et al., 2017). Food taste, quality, appearance, healthiness, and label information were more important to women than men when deciding what to eat (Levi, Chan, & Pence, 2006). Males were less likely to consume fiber, fruits, and vegetables, but more likely to consume fat than females (Anderson-Bill, Winett, & Wojcik, 2011). Also, food and fitness advertising often markets products by targeting vulnerabilities and preferences of males and females. For example, women's health and fitness magazines emphasize diet for weight loss and improving physical appearance, whereas men's health and fitness magazines emphasize body

shape change (e.g. gaining muscle, "bulking up") (Bazzini, Pepper, Swofford, & Cochran, 2015; Mishra & Kern, 2015). It is unclear to what extent food advertising and media exposure affects males' and females' food choices (Mills, Tanner, & Adams, 2013; Vukmirovic, 2015).

Several studies have resulted in mixed findings regarding how the gender identity of the social media account owner may be related to the food and nutrition content in a social media post (e.g., Tweet, Instagram post, Pinterest Pin). Abbar, Mejova, and Weber (2015) found that male-owned Twitter accounts had a higher average caloric value per Tweet than female-owned accounts. In a content analysis of "cheat meal" (i.e., meals often higher in calories, fat, sodium, added sugar, and simple carbohydrates than typical healthier meals eaten while on a diet) posts on Instagram, 60% of the posts came from men and 40% came from women (Pila, Mond, Griffiths, Mitchison, & Murray, 2017). However, Widener and Li (2014) found that among their sample of geotagged Tweets, men were more likely to Tweet about healthy foods than women. The difference between Abbar et al.'s (2015) and Widener and Li's (2014) findings may be due to Abbar et al.'s analysis of real time and historical Tweets (resulting in a larger sample size more representative of different points throughout the year) and Widener and Li's smaller, real time sample collected over a one-month period. Given the paucity and variability of research regarding gender identity differences in post content on social media generally and Instagram in particular, additional research is warranted.

Season and Diet

In addition to gender identity's relationship to eating behavior, there is mixed evidence on how eating patterns vary by season. Some studies show no difference in total caloric intake across seasons (Bernstein et al., 2016; Jahns et al., 2016). However, among obese individuals total daily caloric intake is 86 calories/day higher in the fall compared to the spring (Ma et al.,

2006). Fat and saturated fat intake were also higher in the fall compared to the spring in one study (Ma et al., 2006), while recent research showed that fat and saturated fat intake were higher in late winter to early spring months (February-May) (Marti-Soler et al., 2017). Another study of midlife women showed that participants were more likely to consume fresh fruit, lettuce, salad, and tomatoes during spring and summer, when fresh and local produce may be more readily available, than during winter (Jahns et al., 2016). Food purchase data in New York City suggested that individuals bought (and potentially consumed) more unhealthy food and beverages during the holiday period (Thanksgiving-New Year's) compared to before the holidays (July-Thanksgiving) (Pope, Hanks, Just, & Wansink, 2014). After the holidays (post New Year's to March), healthy food purchases increased while unhealthy food purchases remained the same (Pope et al., 2014).

Social media studies that have explored the timing of food and diet-related social media posts also have varied results. For example, one study showed that the caloric content of recipes accessed online in the Northern hemisphere was lowest in summer months (June-August) and highest in winter months (December-February) (West, White, & Horvitz, 2013). West et al.'s (2013) study also showed similar patterns for calories from fat and protein, sodium, and cholesterol. Internet searches for specific diets and related dieting terms (e.g., weight loss) peak in January and are lowest in December according to one study that examined search trends from 2005-2011 (Markey & Markey, 2013). Specific holidays see surges in food- and diet-related social media posts and advertising (Abbar et al., 2015; Freeman et al., 2014). In a study of Tweets containing weight-loss related keywords, Turner-McGrievy and Beets (2015) found that there were more weight loss-related posts during and after the holiday season (i.e., from Thanksgiving to New Year's) than before the holiday season. Holmberg, Chaplin, Hillman, and

Berg (2016) found that nearly one quarter of their sample of food-related Instagram posts belonging to teenagers referenced a specific holiday. In a study of popular blog recipes, Schneider, McGovern, Lynch, and Brown (2013) found no differences in calories or fat by season but observed 30% more sodium in recipes posted from December to May compared to those posted from June-November.

Ideation Theory

This study examines both seasonal and gender identity trends on diet- and weight loss-related Instagram content through the lens of Ideation Theory. Ideation Theory asserts that individuals are more likely to change health behaviors when more ideation factors such as social norms, social support and influence, knowledge, and self-image factors are present (Kincaid & Figueroa, 2004). Figure 4.1 shows how dieting for weight loss Instagram posts may be understood through Ideation Theory. Ideation Theory suggests that environmental factors that could contribute to a person's dieting for weight loss behavior, such as food cost and accessibility, environmental cues (e.g. smell of food), seasonal variation (e.g. in Fall, mass advertising for Starbuck's Pumpkin Spiced Lattes), and social environmental factors (e.g. increased number of social gatherings featuring high calorie/low nutrient food and beverages during the Holiday season, socially constructed gender roles and beliefs surrounding the ideal body) may contribute to a person's dieting for weight loss behavior. This study focuses specifically on seasonal variation and differences in Instagram posting behavior during the Holiday season as compared to other times of the year. It also focuses on how gender identity might influence posting behavior related to dieting for weight loss.

Purpose of the Study

Research on gender and seasonal trends among studies examining dietary behavior through social media has shown varied and sometimes conflicting findings. In addition, many studies that have explored dietary behavior through social media do not use a theoretical framework (Hawks et al., n.d.). Using a theoretical framework may help to better understand dieting for weight loss posts on photo-based social media platforms such as Instagram which may then inform a theoretically guided social media intervention. In this study, we aimed to: 1) Add to existing research by providing additional information about gender identity and seasonal trends on diet for weight loss Instagram content; and 2) Apply Ideation Theory to better contextualize gender identity and seasonal trends. Table 4.1 displays the study hypotheses, Ideation Theory constructs, and coded elements used to analyze each hypothesis.

Methods

Data Source

Data were collected from an existing dataset of 7,500,725 Instagram posts that were collected via Instagram's public application programming interface from January 1, 2014-June 3, 2015 and geo-tagged within Western San Diego County (California). The use of these data for the purposes of this study was reviewed and approved by San Diego State University's Institutional Review Board.

Dataset for Current Study

On July 12, 2018, we searched the existing data set of 7,500,725 Instagram posts for publicly available posts containing the following keywords: dieting tips, diet food, diet, diet journey, dieting, diet motivation, diet diary, diet life, diet tips, healthy food, healthy eating, and weight loss. Of 54,651 posts that matched one or more keywords, 36,119 (66.1%) of the dataset

were publicly available at the time of the search. The publicly available posts that contained at least one keyword were sorted according to meteorological season (Summer: June – August 2014; Fall: September – November 2014; Winter: December 2014 – February 2015; and Spring: March – May 2015). Meteorological seasons are used by meteorologists and climatologists and based on a 12-month calendar and annual temperature cycles (National Centers for Environmental Information, 2016). Prior research examining seasonal differences in dietary intake and social media post content has used meteorological season categorization (Jahns et al., 2016; Marti-Soler et al., 2017; Schneider et al., 2013; R. West et al., 2013). After sorting, 250 posts per quarter were randomly selected using Excel's random number function for a total of 1,000 included posts. To be included in the study dataset, the post had to contain at least one keyword and be written in English. Multiple posts from the same user were included. The sample included 720 unique users total. Posts were excluded if they did not contain at least one keyword, were written in a language other than English, or were not publicly available.

Coding

JH manually coded all 1,000 posts (including the image and post caption) in the dataset according to a previously developed and tested codebook described elsewhere (Hawks et al., n.d.). Interrater reliability of 0.8-1.0 was established between two independent coders for each variable using Krippendorff's alpha for the majority of variables and Gwet's coefficient for variables with low prevalence (Gwet, 2008; and Hayes & Krippendorff, 2007). This coding procedure has been used with prior Instagram research (Holmberg et al., 2016; and Pila et al., 2017). Coding categories were designed to assess different aspects of the post and thus, were not mutually exclusive. Data were categorized according to Ideation Theory variables including skills and knowledge; social influence; ideal body; season; and beliefs, values, and attitudes.

Elements coded and analyzed in this study are described in Table 4.1. For gender identity, we screenshotted and saved profile information in conjunction with the screenshotted post. Gender identity coding (categories: male, female, transgender, other, or not applicable/unable to determine) was based on JH's assessment of profile information, including both the profile picture and written profile description. "Other" included profiles that belonged to couples. If profile information was insufficient to determine gender identity or the profile belonged to an organization, gender identity was coded as not applicable/unable to determine. Other similar studies have used a similar coding approach but did not attempt to code for transgender individuals and only coded for males and females (Carrotte, Prichard, & Cheng Lim, 2017; Ghaznavi & Taylor, 2015; Pila et al., 2017).

For skills and knowledge, we categorized food items identified in captions (including hashtags – words preceded by the # sign) and photos. For example, if a picture displayed a smoothie and used the hashtags #spinach and #apple, the image would be coded as a beverage, fruit, and vegetable. For images that showed complex food items or meals, the items that were clearly visible and/or described in the caption or caption hashtags were coded. For example, if a taco with a tortilla, cabbage, and fried fish was pictured, the image was coded as grains, vegetables, lean protein, and fried food. Diets (e.g., Paleo, Keto) and dietary strategies (e.g., eating clean, low carbohydrates) were coded if they were mentioned explicitly in the post caption.

For beliefs, attitudes, and values, we coded celebratory reasons for eating and eating restriction. Posts coded as eating restriction had to include language that either implied or specifically mentioned needing to restrict, refrain from, or reduce eating in some way. Both the image and caption were used when coding eating restriction. For example, a picture of a dozen

donuts accompanied by text saying “shouldn’t eat this” would have been coded as eating restriction. Posts coded as celebratory eating had to reference a celebration, social gathering, or holiday as a reason for eating. Information from both the image and caption was used to make this decision. For example, a picture of a cake with candles and a happy birthday sign would have been coded as celebratory eating. Neither category was mutually exclusive. For example, a post that mentioned overeating during Thanksgiving and also mentioned needing to restrict eating or increase exercise to lose weight or avoid weight gain afterward would have been coded as both celebratory eating and eating restriction.

A post’s seasonality was assessed by the season in which it was posted according to the season definitions above. Specific holiday was coded as a dichotomous variable: it was coded “yes” if it mentioned any holiday specifically in the caption or image of the post and “no” if it did not mention a specific holiday. The specific holiday(s) referenced in the post were recorded by hand. No specific holidays were searched, but any holiday that was mentioned was coded as referencing a specific holiday. References to holidays that did not specifically mention the holidays themselves (e.g., mentioning “holiday season” instead of “New Year”) were coded as “no,” as were birthdays, anniversaries, graduations, and other celebrations.

To code for elements related to ideal body, posts that included depictions of full bodies (defined as showing from low thigh to shoulders) were coded as emphasizing muscularity and emphasizing thinness. Muscularity emphasized was coded as a dichotomous yes or no variable and was coded as “yes” if the image depicted clearly visible muscles or text in the caption that emphasized muscularity (e.g., mentions of toned abs). Thinness emphasized was coded as a dichotomous yes or no variable and was coded as “yes” if the image featured an excessively thin body (e.g., an image of a person with protruding hip or collar bones) or text that emphasized

thinness (e.g., mentions of thinness, skinny). It was possible for an image to be coded "yes" for both emphasizing muscularity and thinness. For example, if an image featured a person with a prominent "thigh gap" (space between a person's upper thighs when standing with their legs together) and clearly defined abdominal muscles, the post was coded as both emphasizing muscularity and emphasizing thinness.

Analysis

SPSS Version 25 (IBM Corp., 2017) was used for descriptive statistics. Chi-square analyses were used to assess differences in categorical variables between the four seasons, between posts including males and females, between posts that were posted by males and females, and seasonal differences in posts that were posted by males and females. Chi-square analyses performed only with minimum frequency >5 per cell. Fisher exact test was used if cell frequency was 5 or fewer. A significance level of $\alpha=0.05$ was used for all analyses, and a Bonferroni correction was used for multiple comparisons by dividing 0.05 by the number of comparisons made (0.05/8=0.00625).

Results

Season

Figure 4.2 displays the number of posts per season that contained foods that the US Dietary Guidelines either recommends eating (vegetables, fruits, lean protein, grains [preferably whole grains], dairy [preferably low-fat], and plant-based oils) or limiting (added sugar, red meat, fried foods, sugar-sweetened beverages [SSB], and alcohol). Images/text descriptions of the food types were consistent across posts from each season. There were no statistically significant differences between posts containing each food group across the four seasons (see Table 4.2).

Table 4.2 displays the results from the hypothesis of the study, that posts from fall/winter will feature fewer foods recommended by the US Dietary Guidelines and more foods that the US dietary guidelines recommend limiting than posts from spring/summer. There were no statistically significant differences in the frequency of most types of foods between spring/summer and fall/winter. However, statistically significantly more posts in spring/summer contained red meat (12.2% compared to 7.6%, $\chi^2 = 5.9$, p-value = 0.015, Phi = 0.077) and SSB (8% compared to 4.4%, $\chi^2 = 5.6$, p-value = 0.018, Phi = 0.075) compared to posts from fall/winter.

Few posts (n=31, 3.1%) mentioned a specific holiday. Of those that did, New Year's Day/Eve was most mentioned (n=9), followed by Christmas (n=7), Thanksgiving (n=5), Cinco de Mayo (n=2), Valentine's Day (n=2), Fourth of July (n=2), Easter (n=1), Memorial Day (n=1), Labor Day (n=1), and Veteran's Day (n=1). Posts mentioning a specific holiday were more likely to describe the holiday as a reason for celebratory eating than posts that did not mention a specific holiday (31.0% compared to 3.8%, $\chi^2 = 47.6$, p-value < 0.001, Phi = 0.218). There was no difference between posts that mentioned a specific holiday and those that did not in describing the holiday as a reason for eating restriction.

Gender Identity

When included in images, males and females were portrayed differently in Instagram posts. Instagram posts that included females were more likely to emphasize thinness than posts including males (1.9% compared to 33.1%, $\chi^2 = 36.9$, p-value < 0.001, Phi = 0.373). Instagram posts featuring males were more likely to emphasize muscularity than posts featuring females (62.1% compared to 25.8%, $\chi^2 = 34.8$, p-value < 0.001, Phi = 0.362). Although males were more likely to be portrayed as muscular and females more likely to be portrayed as thin, there were no

statistically significant differences between posts featuring males and females in whether they emphasized certain diets or dietary strategies. Table 4.3 displays the results of the chi-square analyses examining differences in posts featuring males and females and posts that were posted by males and females.

Instagram posts that were posted by males were more likely to emphasize muscularity than posts by females (29.3% compared to 6.9%, $\chi^2 = 69.2$, p-value < 0.001, Phi = 0.298). Instagram posts by females were more likely to emphasize thinness compared to posts by males (7.6% compared to 2.6%, $\chi^2 = 7.036$, p-value = 0.008, Phi = 0.095). Instagram posts by females did not differ from posts by males in terms of specific diets or dietary strategies mentioned.

Gender Identity and Season

Posts by males and females differed in the types of foods that were posted in spring, summer, fall, and winter as shown in Table 4.4. Our hypothesis that posts from female-owned accounts posted during spring and summer will contain more US dietary guideline-recommended foods than posts from male owned accounts was supported by our data. In spring, a higher proportion of females compared to males posted about fruit (31.4% compared to 15.4%, $\chi^2 = 4.9$, p-value = 0.026, Phi = 0.160) and lean protein (32.1% compared to 13.5%, $\chi^2 = 6.7$, p-value = 0.01, Phi = 0.187). A higher proportion of males compared to females posted about red meat in spring (23.1% compared to 9.3%, $\chi^2 = 6.4$, p-value = 0.012, Phi = 0.182). A higher proportion of females compared to males posted about vegetables in summer (30% compared to 45.8%, $\chi^2 = 4.4$, p-value = 0.036, Phi = 0.147).

Our hypothesis that male-owned accounts posted during fall and winter will contain more foods that the US dietary guidelines recommend limiting than posts from female-owned accounts was partially supported. In fall, a higher proportion of females compared to males posted about

vegetables (47.9% compared to 21.1%, $\chi^2 = 13.5$, p-value < 0.001, Phi = 0.267), fruit (40.3% compared to 14.1%, $\chi^2 = 14.5$, p-value < 0.001, Phi = 0.276), and lean protein (37.8% compared to 12.7%, $\chi^2 = 13.8$, p-value < 0.001, Phi = 0.270). Although a higher proportion of males compared to females posted about red meat in winter (21.7% compared to 5.4%, $\chi^2 = 11.0$, p-value = 0.001, Phi = 0.239), a significantly higher proportion of females compared to males posted about added sugar in winter (16.3% compared to 2.2%, $\chi^2 = 6.2$, p-value = 0.011, Phi = 0.239).

Discussion

Many individuals in the US, especially youth and young adults, use social media and Instagram (Anderson et al., 2018; Smith et al., 2018). Social media use may influence weight loss, diet, and exercise behaviors by providing individuals with new knowledge and motivation (Easton, Morton, Tappy, Francis, & Dennison, 2018). However, social media use may also encourage maladaptive weight loss behaviors (Easton et al., 2018; Vaterlaus, Patten, Roche, & Young, 2015). This study used Ideation Theory to better understand gender identity and seasonal trends of diet for weight loss-related Instagram posts. Results are discussed in terms of seasonal trends (including ideation factors of environmental cues (season) and skills/knowledge) and gender identity differences in post content (including ideation factors of skills/knowledge, social influence, and ideal body).

Seasonal Trends

Our results showed no differences among seasons for different food groups. This could have been due to the small number of posts per season, the way that foods were coded, and/or the way seasons were defined. For example, using astrological seasons (based on solstice and equinox dates) may have allowed us to see a difference in seasons more closely related to major

holidays associated with overeating (e.g., Thanksgiving) and dieting (e.g., New Year's). We also had a small number of posts per season, which may have been insufficient to detect differences between seasons. Finally, rather than coding complex food items (e.g., cheeseburger) as a cheeseburger, we coded it based on food groups (e.g., vegetable, dairy, red meat, grains). Had we coded posts as generally healthy or unhealthy, we may have seen more differences across seasons.

Our results showed that significantly more posts in spring/summer contained red meat and SSB compared to posts from fall/winter. This result was opposite of our hypothesis, that spring and summer posts would feature more foods recommended by the US dietary guidelines and fewer foods not recommended by the dietary guidelines than fall and winter posts. Prior research has varied in its findings of food group and nutrient intake across seasons. For example, a systematic review and meta-analysis examining 26 studies of seasonal food intake concluded that meat consumption was higher during spring and summer than during autumn and winter (Stelmach-Mardas et al., 2016), although this study did not separate lean proteins from red meat as we did in this study. In a study of online recipe access behavior with a sample consisting of billions of page views, researchers found that recipes accessed during winter months were higher in calories, calories from fat, calories from protein, sodium, and cholesterol compared to recipes accessed during summer months (R. West et al., 2013). Marti-soler et al. (2017) included data from 9 population-based studies with a total sample size of 44,611 to assess seasonality of dietary intake. They found that saturated fat intake peaked in February for men and March for women, that sugar intake peaked in September among men and August for women, and that protein intake peaked in May for both men and women (Marti-Soler et al., 2017). Although they did not examine specific food groups, sugar intake may be associated with SSB and saturated fat

and protein intake may be associated with higher red meat intake. Our study showed that there were more posts from men containing red meat (higher in saturated fat) compared to posts from women in winter and spring. In contrast, women tended to post about healthier foods such as lean protein, fruits, and vegetables than males across spring, summer, and fall. Our results also showed that during winter, women posted more about foods containing added sugar than males. In a sample of 76 urban US adults, researchers found no significant difference in specific food group intake across seasons (Bernstein et al., 2016). Our results contribute to the varied results on seasonal eating by assessing what foods people post about on Instagram most frequently during each season. Seasonality falls under environmental factors related to a person's behavior, according to Ideation Theory. One of the reasons we found few differences in seasonal dietary intake may be due to the lack of traditional seasons in the area where the data was collected, which experiences mild temperatures year-round. This may increase the year-round availability of US Dietary Guidelines recommended foods like fresh produce.

Our hypothesis that posts mentioning a specific holiday were more likely to describe the holiday as a reason for celebratory eating than posts that did not mention a specific holiday was supported by our data. This finding is consistent with research on Thanksgiving-New Year's holiday food purchases indicating that the number of calories purchased each week increases by 20.2% during the holiday period compared to the baseline period of July-Thanksgiving (Pope et al., 2014). In addition, although healthy food purchases remained the same between baseline and the holiday period, 75% of the additional expenditures during the holiday period were unhealthy food items (Pope et al., 2014). This could indicate that people eat more unhealthy foods during the holiday season, which is generally characterized by multiple social gatherings centered around eating.

We found no difference in eating restriction described in posts that mentioned a specific holiday versus posts not mentioning a specific holiday. Turner-McGrievy and Beets (2015) found that there were more weight loss-related Tweets during and after the holidays compared to before the holidays. Our results may have differed because of our narrower definition of eating restriction (Does the post mention exercising caution or refraining from eating in order to continue weight loss efforts?), whereas Turner-McGrievy and Beets (2015) only looked for keyword mentions (#diet or #weightloss) in their analysis. Ideation theory might suggest that holidays (and specifically holiday social gatherings) are part of the social environment, and thus would influence people to eat in a certain way. For example, across the United States, many individuals celebrate Thanksgiving by eating a turkey dinner with friends and family. However, a holiday like New Year's, which is generally associated with new beginnings and resolutions, may have more association with eating restriction, since weight loss resolutions are common during the New Year.

Gender Identity

Our hypotheses that Instagram posts including females were more likely to emphasize thinness than posts that included males and that posts featuring males were more likely to emphasize muscularity than posts featuring females were supported by our data. In addition, posts by males were more likely to emphasize muscularity than posts by females, and Instagram posts by females were more likely to emphasize thinness compared to posts by males. An analysis of weight loss ads published in January and June between 2001-2011 in 10 popular US magazines found that most weight loss advertisements (81%) were targeted towards women and emphasized weight loss strategies such as low-calorie diets, pharmaceuticals, low-fat combined with low-calorie diets, supplements, low-fat diets, and surgery (Mishra & Kern, 2015). Our

results are similar to research on fitness magazine advertising, which showed that *Men's* and *Women's Health* magazines were both likely to have objectifying image and text on the covers (Bazzini et al., 2015). In addition, similar to our results, images and text from *Women's Health* were more likely to emphasize thinness, while images and text from *Men's Health* were more likely to emphasize muscularity (Bazzini et al., 2015). Although there has been considerable research on thinness being the ideal body type for women, more recent research has emphasized the importance of both muscularity and thinness for women (Bozsik, Whisenhunt, Hudson, Bennett, & Lundgren, 2018). Our data showed that approximately one quarter of images featuring females also emphasized muscularity.

There were no differences between posts including males and females and posts by males and females in their likelihood of mentioning specific diets or dietary strategies. Several studies provide evidence that dieting prevalence is higher among women than men (Davy, Benes, & Driskell, 2006; Markey & Markey, 2005; Oakes & Slotterback, 2002; Slof-Op 't Landt et al., 2017; Tsai, Lv, Xiao, & Ma, 2016). Markey & Markey (2005) found that while the majority of males and females reported engaging in at least one healthy dieting behavior such as eating more fruits and vegetables, females were significantly more likely to have ever tried at least one unhealthy dieting behavior such as vomiting after meals. In addition, Davy et al. (2006) found that among college students, women were more likely than men to have reported trying low-fat diets, low-carb diets, Weight Watchers, and vegetarian diets. In a nationally representative sample of 2009-2010 National Health and Nutrition Examination Survey (NHANES) adult participants, women were more likely than men to report eating more fruits and vegetables, drinking a lot of water, taking prescription diet pills, or joining a weight loss program as a means of weight loss, while men were more likely to report eating less fat and exercising compared to

women (Tsai et al., 2016). Our sample of male-owned accounts may have been too small to detect differences in mentions of diets and dietary strategies between males and females.

Our results may show no difference in mentions of dietary strategies and specific diets between males and females because perhaps Instagrammers are not as likely to post about specific diets and strategies as they are to respond about them in a survey. According to Ideation Theory, individuals are more likely to change dietary behaviors if they perceive that those around them approve of and are practicing similar behaviors (social influence). It is possible that individuals who view diet for weight loss-related Instagram content may be more likely to adopt dietary behaviors (e.g. following a ketogenic diet or "eating clean") if they see others similar to them posting about those dietary behaviors on Instagram. This is particularly true given that young adults often use social media and the internet as a way of finding new information and social support for changing diet and other health behaviors (Vaterlaus et al., 2015).

Limitations

This study should be understood within the context of its limitations. First, we did not exclude multiple posts from the same user, thus posts may have been biased towards accounts that posted multiple times. Other social media studies have included multiple posts from the same user (Moreno, Ton, Selkie, & Evans, 2016; Ofli, Aytar, Weber, al Hammouri, & Torralba, 2017; Pila et al., 2017; Sharma & de Choudhury, 2015). In addition, the most posts from any single account was 21. Most users who posted multiple times posted 5 times or less. In addition, including multiple posts from the same user mimics what users would actually see on Instagram. Data were coded by one coder. However, the codebook used has been piloted in prior research and interrater reliability between two coders was established.

Our results are limited in generalizability to male and female identities/genders. Since Instagram users' gender information (options limited to "male," "female," "prefer not to say," and "custom," [Instagram, 2019]) is private, we were unable to extract user-entered gender information. Assessment of gender identity was limited to the first author's assessment of information presented in profile photos and text. Although we used a similar coding procedure to prior Instagram research, not everyone who presents as male or female in an Instagram profile photo and description would necessarily identify as male or female. While our coding approach was not an ideal way to assess gender identity, given the preliminary nature of this study and lack of prior research on transgender individuals on Instagram, this approach was an appropriate first step. None of the profiles we coded and analyzed were self-identified as transgender and thus, this study does not provide insight into how transgender individuals use Instagram to post about diet and weight loss. Given that social media is an important space for transgender individuals to interact with one another and gain support (Darwin, 2017), future research on social media platforms should investigate diet and weight loss posting behavior among transgender individuals. We recognize the limitations related to our assessment of gender identity and recommend that future studies address this gap in the literature, as sexual and gender minorities are at risk for unhealthy dietary behaviors and are underrepresented in health behavior research in general (Smalley, Warren, & Barefoot, 2016).

There are various ways to assess seasonality, and this study's assessment was based on meteorological seasons. Although we based this decision on multiple studies that examined seasonal trends using meteorological seasons, our results may have differed had we defined seasons in another way. Our sample of Instagram posts was limited to those posted in Western San Diego County, an area that experiences very little seasonal variation in temperature and

weather. Seasonal differences in dietary intake may have been greater in an area with more distinct seasons and variable weather. In addition, San Diego is a health-conscious area (McCann, 2019), so posts from San Diego may be more likely to contain healthy foods in general than posts from other regions. Lastly, our findings regarding dietary intake on specific holidays is also limited, due to the small number of posts that mentioned a specific holiday.

Conclusions

This study examined differences in posts according to season and gender identity. Since research on these topics vary widely by study, this research contributes to the growing body of literature on how season and gender identity may be related to dieting for weight loss posts on Instagram. This study also adds information on how dieting for weight loss Instagram posts can be understood within the Ideation Theory framework and how the ideation factors examined in this paper (dieting for weight loss skills and knowledge; ideal body; social influence: gender identity; environmental: season; and beliefs, values, and attitudes) may influence a person's diet for weight loss posting behavior and intention to diet for weight loss. This study confirmed findings from previous research that media featuring males is more likely to emphasize muscularity and media featuring females is more likely to emphasize thinness due to societal beliefs about ideal male and female bodies. However, this research could be expanded upon by exploring how gender and sexual minorities post about diet and weight loss on photo-based social media platforms such as Instagram. This study also provided information on what types of content were prevalent across seasons. These findings could be used in an Ideation Theory-guided health communication campaign aimed at helping individuals to improve their dieting for weight loss behavior. In addition, our findings indicate that current Instagram content may idealize extremely thin and muscular body types for females and males respectively. It may be

important to balance messaging perpetuating male/female ideal body stereotypes with more body-positive and realistic images on Instagram and other photo-based social media platforms. As little data exists on how social media posting behavior is related to actual behavior, future research on dieting/weight loss-related photo-based social media content should examine how this type of content influences actual dieting for weight loss behavior. This research helps us to better understand how dieting for weight loss content on Instagram differs by season and gender identity, which can help public health professionals to develop better-tailored and more effective health communication interventions.

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REFERENCES

Abbar, S., Mejova, Y., & Weber, I. (2015). You Tweet what you eat: Studying food consumption through Twitter. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (pp. 3197–3206). New York, NY, USA: ACM. http://doi.org/10.1145/2702123.2702153

Anderson, M., Smith, A., & Caiazza, T. (2018). *Teens, social media, & technology 2018*. Washington, DC. Retrieved from https://www.pewinternet.org/2018/05/31/teens-social-media-technology-2018/

Anderson-Bill, E. S., Winett, R. A., & Wojcik, J. R. (2011). Social cognitive determinants of nutrition and physical activity among web-health users enrolling in an online intervention: the influence of social support, self-efficacy, outcome expectations, and self-regulation. *Journal of Medical Internet Research*, *13*(1), 1–16. http://doi.org/10.2196/jmir.1551

Bazzini, D. G., Pepper, A., Swofford, R., & Cochran, K. (2015). How healthy are health magazines? A comparative content analysis of cover captions and images of Women's and Men's Health magazine. *Sex Roles*, *72*, 198–210. http://doi.org/10.1007/s11199-015-0456-2

Bernstein, S., Zambell, K., Amar, M. J., Arango, C., Kelley, R. C., Miszewski, S. G., … Courville, A. B. (2016). Dietary intake patterns are consistent across seasons in a cohort of healthy adults in a metropolitan population. *Journal of the Academy of Nutrition & Dietetics*, *116*, 38–45. http://doi.org/10.1016/j.jand.2015.08.008

Bozsik, F., Whisenhunt, B. L., Hudson, D. L., Bennett, B., & Lundgren, J. D. (2018). Thin is in? Think again: The rising importance of muscularity in the thin ideal female body. *Sex Roles*, *79*, 609–615. http://doi.org/10.1007/s11199-017-0886-0

Cann, A., Dimitriou, K., & Hooley, T. (2011). Social Media : A guide for researchers. *History*, *89*(February), 48.

Carrotte, E., Prichard, I., & Cheng Lim, M. S. (2017). "Fitspiration" on social media: A content analysis of gendered images. *Journal of Medical Internet Research*, *19*(3). 10.2196/jmir.6368

comScore. (2017). *The 2017 U.S. cross-platform future in focus*. Reston, VA.

Dahl, A. A., Hales, S. B., & Turner-McGrievy, G. M. (2016). Integrating social media into weight loss interventions. *Current Opinion in Psychology*, *9*, 11–15. http://doi.org/10.1016/j.copsyc.2015.09.018

Darwin, H. (2017). Doing gender beyond the binary: A virtual ethnography. *Symbolic Interaction*. 10.1002/symb.316

Davy, S. R., Benes, B. A., & Driskell, J. A. (2006). Sex differences in dieting trends, eating

habits, and nutrition beliefs of a group of Midwestern college students. *Journal of the American Dietetic Association*, 1673–1677. http://doi.org/10.1016/j.jada.2006.07.017

Easton, S., Morton, K., Tappy, Z., Francis, D., & Dennison, L. (2018). Young people's experiences of viewing the fitspiration social media trend: Qualitative study. *Journal of Medical Internet Research*, *20*(6), e219. http://doi.org/10.2196/jmir.9156

Freeman, B., Kelly, B., Baur, L., Chapman, K., Chapman, S., Gill, T., & King, L. (2014). Digital junk: Food and beverage marketing on Facebook. *American Journal of Public Health*, *104*(12), e56-64. http://doi.org/10.2105/AJPH.2014.302167

Ghaznavi, J., & Taylor, L. (2015). Bones, body parts, and sex appeal: An analysis of #thinspiration images on popular social media. *Body Image, 14*, 54-61. http://dx.doi.org/10.1016/j.bodyim.2015.03.006

Gwet, K. L. (2008). Computing inter-rater reliability and its variance in the presence of high agreement. *British Journal of Mathematical and Statistical Psychology, 61*, 29–48. http://doi.org/10.1348/000711006X126600

Hawks, J. R., Madanat, H., Walsh-Buhi, E. R., Hartman, S., Strong, D., & Nara, A. (n.d.). Systematic review of social media as a research tool for diet and weight loss. Unpublished manuscript.

Hawks, J. R., Walsh-Buhi, E. R., Madanat, H., Nara, A., Hartman, S., Strong, D., & Anderson, C. (n.d.). Dieting for weight loss on Instagram: A content analysis guided by Ideation Theory. Unpublished manuscript.

Hayes, A. F., & Krippendorff, K. (2007). Answering the call for a standard reliability measure for coding data. *Communication Methods and Measures*, *1*(1), 77–89. http://doi.org/10.1080/19312450709336664

Holmberg, C., Chaplin, J. E., Hillman, T., & Berg, C. (2016). Adolescents' presentation of food in social media: An explorative study. *Appetite, 99*, 121–129. http://doi.org/10.1016/j.appet.2016.01.009

Instagram. (2019). Celebrating #untoldpride this Pride. Retrieved August 13, 2019, from https://instagram-press.com/blog/2019/06/10/celebrating-untoldpride-this-pride/

Jahns, L., Johnson, L. A. K., Scheett, A. J., Stote, K. S., Raatz, S. K., Subar, A. F., & Tande, D. (2016). Measures of diet quality across calendar and winter holiday seasons among midlife women: A 1-year longitudinal study using the automated self-administered 24-hour recall. *Journal of the Academy of Nutrition and Dietetics, 116*(12), 1961–1969. http://doi.org/10.1016/j.jand.2016.07.013

Kincaid, D. L., & Figueroa, M. E. (2004). Ideation and individual behavior change.

Levi, A., Chan, K. K., & Pence, D. (2006). Real men do not read labels: The effects of masculinity and involvement on college students' food decisions. *Journal of American*

College Health, 55(2), 91–98.

Ma, Y., Olendzki, B. C., Li, W., Hafner, A. R., Chiriboga, D., Hebert, J. R., … Ockene, I. S. (2006). Seasonal variation in food intake, physical activity, and body weight in a predominantly overweight population. *European Journal of Clinical Nutrition, 60*(4), 519–528. http://doi.org/10.1038/sj.ejcn.1602346

Markey, C. N., & Markey, P. M. (2005). Relations between body image and dieting behaviors: An examination of gender differences. *Sex Roles, 53*(7/8), 519–530. http://doi.org/10.1007/s11199-005-7139-3

Markey, P. M., & Markey, C. N. (2013). Annual variation in Internet keyword searches: Linking dieting interest to obesity and negative health outcomes. *Journal of Health Psychology, 18*(7), 875–886. http://doi.org/10.1177/1359105312445080

Marti-Soler, H., Guessous, I., Gaspoz, J., Metcalf, P., Deschamps, V., Castetbon, K., … Marques-Vidal, P. (2017). Seasonality of nutrient intake - An analysis including over 44,000 participants in 4 countries. *Clinical Nutrition ESPEN, 21*, 66–71. http://doi.org/10.1016/j.clnesp.2017.05.003

McCann, A. (February 11, 2019). Healthiest and unhealthiest cities in America. Retrieved August 15, 2019, from https://wallethub.com/edu/healthiest-cities/31072/

Mills, S., Tanner, L., & Adams, J. (2013). Systematic literature review of the effects of food and drink advertising on food and drink-related behaviour, attitudes and beliefs in adult populations. *Obesity Reviews, 14*, 303–314. http://doi.org/10.1111/obr.12012

Mishra, S., & Kern, R. (2015). Persuading the public to lose weight: An analysis of a decade (2001-2011) of magazine advertisements. *Journal of Magazine and New Media Research*, *16*(1), 1–21.

Moreno, M., Ton, A., Selkie, E., & Evans, Y. (2016) Secret society 123: Understanding the language of self-harm on Instagram. *Journal of Adolescent Health, 58*, 78-84. 10.1016/j.jadohealth.2015.09.015

National Centers for Environmental Information. (September 22, 2016). Meteorological versus astronomical seasons. Retrieved July 23, 2019 from https://www.ncei.noaa.gov/news/meteorological-versus-astronomical-seasons

Oakes, M. E., & Slotterback, C. S. (2002). The good, the bad, and the ugly: Characteristics used by young, middle-aged, and older men and women, dieters and non-dieters to judge healthfulness of foods. *Appetite, 38*, 91–97. http://doi.org/10.1006/appe.2001.0444

Ofli, F., Aytar, Y., Weber, I., al Hammouri, R., & Torralba, A. (2017). Is saki #delicious?: The food perception gap on Instagram and its relation to health. In *Proceedings of the 26th International Conference on World Wide Web* (pp. 509-518). Geneva, Switzerland: WWW. https://doi.org/10.1145/3038912.3052663

Pila, E., Mond, J. M., Griffiths, S., Mitchison, D., & Murray, S. B. (2017). A thematic content analysis of #cheatmeal images on social media: Characterizing an emerging dietary trend. *International Journal of Eating Disorders*, *50*(6), 698–706. http://doi.org/10.1002/eat.22671

Pope, L., Hanks, A. S., Just, D. R., & Wansink, B. (2014). New year's res-illusions: Food shopping in the new year competes with healthy intentions. *PLoS ONE*, *9*(12). http://doi.org/10.1371/journal.pone.0110561

Schneider, E. P., McGovern, E. E., Lynch, C. L., & Brown, L. S. (2013). Do food blogs serve as a source of nutritionally balanced recipes? An analysis of 6 popular food blogs. *Journal of Nutrition Education & Behavior*, *45*(6), 696–700. http://10.0.3.248/j.jneb.2013.07.002

Sharma, S. S., & De Choudhury, M. (2015). Measuring and characterizing nutritional information of food and ingestion content in Instagram. In *Proceedings of the 24th International Conference on World Wide Web* (pp.115-116). New York, NY, USA: WWW. http://doi.acm.org/10.1145/2740908.2742754

Slof-Op 't Landt, M. C. T., van Furth, E. F., van Beijsterveldt, C. E. M., Bartels, M., Willemsen, G., de Geus, E. J., … Boomsma, D. I. (2017). Prevalence of dieting and fear of weight gain across ages: A community sample from adolescents to the elderly. *International Journal of Public Health*, *62*(8), 911–919. http://doi.org/10.1007/s00038-017-0948-7

Smalley, K. B., Warren, J. C., & Barefoot, K. N. (2016). Differences in health risk behaviors across understudied LGBT subgroups. *Health Psychology*, *35*(2), 103–114. http://doi.org/10.1037/hea/0000231

Smith, A., Anderson, M., & Caiazza, T. (2018). *Social Media Use in 2018*. Washington, DC. Retrieved from https://www.pewinternet.org/2018/03/01/social-media-use-in-2018/

SPSS Version 25 for Windows. (2017). Armonk, NY: IBM Corp.

Stelmach-Mardas, M., Kleiser, C., Uzhova, I., Peñalvo, J. L., La Torre, G., Palys, W., … Boeing, H. (2016). Seasonality of food groups and total energy intake: A systematic review and meta-analysis. *European Journal of Clinical Nutrition*, *70*, 700–708. http://doi.org/10.1038/ejcn.2015.224

Tsai, S. A., Lv, N., Xiao, L., & Ma, J. (2016). Gender differences in weight-related attitudes and behaviors among overweight and obese adults in the United States. *American Journal of Men's Health*, *10*(5), 389–398. http://doi.org/10.1177/1557988314567223

Turner-McGrievy, G. M., & Beets, M. W. (2015). Tweet for health: Using an online social network to examine temporal trends in weight loss-related posts. *Translational Behavioral Medicine*, *5*(2), 160–166. http://doi.org/10.1007/s13142-015-0308-1

Vaterlaus, J. M., Patten, E. V., Roche, C., & Young, J. A. (2015). #Gettinghealthy: The perceived influence of social media on young adult health behaviors. *Computers in Human Behavior*, *45*(January 2014), 151–157. http://doi.org/10.1016/j.chb.2014.12.013

Vukmirovic, M. (2015). The effects of food advertising on food-related behaviours and perceptions in adults: A review. *Food Research International*, *75*, 13–19. http://doi.org/10.1016/j.foodres.2015.05.011

West, R., White, R. W., & Horvitz, E. (2013). From cookies to cooks: insights on dietary patterns via analysis of web usage logs. *WWW '13: Proceedings of the 22nd International Conference on World Wide Web*, 1399–1410. http://doi.org/10.1145/2488388.2488510

Widener, M. J., & Li, W. (2014). Using geolocated Twitter data to monitor the prevalence of healthy and unhealthy food references across the US. *Applied Geography*, *54*(SI), 189–197. http://doi.org/10.1016/j.apgeog.2014.07.017

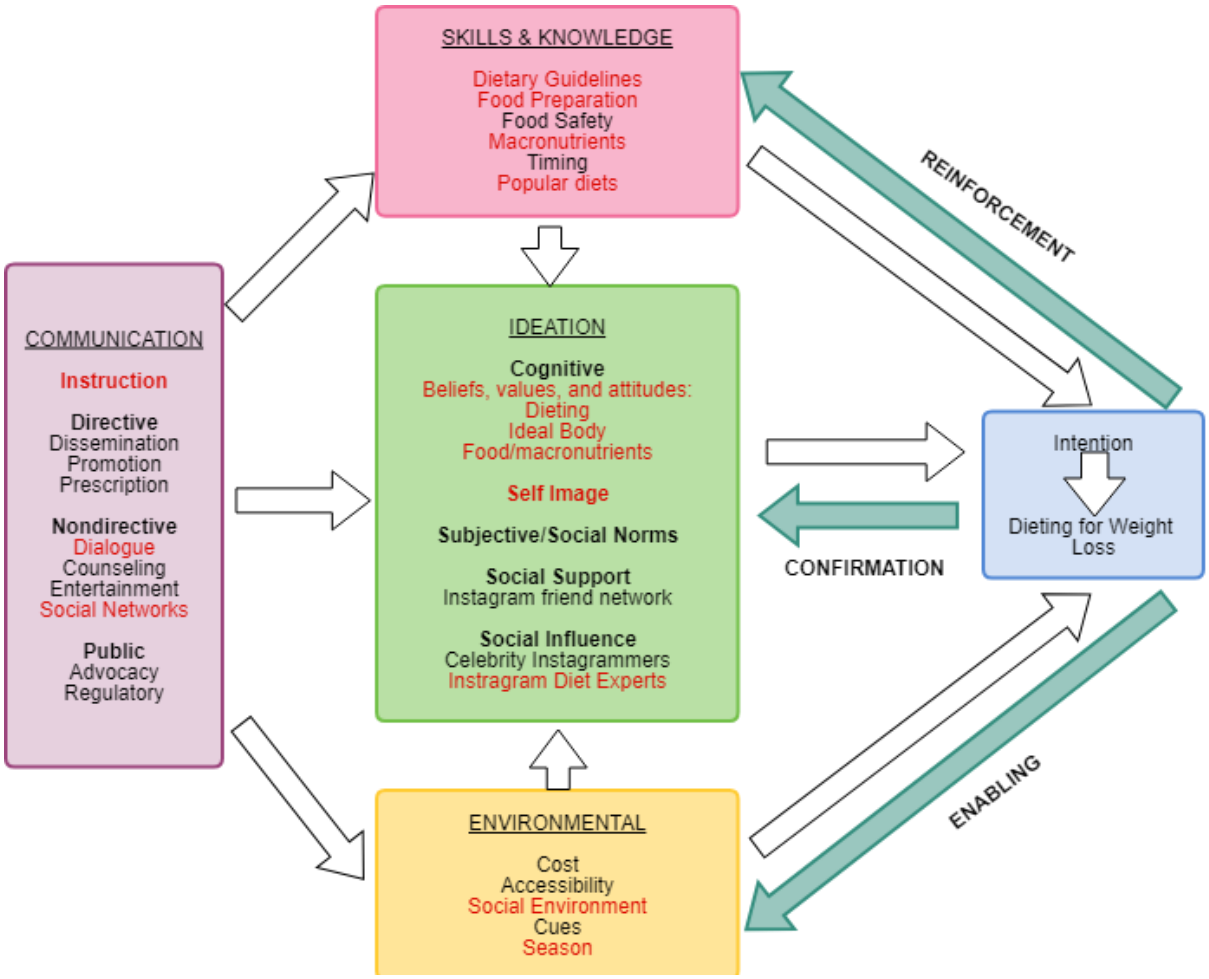

Figure 4.1. Ideation Theory Applied to Dieting for Weight Loss

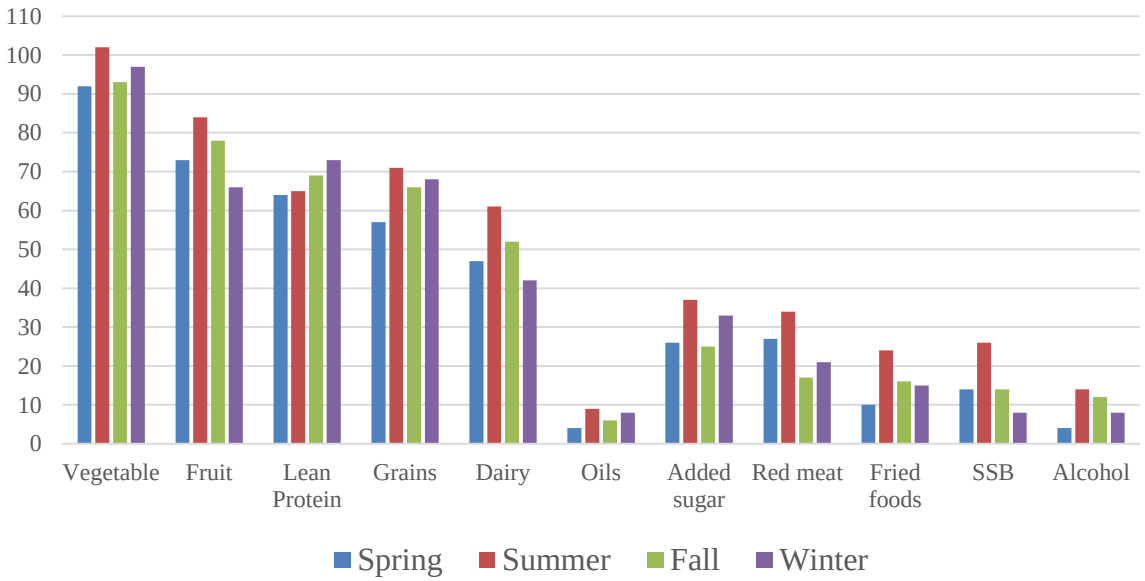

Figure 4.2. Number of Posts Per Season that Contain Various Food Types

Table 4.1. Research Questions and Related Ideation Theory Constructs, Coded Elements, and Definitions

Ideation Theory Construct	Hypothesis	Coded Element and Definition
Environmental: Season **Skills/knowledge**	**Posts that were posted during spring and summer will feature more foods recommended by the US dietary guidelines and fewer foods not recommended by the dietary guidelines than posts that were posted during fall and winter.**	**Recommended Foods:** Does the image show or text mention the following types of foods that the US Dietary Guidelines recommend for a healthy diet?: Vegetable Fruit Lean Protein Grains Dairy Oils **Foods that Should Be Limited:** Does the image show or text mention the following types of foods that the US Dietary Guidelines recommends limiting for a healthy diet?: Added sugar Red meat Fried food Sugar-sweetened beverages Alcoholic beverages
Environmental: Season **Beliefs, values, and attitudes**	**Posts that mention specific holidays will be more likely to mention the holiday as a reason for eating and not as a reason for eating restriction than posts that do not mention specific holidays.**	**Specific Holiday:** Does the post mention a specific holiday? Examples: Thanksgiving, Halloween, Valentine's Day **Restriction:** Does the post mention exercising caution or refraining from eating in order to continue weight loss efforts? Examples: language about a struggle with food when an unhealthy food is pictured (e.g., "after eating this I'm going on a diet."), mentions needing to exercise to work off food eaten **Celebratory Eating:** Does the post reference a celebration, social gathering, or holiday as a reason for eating? Examples: "Girls night out, bring on the wine and cheese!" or "Going to eat all the cake after my graduation."
Social Influence: Gender Identity **Skills/knowledge**	**Instagram posts that were posted by females will be more likely to feature particular diets or dietary strategies than posts that were posted by men.**	**Gender Identity:** For posts originating from an individual person's account, does the post originate from a male's, female's, transgendered person's, or both male and female's account? **Specific Diet:** Does the post mention a specific diet plan? Examples: Paleo, Atkins, Weight Watchers, Ketogenic **Dietary Strategy:** Does the post mention a specific dietary strategy? Examples: Counting calories, eating vegetarian, eating more protein, eating less fat, eating clean, detoxing

Table 4.1 Cont. Research Questions and Related Ideation Theory Constructs, Coded Elements, and Definitions

Ideation Theory Construct	Hypothesis	Coded Element and Definition
Ideal body	**Instagram posts including women will be more likely to emphasize thinness and less likely to emphasize muscularity than posts including men.**	**Gender of person included in image:** Is (are) the person (people) pictured male, female, or if multiple people, both male and female? **Muscularity emphasized:** Does the image depict defined or clearly visible muscles, or does the language of the caption emphasize muscularity? Examples: clearly defined abdomen muscles in image, text that mentions a "six pack," toned abs, muscles, etc. **Thinness emphasized:** Does the image feature an excessively thin body/body parts, or does the language of the caption emphasize thinness? Examples: protruding hip or collar bones in image, text that mentions thinness, skinny, skinny is sexy, etc.
Environmental: Season **Skills/knowledge** **Social Influence: Gender Identity**	**Posts from female-owned accounts posted during spring and summer will contain more US dietary guideline-recommended foods than posts from male-owned accounts.**	See above for coding descriptions.
Environmental: Season **Skills/knowledge** **Social Influence: Gender Identity**	**Posts from male-owned accounts posted during fall and winter will contain more foods that the US dietary guidelines recommend limiting than posts from female-owned accounts.**	See above for coding descriptions.

Table 4.2. Types of food posted in spring/summer compared to fall/winter

Type of food or beverage pictured	Spring N=250 *n (%)**	Summer N=250 *n (%)**	Fall N=250 *n (%)**	Winter N=250 *n (%)**	Spring and summer N=500 *n (%)**	Fall and winter N=500 *n (%)**
Vegetable	92 (36.8%)	102 (40.8%)	93 (37.2%)	97 (38.8%)	194 (38.8%)	190 (38%)
Fruit	73 (29.2%)	84 (33.6%)	78 (31.2%)	66 (26.4%)	157 (31.4%)	144 (28.8%)
Lean protein	64 (25.6%)	65 (26.0%)	69 (27.6%)	73 (29.2%)	129 (25.8%)	142 (28.4%)
Grains	57 (22.8%)	71 (28.4%)	66 (26.4%)	68 (27.2%)	128 (25.6%)	134 (26.8%)
Dairy	47 (18.8%)	61 (24.4%)	52 (20.8%)	42 (16.8%)	108 (21.6%)	94 (18.8%)
Oils	4 (1.6%)	9 (3.6%)	6 (2.4%)	8 (3.2%)	13 (2.6%)	14 (2.8%)
Added sugar	26 (10.4%)	37 (14.8%)	25 (10.0%)	33 (13.2%)	63 (12.6%)	58 (11.6%)
Red meat	27 (10.8%)	34 (13.6%)	17 (6.8%)	21 (8.4%)	61 (12.2%)**	38 (7.6%)**
Fried foods	10 (4.0%)	24 (9.6%)	16 (6.4%)	15 (6.0%)	34 (6.8%)	31 (6.2%)
SSB	14 (5.6%)	26 (10.4%)	14 (5.6%)	8 (3.2%)	40 (8.0%)**	22 (4.4%)**
Alcohol	4 (1.6%)	14 (5.6%)	12 (4.8%)	8 (3.2%)	18 (3.6%)	20 (4%)

*Categories were not mutually exclusive, thus percentages do not add up to 100%

**Statistically significant at $p<0.05$

Table 4.3. Muscularity, Thinness, and Specific Diets/Dietary Strategies by Gender Identity

	Male subjects only n=103	**Female subjects only n=163**	**Posted by a male n=162**	**Posted by a female n=512**
Image/caption emphasize…	*n (%)**	*n (%)**	*n (%)**	*n (%)**
Muscularity	64 (62.1%)**	42 (25.8%)**	67 (29.3%)**	38 (6.9%)**
Thinness	2 (1.9%)**	54 (33.1%)**	6 (2.6%)**	42 (7.6%)**
Caption mentions…				
Specific diet	10 (9.7%)	15 (9.2%)	27 (11.8%)	59 (10.7%)
Dietary strategy	47 (45.6%)	55 (33.7%)	92 (40.2%)	220 (40.0%)

*Categories were not mutually exclusive, thus percentages do not add up to 100%
**Statistically significant at $p<0.05$

Table 4.4. Seasonal differences in types of food posted among males and females by season

Type of food or beverage pictured	Spring		Summer		Fall		Winter	
	Males n=52 *n (%)**	**Females n=140** *n (%)**	**Males n=60** *n (%)**	**Females n=144** *n (%)**	**Males n=71** *n (%)**	**Females n=119** *n (%)**	**Males n=46** *n (%)**	**Females n=147** *n (%)**
Vegetable	14 (26.9%)	59 (42.1%)	18 (30.0%)**	66 (45.8%)**	15 (21.1%)**	57 (47.9%)**	19 (41.3%)	58 (39.5%)
Fruit	8 (15.4%)**	44 (31.4%)**	14 (23.3%)	52 (36.1%)	10 (14.1%)**	48 (40.3%)**	7 (15.2%)	42 (28.6%)
Lean protein	7 (13.5%)**	45 (32.1%)**	15 (25.0%)	45 (31.3%)	9 (12.7%)**	45 (37.8%)**	11 (23.9%)	44 (29.9%)
Grains	16 (30.8%)	29 (20.7%)	13 (21.7%)	41 (28.5%)	18 (25.4%)	33 (27.7%)	11 (23.9%)	42 (28.6%)
Dairy	10 (19.2%)	29 (20.7%)	10 (16.7%)	39 (27.1%)	12 (16.9%)	27 (22.7%)	7 (15.2%)	27 (18.4%)
Oils	0 (0%)	3 (2.1%)	2 (3.3%)	5 (3.5%)	1 (1.4%)	4 (3.4%)	0 (0%)	5 (3.4%)
Added sugar	6 (11.5%)	13 (9.3%)	10 (16.7%)	19 (13.2%)	8 (11.3%)	9 (7.6%)	1 (2.2%)**	24 (16.3%)**
Red meat	12 (23.1%)**	13 (9.3%)**	9 (15.0%)	19 (13.2%)	7 (9.9%)	4 (3.4%)	10 (21.7%)**	8 (5.4%)**
Fried foods	2 (3.8%)	6 (4.3%)	7 (11.7%)	10 (6.9%)	8 (6.4%)	6 (5.0%)	5 (10.9%)	8 (5.4%)
SSB	3 (5.8%)	10 (7.1%)	8 (13.3%)	16 (11.1%)	2 (2.8%)	7 (5.9%)	0 (0%)	7 (4.8%)
Alcohol	2 (3.8%)	4 (2.1%)	3 (5.0%)	9 (6.3%)	3 (4.2%)	6 (5.0%)	2 (4.3%)	4 (2.7%)

*Categories were not mutually exclusive, thus percentages do not add up to 100%
**Statistically significant at $p<0.05$

CHAPTER 5

CONCLUSION

Overview

This dissertation research was undertaken to better understand how individuals use photo-based social media to post about diet and weight loss. Understanding this will help public health professionals to develop more appropriate interventions and communication campaigns when using photo-based social media. The following objectives were addressed by this research: **Objective 1.** To systematically review dietary behavior and social media literature in order to develop a framework for studying dietary behavior on photo-based social media platforms such as Instagram. **Objective 2.** To collect and analyze a set of dieting for weight loss Instagram posts following the framework developed in Objective 1. **Objective 3.** To evaluate gender identity and seasonal trends within dieting for weight loss-related Instagram content. This dissertation used quantitative and systematic review methods to meet these study objectives. This study contributes information addressing research gaps among studies that use social media as a research tool for studying diet and weight loss. It also contributes to the growing body of research that examines influences on dieting for weight loss behavior, particularly interaction with photo-based social media. Results of this research can be used to develop photo-based social media interventions and health communication campaigns to address weight loss behaviors that are better tailored and timed to be maximally effective.

Systematic Review Findings

Chapter 2 addressed objective 1 through a systematic review of social media studies that use social media as a research tool to study diet and weight loss. It included studies focused on individual behavior change (46%) and social media content (54%), and most studies were

focused on either Facebook or Twitter (67%). Many studies were non-experimental (41%) and did not use a guiding theoretical framework (54%). We included studies focused on both individual behavior change and social media content. Our comprehensive approach expanded findings from prior systematic reviews that have only included social media-based studies focused on human subjects and dietary behavior change and weight loss interventions (Balatsoukas, Kennedy, Buchan, Powell, & Ainsworth, 2015; Klassen, Douglass, Brennan, Truby, & Cheung Lim, 2018; Maher et al., 2014; Neve, Morgan, Jones, & Collins, 2010). We gathered comprehensive information on the types of diet and weight loss content that are posted on social media platforms and how that content is related to population health outcomes like rates of obesity and diabetes. Our findings indicated that most intervention studies to date have been inadequately controlled and powered pilot studies. Future research should include more rigorously designed randomized controlled trials that builds on the promising pilot research conducted to date. In addition, our findings indicated that despite the growing body of research on social media and dietary behavior, few studies examine how specifically interaction with social media is related to actual behavior. This represents a major gap in the literature, and rigorously designed research that evaluates how interaction with social media is related to dietary behavior (including dieting for weight loss) should be conducted.

Dieting for Weight Loss on Instagram

Chapters 3 and 4 addressed objectives 2 and 3 of this dissertation using content analysis and quantitative methods. Chapters 3 and 4 both used a sample of 1,000 Instagram posts that were geotagged within Western San Diego County, included diet- and weight loss-related keywords, and were posted between January 1, 2014 to June 3, 2015. Of the 1,000 posts, approximately 80% belonged to individuals and 55% belonged to females. This is consistent

with prior research showing higher social media and Instagram use among females than males (Abbar, Mejova, & Weber, 2015; Holmberg, Chaplin, Hillman, & Berg, 2016; Mejova, Haddadi, Noulas, & Weber, 2015; Pew Research Center, 2018). The majority (57%) of posts contained an image of food, with vegetables most commonly depicted (38% of posts), and less than 20% of images contained food items that the US Dietary Guidelines recommend limiting. Prior research has reported that unhealthy foods are more commonly posted on Instagram than healthy foods (Holmberg et al., 2016; Mejova et al., 2015; Pila, Mond, Griffiths, Mitchison, & Murray, 2017). It is possible that our sample had a higher proportion of healthy foods than unhealthy foods because our sample posts all contained keywords related to diet or weight loss. This is encouraging, because it may indicate that people who post about diet or weight loss on Instagram are actively trying to eat healthier foods. However, the relationship between social media posting behavior and actual dieting for weight loss behavior is unclear and merits further research.

Recipes and motivating language were more common in the most liked 100 posts compared to the least liked 900 posts, indicating that the most popular posts helped to provide instruction to increase skills and knowledge related to food preparation. Prior research on how young adults use social media to change diet and exercise behaviors supports this finding (Dahl, Hales, & Turner-McGrievy, 2016; Easton, Morton, Tappy, Francis, & Dennison, 2018; Vaterlaus, Patten, Roche, & Young, 2015). Given the research on how young adults use social media to help change their health behaviors and our data showing the popularity of posts that provide recipes and use motivational language, further research should be conducted on specific post elements and measuring how these elements might be related to actual behavior change when seen by others.

Gender Identity. Among our sample, females were more likely to be portrayed as thin than males, and males were more likely to be portrayed as muscular than females. This is consistent with prior research on portrayal of male and female bodies in popular US magazines (Bazzini, Pepper, Swofford, & Cochran, 2015; Mishra & Kern, 2015), although recent research indicated that both muscularity and thinness are important for women (Bozsik, Whisenhunt, Hudson, Bennett, & Lundgren, 2018). Ideation Theory (Kincaid & Figueroa, 2004) proposes that the messaging about the ideal body can influence a person's desire and intention to lose weight, build muscle, gain weight, etc. It also indicates that people may be more heavily influenced by those they perceive as similar to them. For example, a post from a female-owned Instagram account that portrays an extremely thin female may be more influential for someone who identifies as female to want to be thin than a post from a male-owned account or a post that features a male.

Season. Our data indicated that more posts published in spring and summer contained red meat and sugar-sweetened beverages than posts published in fall and winter. In addition, in general, female-owned accounts posted about US dietary guideline-recommended foods like fruits, vegetables, and lean protein more often than male-owned accounts across seasons. Males posted more often about red meat in spring and winter than females, while females posted more about foods with added sugar than males during winter. Some research has indicated higher meat consumption during spring and summer months compared to autumn and winter months (Stelmach-Mardas et al., 2016), although other research has found that nutrients like sugar and protein intake peak at different times of the year (Marti-Soler et al., 2017) or not at all (Bernstein et al., 2016). Our results also indicated that posts mentioning a specific holiday were significantly more likely to describe the holiday as a reason for celebratory eating than a reason

to restrict eating. This is consistent with prior research on holiday food spending patterns (Pope, Hanks, Just, & Wansink, 2014). However, it is inconsistent with Twitter data showing more weight loss-related Tweets during and after the holidays compared to before the holidays (Turner-McGrievy & Beets, 2015).

Limitations

For the systematic review in Chapter 2, the first author was primarily responsible for screening, abstracting, and managing data. To improve objectivity, the matrix form used to abstract data was piloted using a random sample of approximately 10% of studies and agreement between JH and the other trained research assistant was high. Given the heterogeneity of findings, a narrative approach was used to summarize results.

For chapters 3 and 4, our sample came from a larger sample of posts that were geotagged in Western San Diego County (California, USA). San Diego is a health-conscious area of the United States. Findings may not be generalizable to Instagram posts that are not geotagged or that are geotagged in other areas of the United States and world. It is important to conduct similar studies to assess whether the results from our study are consistent across samples from other locations. Similar studies conducted in areas of the state or country with higher or lower rates of diet-related health outcomes like heart disease and diabetes may post different types of dieting for weight loss related Instagram content.

Our sample size is small compared to the available number of posts in the larger dataset. However, we were able to analyze posts in-depth and code both captions and images due to our relatively small sample size. Including multiple posts from the same user may have biased our results towards the content from accounts responsible for multiple posts. However, including multiple posts from the same user mimics what users would actually see on Instagram. Our

keyword search strategy may have led us to miss important diet and weight loss-related posts. For example, our future research will include search keywords like #physique, which we noted was often used in our sample posts regarding male weight loss, body building, and/or body image.

Coding of food images was based on recommended and non-recommended foods according to the US Dietary Guidelines. This approach was useful for gathering preliminary information on the types of foods posted in diet for weight loss-related Instagram content. However, some food groups like vegetables may have been deceptively high, since vegetables are often consumed alongside non-recommended foods like red meat. In addition, we did not code the amount of each food group present in each post. Thus, it is possible that a photo consisting of mostly unhealthy food items (e.g. a cupcake with ice cream and a single cherry on top) would have been coded yes for "fruit" even though the focus of the post were the unhealthy food items with added sugar. Future research interested in the healthiness of posts may consider coding the post as "healthy" or "unhealthy" based on what foods are most prominent in the post rather than focusing on individual recommended or non-recommended food groups. Another potentially useful approach would be to code different types of foods rather than food groups (e.g., coding ice cream as a dessert rather than as "dairy" and "added sugar"). A different coding approach may help to better understand the types of foods included in diet for weight loss-related posts.

Assessment of gender identity was limited to the first author's assessment of information presented in photos and profile text, and no profiles were identified as belonging to transgender individuals. Although a person may present as male or female, they may identify as a different gender. While our coding approach was not ideal, given the preliminary and exploratory nature

of this study, lack of prior research, and lack of access to user-entered gender information, our coding approach was an appropriate first step. We recommend that future studies address this gap in the literature, as sexual and gender minorities are at risk for unhealthy dieting for weight loss behaviors and are underrepresented in health behavior research in general (Smalley, Warren, & Barefoot, 2016).

This study defined season based on month rather than equinox and solstice dates. Although other studies have examined seasonal trends by month, our results may have differed had we defined seasons by solar dates. Our sample of Instagram posts was limited to an area that experiences little variation in temperature and weather throughout the year, thus potentially muting differences in posts about foods that are more season-dependent like locally produced fresh fruit and vegetables.

Conclusions

It is essential to help youth and young adults develop and maintain healthy dietary behavior. Dietary behaviors developed in childhood and adolescence are likely to be maintained into adulthood (Craigie, Lake, Kelly, Adamson, & Mathers, 2011). A healthy diet is associated with reduced risk of several health conditions, while poor diet is related to an increased risk of overweight and obesity (US Department of Health and Human Services & US Department of Agriculture, 2015). Obesity puts individuals at increased risk of several diseases including heart disease and stroke, diabetes, and certain cancers (Guh et al., 2009). Dietary factors such as low fruit and whole grain intake and high sodium consumption contributed to 255 million DALYs and 11 million deaths globally (GBD 2017 Diet Collaborators, 2019).

Given that 89% of teens go online “almost constantly” or “several times a day” (Anderson, Smith, & Caiazza, 2018) and that adults spend 1/5 of their online leisure time on

social media (comScore, 2017), social media is an important space in which to conduct dietary behavior change interventions. In addition, multiple studies reported the high prevalence of unhealthy diet-, food-, and body image-related content on social media (Carrotte, Prichard, & Cheng Lim, 2017; Ghaznavi & Taylor, 2015; Holmberg et al., 2016; Mejova et al., 2015; Pila et al., 2017). Social media may be a space where public health professionals can derail unhealthy food and diet messaging while promoting healthy food, diet, and body image messaging. Ignoring social media as a potential point of intervention would be detrimental to healthy diet promotion, especially given the current obesity epidemic in the United States and the high amount of preventable, diet-related morbidity and mortality. In addition, information shared on social media can potentially reach far more people than the initial target audience (Spitzberg, 2014), making it an appealing means of quickly spreading diet and weight loss information to a wide audience. Photo- and video-based social media can be used as a complementary approach to interventions that address diet- and weight-related behavior at other levels of the Social Ecological Model (McLeroy, Bibeau, Steckler, & Glanz, 1988).

Our research can be understood in two ways, from the perspective of individuals creating Instagram content and from those receiving the content. Some post characteristics that were positively associated with engagement by receivers (i.e., number of likes and comments) were posts from organizations; mentions of achievement, eating restriction, motivation, and dairy; a person's full body visible; and posts from profiles that explicitly mentioned an interest in food. Post creators (e.g., researchers, public health professionals) can use information about post characteristics positively and negatively associated with engagement to tailor diet/weight loss communication interventions based on Ideation Theory.

An Ideation Theory-based campaign should consider the following: food preparation and general nutrition knowledge; beliefs, values, and attitudes surrounding dieting and the ideal body; and the social environment, particularly how post content might be targeted to provide more information to males and females. Given that our data showed that images posted of and by males and females tended to feature extremely muscular and thin bodies, respectively, thus perpetuating societal norms surrounding the ideal body, it may be important to include a wider variety of body types representing a wider variety of gender identities. Including a wider variety of body types may help Instagram users to begin to develop more healthy, body-accepting ideation, which is linked to healthier and more sustainable diet and weight loss practices (Markey & Markey, 2005). Additionally, since one of the purposes of the communication campaign would be to increase skills and knowledge surrounding food preparation and general nutrition, it would be important to use the findings from our study related to the different types of foods that males and females post about across season. For example, since males tended to post about red meat more often than females in spring and winter, posts directed towards males during these times may benefit from messaging around other recommended foods that pair well with red meat and about potential red meat alternatives along with simple recipes to prepare the recommended foods. Increasing nutrition and food preparation skills and knowledge will ideally lead to more positive ideation surrounding diet and weight loss.

Although an Ideation Theory-based diet and weight loss social media campaign is a long-term goal of this research, the next step is to better characterize how interacting with social media content is related to actual diet and weight loss behavior. Additional qualitative research conducting focus groups and individual interviews is needed to better understand how specifically people interact with photo-based social media for support with diet and weight loss

behaviors. This would give better information on how to craft effective messages for a future diet and weight loss social media campaign. In addition, an ecological momentary assessment study may be useful to better understand how interaction with photo-based social media is related to actual diet behavior. For example, a group of participants that agreed to give researchers access to their social media data could be surveyed at various points throughout the day (e.g. around meal times, whenever they open their social media account, whenever they post to social media) regarding their actual diet, weight loss, and eating behavior.

As the relationship between interaction with dieting for weight loss social media content and actual dieting behavior becomes clear through additional research, it will become easier to test the effectiveness of social media-based interventions for behavior change. Other social media-based diet and weight loss interventions have shown positive effects in terms of dietary behavior change, improved blood sugar and triglycerides, and weight loss (Barragan et al., 2014; Cavallo et al., 2016; Chung, Skinner, Hasty, & Perrin, 2017; Dagan, Beskin, Brezis, & Reis, 2015; and West et al., 2016). In addition, the most engaged users lost the most weight (Hales, Davidson, & Turner-McGrievy, 2014; and Turner-McGrievy & Tate, 2011). We expect similar results would be possible with a photo-based social media intervention guided by Ideation Theory.

This dissertation presented one of the first systematic reviews to incorporate diet/weight loss studies focused on both individual behavior and those focused on social media content. Incorporating studies focused on both individual behavior and social media content allowed for synthesis of data on individual behavior change with population insights that can be gained from social media and big data analysis. This systematic review also highlighted the need for more

research dedicated to diet and weight loss on social media, particularly sufficiently powered, controlled, and rigorous intervention trials that build on promising pilot data.

This dissertation was a preliminary step in investigating the relationship between interaction with photo-based social media and influences on dieting for weight loss. It contributes information on how dieting for weight loss Instagram posts can be understood within the context of Ideation Theory and how Instagram posts may contribute to a person's intention to diet for weight loss. Based on our data, posts that use motivating language and provide recipes may be important elements of a dietary behavior change social media campaign. This dissertation contributes to information on how season and gender identity may be related to dieting for weight loss posts on Instagram. Across seasons, posts from male-owned accounts tended to feature less US dietary guideline-recommended foods and more red meat than female-owned accounts. Future research should be conducted on whether seasonal disparities among gender identities are consistent across diverse samples. Males may benefit from different types of food messaging than females, including an emphasis on foods that are recommended by the dietary guidelines. Additional research should be conducted on how gender and sexual minorities post about diet and weight loss on photo-based social media platforms such as Instagram. Additional research should be conducted on the timing of dietary behavior change social media campaigns in order to optimize intervention effectiveness. Finally, more rigorous research is needed to quantify how specifically interaction with dieting/weight loss-related photo-based social media is related to actual dieting for weight loss behavior.

REFERENCES

Abbar, S., Mejova, Y., & Weber, I. (2015). You Tweet what you eat: Studying food consumption through Twitter. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (pp. 3197–3206). New York, NY, USA: ACM. http://doi.org/10.1145/2702123.2702153

Anderson, M., Smith, A., & Caiazza, T. (2018). *Teens, social media, & technology 2018*. Washington, DC. Retrieved from https://www.pewinternet.org/2018/05/31/teens-social-media-technology-2018/

Balatsoukas, P., Kennedy, C. M., Buchan, I., Powell, J., & Ainsworth, J. (2015). The role of social network technologies in online health promotion: A narrative review of theoretical and empirical factors influencing intervention effectiveness. *Journal of Medical Internet Research, 17*(6), e141. http://doi.org/10.2196/jmir.3662

Barragan, N. C., Noller, A. J., Robles, B., Gase, L. N., Leighs, M. S., Bogert, S., … Kuo, T. (2014). The "sugar pack" health marketing campaign in Los Angeles County, 2011-2012. *Health Promotion Practice, 15*(2), 208–216. http://doi.org/10.1177/1524839913507280

Bazzini, D. G., Pepper, A., Swofford, R., & Cochran, K. (2015). How healthy are health magazines? A comparative content analysis of cover captions and images of Women's and Men's Health magazine. *Sex Roles, 72*, 198–210. http://doi.org/10.1007/s11199-015-0456-2

Bernstein, S., Zambell, K., Amar, M. J., Arango, C., Kelley, R. C., Miszewski, S. G., … Courville, A. B. (2016). Dietary intake patterns are consistent across seasons in a cohort of healthy adults in a metropolitan population. *Journal of the Academy of Nutrition & Dietetics, 116*, 38–45. http://doi.org/10.1016/j.jand.2015.08.008

Bozsik, F., Whisenhunt, B. L., Hudson, D. L., Bennett, B., & Lundgren, J. D. (2018). Thin is in? Think again: The rising importance of muscularity in the thin ideal female body. *Sex Roles, 79*, 609–615. http://doi.org/10.1007/s11199-017-0886-0

Carrotte, E., Prichard, I., & Cheng Lim, M. S. (2017). "Fitspiration" on social media: A content analysis of gendered images. *Journal of Medical Internet Research, 19*(3). 10.2196/jmir.6368

Cavallo, D. N., Sisneros, J. A., Ronay, A. A., Robbins, C. L., Jilcott Pitts, S. B., Keyserling, T. C., … Samuel-Hodge, C. D. (2016). Assessing the feasibility of a web-based weight loss intervention for low-income women of reproductive age: A pilot study. *JMIR Research Protocols, 5*(1), e30. http://doi.org/10.2196/resprot.4865

Chung, A. E., Skinner, A. C., Hasty, S. E., & Perrin, E. M. (2017). Tweeting to health: A novel mHealth intervention using Fitbits and Twitter to foster healthy lifestyles. *Clinical Pediatrics, 56*(1), 26–32. http://doi.org/10.1177/0009922816653385

comScore. (2017). *The 2017 U.S. cross-platform future in focus*. Reston, VA.

Craigie, A. M., Lake, A. A., Kelly, S. A., Adamson, A. J., & Mathers, J. C. (2011). Tracking of obesity-related behaviours from childhood to adulthood: A systematic review. *Maturitas, 11*(3), 266-284. http://doi.org/10.1016/j.maturitas.2011.08.005

Dagan, N., Beskin, D., Brezis, M., & Reis, B. Y. (2015). Effects of social network exposure on nutritional learning: Development of an online educational platform. *JMIR Serious Games*, *3*(2), e7. http://doi.org/10.2196/games.4002

Dahl, A. A., Hales, S. B., & Turner-McGrievy, G. M. (2016). Integrating social media into weight loss interventions. *Current Opinion in Psychology*, *9*, 11–15. http://doi.org/10.1016/j.copsyc.2015.09.018

Easton, S., Morton, K., Tappy, Z., Francis, D., & Dennison, L. (2018). Young people's experiences of viewing the fitspiration social media trend: Qualitative study. *Journal of Medical Internet Research*, *20*(6), e219. http://doi.org/10.2196/jmir.9156

GBD 2017 Diet Collaborators. (2019). Health effects of dietary risks in 195 countries, 1990–2017: A systematic analysis for the Global Burden of Disease Study 2017. *Lancet, 393*, 1958–72. http://doi.org/10.1016/S0140-6736(19)30041-8

Ghaznavi, J., & Taylor, L. (2015). Bones, body parts, and sex appeal: An analysis of #thinspiration images on popular social media. *Body Image, 14*, 54-61. http://dx.doi.org/10.1016/j.bodyim.2015.03.006

Guh, D. P., Zhang, W., Bansback, N., Amarsi, Z., Birmingham, C. L., & Anis, A. H. (2009). The incidence of co-morbidities related to obesity and overweight: A systematic review and meta-analysis. *BMC Public Health, 9*(88), 1–20. http://doi.org/10.1186/1471-2458-9-88

Hales, S. B., Davidson, C., & Turner-McGrievy, G. M. (2014). Varying social media post types differentially impacts engagement in a behavioral weight loss intervention. *Translational Behavioral Medicine, 4*(4), 355–362. http://doi.org/10.1007/s13142-014-0274-z

Holmberg, C., Chaplin, J. E., Hillman, T., & Berg, C. (2016). Adolescents' presentation of food in social media: An explorative study. *Appetite, 99*, 121–129. http://doi.org/10.1016/j.appet.2016.01.009

Kincaid, D. L., & Figueroa, M. E. (2004). Ideation and individual behavior change.

Klassen, K. M., Douglass, C. H., Brennan, L., Truby, H., & Lim, M. S. C. (2018). Social media use for nutrition outcomes in young adults: A mixed-methods systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, *15*(70). http://doi.org/10.1186/s12966018-0696-y

Maher, C. A., Lewis, L. K., Ferrar, K., Marshall, S., De Bourdeaudhuij, I., & Vandelanotte, C. (2014). Are health behavior change interventions that use online social networks effective? A systematic review. *Journal of Medical Internet Research, 16*(2). http://doi.org/10.2196/jmir.2952

Markey, C. N., & Markey, P. M. (2005). Relations between body image and dieting behaviors: Examination of gender differences. *Sex Roles, 53*(7/8), 519-530. http://doi.org/10.1007/s11199-005-7139-3

Marti-Soler, H., Guessous, I., Gaspoz, J., Metcalf, P., Deschamps, V., Castetbon, K., … Marques-Vidal, P. (2017). Seasonality of nutrient intake - An analysis including over 44,000 participants in 4 countries. *Clinical Nutrition ESPEN*, *21*, 66–71. http://doi.org/10.1016/j.clnesp.2017.05.003

McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly, 15*(4), 351-377.

Mejova, Y., Haddadi, H., Noulas, A., & Weber, I. (2015). #FoodPorn: Obesity Patterns in Culinary Interactions. In *Proceedings of the 5th International Conference on Digital Health 2015* (pp. 51–58). New York, NY, USA: ACM. http://doi.org/10.1145/2750511.2750524

Mishra, S., & Kern, R. (2015). Persuading the public to lose weight: An analysis of a decade (2001-2011) of magazine advertisements. *Journal of Magazine and New Media Research*, *16*(1), 1–21.

Neve, M., Morgan, P. J., Jones, P. R., & Collins, C. E. (2010). Effectiveness of web-based interventions in achieving weight loss and weight loss maintenance in overweight and obese adults: A systematic review with meta-analysis. *Obesity Reviews, 11*(4), 306–321. http://doi.org/10.1111/j.1467-789X.2009.00646.x

Pew Research Center. (2018). Social Media Fact Sheet. Retrieved April 2, 2019, from https://www.pewinternet.org/fact-sheet/social-media/

Pila, E., Mond, J. M., Griffiths, S., Mitchison, D., & Murray, S. B. (2017). A thematic content analysis of #cheatmeal images on social media: Characterizing an emerging dietary trend. *International Journal of Eating Disorders*, *50*(6), 698–706. http://doi.org/10.1002/eat.22671

Pope, L., Hanks, A. S., Just, D. R., & Wansink, B. (2014). New year's res-illusions: Food shopping in the new year competes with healthy intentions. *PLoS ONE, 9*(12). http://doi.org/10.1371/journal.pone.0110561

Smalley, K. B., Warren, J. C., & Barefoot, K. N. (2016). Differences in health risk behaviors across understudied LGBT subgroups, *35*(2), 103–114. http://doi.org/10.1037/hea/0000231

Spitzberg, B. H. (2014). Toward a model of meme diffusion (M^3D). *Communication Theory, 24*, 311-339.

Stelmach-Mardas, M., Kleiser, C., Uzhova, I., Peñalvo, J. L., La Torre, G., Palys, W., … Boeing, H. (2016). Seasonality of food groups and total energy intake: A systematic review and meta-analysis. *European Journal of Clinical Nutrition*, *70*, 700–708.

http://doi.org/10.1038/ejcn.2015.224

Turner-McGrievy, G. M., & Beets, M. W. (2015). Tweet for health: Using an online social network to examine temporal trends in weight loss-related posts. *Translational Behavioral Medicine*, *5*(2), 160–166. http://doi.org/10.1007/s13142-015-0308-1

Turner-McGrievy, G. M., & Tate, D. (2011). Tweets, apps, and pods: Results of the 6-month Mobile Pounds Off Digitally (Mobile POD) randomized weight-loss intervention among adults. *Journal of Medical Internet Research*, *13*(4). http://doi.org/10.2196/jmir.1841

US Department of Health and Human Services, & US Department of Agriculture. (2015). *2015-2020 Dietary Guidelines for Americans, 8th Edition*.

Vaterlaus, J. M., Patten, E. V., Roche, C., & Young, J. A. (2015). #Gettinghealthy: The perceived influence of social media on young adult health behaviors. *Computers in Human Behavior*, *45*(January 2014), 151–157. http://doi.org/10.1016/j.chb.2014.12.013

West, D. S., Monroe, C. M., Turner-McGrievy, G., Sundstrom, B., Larsen, C., Magradey, K., … Brandt, H. M. (2016). A technology-mediated behavioral weight gain prevention intervention for college students: A controlled, quasi-experimental study. *Journal of Medical Internet Research*, *18*(6), 61. http://doi.org/10.2196/jmir.5474