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Health interventions and validity on social media: A literature review

Maja Åskov Tengstedt[a], Asle Fagerstrøm[b,*], Hilde Mobekk[a]

[a]*Oslo Metropolitan University, 0130 Oslo, Norway*
[b]*Westerdals Oslo School of Arts, Communication and Technology, 0186 Oslo, Norway*

Abstract

Social media changes the way people and organizations communicate with each other. Health interventions on social media are, however, a relatively new phenomenon. This article includes a review of health intervention studies done via social media. The review is divided into four different validity types: (a) statistical conclusion validity, (b) internal validity, (c) construct validity, and (d) external validity. Findings show that health interventions on social media have validity challenges because of small sample size, geographic area, level of reductionism, measurement instruments, participants memories and experience, and a lack of experimental control. The conclusion is that health intervention on social media is possible—and needed. However, a focus on validity is important. Guidelines for social media intervention are suggested, and implications for future research are given.

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Keywords: Health; intervention; social media; validity types

* Corresponding author. Tel.: +47 95075325.
E-mail address: asle.fagerstrom@westerdals.no

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1. Introduction

Traditionally, health organizations distribute recommendations and other information to the public. Social media has changed the way organizations and citizens communicate [9] and enabled more interactive communication. Social media makes it possible to have a dialogue and provides an opportunity for immediate feedback. It is possible to reach more people and gather and share health related information more quickly and directly than at any other time in human history. A message from Twitter can spread faster than any influenza virus. Taken as a whole, social media comprises an important element for improving public health. Individuals can find an instant stream health information that they can like, comment, and share with others. As a consequence, social media may play a role in achieving a new and better level of public health [9]. Social media can be used by health workers to create a dialogue with the public by initiating a positive and professional interaction, to acquire information from the public, and to make interventions [6].

Health workers around the world face different challenges in preventing and clarifying epidemic and lifestyle diseases. According to the World Health Organization [21], low-income countries score high on deaths attributed to risk factors such as low weight among children, unsafe water, risky sexual behavior, sanitation, hygiene, and vitamin A and iron deficiencies. Middle- and high-income countries are over-represented among lifestyle diseases such as high blood pressure, substance abuse, overweight, and obesity. Effective communication between professionals in health-care organizations and the public is, therefore, of great importance. In this context, intervention has an obvious advantage in that it provides an opportunity to demonstrate a change by using feedback systems and tracking features. Health-related intervention can be defined as policies and programs that attribute health risk to factors such as social, economic, and environmental conditions [6]. However, when designing a health-related intervention, it is important to identify and evaluate validity issues.

Validity refers to how likely an approximation of a causal relationship is to be true or false [3]. It is important to use the word “approximated” because the truth is unknown. Cook and Campbell [3] describe four validity types: (a) statistical conclusion validity, (b) internal validity, (c) constructed validity, and (d) external validity. Statistical conclusion validity describes the chances of making two types of mistakes: (I) to conclude that an intervention has an effect, when—in truth—it does not, or (II) to conclude that the intervention has no effect, when it, in truth, does. Internal validity refers to the cause and effect. Constructed validity is about “confounding,” and refers to the construction of a study and an operation representing a cause or effect. External validity refers to whether the relationship between the variables can be generalized to other groups of people, time perspectives, and settings.

The purpose of this study is to highlight validity challenges in relation to health interventions on social media. The following question will be answered: What are the validity challenges in health-related interventions on social media? This study is structured as follows: First, there will be a presentation of the method that has been used for the literature search. Second, examples will be presented of how researchers have used social media in health interventions together with validity issues. This will be followed by a discussion and conclusion of the validity challenges when doing health interventions via social media.

2. Validity and health intervention on social media

Based on a rapid structured literature review research strategy [1], findings includes 44 studies on health interventions on social media conducted between February 2015 and March 2018. Query terms included “Facebook,” “health,” “intervention,” and “social media.” The collection of data was done by searching the databases Scopus, PubMed, Medline, PsycINFO, and Web of Science. The keywords can be used in a broad sense, and there were many hundreds of “hits.” “Facebook” was selected over YouTube and Twitter because Facebook is the biggest platform on social media [17]. The inclusion criterion was that the health topic should be related to the World Health Organization’s [22] definition of health: “Health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity,” p. 100. The purpose was to review validity challenges in different kinds of health-related interventions on social media. Full-text articles and articles used for worldwide conference committees were included to give variations in order not to exclude relevant information. Six of the 44 articles were health-related literature reviews done on social media. Reviews were included to provide information about what already has been evaluated and discussed regarding social media and health. The last 38 articles were health studies done on social

media. A concepts matrix was designed, and articles were structured according to sample, intervention, results, and validity issues.

Most of the studies reviewed for this article have been conceptual in that they discuss interventions via social media [15, 18, 19], while a few have tried to do interventions via social media in relation to different kinds of health topics [2, 4, 5, 7, 13, 14, 16, 20, 23]. Tables 1a, 1b, and 1c describe nine of the studies included in this review. These studies are selected because they are the most relevant empirical studies with the use of social media where validity is challenged [1]. They are further discussed in more depth in relation to the overall validity in this review study.

Table 1a. Interventions on social media.

Reference	Sample	Intervention	Results	Validity issues
Young, Harrell, Jaganath, Cohen and Shoptaw [23]	Sixteen peer leaders among men who have sex with men were recruited for either an HIV prevention or general health intervention using social media.	The participants received training on using social media for public health discussions.	No change was found in the level of comfort in discussing various health items on social media after the training, except an increased level concerning discussions on sexual positions.	Small sample size, real-life setting, self-reported data.
Hansen and Johnson [5]	1,022 users who downloaded the Facebook FactCheck: HPV App.	The FactCheck: HPV app was designed for younger women with the intent to educate about HPV. A person received a message from a friend, without revealing the identity of the friend.	It was five times more likely that the user would download the FactCheck: HPV app if they received an invitation from an anonymous friend rather than a known friend.	Large sample size, self-selection, lack of experimental control.
Bull, Levine, Black, Schmiege and Santelli [2]	1,578 participants recruited through newspaper ads, online, face-to-face, and invited friends.	This study aimed to determine whether a message delivered on Facebook prevents an increase in sexually risky behavior. The participants were exposed for 2 months to either Just/Us, a Facebook page developed with youth input or, to control, content on 18–24 News, a Facebook page with current events.	Seventy-five percent of participants completed at least one study follow-up. Time by treatment effects were observed at two months for condom use, and the result was 68% in the intervention group vs. 56% in the control group. The result of sex acts protected by condoms was 63% in the intervention group vs. 57% in the control group.	Large sample size, self-selection, self-reported data.

Table 1b. Interventions on social media.

Reference	Sample	Intervention	Results	Validity issues
Pope, Lee, Zeng, Lee and Gao [14]	Ten breast cancer survivors recruited via flyers in the University's Cancer Hospital and surrounding medical buildings, University-wide mass emails, online postings, and word of mouth.	The aim was to improve breast cancer survivors' physical activity and health by employing a mobile health application, MapMyFitness, and a social cognitive theory-based, Facebook-delivered health education intervention.	Ten participants enrolled, but two dropped out due to changes in health status. Average use of MapMyFitness per week was 3.75 times. The app was experienced as an encouraging prompt but challenging to use. Health education tips were posted twice a week on Facebook. Participants contributed to 16 posts where 11 were regarding workout. Average weight loss was 2.4 kg.	Small sample size, real-life setting, self-reported data, lack of randomization, 10-week duration, and combined multifaceted interventions.
Jane et al. [7]	Participants in the target group were recruited via advertisement in the newspaper. Data from 67 participants were used in the analysis.	This study aimed to understand the impact of using social media to augment the delivery of a weight-management program. Participants were randomly divided into two intervention groups or a control group. A weight-management program, along with a support network with the group, was given to intervention group 1. Intervention group 2 received the same program in a booklet. The control group was given standard care.	Intervention group 1 reported a 4.8% loss in initial weight, significant compared to the control group only ($p = 0.01$). Moreover, intervention group 1 show numerically greater improvements in body mass index, waist circumference, fat mass, lean mass, and energy intake compared to the intervention group 2 and the control group.	Small sample size, participant burden since a large amount of data was collected.
Pechmann, Pan, Delucchi, Lakon and Prochaska [13]	Forty adults who wanted to quit smoking were recruited using Google AdWords.	Automessage was delivered online on Twitter to two groups of 20 participants for 100 days. The first type of Automessage should encourage group members to engage in a group discussion of an evidence-based, cessation-related or community-building topic. The second type of Automessage should deliver an individualized feedback message to all participants on their past 24 hours tweeting.	Seventy-eight percent of the participants, when combining the two groups, had sent at least one tweet and, on average, the participants sent 72 tweets during 100 days. The tweets after an Automessage were all related to a given topic. The tweets were related to dates for quitting, use of nicotine patches, obstacles when wanting to quit, and motivation factors. Out of all tweets, 22.78% were a response on the Automessage, and 77.28% were spontaneous tweets.	Small sample size, self-selection, self-reported data.

Table 1c. Interventions on social media.

Reference	Sample	Intervention	Results	Validity issues
Haines-Saah, Kelly, Oliffe and Bottorff [4]	Sixty young adults aged 19-24 years were recruited to participate in the study. The participants identified themselves as current smokers or had quit smoking in the last year.	The purpose of this study was to motivate critical reflection on one's own tobacco use with the use of an intervention called Picture Me Smokefree. A goal was to find out if there were gender-related factors among participants that could influence and, at the same time, explore gender-related topics in an online forum and gain knowledge about how to design future interventions.	The result revealed Facebook as a good platform for young adults to reflect on their tobacco use and the benefits of quitting. The use of Facebook made it easy to develop person-to-person support across a mixed group of participants.	Small sample size, some participants were couples, mixed intervention groups, low participation rate, many dropouts.
Rote, Klos, Brondino, Harley and Swartz [16]	The participants totaled 63 college freshmen.	This study aimed to increase physical activity (steps per day) among young women. The participants were randomized into two groups: A Facebook Social Support Group or a Standard Walking Intervention. Both groups were informed every week about the steps goal. The women in the Facebook group were asked to post information about their goal for daily steps and to support other members of the group.	After eight weeks of intervention, the result for both groups was an increase in the number of steps. The women in the Facebook group had increased their steps to 1.5 miles per day compared to the standard walking group.	Small sample size, self-reported data, difficult to know whether social support or self-registration was the cause of physical activity.
Wang, Leon, Scott, Chen, Acquisti and Cranor [20]	Twenty-eight Facebook users attended this study.	The researcher wanted to nudge the users to think twice before posting statements on Facebook. Three privacy nudges were designed. The first picture nudge was designed to help the participants consider the audience for their posts. The second nudge was used to delay the post, so participants could think twice before posting. The third sentiment nudge should help the participant not post sensitive information.	Two of the three nudges had a delaying effect because before posting information on Facebook the user could see how other Facebook users viewed the information. It had a positive effect on the users Facebook behavior.	Small sample size, natural environment, lack of control.

3. Discussion

The purpose of this study is to highlight validity challenges in relation to health interventions on social media. Findings from a literature review show that there are challenges when it comes to validity in health intervention studies on social media. Validity is challenged when health intervention studies use only surveys and interviews to measure a dependent variable because participants can over- and under-report, misunderstand questions, and have subjective perceptions [e.g., 3]. Data based on participants' experience and memory makes it difficult to draw generalizable conclusions. However, knowledge from these types of interventions can help researchers to improve and target future

designs of health interventions on social media. Statistical and external validity are challenged in the studies of Haines-Saah, Kelly, Oliffe and Bottorff [4], Jane, Hagger, Foster, Ho, Kane and Pal [7], Pechmann, Pan, Delucchi, Lakon and Prochaska [13], Pope, Lee, Zeng, Lee and Gao [14], Rote, Klos, Brondino, Harley and Swartz [16], Wang, Leon, Scott, Chen, Acquisti and Cranor [20], Young, Harrell, Jaganath, Cohen and Shoptaw [23] because the sample size is small and, therefore, it is difficult to make a general conclusion. Statistical and external validity were better in the Hansen and Johnson [5] study due to a large sample size. However, the study of Hansen and Johnson [5] lacked internal and construct validity because of the lack of experimental control. This illustrates the complexity of doing health intervention on social media to demonstrate a change.

Studies included in this review should focus on how the experiment was designed and accomplished. For example, it is desired to know researchers' reflections on methods of recruiting participants and the motivation participants may have to be a part of the intervention. The researchers should carefully evaluate whether the participants included in the intervention are representative of the population about which they want to say something. In this early phase of studying health interventions on social media as a new phenomenon, all details in the design process are important so that studies can be replicated, researchers can learn from each other, and designs for conducting future health interventions on social media can be improved.

Sample size and type of measurement are factors which can be discussed in every study, regardless of scientific direction. Researchers in the humanities and social sciences who try to combine qualitative and quantitative methods with big data find achieving validity in health intervention on social media very challenging [8]. Big data is a term that describes unstructured data sets so big that only software tools can manage and process them. Big data has expanded the conditions for doing scientific work, especially for the humanities and social science [8]. Since the world is becoming more digital, new computationally-based research methods are needed so researchers can navigate and use the information in a big dataset optimally. So far, most studies in the humanities, where datasets are published as large, cannot even be compared to the datasets published in computer science. The difference is that the large dataset from the humanities and social science studies can be controlled and manage by a desktop computer and computers using standard software, whereas studies in computer science require supercomputers [8]. This gap will disappear sooner or later, and a new platform will be created for studies in humanities and social science. It would then be possible to access information about billions of uploaded pictures, create metadata as tags, and access transaction data.

3.1. Managerial implications

This review indicated the important relationship between studies and real-life practice. The researchers try to implement their study in different practical settings [16, 20, 23]. As of today, the United States uses 8% of its gross domestic product on public health expenditures [11]. This means a huge amount of money is invested in public health every year, and it is important that this benefit the population. This review provides health-worker contributions to health studies done on social media and their validity. Health workers can be inspired by how social media can be used in public health, and they can evaluate challenges in validity relative to the amount of money and time an intervention using social media will cost.

This review provides the researcher an overview of health interventions on social media and challenges in validity which can be used for future research. Researchers remain very optimistic toward the benefits of using social media in health interventions. However, the effect is still unclear. One reason why the effect remains unclear can be assigned to the fact that most studies are based on descriptive statistics. Descriptive statistical analysis is useful in providing updates on available information, but it is impossible for these types of studies to give clear answers as to why, how, and when an effect may occur due to health intervention on social media.

3.2. Limitations and directions for future research

Because of the huge number of studies done on social media and health, the review risks missing relevant articles. Most studies done in health on social media are based on descriptive statistics [10]. Studies using experimental designs are very limited so far, but they would be useful to show experimental control of variables and increased validity. Researchers should, in the future, try to determine the connection between the cause and effect. Combining qualitative

and quantitative methods with data analytics may give researchers more knowledge about conducting health interventions on social media. As shown in this review, some researchers use data analytics and technical devices to conduct interventions and combine that with a survey or interviews. Wang, Leon, Scott, Chen, Acquisti and Cranor [20] designed a nudge to help Facebook users delay posts that they might regret later, Pechmann, Pan, Delucchi, Lakon and Prochaska [13] used Automessages to help smokers quit cigarettes, and Rote, Klos, Brondino, Harley and Swartz [16] used pedometers to measure steps taken by participants in another study. Technology on social media is emerging, [12] and researchers should continue their creativity and use that technology when designing interventions in the future. Anyhow, a discussion about the concepts of validity is needed. Researchers interact with the environment, which today is influenced by technological innovations. Future studies should discuss whether validity concepts used in this study are useful for future health interventions on social media.

4. Conclusion

The literature review demonstrates validity challenges in health interventions on social media. It seems evident that health intervention on social media is in its early phase, where knowledge about how to design interventions is limited. The interventions are mostly explorative and combined with surveys or interviews to gain knowledge about the participants' opinions of the intervention. Validity is challenged because the researchers must experiment with new designs to measure behavior on social media. Most interventions are done in the participants' natural environment, which limits the experimental control of variables and, therefore, threats to validity. However, this can be positive too since a natural setting can give a more realistic result and, therefore, increase external validity. Most health interventions on social media are based on descriptive statistics and cannot give researchers a clear answer as to the true effect of using social media in health work. Very few health-related studies are based on experimental designs, but researchers remain optimistic about using social media in health interventions.

References

[1] A. Armitage, and D. Keeble-Allen, "Undertaking a Structured Literature Review or Structuring a Literature Review: Tales from the Field," *The Electronic Journal of Business Research Methods,* vol. 6, no. 2, pp. 123-216, 2008.

[2] S. S. Bull, D. K. Levine, S. R. Black, S. J. Schmiege, and J. Santelli, "Social Media–Delivered Sexual Health Intervention," *American Journal of Preventive Medicine,* vol. 43, no. 5, pp. 467-474, 2012.

[3] T. D. Cook, and D. T. Campbell, "Quasi-Experimentation. Design & analysis issues for field settings," 1979.

[4] R. J. Haines-Saah, M. T. Kelly, J. L. Oliffe, and J. L. Bottorff, "Picture Me Smokefree: A Qualitative Study Using Social Media and Digital Photography to Engage Young Adults in Tobacco Reduction and Cessation," *Journal of Medical Internet Research,* vol. 17, no. 1, pp. e27, 2015.

[5] D. L. Hansen, and C. Johnson, "Veiled viral marketing: disseminating information on stigmatized illnesses via social networking sites," in Proceedings of the 2nd ACM SIGHIT International Health Informatics Symposium, Miami, Florida, USA, 2012, pp. 247-254.

[6] P. Hawe, and L. Potvin, "What is population health intervention research?," *Can J Public Health*, pp. 7, 2009.

[7] M. Jane, M. Hagger, J. Foster, S. Ho, R. Kane, and S. Pal, "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,* vol. 12, no. 6, pp. e0178326, 2017.

[8] L. Manovich, "Trending: The Promises and the Challenges of Big Social Data," *Debates in the Digital Humanities*: University of Minnesota Press, 2012.

[9] C. McNab, "What social media offers to health professionals and citizens," *Bull World Health Organ,* vol. 87, no. 8, pp. 566, Aug, 2009.

[10] S. A. Moorhead, D. E. Hazlett, L. Harrison, J. K. Carroll, A. Irwin, and C. Hoving, "A New Dimension of Health Care: Systematic Review of the Uses, Benefits, and Limitations of Social Media for Health Communication," *Journal of Medical Internet Research,* vol. 15, no. 4, pp. e85, 2013.

[11] OECD, *Health expenditures*, http://www.oecd.org/health/health-systems/health-data.htm, 2015.

[12] M. E. Ouirdi, A. El Ouirdi, J. Segers, and E. Henderickx, "Social Media Conceptualization and Taxonomy:A Lasswellian Framework," *Journal of Creative Communications,* vol. 9, no. 2, pp. 107-126, 2014.

[13] C. Pechmann, L. Pan, K. Delucchi, C. M. Lakon, and J. J. Prochaska, "Development of a Twitter-Based Intervention for Smoking Cessation that Encourages High-Quality Social Media Interactions via Automessages," *Journal of Medical Internet Research,* vol. 17, no. 2, pp. e50, 2015.

[14] Z. Pope, J. E. Lee, N. Zeng, H. Y. Lee, and Z. Gao, "Feasibility of smartphone application and social media intervention on breast cancer survivors' health outcomes," *Translational Behavioral Medicine*, pp. iby002-iby002, 2018.

[15] J. P. Richter, D. B. Muhlestein, and C. E. A. Wilks, "Social Media: How Hospitals Use It, and Opportunities for Future Use," *Journal of Healthcare Management,* vol. 59, no. 6, pp. 447-460, 2014.

[16] A. E. Rote, L. A. Klos, M. J. Brondino, A. E. Harley, and A. M. Swartz, "The Efficacy of a Walking Intervention Using Social Media to Increase Physical Activity: A Randomized Trial," *Journal of Physical Activity and Health,* vol. 12, no. 6 Suppl 1, pp. S18-S25, 2015.

[17] Statista, *Number of monthly active Facebook users worldwide as of 4th quarter 2014 (in millions)*, http://www.statista.com/statistics/264810/number-of-monthly-active-facebook-users- worldwide/, 2014.

[18] R. Thackeray, B. L. Neiger, A. K. Smith, and S. B. Van Wagenen, "Adoption and use of social media among public health departments," *BMC Public Health,* vol. 12, no. 1, pp. 242, March 26, 2012.

[19] C. Vandelanotte, M. Kirwan, A. Rebar, S. Alley, C. Short, L. Fallon, G. Buzza, S. Schoeppe, C. Maher, and M. J. Duncan, "Examining the use of evidence-based and social media supported tools in freely accessible physical activity intervention websites," *International Journal of Behavioral Nutrition and Physical Activity,* vol. 11, no. 1, pp. 105, August 17, 2014.

[20] Y. Wang, P. G. Leon, K. Scott, X. Chen, A. Acquisti, and L. F. Cranor, "Privacy nudges for social media: an exploratory Facebook study," in Proceedings of the 22nd International Conference on World Wide Web, Rio de Janeiro, Brazil, 2013, pp. 763-770.

[21] World Healt Organization, *Mortality and burden of disease attributable to selected major risks*, http://www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_full.pdf, 2009.

[22] World Healt Organization, *Official Records of the World Health Organization No. 2*, apps.who.int/iris/bitstream/10665/85573/1/Official_record2_eng.pdf, 1948.

[23] S. D. Young, L. Harrell, D. Jaganath, A. C. Cohen, and S. Shoptaw, "Feasibility of recruiting peer educators for an online social networking-based health intervention," *Health Education Journal,* vol. 72, no. 3, pp. 276-282, 2013.