

Increasing Interest of Mass Communication Media and General Public in the Distribution of Tweets About Mental Diseases

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Abstract

Background: The contents of traditional communication media and new Internet social media reflect the interests of society. However, certain barriers and a lack of attention towards mental disorders have been previously observed.

Objective: To measure the relevance of influential American mainstream media outlets for the distribution of psychiatric information and the interest generated in these topics among their Twitter followers.

Methods: We investigated tweets generated about mental health conditions and diseases among 15 mainstream general communication media outlets in the United States of America (USA) between January 2007 and December 2016. Our study strategy focused on identifying several psychiatric terms of primary interest. The number of retweets generated from the selected tweets was also investigated. As a control, we examined tweets generated about the main causes of death in the USA, the main chronic neurological degenerative diseases, and human immunodeficiency virus (HIV).

Results: In total, 13,119 tweets about mental health disorders sent by the American mainstream media outlets were analyzed. The results showed a heterogeneous distribution but preferential accumulation for a select number of conditions. Suicide and gender dysphoria accounted for half of the number of tweets sent. Variability in the number of tweets related to each control disease was also found (5,998). The number of tweets sent regarding each different psychiatric or organic disease analyzed was significantly correlated with the number of retweets generated by followers (1,030,974 and 424,813 responses to mental health disorders and organic diseases, respectively). However, the probability of a tweet being retweeted differed significantly among the conditions and diseases analyzed. Furthermore, the retweeted/tweet ratio was significantly higher for psychiatric diseases than for the control diseases (OR=1.11 [1.07- 1.14], $p<0.001$).

Conclusions: American mainstream media outlets and the general public demonstrate a preferential interest for psychiatric diseases on Twitter. The heterogeneous weights given by the media outlets analyzed to the different mental health disorders and conditions are reflected in the responses of Twitter followers.

Keywords: twitter; social media; psychiatry; mental health

Introduction

Mental health disorders occur frequently in the general population. In 2015, approximately 44 million Americans suffered from some type of mental illness, with depression and anxiety representing the most prevalent forms [1]. Mental health disorders lead to a poor quality of life and patient disability [2,3]. Furthermore, mortality is significantly higher among people with mental health disorders than it is among comparable populations, with a 10-year median of potential life lost [4,5]. Additionally, mental health diseases commonly provoke self-stigma and/or societal stigma, both of which negatively affect patients' disclosure of these psychiatric disorders [6,7]. Social regard for mental health disorders appears to be a key factor for the adequate consideration of these diseases, for the understanding and support received by psychiatric patients, and for the funding provided for medical investment and research of these disorders [8]. Thus, measurement of the social relevance of mental disorders is a fundamental objective for progressing the field of psychiatry [9].

Access to and the diffusion of news information has dramatically changed in recent years. In addition to traditional media, the Internet and social media have become pivotal instruments for sharing knowledge [10-12]. Accordingly, the Internet has radically modified how most people find, communicate, and share information regarding health and medical conditions, and its use and popularity have increased considerably [13]. Its relevance is further exemplified by the growing reliance on the Internet as a source of information and health advice [14]. Social media is a relatively new health communication channel that enables interactions among large groups of people suffering from the same afflictions and promotes the ability to find and share information about health and medical conditions and receive health messages [15].

For example, Twitter is a social networking site that is one of the most popular and widely used forms of social media [16,17] in which users ("tweeters") post status updates (i.e., "tweets") that are distributed to "followers". These tweets are also made available to the public. This form of largely public conversation in which "short bursts" of inconsequential information are relayed in 140-character "tweets" seems an unlikely source for lifelong learning [18,19].

Mainstream media outlets, such as television, radio, newspapers, and on-line journals are considered to be sensors and drivers of society [20-22]. These media outlets use Twitter as a tool for news distribution and thus subsequently influence large groups of people in real time [23]. The analysis of distributed tweets could represent an effective indicator of "real-world performance" [24-26]. Furthermore, because Twitter has become more popular, different players in health and medicine have begun to realize its potential for acquiring and distributing medical information [27]. Moreover, the qualitative and quantitative relevance of tweets has been shown in various investigations, including analyses of the interests and feelings

of the general population with respect to health/disease, the interactions between patients and doctors/healthcare providers, and the promotion of the scientific impact of medical research in the news media. However, the validity of Twitter as a reflection of public opinion has been challenged [28-32]. Furthermore, patient attitudes toward various medical topics, including vaccines, illnesses, pain, drug use, and oncological and cardiovascular disease have been analyzed [33-41]. Consequently, the analysis of distributed tweets about mental health disease by primary media channels and the frequency of retweets they generate may be an effective tool for assessing social and individual interest toward psychiatric diseases.

In this paper, we investigated the distribution of tweets about mental health diseases from highly recognized and relevant American communication media sources. More specifically, the study cites periodicals and various television and radio channels, which are used as sensors of societal attitudes towards psychiatric disease throughout the first decade of Twitter's networking activity. Furthermore, we analyzed the interest generated among followers through the quantification of subsequent retweets. As a control, we simultaneously studied the number of tweets distributed by our selected social media platforms about diseases considered to be the main causes of death within the United States of America (USA) as well as tweets about human immunodeficiency virus (HIV) because of its recognized social relevance.

Methods

Communication Media Analyzed

In this study, we focused on tweets sent among a representative sample of primary American communications media outlets. We selected 15 general media outlets among those with the highest number of followers on Twitter as estimated by their individual accounts and ranked among those with highest social influence during the study duration [42-46]. Furthermore, we selected representative samples from different categories of media outlets to avoid potential bias. We included 6 newspapers (*New York Times*, *Washington Post*, *Los Angeles Times*, *USA Today*, *Chicago Tribune*, and *New York Post*), 5 TV/radio channels (NBC, CBS, Fox, CNN, and ABC), 1 general magazine (*Time*), 1 news agency (AP), and 2 online news outlets (*BuzzFeed* and *Huffington Post*).

Search Strategy

Our research strategy focused on searching for tweets that referred to common psychiatric terms of interest. We investigated all tweets sent from Twitter accounts, filtering them according to specific criteria using the following list of keywords: anxiety, phobias, PTSD/posttraumatic stress disorder, panic disorder, GAD/generalized anxiety disorder, OCD/obsessive compulsive disorder, depressive disorder, suicide, bipolar disorder, insomnia, schizophrenia, ADHD/attention deficit

hyperactivity disorder or hyperactivity, alcoholism, drug addiction, gambling disorder, anorexia nervosa, bulimia, dysthymia, addictions, addictive, Asperger syndrome, autism, personality disorder, and gender dysphoria. Additionally, as controls, we used tweets focused on the main causes of death in the USA (prostate, lung, colorectal, and breast cancer, stroke, diabetes mellitus, and chronic obstructive pulmonary disease (COPD)), the main causes of chronic neurologic degenerative disease (Alzheimer's and Parkinson's diseases) [47,48], and HIV infection.

Search Tool Utilized

In this study, we used the Twitter Firehose data stream, which is managed by GNIP and allows access to 100% of all public tweets that match a set of "search" criteria (query) [49]. In our study, the search criteria were the previously indicated keywords, and the following is an example of a query: "depression -economic -great -tropical from:nytimes OR from:washingtonpost OR from:nypost OR from:latimes OR from:USATODAY OR from:chicagotribune OR from:CNN OR from:ABC OR from:NBCNews OR from:CBSNews OR from:FoxNews OR from:AP OR from:TIME OR from:HuffingtonPost OR from:BuzzFeed until:2017-01-01. Tweet Binder, the search engine we employed, uses automatic machine learning text analysis algorithms, and it also uses node.js and the PHP language, which enables an analysis of tweets in the json format (used by GNIP).

Next, all the collected tweets were individually inspected by 3 members of the research team to identify tweets deemed irrelevant for the purpose of this study. Tweets that included keywords not related to psychiatric content were excluded, such as those referring to suicide attacks, economic depression, etc. The content of the tweets was then specifically analyzed by 3 separate blinded members of the research team, and those with at least 2 coincidences were excluded. This process led to the creation of a more concise database that we could easily reference. Moreover, the number of tweets generated was stratified by month and year beginning in January 2007 and terminating in December 2016. We also analyzed the number of retweets that each tweet generated, which yielded a total database of 19,117 tweets and 1,455,787 retweets.

Statistical Analysis

A descriptive analysis of the number of tweets and retweets was performed for both the mental health and control conditions. The correlations among the observation time units (months) were evaluated using Spearman's rank test. To analyze the retweets generated by the disease-related tweets, odds ratios (ORs) were calculated for each of the studied diseases. The odds of the sum of all conditions (retweet/tweet ratio) was used as the baseline and confidence intervals were calculated using a Bonferroni-adjusted significance level (alpha) of 0.001. To evaluate the annual changes within and differences between the two groups, a multivariable generalized linear model (negative binomial regression) was performed for both tweets and retweets. Finally, seasonality was studied through

the Seasonal Decomposition procedure of a multiplicative time series model. All statistical analyses were performed using SPSS v22 and STATA v14.

Results

Media Outlets Showed a Marked Interest in Mental Health Diseases and Tweet Patterns Generated Responses from Followers

We first analyzed the number of tweets generated by 15 mainstream American media outlets related to mental health disorders beginning in 2007 (soon after the launch of Twitter) through December 2016. As a control, we also included a parallel analysis of tweets related to the primary causes of death in the USA (prostate, lung, colorectal, and breast cancer; stroke, diabetes mellitus, and COPD), the two most relevant chronic neurologic degenerative diseases (Alzheimer’s and Parkinson’s disease), and HIV infection.

As shown in Table 1, 13,119 tweets were generated by media about mental health disorders. The number of tweets about each of the analyzed diseases follows a heterogeneous pattern of distribution, with a preferential accumulation for a select number of conditions. Suicide and gender dysphoria accounted for half of the total number of tweets. The tweets related to highly prevalent anxiety and its different clinical forms only accounted for 11.39% of the total number, and it was followed by depression, which accounted for 10.66% of tweets. Mental health diseases characterized by child and adolescent incidence, such as autism, Asperger’s syndrome, ADHD, anorexia, and bulimia, accounted for 13.87% of the total tweets generated. Additionally, 9.39% of all tweets were related to addictive disorders, specifically alcoholism, drug abuse, and gambling disorders. Less than 8% of the analyzed tweets referred to the eight other diseases included in the study. Of note, bipolar disorder and schizophrenia, both of which are highly prevalent and disabling, only accounted for 0.63% and 1.33 of all generated tweets, respectively.

Table 1. Number of tweets about mental health conditions, diseases and control diseases distributed by American media and the retweets they generated. Percentages (%) were calculated with respect to the total number of tweets or retweets distributed in both groups of diseases. Spearman's rank correlation coefficients between the tweets and retweets are shown for each condition or disease along with the level of statistical significance.

Mental health conditions and diseases	Tweet		Retweet		Spearman's rho	p
	N	%	N	%		
Suicide	4,124	31.44	268,395	26.03	0.876	<0.001

		%		%		
Gender dysphoria	2,555	19.48 %	238,298	23.11 %	0.941	<0.001
Total anxiety	1,494	11.39 %	134,726	13.07 %	0.907	<0.001
Anxiety	984	7.50%	92,042	8.93%	0.872	<0.001
PTSD	453	3.45%	39,243	3.81%	0.991	<0.001
Phobia	34	0.26%	1,018	0.10%	0.886	<0.001
GAD	22	0.17%	2,386	0.23%	0.172	0.064
Panic disorder	1	0.01%	37	<0.01 %	-0.008	0.927
Depression	1,399	10.66 %	116,067	11.26 %	0.785	<0.001
Autism spectrum disorders	1,337	10.19 %	129,066	12.52 %	0.87	<0.001
Autism	1,253	9.55%	117,955	11.44 %	0.86	<0.001
Asperger	84	0.64%	11,111	1.08%	0.875	<0.001
Addictive disorders	1,232	9.39%	83,809	8.13%	0.822	<0.001
Addictions	933	7.11%	67,114	6.51%	0.798	<0.001
Alcoholism	146	1.11%	7,392	0.72%	0.865	<0.001
Drug addiction	143	1.09%	8,997	0.87%	0.865	<0.001
Gambling disorder	10	0.08%	306	0.03%	0.933	<0.001
Anorexia and bulimia	274	2.09%	11,792	1.14%	0.852	<0.001
ADHD	208	1.59%	12,103	1.17%	0.853	<0.001
Schizophrenia	174	1.33%	15,232	1.48%	0.839	<0.001
Insomnia	128	0.98%	10,014	0.97%	0.825	<0.001
Bipolar disorder	82	0.63%	6,946	0.67%	0.867	<0.001

OCD	81	0.62%	3,564	0.35%	0.907	<0.001
Personality disorder	31	0.24%	962	0.09%	0.038	0.684
Dysthymia	0	0.00%	0	0.00%		
Total mental group	13,119	100%	1,030,974	100%	0.915	<0.001
Control diseases	Tweet		Retweet			
	N	%	N	%		
Total cancer	1,863	31.06%	109,697	25.82%	0.715	<0.001
Breast cancer	1,321	22.02%	79,152	18.63%	0.763	<0.001
Prostate cancer	326	5.44%	13,675	3.22%	0.648	<0.001
Lung cancer	196	3.27%	16,425	3.87%	0.733	<0.001
Colorectal cancer	20	0.33%	445	0.10%	0.845	<0.001
HIV	1,367	22.79%	110,919	26.11%	0.812	<0.001
Alzheimer's	1,053	17.56%	82,334	19.38%	0.828	<0.001
Diabetes	760	12.67%	47,354	11.15%	0.734	<0.001
Stroke	701	11.69%	44,328	10.43%	0.796	<0.001
Parkinson's	249	4.15%	30,160	7.10%	0.873	<0.001
COPD	5	0.08%	21	<0.01%	0.624	<0.001
Total control group	5,998	100%	424,813	100%	0.869	<0.001

OCD=obsessive-compulsive disorder. PTSD=posttraumatic stress disorder. ADHD=attention deficit hyperactivity disorder. GAD=generalized anxiety disorder. HIV=human immunodeficiency virus. COPD=chronic obstructive pulmonary disease.

In the parallel control study, we measured the tweets distributed by American media on the diseases that are considered to be the main causes of death in the USA and paradigmatic examples of diseases with a demonstrated level of social interest. In total, only 5,998 tweets were generated by social media on this group of prevalent and severe diseases. The number of tweets focused on each individual disease analyzed also followed a heterogeneous pattern of distribution. A predominance of tweets was observed for a select number of conditions. In total, 31.06% of the tweets referred to the four most lethal forms of cancer, although they mainly focused on breast cancer (22.02%). HIV infection and Alzheimer's disease received 22.79% and 17.56% of the tweets about organic disease generated by social media, respectively. Additionally, 28.59% of the tweets were related to diabetes mellitus, stroke, Parkinson's disease, and COPD. However, despite its prevalence, COPD only accounted for 0.08% of the tweets.

Next, we investigated the impact of tweets about mental health and disease control among social media followers by analyzing the responses based on the number of retweets. In total, 1,030,974 retweets were related to the studied mental health diseases and 424,813 were related to the control organic diseases (Table 1). We observed a significant correlation between the number of tweets referring to each individual mental health disorder and the number of subsequent retweets generated. The statistical significance of the correlations were similar for the control organic diseases. The percentages of tweets and retweets generated for each of the control diseases, mental health conditions, and psychiatric diseases are shown in a figure in the Supplementary Materials. A scatterplot of the tweets about mental health conditions, psychiatric diseases and control diseases as well as the number of retweets that they subsequently generated is also shown in the Supplementary Materials.

We also investigated the retweets of disease-related tweets by analyzing the retweet/tweet ratio and absolute numbers for the mental health disorders and control diseases. We found that the retweet/tweet ratio for the psychiatric diseases was significantly higher than that found for the control diseases (OR=1.11 [1.07-1.14], $p < 0.001$). The analysis of the probabilities of retweeting a tweet related to a specific disease showed a marked heterogeneity between mental health and organic disorders (Figure 1). Among the mental health conditions and diseases, the tweets about suicide, addictive disorders, anorexia and bulimia, ADHD, and OCD had a statistically significantly lower probability of being retweeted. In contrast, the probability of being retweeted was significantly higher for tweets related to gender dysphoria, anxiety and autism spectrum disorders. For the control diseases, we also found a heterogeneous pattern of retweet responses, with the highest statistically significant probability of being retweeted found for Parkinson's disease. In contrast, the tweets about cancer, diabetes, and stroke had significantly lower probabilities of being retweeted.

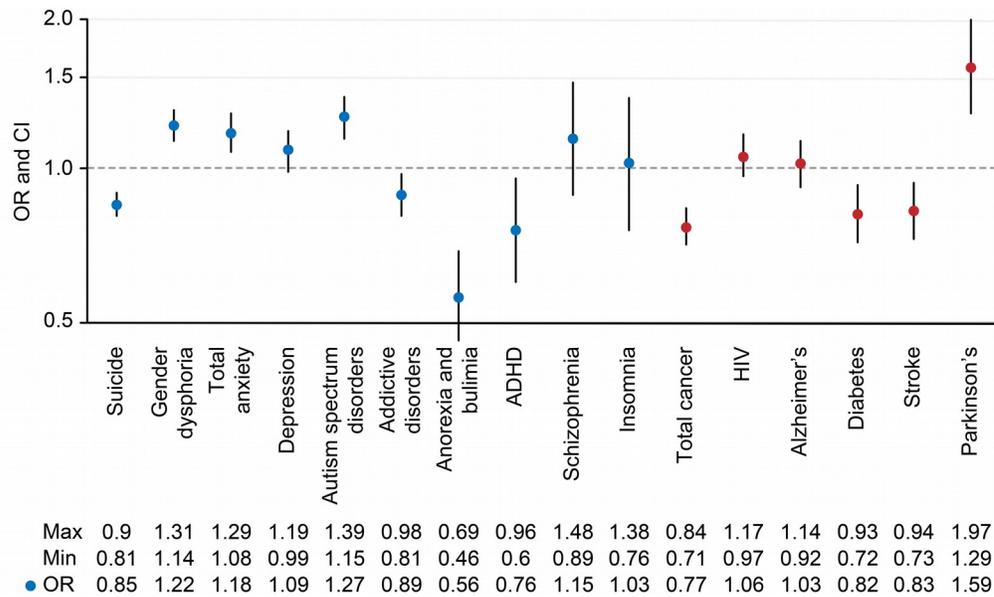


Figure 1. Different probabilities of retweets generated for tweets posted on mental health conditions and diseases (blue color) and organic diseases (red color). The odds ratios (ORs) are shown for the retweet/tweet ratios found for each individual disease with more than 100 tweets. Circles represent the calculated OR, and the vertical lines represent the confidence interval.

Number of Mass Media Tweets and Follower Retweets is Continuously Increasing

We analyzed the evolution of the number of tweets about mental health conditions and control diseases that were distributed by the mainstream American media outlets along the analyzed decade. We also studied the kinetics of the retweets that these tweets generated (Figure 2) and observed a steady and progressive increase in the number of tweets generated for mental health conditions and diseases by social media across the analyzed years. We also found an associated increase in the number of retweets sent by followers. Interestingly, a large increase in retweet responses was observed beginning in 2014. For the control diseases, an increase in the number of social media generated tweets was observed between 2007 and 2012, and a steady level was reached by 2016. However, the number of generated retweets among nonpsychiatric control diseases also showed a continuous increase. To determine the effects of the year and type of disease, we ran generalized linear models for both tweets and retweets. In both models, these variables were statistically significant ($p < 0.001$). The output of the negative binomial regression parameters are included in the Supplementary Materials.

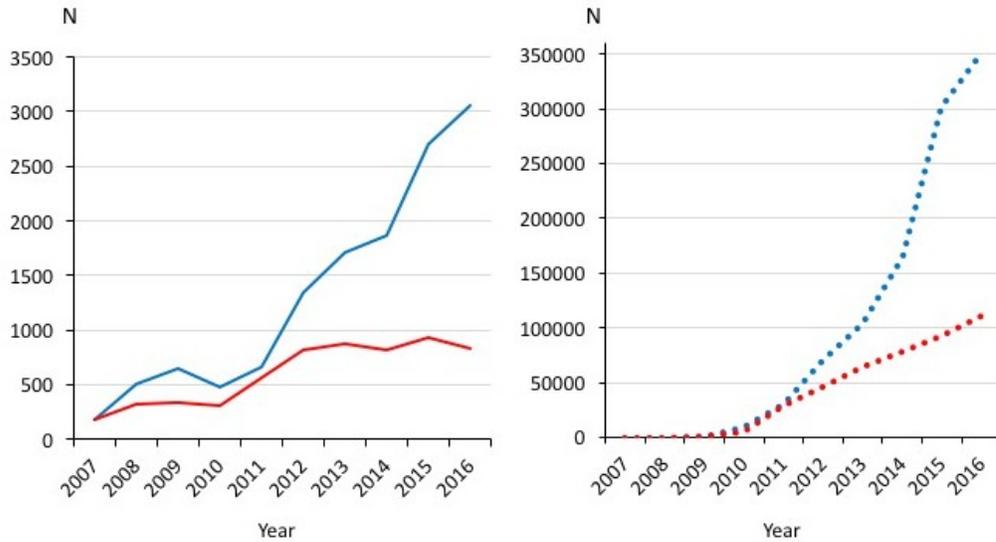


Figure 2. Kinetic study of the number of tweets (left panel, continuous line) distributed by American mass media outlets on mental health conditions and diseases (blue color) and control diseases (red color) and retweets (right panel, dotted line) generated by their followers. Y-axis: total number; X-axis: data calculated for each year of the study.

We also investigated the number of tweets generated over continuous months about the mental health and control diseases. Temporal variability was observed in the frequency of tweets about psychiatric disease, with a significant increase in months 4 and 8 and a decrease in month 2 (Figure 3). Monthly variability in the tweets generated about organic control diseases was also observed, with a statistically significant increase in months 7 and 10 and a decrease in month 1. This monthly variability was also observed in the analysis of individual mental health conditions and diseases. The results obtained for gender dysphoria, depression, breast cancer, and HIV are shown as representative cases.

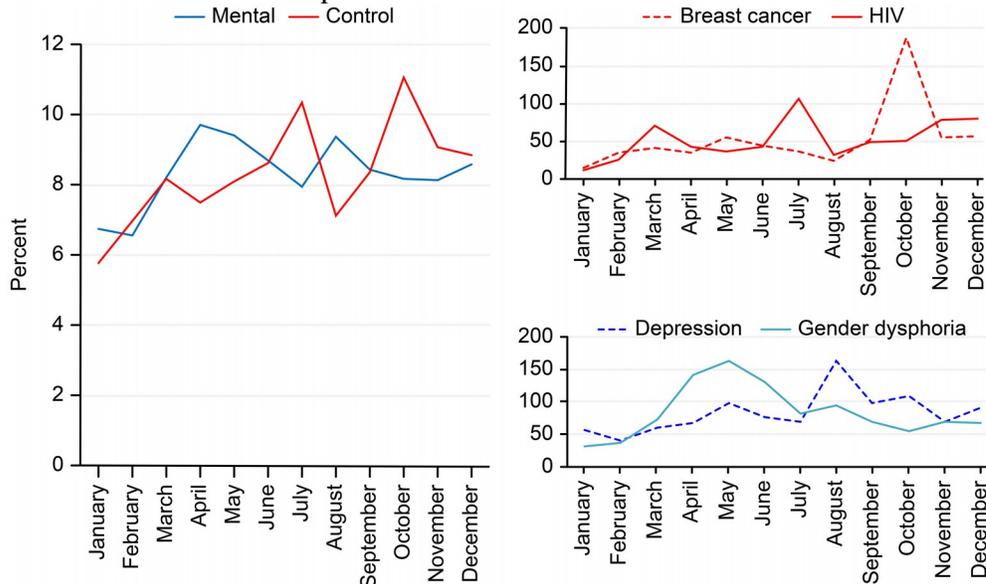


Figure 3. Monthly distribution of the tweets sent by American mass media outlets about mental health conditions and diseases (blue line) and control diseases (red line). (Left panel) Y-axis: percentages were calculated with respect to the total number of tweets. X-axis: data for each month of the year. Top right panel: specific analyses of breast cancer and HIV infection; bottom right panel: specific analyses of depression and gender dysphoria. Y-axis: number of tweets. X-axis: data calculated for each month of the year.

Discussion

In this paper, we showed that American outlets show preferential interest in psychiatric disorders compared with prevalent and severe organic diseases. The elevated number of tweets sent by the analyzed media outlets about mental health conditions and diseases was heterogeneously distributed between the different clinical entities studied. The relative attention of the media outlets for the different mental health disorders conditioned the retweet response of followers.

The important role of communication media outlets in generating popular opinion and emotions via information distribution has been clearly established in our society [50]. In addition to traditional forms of communication media, both the Internet and social media have become particularly pivotal instruments for sharing knowledge and news. Along with this change in the pattern of access to and sharing of information, communicative mass media includes the use of social media for connecting to the public. Currently, the use of social media websites, such as Facebook and Twitter, is commonplace, with approximately 65% of American adults and 66% of British adults reporting ownership of at least one active social media account [51]. Likewise, Twitter is currently considered an equally effective channel for communication [52].

Our work demonstrates that American classic communication media outlets show a relevant interest in psychiatric diseases as measured by the number of tweets sent about mental health conditions and disorders with respect to those sent about a group of severe and prevalent nonpsychiatric diseases, including the main causes of death in the USA. In recent decades, the stigma associated with mental health-related disorders has been widespread as evidenced by our social behaviors [53,54]. This social attitude has had major adverse effects on the lives of people with mental health problems, conditions, and diseases [55]. Therefore, the interest of traditional communication media outlets in psychiatric diseases should decrease over time. However, our findings contradict this hypothesis. The number of tweets sent about the analyzed mental conditions and diseases was higher than that of the control group throughout the decade examined, and a continuously increasing trend was observed in recent years. Interestingly, the control diseases included the main causes of mortality in the USA, such as the most predominant malignant tumor cause of death, stroke, diabetes mellitus, chronic degenerative neurologic disease, and COPD [47,48]. The control group also included HIV infection, a disease that has maintained a high level of general interest in our society in recent decades [56,57].

In addition to the demonstrated interest in mental health conditions and diseases by mass media, we found that this interest is more focused on certain clinical entities.

Interestingly, the relative weight given to each disease as defined by the percentage of tweets received was not related to the actual prevalence of the disease (the prevalence of mental health conditions, psychiatric diseases, and control diseases are included in the Supplementary Materials). Despite the low incidence of suicide and gender dysphoria, these topics accounted for half of the tweets generated by communication media. In contrast, anxiety and depression are highly prevalent in society but only accounted for a quarter of the total number of tweets. Furthermore, psychiatric diseases with a marked prevalence and associated morbidity, such as schizophrenia and bipolar disorder, only accounted for a marginal percentage of the tweets. This lack of correlation between the prevalence and the morbidity and/or mortality of a disease and its relative presence in the number tweets generated by communication media outlets was also observed in the control group. These results are aligned with previous results demonstrating that certain chronic diseases, such as hypertension, are “undertweeted” relative to their prevalence, whereas other chronic diseases, such as diabetes and heart failure, are “over-tweeted” relative to their prevalence [58].

The interest provoked by mental health disease-associated tweets sent by mass media organizations to the general public as measured by the number of retweets generated by followers is clearly relevant. The retweet frequency is a parameter that indicates the user interest in the topic of each tweet [59,60]. Our data demonstrate that the retweet/tweet ratio generated by mental health disease-related tweets was significantly higher than that of the control diseases. Thus, in addition to a correlation between the number of tweets sent about a specific disease and the retweet response provoked, the characteristics of the health disorder also modulate the interest and quantitative retweet response of the followers. This finding is clearly supported by the significantly higher possibility of retweeting a tweet on gender dysphoria, anxiety, and autism spectrum disorders and the decreased possibility of retweeting a tweet related to suicide, addictive disorders, anorexia and bulimia, and ADHD. Several reasons that are not mutually exclusive may explain this public behavior. First, the potential anonymity of Twitter might favor its use by people who present feelings of potential self-stigma. For example, tweeting about mental health conveys the notion of a “Twitter community” that allows communication to flourish, awareness to be raised, stigmas to be fought, and support to be both offered and received [51]. Twitter use allows for anonymity; thus, it is preferred by people with real or perceived personal and/or or social restrictions [61]. The reported use of Twitter by transgender individuals and allies to discuss health and social needs supports this statement [62]. Second, Twitter is becoming more popular in our society, and the average user profile is distributed across different age groups. However, Twitter is predominantly used by younger and middle-aged demographics [63,64]. Thus, the social media pattern of Twitter might indicate a modification in attitudes toward mental health diseases among these two generations. Furthermore, the age of the person affects his/her general interest in

health-related matters [65]. Third, high rates of social media use are observed among individuals who experience mental health problems [66,67]. Fourth, healthcare professionals and provider communities may also show a greater interest in mental diseases and contribute to the dissemination of this information. However, the attitudes of professionals, such as general practitioners, towards these diseases cannot be considered optimal at the present time [68]. Additionally, certain mental health conditions, such as gender dysphoria and suicide, are topics that often appear in breaking social news and may easily go viral on Twitter. The information transmitted by the mass media may be selected using different criteria, including content generally considered to be of public interest [69]. According to cultural selection theory, any selection of messages from communication media outlets will have a profound effect on society at large and can contribute to the modulation of individual and societal attitudes and knowledge [70]. Based on the frequency of tweets generated about mental health disorders found in this work, we conclude that mass media outlets do not support a quantitative stigmatic exclusion of psychiatric patients. However, the results observed for suicide should be further discussed. Suicide was one of the most frequently mentioned topics on Twitter by communication media outlets. Interestingly, the Werther effect of suicide reports in social media networks, such as Twitter, has been established [71]. Thus, the criteria applied for generating this increased frequency of suicide-related tweets by communication media outlets may require revision. Fortunately, a suicide-related tweet has a significantly reduced possibility of being retweeted by followers.

This study has some limitations. The relevance of Twitter as a marker of social interest is a matter of controversy [24-26, 28-32]. Furthermore, news media outlets do not necessarily reflect the interests of society [72]. Large media outlets can also have a different set of priorities than the news media in general. The newsworthiness of health science articles has previously been reported [73-75].

In conclusion, our findings show a marked correlation between the number of tweets generated about a psychiatric or control disease and the number of retweets that are subsequently generated. These results could represent a coincidence between the interest of communication media outlets and the general population and/or merely the quantitative reactive response of followers to the tweets they receive. Interestingly, the frequency of retweeting a tweet related to suicide was less than expected, whereas that of gender dysphoria was greater. Moreover, there are contradictory results with respect to the association between mental health problems and social media, which indicates either the potential for harm or a significant improvement in social media engagement as previously described [71,76-78].

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Conflicts of Interest

None declared

References

1. Any mental illness (AMI) among adults. <http://www.nimh.nih.gov/health/statistics/prevalence/any-mental-illness-ami-among-adults.shtml>. Archived at: <http://www.webcitation.org/6vSpzoaEm>
2. Evans DL, Charney DS, Lewis L, Golden RN, Gorman JM, Krishnan KR, et al. Mood disorders in the medically ill: Scientific review and recommendations. *Biol Psychiatry* 2005 Aug;58(3):175-189. PMID: 16084838
3. Murray CJ, Vos T, Lozano R, Naghavi M, Flaxman AD, Michaud C, et al. Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: A systematic analysis for the global burden of disease study 2010. *Lancet* 2012 Dec;380(9859):2197-2223. PMID: 23245608
4. Chang CK, Hayes RD, Perera G, Broadbent MT, Fernandes AC, Lee WE, et al. Life expectancy at birth for people with serious mental illness and other major disorders from a secondary mental health care case register in London. *PLoS One* 2011;6(5):e19590. PMID: 21611123
5. Walker ER, McGee RE, Druss BG. Mortality in mental disorders and global disease burden implications: A systematic review and meta-analysis. *JAMA Psychiatry* 2015 Apr;72(4):334-341. PMID: 25671328
6. Dickerson FB, Sommerville J, Origoni AE, Ringel NB, Parente F. Experiences of stigma among outpatients with schizophrenia. *Schizophr Bull* 2002 Jan;28(1):143-155. PMID: 12047014
7. Drapalski AL, Lucksted A, Perrin PB, Aakre JM, Brown CH, DeForge BR, et al. A model of internalized stigma and its effects on people with mental illness. *Psychiatr Serv* 2013 Mar 1;64(3):264-269. PMID: 23573532
8. Thornicroft G, Mehta N, Clement S, Evans-Lacko S, Doherty M, Rose D, et al. Evidence for effective interventions to reduce mental-health-related stigma and discrimination. *Lancet* 2016 Mar;387(10023):1123-1132. PMID: 26410341
9. Prince M, Patel V, Saxena S, Maj M, Maselko J, Phillips MR, et al. No health without mental health. *Lancet* 2007 Sep;370(9590):859-877. PMID: 17804063
10. McGowan BS, Wasko M, Vartabedian BS, Miller RS, Freiherr DD, Abdolrasulnia M. Understanding the factors that influence the adoption and meaningful use of social media by physicians to share medical information. *J Med Internet Res* 2012 Sep;14(5):e117. PMID: 23006336
11. Antheunis ML, Tates K, Nieboer TE. Patients' and health professionals' use of social media in health care: motives, barriers and expectations. *Patient Educ Couns* 2013 Sep;92(3):426-431. PMID: 23899831
12. Melvin L, Chan T. Using Twitter in clinical education and practice. *J Grad Med Educ* 2014 Sep;6(3):581-582. PMID: 26279790
13. Fox S, Duggan M. 2013. Pew Internet and American Life Project. <http://www.pewinternet.org/2013/01/15/health-online-2013/>. Archived at: <http://www.webcitation.org/6vT1ISBAz>

14. Hesse BW, Moser RP, Rutten LJ. Surveys of physicians and electronic health information. *N Engl J Med* 2010 Mar;362(9):859-860. PMID: 20200398
15. Moorhead SA, Hazlett DE, Harrison L, Carroll JK, Irwin A, Hoving C. A new dimension of health care: Systematic review of the uses, benefits, and limitations of social media for health communication. *J Med Internet Res* 2013 Apr;15(4):e85. PMID: 23615206
16. Topf JM, Hiremath S. Social media, medicine and the modern journal club. *Int Rev Psychiatry* 2015 Apr;27(2):147-154. PMID: 25906989
17. Twitter, Inc. About twitter. 2015. <https://about.twitter.com/company>. Archived at: <http://www.webcitation.org/6vSqUsqnI>
18. Peters ME, Uible E, Chisolm MS. A twitter education: Why psychiatrists should tweet. *Curr Psychiatry Rep* 2015 Dec;17(12):94. PMID: 26463050
19. Sano D. 2009. Twitter creator Jack Dorsey illuminates the site's founding document. Los Angeles Times. <http://latimesblogs.latimes.com/technology/2009/02/twitter-creator.html>. Archived at: <http://www.webcitation.org/6vSrMRloz>
20. Lauridsen MG, Sporrang SK. How does media coverage effect the consumption of antidepressants? A study of the media coverage of antidepressants in Danish online newspapers 2010–2011. *Res Soc Adm Pharm [Internet]*. 2017 Aug 1 [cited 2018 Mar 27];0(0). Available from: [http://www.rsap.org/article/S1551-7411\(17\)30130-4/fulltext](http://www.rsap.org/article/S1551-7411(17)30130-4/fulltext)
21. Hernandez JF, Mantel-Teeuwisse AK, van Thiel GJ, Belitser SV, Warmerdam J, de Valk V, et al. A 10-year analysis of the effects of media coverage of regulatory warnings on antidepressant use in The Netherlands and UK. *PLoS One* 2012 Sept;7(9):e45515. PMID: 23029065
22. Slothuus R, De Vreese CH. Political parties, motivated reasoning, and issue framing effects. *J Politics* 2010;72(3):630-645. doi:10.1017/S002238161000006X
23. Jansen BJ, Zhang M, Sobel K, Chowdury A. Twitter power: Tweets as electronic word of mouth. *J Am Soc Inf Sci Technol* 2009 Jul;60(11):2169-2188. doi:10.1002/asi.21149
24. Asur S, Huberman BA, editors. Predicting the future with social media. *IEEE/WIC/ACM International Conference on Web Intelligence and Intelligent Agent Technology (WI-IAT)*; 2010 Aug 31-Sept 3; Toronto, ON, Canada: IEEE: 2010.
25. Bollen J, Mao H, Zeng X-J. Twitter mood predicts the stock market. *J Comput Sci* 2010;2(1):1-8. doi:10.1016/j.jocs.2010.12.007
26. Carr A. Facebook, Twitter Election Results Prove Remarkably Accurate [Internet]. *Fast Company*. 2010 [cited 2018 Mar 27]. Available from: <https://www.fastcompany.com/1699853/facebook-twitter-election-results-prove-remarkably-accurate>
27. Boulos MNK, Anderson PF. Preliminary survey of leading general medicine journals' use of Facebook and Twitter. *J Can Health Libr Assoc* 2012;33(2):38-47. doi:10.5596/c2012-010
28. Mitchell A, Hitlin P. Twitter Reaction to Events Often at Odds with Overall Public Opinion [Internet]. *Pew Research Center*. 2013 [cited 2018 Mar 27].

- Available from: <http://www.pewresearch.org/2013/03/04/twitter-reaction-to-events-often-at-odds-with-overall-public-opinion/>
29. Tufekci Z. Big Questions for social media big data: Representativeness, validity and other methodological pitfalls. In: Proceedings of the 8th International Conference on Weblogs and Social Media, ICWSM 2014. The AAAI Press; 2014. p. 505–14.
 30. Gayo-Avello D, Metaxas PT, Mustafaraj E. Limits of Electoral Predictions using Twitter. Proc Fifth Int AAAI Conf Weblogs Soc Media [Internet]. 2011 [cited 2018 Mar 27]; Available from: <http://digibuo.uniovi.es/dspace/handle/10651/11899>
 31. Cohen R, Ruths D. Classifying political orientation on Twitter: It's not easy! In: Proceedings of the 7th International Conference on Weblogs and Social Media, ICWSM 2013. AAAI press; 2013. p. 91–9.
 32. Daniel. Gayo-Avello. I wanted to predict elections with twitter and all I got was this Lousy paper. arXiv:1204.6441. 2012.
 33. Robillard JM. Aging 2.0: Health information about dementia on twitter. PLoS One 2013 Jul;8(7):e69861. PMID: 23922827
 34. Mowery J. Twitter influenza surveillance: Quantifying seasonal misdiagnosis. Online J Public Health Inform 2016;8(3): e198. PMID: 28210419
 35. Quintana DS, Doan NT. Twitter article mentions and citations: An exploratory analysis of publications in the american journal of psychiatry. Am J Psychiatry 2016 Feb;173(2):194. PMID: 26844798
 36. Meng Y, Elkaim L, Wang J, Liu J, Alotaibi NM, Ibrahim GM, et al. Social media in epilepsy: A quantitative and qualitative analysis. Epilepsy Behav 2017 Jun;71(Pt A):79-84. PMID: 28554148
 37. Joseph AJ, Tandon N, Yang LH, Duckworth K, Torous J, Seidman LJ, et al. #Schizophrenia: Use and misuse on Twitter. Schizophr Res 2015 Jul;165(2-3):111-115. PMID: 25937459
 38. Diug B, Kendal E, Ilic D. Evaluating the use of twitter as a tool to increase engagement in medical education. Educ Health 2016 Sep-Dec;29(3):223-230. PMID: 28406107
 39. Sedrak MS, Cohen RB, Merchant RM, Schapira MM. Cancer communication in the social media age. JAMA Oncol 2016 Jun 1;2(6):822-823. PMID: 26940041
 40. Nastasi A, Bryant T, Canner JK, Dredze M, Camp MS, Nagarajan N. Breast cancer screening and social media: A content analysis of evidence use and guideline opinions on twitter. J Cancer Educ 2017 Jan 17. PMID: 28097527
 41. Fox CS, Bonaca MA, Ryan JJ, Massaro JM, Barry K, Loscalzo J. A randomized trial of social media from circulation. Circulation 2015 Jan;131(1):28-33. PMID: 25406308
 42. Twitter feeds of major American news outlets 2011 | Statistic [Internet]. Statista. [cited 2018 Mar 27]. Available from: <https://www.statista.com/statistics/207367/twitter-feeds-of-major-american-news-outlets/>
 43. Nur Bremmen. The 100 most influential news media Twitter accounts. <https://memeburn.com/2010/09/the-100-most-influential-news-media-twitter-accounts/>. Archived at: <http://www.twitter.com/nurbremmen>

44. Mitchell A, Matsa KE, Kiley J, Gottfried J. Political Polarization and Media Habits. U.S.: Pew Research Center; 2014.
45. Mitchell A, Page D. State of the News Media 2015. U.S.: Pew Research Center; 2015.
46. Holcomb J, Gross K, Mitchell A. How Mainstream Media Outlets Use Twitter. U.S.: Pew Research Center; 2011.
47. Heron M. Deaths: Leading causes for 2014. *Natl Vital Stat Rep* 2016 Jun;65(5):1-96. PMID: 27376998
48. Kowal SL, Dall TM, Chakrabarti R, Storm MV, Jain A. The current and projected economic burden of Parkinson's disease in the United States. *Mov Disord* 2013 Mar;28(3):311-318. PMID: 23436720
49. Morstatter F, Pfeffer J, Liu H, Carley KM. Is the sample good enough? Comparing data from Twitter's streaming API with Twitter's firehose. 2013. arXiv:1306.52042013.
50. Wakefield MA, Loken B, Hornik RC. Use of mass media campaigns to change health behaviour. *Lancet* 2010 Oct 9;376(9748):1261-1271. PMID: 20933263
51. Berry N, Lobban F, Belousov M, Emsley R, Nenadic G, Bucci S. #WhyWeTweetMH: Understanding why people use twitter to discuss mental health problems. *J Med Internet Res* 2017 Apr 5;19(4):e107. PMID: 28381392
52. Ferguson C, Inglis SC, Newton PJ, Cripps PJ, MacDonald PS, Davidson PM. Social media: A tool to spread information: A case study analysis of twitter conversation at the Cardiac Society of Australia & New Zealand 61st annual scientific meeting 2013. *Collegian* 2014;21(2):89-93. PMID: 25109206
53. Thornicroft G. *Shunned: Discrimination Against People with Mental Illness*. Oxford University Press: Oxford; 2006.
54. Evans-Lacko S, Courtin E, Fiorillo A, Knapp M, Luciano M, Park AL, et al. The state of the art in European research on reducing social exclusion and stigma related to mental health: A systematic mapping of the literature. *Eur Psychiatry* 2014 Aug;29(6):381-389. PMID: 24726533
55. Corrigan PW, Larson JE, Rüsçh N. Self-stigma and the "why try" effect: Impact on life goals and evidence-based practices. *World Psychiatry* 2009 Jun;8(2):75-81. PMID: 19516923
56. Acheson ED. AIDS: A challenge for the public health. *Lancet* 1986;327(8482):662-666.
57. Ayers JW, Althouse BM, Dredze M, Leas EC, Noar SM. News and internet searches about human immunodeficiency virus after Charlie Sheen's disclosure. *JAMA Intern Med* 2016 Apr;176(4):552-554. PMID: 26902971
58. Sinnenberg L, DiSilvestro CL, Mancheno C, Dailey K, Tufts C, Bittenheim AM, et al. Twitter as a potential data source for cardiovascular disease research. *JAMA Cardiol* 2016 Dec;1(9):1032-1036. PMID: 27680322
59. Suh B, Hong L, Pirolli P, Chi EH, editors. Want to be retweeted? Large scale analytics on factors impacting retweet in twitter network. *IEEE Second International Conference on Social Computing*; 2010 20-22 Aug, Minneapolis, MN, USA: IEEE; 2010.

60. Kwak H, Lee C, Park H, Moon S. What is twitter, a social network or a news media? In: Proceedings of the 19th International Conference on World Wide Web [Internet]. 2010 [cited 2018 Mar 27]. p. 591–600. Available from: <http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.212.1490>
61. Gillespie-Lynch K, Kapp SK, Shane-Simpson C, Smith DS, Hutman T. Intersections between the autism spectrum and the internet: Perceived benefits and preferred functions of computer-mediated communication. *Intellect Dev Disabil* 2014 Dec;52(6):456-469. PMID: 25409132
62. Simoncic TE, Kuhlman KR, Vargas I, Houchins S, Lopez-Duran NL. Facebook use and depressive symptomatology: Investigating the role of neuroticism and extraversion in youth. *Comput Human Behav* 2014 Nov;40:1-5. doi:10.1016/j.chb.2014.07.039
63. Sloan L, Morgan J, Burnap P, Williams M. Who tweets? Deriving the demographic characteristics of age, occupation and social class from twitter user meta-data. *PLoS One* 2015;10(3):e0115545. PMID: 25729900
64. Pew Research Center. Social media usage: 2005–2015. <http://www.pewinternet.org/2015/10/08/social-networking-usage-2005-2015/>. Archived at: <http://www.webcitation.org/6vSv9VPJ4>
65. Deeks A, Lombard C, Michelmore J, Teede H. The effects of gender and age on health related behaviors. *BMC Public Health* 2009 Jun;9:213. PMID: 19563685
66. Gowen K, Deschaine M, Gruttadara D, Markey D. Young adults with mental health conditions and social networking websites: Seeking tools to build community. *Psychiatr Rehabil J* 2012 Winter;35(3):245-250. PMID: 22246123
67. Birnbaum Michael L, Rizvi Asra F, Correll Christoph U, Kane John M, Confino J. Role of social media and the Internet in pathways to care for adolescents and young adults with psychotic disorders and non-psychotic mood disorders. *Early Interv Psychiatry* 2015 Aug;11(4):290-295. doi:10.1111/eip.12237
68. Manzanera R, Lahera G, Álvarez-Mon MÁ, Alvarez-Mon M. Maintained effect of a training program on attitudes towards depression in family physicians. *Fam Pract* 2017 Jul;35(1):61-66. doi:10.1093/fampra/cmz071
69. Fog A. *Mass Media. Cultural Selection*. Dordrecht: Springer; 1999.
70. Pew Research Center: Journalism and Media Staff. 2008. Health news coverage in the US media. Washington, DC: Pew Internet & American Life Project. <http://www.journalism.org/2008/11/24/health-news-coverage-in-the-u-s-media/>. Archived at: <http://www.webcitation.org/6vSqrvcnL>
71. Niederkrotenthaler T, Fu KW, Yip PS, Fong DY, Stack S, Cheng Q, et al. Changes in suicide rates following media reports on celebrity suicide: A meta-analysis. *J Epidemiol Community Health* 2012 Nov;66(11):1037-1042. PMID: 22523342
72. Mitchell A, Simmons K, Matsa KE, Silver L. *Publics Globally Want Unbiased News Coverage, but are Divided on Whether Their News Media Deliver*. U.S.: Pew Research Center; 2018.

73. Zhang Y, Willis E, Paul MJ, Elhadad N, Wallace BC. Characterizing the (perceived) newsworthiness of health science articles: A data-driven approach. *JMIR Med Inform* 2016 Sep;4(3):e27. PMID: 27658571
74. O'Connor EM, Nason GJ, O'Kelly F, Manecksha RP, Loeb S. Newsworthiness vs scientific impact: Are the most highly cited urology papers the most widely disseminated in the media? *BJU Int* 2017 Sep;120(3):441-454. PMID: 28418091
75. Wright D, Young A, Iserman E, Maeso R, Turner S, Haynes R, et al. The clinical relevance and newsworthiness of NIHR HTA-funded research: A cohort study. *BMJ Open* 2014;4(5):e004556. doi:10.1136/bmjopen-2013-004556
76. Lin LY, Sidani JE, Shensa A, Radovic A, Miller E, Colditz JB, et al. Association between social media use and depression among U.S. Young adults. *Depress Anxiety* 2016 Apr;33(4):323-331. PMID: 26783723
77. Rosen LD, Whaling K, Rab S, Carrier LM, Cheever NA. Is Facebook creating "iDisorders"? The link between clinical symptoms of psychiatric disorders and technology use, attitudes and anxiety. *Comput Human Behav* 2013 May;29(3):1243-1254.
78. Mabe AG, Forney KJ, Keel PK. Do you "like" my photo? Facebook use maintains eating disorder risk. *Int J Eat Disord* 2014 Jul;47(5):516-523. PMID: 25035882