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Internet Monitoring of Suicide Risk in the Population

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Abstract

Background—Public health statistics are often released too late to affect reversible societal factors affecting suicide. Increasingly, internet search volume is used in epidemiology, but this method has not yet been applied to suicide.

Methods—Google internet search engine activity for suicide-related terms from the years 2004–2009 was measured and correlated to available suicide and intentional self-injury data from the Centers of Disease Control (CDC).

Results—Google search volumes correlated to CDC statistics for both suicide and self-injury, but in patterns that differed by age. Whereas internet search activity was negatively correlated to the suicide rate in the general population, it was positively correlated to both intentional self-injury and completed suicides among youth.

Conclusions—Monitoring changes in search volumes on the internet may provide an early indicator of suicide risk within the population. Furthermore, youth may utilize the internet in ways that differ from the general population with respect to suicide.

Keywords

Suicide; Internet; Youth; Season; Risk; Epidemiology

1. Introduction

Efforts to track suicide in populations are hampered by difficulties in data collection. At present, lag times for reporting are three years for data in the United States through the Centers of Disease Control (CDC, 2009) and five years or more for the World Health Organization (WHO, 2009). In contrast, social or economic conditions affecting the suicide rate may shift rapidly. Critically, some of these protective or predisposing factors may also be modifiable. However, using current methods, by the time a trend is associated with elevated suicide risk, it may have already peaked and waned, thereby closing the window for intervention.

In the field of infectious disease, large-scale monitoring rapidly identifies new patterns in the spread of illnesses. As a result, when an outbreak occurs resources can be rapidly mobilized to the affected area to contain further spread. Epidemiologists now monitor the use of internet search engines to track epidemics, inferring their movements through changes in the search volumes for phrases that are closely linked with a particular pathogen such as “Salmonella”,

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“diarrhea” and “food poisoning” (Brownstein et al., 2009). The present study investigated the feasibility of monitoring the volume of suicide-related internet searches as a tool to more rapidly identify trends that could influence suicide risk on a population-wide level.

2. Methods

The terms “suicide”, “teen suicide”, “depression”, “divorce” and “unemployment” were entered into Google Trends (Google Trends, 2009), an online log of internet search volumes. Results were limited to the United States. Search terms were chosen for their widespread use in the lay public and hypothesized relevance to suicide risk. Less commonly used terms like “anhedonia” fail to generate sufficient search volumes for analysis and were not used. Data for each term were normalized to the search volume for the word during the first week of January, 2004 (earliest data available). As only Google Trends information from the United States was considered, it could be directly compared to official CDC statistics by category for the years 2004–2007. Data from the CDC for completed suicides (up to 2006) and intentional self-injury (up to 2007) are publicly available at the CDC Web-based Injury Statistics Query and Reporting System. The data were evaluated for both sexes combined, but separated into two age groups: the general population, defined as 1–85 + years old and youth, defined as 15–25 years old. Averaged data were analyzed by one-way ANOVA with Tukey-Kramer post-hoc analysis. Significance for all statistical tests was defined as $p < 0.05$.

3. Results

The terms “depression”, “suicide” and “teen suicide” showed a cyclical pattern of internet search volume. When years were averaged to evaluate recurring changes in volume, search activity for the term “suicide” peaked in the first quarter of each year, troughed during the middle half, and rose again for the final quarter. Search volume for the term “suicide” was significantly decreased in the third quarter of each year (weeks 27–39, early-July to late September) relative to the other three ($p < 0.001$ vs quarters 1 and 4, $p < 0.01$ vs quarter 2, see Figure 1). Search volumes for the terms “divorce” and “unemployment” did not differ on a regular cycle.

Search volumes for the terms “suicide” and “depression” were highly correlated with each other ($r = 0.848$), as were “teen suicide” and “depression” ($r = 0.900$). Search volume for the term “unemployment” greatly increased over the year 2008–2009, however the terms “suicide” and “unemployment” were not strongly correlated ($r = -0.0145$), nor were the terms “suicide” and “divorce” ($r = 0.064$).

Weekly search volumes for “suicide” and “teen suicide” were summed for each year (52 wk) period. These summed volumes were then compared to the CDC data for the corresponding years for both completed suicide and intentional self-injury (Table 1). Among the general population there was no correlation between search volume for the term “suicide” and purposeful self-injury ($r = -0.0436$). In contrast, there was a strong negative correlation between the internet search term “suicide” and suicide deaths. The data for youth differed markedly from those of the general population. Search volume for “suicide” was positively correlated with both intentional self-injury ($r = 0.498$) and completed suicides ($r = 0.699$).

4. Discussion

Depression is a risk factor for suicide (reviewed by Rihmer, 2007). The time course, relationship to official suicide/self-injury statistics and positive correlation between the terms “suicide” and “depression” suggest that searches for these phrases reflect interest in overlapping psychiatric constructs, rather than homonyms that are non-psychiatric in nature

(e.g. “depression” as economic collapse or “suicide” related to terrorism). Therefore, internet searches for the terms “suicide” and “teen suicide” are likely relevant to psychiatric epidemiology.

There is an inverse correlation between internet searches and suicides in the general population. These findings suggest that the internet is used by many to seek help or otherwise reduce suicide risk. In support of this interpretation, Recupero et al. (2006) suggested that internet searches more frequently result in anti-suicide messages compared to suicide promotion, thereby making it probable that an internet search would identify multiple options for support before leading one to information encouraging suicide.

Speaking against a non-specific cyclicality to internet search volumes, there was no seasonal variation in search volume for the terms “divorce” and “unemployment”. Instead, volume for “unemployment” grew rapidly and specifically from 2008–2009, a period of severe economic difficulty, when the unemployment rate increased sharply, thereby providing a positive control of sorts for the present study.

Internet search volume for the term “suicide” is lowest during the summer, the time where most studies report a peak in suicide deaths (Bjorksten et al., 2009; Reutfors et al., 2009; Sebestyen et al., 2009). The interpretation above explains this discrepancy between internet search activity and the seasonality of suicide. If internet search activity is related to suicide in a reciprocal manner, the negative correlation of internet activity to suicide for the general population fit the existing model, and suggests a corollary that people are less likely to seek help on the internet during the summer months.

4.1 Age differences in suicide-related internet searches

In contrast to the general population, internet searches are positively correlated with self-injury and suicide among youth, suggesting this group uses the internet to facilitate self-injury. The literature on youth suicide and the internet is small, and originates primarily from outside of the United States. Nonetheless, internet use has been associated with greater suicide risk, suicide pacts and suicide epidemics among youth (Katsumata et al., 2008; Hagihara et al., 2007; Nicolis, 2007). It has also been shown that the quality of internet suicide support resources varies considerably, possibly requiring considerable effort and motivation to navigate (Recupero and Rainey, 2006). These traits may be underdeveloped in some youth, causing them to choose less selectively among the available options or to be drawn to the most salient choices.

4.2 Demographic characteristics of suicide and internet use

Google search volumes reflect a large proportion of all available internet search data on the chosen terms, thereby capturing a vast amount of information. While the dataset is large, it is also missing key demographic information. Age bias in particular could jeopardize the validity of comparing internet search statistics to suicide rates. The CDC suicide statistics used in this study were re-evaluated against the age ranges used by Jones and Fox (2009) to measure internet use. In accord with previous reports (Vastag, 2001), the youngest group (18–32 years old) is over represented on the internet relative to their suicide rate, whereas the oldest age group (age 74 +) is over represented among suicide victims relative to internet use. However, among the middle aged (33–73 years old), the proportional contributions to both total internet use and total suicides were similar across the age range. This intermediate age cohort represents ~65% of the totals of both internet users and suicide deaths. As such, these findings suggest that while generally useful, caution should be used in interpreting suicide-internet correlations as they may not generalize to specific populations.

4.3 Conclusion

A connection between suicide and internet search activity has been supported, suggesting internet searches for suicide-related terms may predict actual self-injury and death. While limited, these findings nonetheless provide testable hypotheses that will be supported, refuted or refined in coming years as more epidemiological data accumulate. Like systems utilized to monitor the spread of infectious pathogens, internet search volumes may be a useful indicator for tracking suicide trends. Given the risky climate of economic instability, large numbers of returning war veterans and widespread disconnection from medical care, efforts to track large-scale mental health crises in real time could lead to focused interventions in sensitive populations.

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Figure 1.

Google internet search volume for the term "suicide" averaged across the year. Data reflect the averages of 2004 to 2009. Week 1 corresponds to the first week of January for each year. Data are normalized to the volume of searches performed during the first week of 2004. Error bars $\pm$ SEM

Table 1

Google search volumes compared to CDC suicide and self-injury data
Combined yearly Google search volumes for the term “suicide” compared to yearly CDC statistics for completed suicides and intentional self-injurious behavior (SIB). Data are shown for general population (above) and for youth (below).

Total Population						
Year	2004	2005	2006	2007	Correlation to Google	
Google Volume “Suicide”	53.74	55.48	48.07	45.04	N/A	
CDC-Completed Suicides	32,428	32,629	33,292	not available	−0.900178	
CDC-Intentional SIB	425,603	372,722	395,146	395,175	−0.043599	
Youth 15–25						
Year	2004	2005	2006	2007	Correlation to Google	
Google Volume “Teen Suicide”	47.92	37.99	27.62	22.38	N/A	
CDC-Completed Suicides	4,820	4,734	4,757	not available	0.698595	
CDC-Intentional SIB	148,041	134,134	138,862	139,821	0.498077	