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Research report

# The association of suicide-related Twitter use with suicidal behaviour: A cross-sectional study of young internet users in Japan



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## ABSTRACT

**Background:** Infodemiology studies for suicide prevention have become increasingly common in recent years. However, the association between Twitter use and suicide has only been partially clarified. This study examined the association between suicide-related tweets and suicidal behaviour to identify suicidal young people on the Internet.

**Methods:** A cross-sectional survey was conducted using Internet survey panels ( $n=220,848$ ) comprising users in their 20s, through a major Japanese Internet survey company. Final analyses included the data of 1000 participants.

**Results:** Of the participants ( $n=1000$ ) used in the final analysis, 61.3% were women and the mean age was 24.9 years ( $SD=2.9$ , range=20–29). Logistic regression analyses showed that tweeting “want to die” and “want to commit suicide” was significantly related to suicidal ideation and behaviour. Lifetime suicide attempts, the most powerful predictor of future suicide out of all suicidal behaviours, were more strongly associated with tweeting “want to commit suicide” than tweeting “want to die”. Having a Twitter account and tweeting daily were not associated with suicidal behaviour.

**Limitations:** An online panel survey has some inherent biases, such as coverage bias. Respondents were already registered as members of a particular Internet survey company in Japan, which limits the possibility of generalization.

**Conclusions:** Twitter logs may be used to identify suicidal young Internet users. This study provides a basis for the early identification of individuals at high risk for suicide.

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## 1. Introduction

All around the world, suicide is a leading cause of death among youth and can therefore be considered a major public health issue (World Health Organization, 2014). In Japan, the suicide rate among youth has slightly but steadily increased since the 2000s, and adopting appropriate suicide prevention measures is now an urgent social challenge (Japanese Cabinet Office, 2013).

Employing the Internet's capabilities effectively is key to suicide-prevention approaches for youths, as those with a history of self-injury, or at a high risk for suicide, use the Internet frequently, according to systematic reviews of studies on suicide and Internet use among youths (Daine et al., 2013). However, as suggested by a large-scale prospective cohort study on young Internet users, Internet use is likely to promote suicide (Sueki et al., 2014), highlighting the necessity of developing appropriate ways to use it for suicide prevention.

Infodemiology studies for suicide prevention have become increasingly common in recent years. Infodemiology is the science of distribution and determinants of information in an electronic medium, specifically the Internet, or in a population, with the ultimate aim of informing public health and public policy (Eysenbach, 2009). Predicting the prevalence of influenza using Google Web Search is an example of such approaches. Web-search activities are associated not only with diseases, but also suicide rates; a chronological and region-dependent association between the two has been reported in a large number of recent studies (Bragazzi, 2014; Gunn and Lester, 2013; Hagihara et al., 2012; McCarthy, 2010; Sueki, 2011; Yang et al., 2011). Additionally, a cross-sectional study based on a detailed review of the inquest reports of suicides showed that in some cases, the individuals had used the Internet to research the methods of suicide they used (Gunnell et al., 2012). In short, there is an association between Web searches and suicide, and this indicates the possibility of information-based epidemiology being useful in assessing suicide risks and guiding individuals in trouble toward appropriate helpful resources by placing advertisements on pages of Web search results.

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The low accuracy of prediction is a limitation of suicide infodemiology research that mainly examines related search activities. This low accuracy is a result of the relatively weak association between suicide and searches using suicide-related keywords. To address this, studies are being conducted to examine the association between suicide and data collected through social networking services, such as Twitter. Twitter, in particular, has been drawing researcher attention, as it provides data that are easily accessible and applicable for research purposes. Furthermore, as the data frequently reflect users' emotional states (Balabantaray et al., 2012; Yamauchi et al., 2013), such data are also likely to be useful for the prediction of suicide.

However, the association between Twitter use and suicide has only been partially clarified. The data collected in the United States indicate a geographic association between the number of suicide-related tweets and suicide rate (Jashinsky et al., 2014). Additionally, analysis results of the log data, left behind by a Twitter user immediately before dying by suicide, suggest that posts to Twitter serve as suicide notes in some cases (Gunn and Lester, 2012). These are currently the only findings obtained regarding the association between Twitter use and suicide, and the association between suicide-related tweets and suicide risk remains unclear.

Therefore, a cross-sectional study was conducted on young Internet users to examine the association between suicide-related tweets and suicidal behaviour. By examining such an association, this study, like those on Web-search activities, may provide a basis for the early identification of individuals at high risk for suicide, and consequently, may contribute to suicide prevention.

## 2. Methods

### 2.1. Study design

The study was a cross-sectional study. The screening survey and main survey were conducted using Internet survey panels comprising users in their 20s, collected via a major Japanese Internet survey company (Cross Marketing Inc., Tokyo, Japan; see Fig. 1). The sample size for the screening survey was determined based on the expected response rate (10% or more) of previous Internet surveys about suicidal Internet use (Sueki et al., 2014).

We briefed participants on the possibility that reading or responding to the questionnaire might lead to a mood change before they consented to participate in the study and obtained their informed consent online. Additionally, links to websites containing professional support resources were shown to participants occasionally while they completed the questionnaire. For the screening survey, participants who did not consent to participating in the survey or who gave incomplete answers were excluded.

In the screening survey, questions about Twitter use were asked. The participants were divided into four groups based on the results of the four following questions: "Q1: Do you have a Twitter account?", "Q2: Do you routinely tweet on Twitter?", "Q3: Have you ever tweeted "want to die" ("shinitai" in Japanese) on Twitter?" and "Q4: Have you ever tweeted "want to commit suicide" ("jisatsu-shitai" in Japanese) on Twitter?". We categorized participants who answered "No" to Q1 as the "no Twitter" account group, "Yes" to Q1 and "No" to Q2 as inactive Twitter users, "Yes" to Q1 and Q2 and "No" to both Q3 and Q4 as active Twitter users without suicidal tweets, and the others as active Twitter users with suicidal tweets.

In the main survey, a different questionnaire was administered to randomly selected participants who had completed the screening survey. The sample size was decided based on previous studies about multivariate analysis using logistic regression (Long, 1997; Peduzzi et al., 1996). In accordance with our contract with the

survey company, the data delivered to the author consisted of a random sampling of the first 250 questionnaires from the four types of user groups (1000 in total).

### 2.2. Measurements

Participants answered a self-administered online questionnaire containing questions about Twitter use, suicidal behaviour, depression and anxiety, and demographic characteristics (e.g. sex, age, educational background, marital status, household income, job status, alcohol use, and hospital visits).

Participants were asked yes–no questions about their experiences with Twitter use: having a Twitter account (Q1), tweeting daily (Q2), lifetime suicide-related tweeting (Q3 and Q4), suicide-related tweeting within a month and the device used to access the Internet.

With regard to suicidal behaviour, participants were asked whether they had deliberately harmed themselves in the past (e.g. "Have you ever deliberately hurt yourself?"), whether they had a history of suicidal ideation ("Have you ever seriously thought of suicide?"), whether they had planned suicide ("Have you ever seriously planned to commit suicide?") and whether they had attempted suicide ("Have you ever attempted to commit suicide?"). All questions were binary-choice items (i.e. yes or no).

The K6 was used to measure tendencies for depression and anxiety (Kessler et al., 2002). The original scale was an abridged version of K10, which is a screening scale proposed by Kessler et al. (2002), based on item-response theory for effectively detecting mental disorders. For each item, responses were rated on a five-point scale with a range of 1 (*Not at all*) to 5 (*Always*). Scores could vary from 6 to 30. The Japanese version of the K6 was developed and demonstrated screening performances essentially equivalent to that of the original English versions (Furukawa et al., 2008).

### 2.3. Statistical analyses

We analyzed the final data set, which consisted of participants who gave complete answers on both the surveys (see Fig. 1). The descriptive statistics show the differences in participant characteristics between the four groups (i.e. no Twitter account, inactive Twitter users, active Twitter users without suicidal tweets, and active Twitter users with suicidal tweets). To compare characteristics between the four groups, analysis of variance was employed for continuous data, and the chi-square test was used for binary data.

Logistic regression analyses were performed to examine the relationship between Twitter use and suicidal behaviour. The independent variables were having a Twitter account (Q1), tweeting daily (Q2) and lifetime suicide-related tweeting (Q3 and Q4). The dependent variables were lifetime experiences of deliberate self-harm, suicidal ideation, suicide planning and suicide attempts. In the logistic regression analyses, we added potential confounds (e.g. sex, age, educational background, marital status, household income, job status, alcohol use, hospital visits, and depression and anxiety) to the models to eliminate confounding bias and improve the robustness of the results. This is because previous studies have reported that these characteristics and the participants' mental health score have an impact on both suicidal behaviour and Internet use in young people (Gould et al., 2003; Sueki et al., 2014).

Odds ratios (ORs) and their 95% confidence intervals (CI) were calculated for each analysis. The *P*-values presented are for two-tailed tests. The analysis was performed using SPSS software (SPSS 21.0 for Windows; SPSS Inc., Chicago, IL, USA).

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