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Research report

Railway suicide attempts are associated with amount of sunlight in recent days

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ABSTRACT

Background: To assess the relationship between hours of sunlight and railway suicide attempts, 3–7 days before these attempts.**Methods:** All railway suicide attempts causing railway suspensions or delays of 30 min or more between 2002 and 2006. We used a linear probability model to assess this relationship. This study was conducted at Tokyo, Kanagawa, and Osaka prefectures in Japan. Data were collected from the railway delay incident database of the Japanese Railway Technical Research Institute and public weather database of the Japan Meteorological Agency.**Results:** About 971 railway suicides attempts occurred between 2002 and 2006 in Tokyo, Kanagawa, and Osaka. Less sunlight in the 7 days leading up to the railway suicide attempts was associated with a higher proportion of attempts ($p=0.0243$). Sunlight over the 3 days before an attempt had a similar trend ($p=0.0888$). No difference was found in sunlight hours between the days with (median: 5.6 [IQR: 1.1–8.8]) and without (median: 5.7 [IQR: 1.0–8.9]) railway suicide attempts in the evening. Finally, there was no apparent correlation between the railway suicide attempts and the monthly average sunlight hours of the attempted month or those of a month before.**Limitations:** Railway suicides were not the main suicidal methods in Japan.**Conclusions:** We observed an increased proportion of railway suicide attempts after several days without sunlight. Light exposure (blue light or bright white light) in trains may be useful in reducing railway suicides, especially when consecutive days without sunshine are forecasted.

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1. Introduction

Psychiatric disorders are widespread and contribute substantially to the total burden of disease on the general population in Japan and the world (Murray et al., 2012). Many psychiatric disorders, especially depression, lead to an increased risk of suicide. In Japan, the number of suicides increased substantially in the year 1998, and has remained high ever since. In the Tokyo Metropolitan Area, almost half of all train delays in 1998 were caused by suicides (Railway Bureau Ministry of Land, Infrastructure and Transport, Japan, 2009). Since 2005, more than 200 railway suicides have been attempted in this area every year (mean=265, SD=29.6 suicides per year). The economic cost of railway transport delays due to suicide in Japan was estimated at 89 million yen (1 million USD) per railway suicide attempt (Railway Bureau Ministry of Land, Infrastructure and Transport, Japan, 2010).

Thus, 23.6 billion yen (265 million USD: 89 million yen/suicide × 265 suicides/year) are lost on average because of railway suicides annually, only in the Tokyo Metropolitan Area (Railway Bureau Ministry of Land, Infrastructure and Transport, Japan, 2009, 2010). Thus, railway suicide attempts are not only a severe health problem, but they contribute to substantial economic loss.

Psychiatrists, epidemiologists, and sociologists have debated whether suicide is associated with the weather conditions. However, no specific associations between suicides and meteorological factors have yet been established (Deisenhammer, 2003). Previous studies have focused on seasonality or current weather conditions such as hours of sunlight, cloud cover, precipitation, humidity, wind speed, air pressure (Kordic et al., 2010), and temperature (Kim et al., 2011; Likhvar et al., 2011). However, few studies have focused on recent weather conditions such as sunlight duration several days before the suicidal attempts, instead opting to examine the weather conditions of the attempted days. In addition, studies have shown that certain methods of suicide may have an association with various meteorological factors (Ajdacic-Gross et al., 2010; Deisenhammer, 2003). Reports suggest that weather

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factors may be more associated with violent suicides (e.g., hanging, drowning, firearms, jumping from buildings, or being run over by a train) than with non-violent suicides (e.g., poisoning) (Ajdacic-Gross et al., 2010; Deisenhammer, 2003). Suicide methods are now thought to be to some extent associated with the season that they are attempted (Ajdacic-Gross et al., 2010), and jumping from high places and being run over by a train are thought to have the highest associations with weather factors. Because of this, the lack of clear associations from previous research might be explained in part by their inclusion of multiple methods of suicide into a single analysis. This may have obscured any observable association between suicidal behavior and weather, if some methods are associated with weather, and some are not.

To further illustrate that suicide attempts might be related to weather factors, some forms of depression have been shown to be alleviated by therapies involving bright light. For example, studies have reported that around 10% and 2% of seasonal affective disorder (SAD) patients had suicidal ideas and past suicidal attempts, respectively (Lam et al., 2001), but after at least 2 weeks of bright light therapy, SAD patients have shown significant reductions in suicidal ideation (Lam et al., 2000). SAD, also known as winter depression, is believed to manifest as a result of the fewer hours of sunlight in winter (American Psychiatric Association, 2000). Bright light therapy has been shown to be the most effective therapy in treating SAD (Konstantinidis and Winkler, 2003; Lam et al., 1999; Partonen and Lonnqvist, 1998). Responses to this therapy generally occur within 2–4 days, and measurable improvement in SAD symptoms can often be seen within one week (Konstantinidis and Winkler, 2003; Lam et al., 1999). Thus, the effects of bright light – such as sunshine – on mood may take several days to have maximum benefit. In addition, when bright light therapy is stopped, SAD symptoms typically relapse within about a week (Rosenthal et al., 1985).

Bright light therapy also has beneficial effects for non-seasonal depression, which is the majority of depression cases. A 7-day course of bright light therapy is effective in non-seasonal depression (Even et al., 2008; Yamada et al., 1995). As with SAD treatment, the antidepressant effect of bright light therapy ends after about a week when being used to treat non-seasonal major depressive disorder (Martiny et al., 2006). Thus, bright light exposure that proceeds over several days might affect the moods of both seasonal and non-seasonal depressive subjects days later.

Thus, we hypothesized that the hours of sunlight in the days preceding the suicide attempt, but not those of the actual day of the attempt, may affect suicidal behavior. In order to test this hypothesis, we decided to confine the suicide method to railway suicide, as there is an accessible database for railway delays in Japan (Railway Technical Research Institute). Thus, using databases to collect information on railway delays and weather in three different prefectures, we analyzed the association between railway suicide attempts and duration of sunlight in the past few days.

2. Methods

2.1. Data collection and variables

Data on suicides were taken from the database of the Railway Technical Research Institute (Railway Technical Research Institute). This database contains reports of all the incidents that have caused suspensions in railway services or delays of 30 min or more, including the time, location, and details of the incidents. We used “suicide” as the key word to search for incidents between 1 January 2002 and 12 December 2006. We chose these dates because the annual number of railway suspensions or delays caused by suicides was similar during this period (Railway Bureau Ministry of Land, Infrastructure and Transport, Japan, 2009).

Data on the weather during the studied period were available from the public database (Japan Meteorological Agency), which reports the hours of sunlight, cloud cover, precipitation, humidity, wind speed, air pressure, temperature, and time of sunset. “Hours of sunlight” were defined as the duration of hours when direct sunlight of 0.12 kw/m² or more reached the ground. We measured the number of hours of sunlight 3 days, 7 days, and 1 month before the suicide attempt, in order to measure the precise range of time it takes for sunlight to have an effect.

2.2. Study areas

Tokyo, Kanagawa, and Osaka prefectures were chosen as the target areas, because the numbers of railway delays caused by suicide were highest in these three prefectures across the whole of Japan. In addition, as these three prefectures are relatively small, we believed that the weather data would be similar across them. Weather data from the Shinjyu-ku area, Yokohama city, and Osaka city were used as representative of those in Tokyo, Kanagawa, and Osaka, respectively.

2.3. Statistical analysis

For continuous variables with a normal distribution, we report means and standard deviations. For not normally distributed variables, we report medians and interquartile ranges (IQR).

The relationship between suicide attempts and hours of sunlight (direct sunlight of 0.12 kw/m² or more reaching the ground) during the overlapping 3- and 7-day periods before the attempt was analyzed using the linear probability model, where suicide attempt was set as a binary variable (1: at least one suicide attempt per day, 0: no suicide attempts), because more than one suicide attempt in the same prefecture was very rare. The hours of sunlight were categorized into the number of days with sunlight for ≥ 1 h and that for < 1 h, because sunlight duration had two peaks in the distribution: one at less than 1 h and the other at 8.5 h (Fig. 1). As a sensitivity analysis, we also applied a log-linear model, a logistic regression model, and a Poisson regression model for count data. All reported *p*-values are two-sided; those under 5% are considered statistically significant without multiplicity adjustments because this study is exploratory research. Statistical analyses were performed using SAS version 9.2 (SAS Institute Inc., Cary, NC).

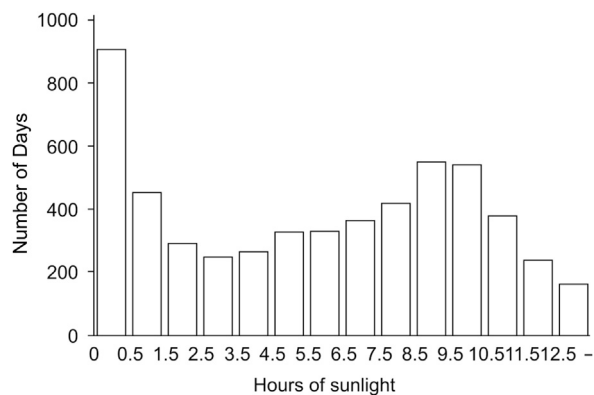


Fig. 1. Distribution of daily sunlight hours. Distribution of hours of sunlight per day in Tokyo, Kanagawa, and Osaka from 2002 to 2006. “Hours of sunlight” were defined as the direct sunlight of 0.12 kw/m² or more reached the ground. Numbers of days with “hours of sunlight” of 0–0.5, 0.5–1.5, 1.5–2.5 and 12.5 or more were plotted, respectively. The total number of observations was 5478 (5 years in 3 areas. 365.2 day × 5 years × 3 areas = 5478).

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