Season, weather, and suicide – further evidence for ecological complexity

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Abstract

BACKGROUND: Seasonality in suicide is reported worldwide, and peaks in late spring. Despite the potential connection to the weather, associations between meteorological variables and suicide does not explain seasonality. Studies testing for seasonality while controlling for the weather show patterns that are more complex than a straightforward link between spring-like weather and suicide. METHODS: We tested whether seasonality in suicide was due to meteorological variation (hours of sunshine, rainfall, or temperature) in a novel population (Scotland; 2003 - 2013). We also sought to further explore the ecological complexity demonstrated in previous work by testing associations at a single location (Tay Road Bridge; 1968 - 2017). RESULTS: We found peaks in suicidal behavior in June at the bridge, but no seasonality for Scotland as a whole. Seasonality was reduced when we controlled for maximum temperature and hours of sunshine. We found patterns to be dependent upon sex, with stronger seasonal and meteorological effects amongst men. LIMITATIONS: Our study was exploratory and relies on population-level data. CONCLUSIONS: Seasonal and meteorological effects on suicide are dependent upon local and individual context, with significant effects apparent at the Tay Road Bridge and not across Scotland as a whole. Men may be more sensitive to season and weather. In order to determine whether seasonality in suicide is due to meteorological variation, future research should test patterns in small geographical units, in men and women, and for different suicide methods, and seek to identify the social and physical factors which predict variation in patterns.

KEYWORDS: Season; Suicide; Weather; Meteorology; Gender; Self-harm.

Introduction

Suicide rates peak in late spring and early summer, and fall during the winter (Barker et al. 1994; Bridges et al. 2005; Chew and McCleary, 1995; Christodoulou et al. 2012; Dixon and Kalkstein, 2018; Durkheim, 1897; Khorshidi et al. 2014; Partonen et al. 2004; Petridou et al. 2002; Preti et al. 2000; Rocchi et al. 2004; Zonda et al. 2005). Patterns are strongest for suicides by violent methods (Ajdacic-Gross et al. 2002; Hakko et al. 1998; Kadotani et al. 2014; Räsänen et al. 2002; Qi et al. 2015), and women may have a second peak in the autumn (Meares et al. 1981; Micciolo et al. 1989; Nayha, 1982).

One obvious potential mechanism is seasonal variation in the weather via, for example, effects of sunlight on serotonin regulation (e.g. Spindlegger et al. 2012), or the sleep-wake cycle via melatonin (Lavebratt et al. 2010a, b) with consequences for insomnia symptoms (Pompili et al. 2013). Hours of sunshine, however, have been found to correlate with suicide rates both positively (Lambert et al. 2003; Soutre et al. 1987) and inversely (Rock et al. 2003), even within different regions in the same study (Tietjen et al. 1994). Temperature and precipitation are, of course, closely correlated with hours of sunshine, and the independent consequences of each are difficult to disentangle (Bazas et al. 1979; Lambert et al. 2002). As with hours of sunshine, suicide rates have been shown to increase with both colder (Linkowski et al. 1992; Rock et al. 1999; Soutre et al. 1987, 1990; Tsai, 2010) and hotter (Dixon et al. 2014; Dixon and Kalkstein, 2018; Kim et al. 2011; Lee et al. 2006; Likhvar et al. 2011; Page et al. 2007) temperatures, and to be uncorrelated (Dixon et al. 2007). Higher rainfall has been shown to be associated with increased numbers of suicide attempts (Barker et al. 2008), but not with suicide rates (Ajdacic-Gross et al. 2007).

Diversity in findings may stem from heterogeneity in research methodologies and target populations, which differ in social and physical ecology (Dixon et al. 2007; Ajdacic-Gross et al. 2010). There is also no consensus among researchers as to which variable - if any - is the driving meteorological mediator of seasonality in suicide. Furthermore, demonstrating correlations between suicide rates and meteorological variables is not sufficient to explain seasonality. What is required is demonstration that seasonality is reduced when adjusted for meteorological variables (Ajdacic-Gross et al. 2007). Relatively few studies have attempted this, and those that have show complex patterns. In data from Australia, Greece, and Norway, seasonality was not due to variation in hours of sunshine (White et al. 2015). A positive relationship between temperature and suicide rates was strongest in the winter over 100 years in Switzerland, suggesting that the association between temperature and suicide was not due so much to warm temperatures in the summer, but rather to a lack of cold temperatures in the winter (Ajdacic-Gross et al. 2007). Interestingly, two suicide methods (jumping from high places and railway deaths) were most closely associated with temperature, suggesting method to be a further moderating factor (Ajdacic-Gross et al. 2007).

The state of our understanding of the contribution of meteorological mechanisms to seasonality in suicide, then, is in its infancy. We need to test for seasonality in suicide rates while controlling for meteorological variables, associations between meteorological variables and suicide rates while controlling for seasonality, and the interaction between the two, in populations that differ in latitude, climate, and socioecology (Ajdacic-Gross et al. 2007). We should also determine whether any such patterns differ for men and women (Meares et al. 1981; Micciolo et al. 1989; Nayha, 1982). Here we tested for (i) seasonality in suicide, (ii) relationships between meteorological variables and suicide, (iii) mediation of seasonality by meteorological variables, (iv) interactions between seasonal and meteorological variables in associations with suicidality, and (v) whether any of the associations described above differed for men and women. We tested for relationships in (a) Scotland and (b) at a single specific location (the Tay Road Bridge, Scotland; Figure 1) in order to determine whether geographical scale contributes to heterogeneity in results. We tested for rates of suicidal behavior more broadly (i.e. attempted, suspected, and completed suicides) at the Tay Road Bridge, as completed suicides are only the tip of the iceberg of suicidality and there is evidence for seasonality in suicidal behavior more broadly (Coimbra et al. 2016). We chose the Tay Road Bridge as there is evidence that seasonal patterns are strongest for violent suicide methods such as jumping from high places (Ajdacic-Gross et al. 2007; Hakko et al. 1998; Kadotani et al. 2014; Qi et al. 2015; Räsänen et al. 2002), and testing patterns in a single location close to a weather station increases the precision of measures of meteorology. Therefore, we hoped that testing patterns in this single location would provide a sensitive test of seasonal and meteorological contributions to suicide. Finally, Scotland is a reasonably novel population for testing as only one study, published over 25 years ago, has tested for seasonality in suicide here (Masterton, 1991), reporting seasonal patterns in parasuicide for women but not for men.

Methods

Locations

(a) Scotland has a population of approximately 5.4 million, and covers an area of approximately 30, 000 square miles (see Figure 1). (b) The Tay Road Bridge spans the estuary of the River Tay between Dundee and Fife, and is approximately 2.25 kilometres (1.4 miles) long (see Figure 1 for location). It is comprised of 2 dual carriageways with a central walkway.

Figure 1 about here.

Suicidal behavior

(a) Scotland. We obtained numbers of male and female suicides for each month from January 2003 to December 2013 inclusive from the Scottish Records Office. In 2011, coding of deaths changed so, to maintain consistency, we used numbers of suicides calculated using the old coding rules for each year. The Scottish Records Office collates data on causes of deaths from the Crown Procurator Fiscal's office, following established national codes (NRS report on Probable Suicides, 2017). We

calculated the monthly male and female suicide rate per 100, 000 of the sex-specific population ((number of male or female suicides / mid-year sex-specific population size)*100, 000).

(b) Tay Road Bridge. Data on suicidal behavior were extracted from the Tay Road Bridge Incident Log, which has been kept by bridge staff since 1968. Each incident of suicidal behavior has been recorded, including the gender of the individual and a description of the incident. In total, 759 incidents were recorded of which 685 (90.25%) were classified as 'suicidal behavior'. Other incidents included unconfirmed sightings, non-suicidal disruptive behavior or were recorded but the nature of the behavior was unspecified. Suicidal behavior was classified by bridge staff as anyone who crossed from the central walkway, across the carriageway to the barriers at the edge of the bridge, in combination with judgement of suicidal intent based on the individual's behavior, expressed intent, and visible distress. Date, gender, and nature of suicidal behavior (suspected suicidal behavior, attempted suicide, completed suicide) were extracted for all reports. We calculated the monthly rate of suicidal behavior by men and women per 100, 000 of the sex-specific population of Dundee ((number of incidents of suicidal behavior by men or women / mid-year sex-specific population size)*100, 000). We chose Dundee as our reference population as one end of the bridge is situated in the city centre, and it is the largest population centre close to the bridge. As numbers of incidents were so small, and completed suicides are likely to represent only a small proportion of total suicidality, we did not distinguish between incidents on the basis of their nature, rather we grouped them as 'suicidal behavior'.

Meteorological conditions

We obtained monthly maximum temperature (^{o}C), total rainfall (mm), and hours of sunshine from Met Office historical archives (www.metoffice.gov.uk). The Met Office is the UK national weather service with weather stations located across the UK. We extracted data from the 8 Scottish weather stations that cover the body of the region (Figure 1). For details of data quality control, see https://www.metoffice.gov.uk/climate/uk/stationdata/. We calculated the mean maximum temperature, rainfall, and hours of sunshine for each month across all 8 weather stations. For the Tay Road Bridge, we selected data from the Leuchars weather station, located 6 miles south of the bridge.

Analyses

Our analytic strategy followed that of White et al. (2015). For Scotland-wide data we tested for (i) seasonality in pooled male and female suicide rates by fitting linear regression models adjusted for each month of the year. For this we created dummy variables for each month (excluding one month (December) to reduce multicollinearity). To test for (ii) associations between meteorological variables and suicide rates, we fit models with each meteorological variable as the predictor variable of pooled male and female suicide rates in turn. To determine whether (iii) meteorological variables contributed to seasonality in suicide, we fit the models described in (i) adjusted for each meteorological variable in turn. To determine (iv) whether season moderated relationships between meteorological variables and suicide rates, we created interaction terms for each month with each meteorological variable. We entered these interaction terms as predictor variables with pooled male and female monthly suicide rate as the dependent variable in models for each meteorological variable in turn. Where there were significant interaction terms, we conducted post-hoc bivariate correlational (Spearman's) analyses within the subset of data for the relevant month, and separately for the remainder of the year. We created (v) interaction terms between a sex dummy variable and month dummy variables, and the sex dummy variable and meteorological variables, and fit models predicting pooled male and female monthly suicide rates. Where there were significant interaction terms we conducted post-hoc independent samples t-tests to explore the nature of the interaction.

We conducted analyses for the Tay Road Bridge data separately, as the rate of completed suicides in Scotland was not synonymous with rates of broader suicidal behavior at the bridge. We tested for associations by fitting identical models to those described above.

All analyses were conducted using IBM SPSS Version 22.

Results

Table 1 about here.

(a) Scotland

(i) Seasonal variation in suicide rates. Months of the year did not significantly predict suicide rates (all $p > 0.2$). For full model results, see Supplementary Material Table 1a.

(ii) Associations between meteorological variables and suicide rate. Meteorological variables did not significantly predict suicide rates (all $p > 0.4$). For full model results, see Supplementary Material Table 1b.

(iii) Associations between meteorological variables and suicide rate adjusted for season. As the relationships in (i) and (ii) were non-significant, we did not check for seasonality corrected for meteorological variables.

(iv) Moderation of associations between meteorological variables and suicide rate by season. Month did not significantly moderate associations between suicide rate and maximum temperature, hours of sunshine, or rainfall (all $p > 0.5$). For full model results, see Supplementary Material Table 1c.

(*v) Moderation of associations by sex.* All sex*month interaction terms were predictors of monthly suicide rate (all $p < 0.001$). For full results, see Table 2. Figure 2A shows the patterns of suicide rates across the year for men and women. We conducted post-hoc independent samples t-tests (corrected for number of tests, so that the critical p-value was 0.01) which revealed that there were no significant differences in suicide rates between each month and the remainder of the year for men or women.

Table 2 about here.

Figure 2 about here.

There were significant interactions between sex and each meteorological variable (Adj R^2 = 0.77, $F(3, 263)$ = 287.41, $p < 0.001$). Post-hoc analyses demonstrated that the significant interaction between sex and maximum temperature (β = 0.21, p = 0.037) was due to a marginally significant and positive relationship for men (rs(132) = 0.17, p = 0.052), and a non-significant and negative relationship for women (rs(132) = -0.003, p = 0.971). The significant interaction between sex and hours of sunshine on suicide rate (β = 0.39, $p < 0.001$) was due to a significant positive relationship for men (rs(132) = 0.17, p = 0.049), and a non-significant relationship for women (rs(132) = 0.02, p = 0.845). The significant interaction between sex and rain (β = 0.36, $p < 0.001$) was due to a negative relationship between rainfall and suicide rate in men (rs(132) = -0.04, p = 0.615) and a positive relationship in women (rs(132) = 0.07, p = 0.422).

(b) Tay Road Bridge

(i) Seasonal variation in suicidal behavior. June significantly predicted pooled male and female rate of suicidal behaviour, such that the rate was higher in June (mean = 1.77, SD = 2.21) than the rest of the year (mean = 1.22, SD = 1.67; β = 0.12, p = 0.046). For full model results, Table 3a.

Table 3 about here.

(ii) Associations between meteorological variables and suicidal behavior. Maximum temperature significantly predicted rates of suicidal behavior (Adj R^2 = 0.02, F(1, 477) = 9.75, p = 0.002, β = 0.14), whereas hours of sunshine (Adj R^2 < 0.001, F(1, 207) = 0.032, p = 0.859, β = 0.01) and rainfall (Adj R^2 < 0.001, F(1, 479) = 0.7, p = 0.403, β = -0.04) did not.

(iii) Associations between meteorological variables and suicidal behavior adjusted for season. When the model described in (i) was adjusted for maximum temperature, the R^2-change was non-significant (R^2-change = 0.03, P = 0.246) and maximum temperature was not significantly associated with suicide rate (β = 0.21, P = 0.231). The association between June and suicidal behavior lost significance (β = -0.003, P = 0.98). For full model results see Table 3b.

When the model was adjusted for hours of sunshine, the R^2-change was non-significant (R^2-change = 0.04, p = 0.824) and hours of sunshine was not significantly associated with suicidal behavior (β = -0.18, p = 0.307). The association between

June and suicidal behavior lost significance (β = 0.25, p = 0.129). For full model results see Table 3c.

When the model was adjusted for rainfall, the R^2-change was non-significant (R^2-change = 0.03, p = 0.236) and rainfall was not significantly associated with suicidal behavior (β = -0.06, p = 0.199). The relationship between June and suicidal behavior remained significant (β = 0.12, p = 0.046). For full model results see Table 3d.

(iv) Moderation of associations between meteorological variables and suicide rate by season. The model for maximum temperature was non-significant (Adj R^2 = 0.01, F(11, 477) = 1.32, p = 0.208). There was a significant interaction between June and maximum temperature (β = 0.13, p = 0.031). Post-hoc correlational analyses revealed that the positive association between maximum temperature and suicidal behavior was stronger in June (rs(438) = 0.11, p = 0.487) than in the rest of the year (rs(438) = 0.07, p = 0.134).

The model for hours of sunshine was non-significant (Adj R^2 < 0.001, F(11, 231) = 0.88, p = 0.566). March (β = -0.15, p = 0.044) and April (β = -0.16, p = 0.04) significantly moderated the association between hours of sunshine and suicidal behavior. Post-hoc correlational analyses revealed that the negative relationship between hours of sunshine and suicidal behavior was weaker in March (rs(18) = -0.13, p = 0.604) than the rest of the year (rs(190) = -0.3, p = 0.675). The negative relationship was stronger in April (rs(18) = -0.25, p = 0.319) than in the rest of the year (rs(190) = -0.01 p = 0.852).

The model for rainfall was non-significant (Adj $R^2 < 0.001$, $F(11, 479) = 0.84$, $p = 0.591$). April ($\beta = -0.11$, $p = 0.025$) significantly moderated the association between rainfall and suicidal behavior. Post-hoc correlational analyses revealed that the negative relationship between rainfall and suicidal behavior was stronger in April ($rs(40) = -0.26$, $p = 0.11$) than the rest of the year ($rs(440) = -0.01$, $p = 0.808$).

For full model results, see Supplementary Material Table 2.

(*v*) *Moderation by sex.* There were significant interactions between sex and May ($\beta = 0.16$, $p < 0.001$), June ($\beta = 0.19$, $p < 0.001$), July ($\beta = 0.12$, $p = 0.008$), August ($\beta = 0.12$, $p = 0.008$), and September ($\beta = 0.1$, $p = 0.021$). For full results see Table 4. Figure 2B shows the pattern of suicidal behavior across the year for men and women. Post-hoc independent samples t-tests revealed no significant differences between May, June, July, August or September and the rest of the year in male or female rates of suicidal behavior (all $p > 0.07$).

Table 4 around here

There were no significant interactions between sex and meteorological variables ($p > 0.2$). For full model results see Supplementary Material Table 4.

Discussion

Here we sought to add to the small body of work which has tested for seasonality in suicide rates while controlling for meteorological variables, as well as the effects of both in combination. We found evidence for seasonality of suicide, and of effects of meteorological variables, only at a specific location (Tay Road Bridge) using local meteorological measures, and not across a wider geographical region using pooled meteorological measures. Seasonality differed for men and women, and at the Tay Road Bridge was due to seasonal variation in hours of sunshine and maximum temperature.

The suicide rate in Scotland was not seasonal, but suicidal behavior at the Tay Road Bridge peaked in June. The latter is consistent with the findings of previous studies (Barker et al. 1994; Bazas et al. 1979; Bridges et al. 2005; Chew and McCleary, 1995; Dixon et al. 2007; Durkheim, 1897; Hakko et al. 1998; Khorshidi et al. 2014; Nayha, 1982; Partonen et al. 2004; Petridou et al. 2002; Preti et al. 2000; Rocchi et al. 2004; Rock et al. 2003; Zonda et al. 2005) and, despite evidence of high replicability of this pattern across societies (Woo et al. 2012), is the first evidence for seasonality in Scotland (albeit only in a single location).

There were no associations between meteorological variables and Scottish suicide rates. The seasonal peak of suicidal behavior at the Tay Road Bridge was mediated by maximum temperature and hours of sunshine. This is consistent with a study of suicides over 100 years in Switzerland, in which jumping from high places and railway deaths were associated with temperature (Ajdacic-Gross et al. 2007), but is counter to results from Australia, Greece, and Norway in which seasonality was not due to hours of sunshine (White et al. 2015). Although hours of sunshine and maximum temperature are closely correlated (Lambert et al. 2002), our results suggest a positive relationship between maximum temperature and suicidal behavior, and a negative relationship with hours of sunshine and suicidal behavior. In our data for the Tay Road Bridge, then, high temperatures result in increased suicidal behaviour, but hours of sunshine work against this by reducing suicidal behaviour. While we are reluctant to make firm conclusions about specific meteorological contributions to seasonality on the basis of this single sample, systematic review and meta-analysis of all studies to date will provide more definitive conclusions.

Season and meteorological variables did not interact in their associations with the Scottish suicide rate. However, the positive relationship between maximum temperature and the rate of suicidal behavior at the Tay Road Bridge was stronger in June than it was in the rest of the year, and the negative relationships between rate of suicidal behaviour and rainfall and hours of sunshine were stronger in April than in the rest of the year. One potential interpretation is that sensitivity to meteorological variables is heightened during the spring when people spend more time outdoors as the seasons change.

Finally, there were interactions between sex, season, and the weather. We found significant interactions between sex and each month for the Scottish suicide rate. Although visual inspection of the data suggests that there is a stronger tendency towards seasonality in male than female suicide rates, post-hoc analyses did not reveal any significant patterns. Likewise, there were significant interactions between the months of May to September and sex for rates of suicidal behaviour at the Tay Road Bridge, which again look on visual inspection to be due to stronger seasonality in male suicidality. Again, however, this was not supported by post-hoc analyses. As yet, then, we cannot determine how season influences male and female suicidality differently, although our data suggest that it does. The positive relationships between maximum temperature and hours of sunshine with the Scottish suicide rate, and the negative association between rainfall and the suicide rate were all stronger for men than for women. This suggests that meteorological effects on suicidality are stronger for men than women, and may be interpreted in light of the stronger seasonal effects for violent methods (Ajdacic—Gross et al. 2007) and the greater rate of adoption of violent methods amongst men than women (Lester and Frank, 1988).

We sought to test for patterns in samples which would provide a balance between a larger region and a single location. Our results suggest that the size of geographical regions and proximity of measurement of meteorology are important in determining the sensitivity of our tests. Although we chose to use the most commonly tested meteorological variables, we may have failed to assess more important factors. Ruuhela et al (2009), for example, show that cumulative global solar radiation was a stronger predictor of suicide rates than temperature or precipitation, and the mental wellbeing of psychiatric patients has been shown to be correlated with barometric pressure (Schory et al. 2003) and humidity (Vida et al. 2012). We should note that our decision to test predictions at the Tay Road Bridge stemmed from its proximity to a Met Office weather station, but also due to the careful records that have been kept of all instances of suicidal behaviour, which is not standard at such locations. Recording of an event as 'suicidal behavior' by bridge staff was based upon objective criteria (i.e. the individual crossed the carriageway from the central walkway to the outer barrier) combined with subjective judgement (i.e. based on the individual's visible distress and expressed intent). It is possible that some cases that were suicidal behavior were not recorded as such, and also that some cases were recorded which were not truly suicidal behavior. Therefore, counts of incidents of suicidal behavior are likely to be a crude estimate of the phenomena, although we argue that they are least indicative of overall trends in incidents. In addition, it is also not possible to know from the data reported here the degree to which suicidal intent underpinned each incident, the duration of suicidal feelings, the degree of planning, or any further details of the state of mind of each individual involved. Future research could establish a formal coding structure for classifying suicidal behavior, the duration of suicidal feelings and the degree of suicidal intent. Finally, we chose to test complex inter-relationships between a complex set of meteorological and seasonal variables on suicide and suicidal behavior. This allowed us to identify potential sources of variation in the results of previous studies, and to identify trends from which future hypotheses can be derived and tested.

We have provided the first evidence for seasonality in suicide rates in Scotland, from a single location, but failed to replicate this across Scotland as a whole. We have also demonstrated that seasonality was mediated by hours of sunshine and maximum temperature, suggesting that seasonal peaks in suicidal behavior are due to equivalent patterns in temperature and sunshine. Season interacted with the weather in associations with suicidal behavior, perhaps helping to explain why there are inconsistent findings reported in the literature around relationships between meteorological variables and suicide rates. We also found meteorological and seasonal effects to be stronger for men than for women. We argue that future research should test patterns in small geographical units, in men and women and for different suicide methods, and seek to identify the social and physical factors which predict variation in patterns across units.

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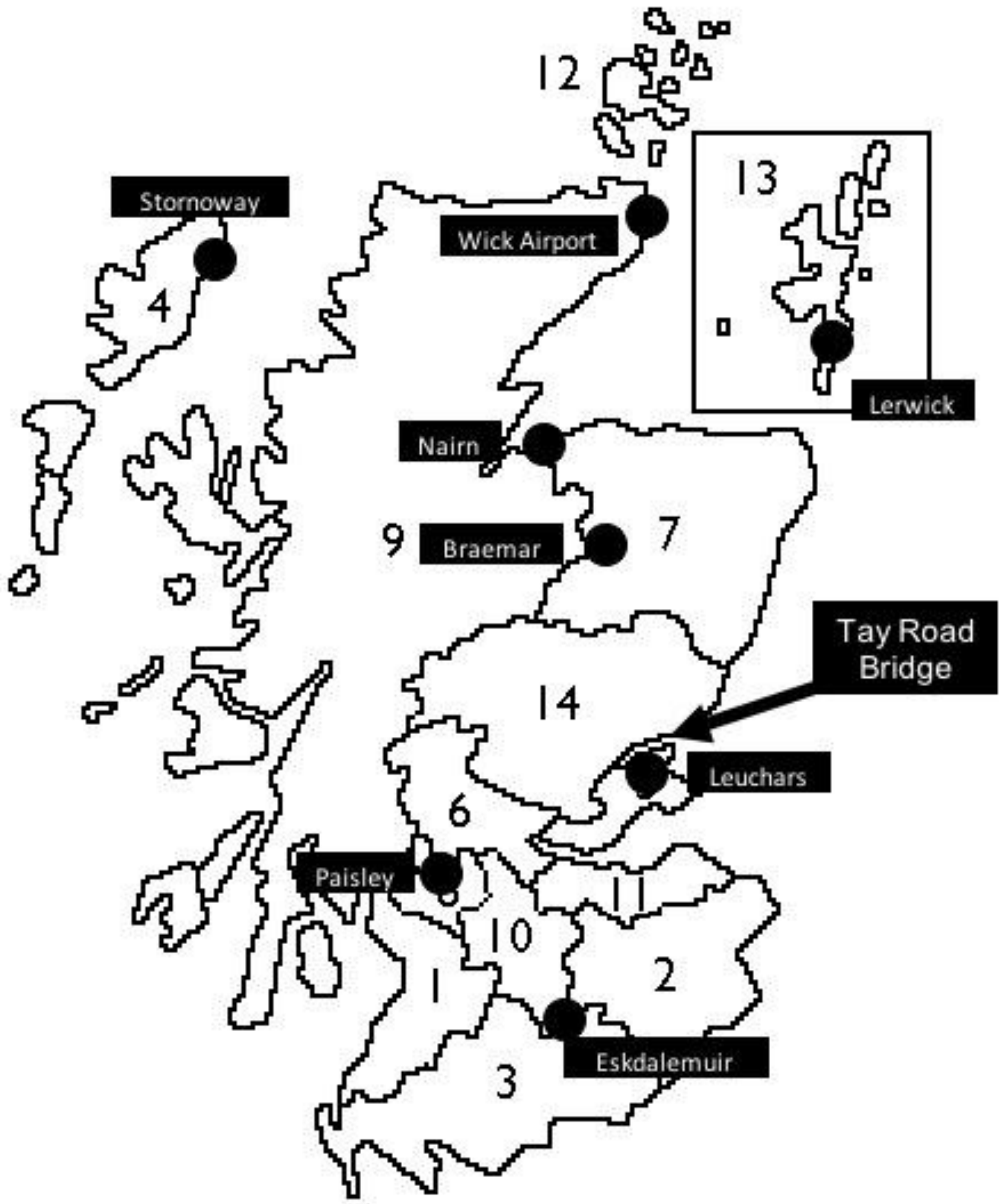

Figure 1. Map of Scotland showing weather stations from which meteorological data were extracted, and the location of the Tay Road Bridge.

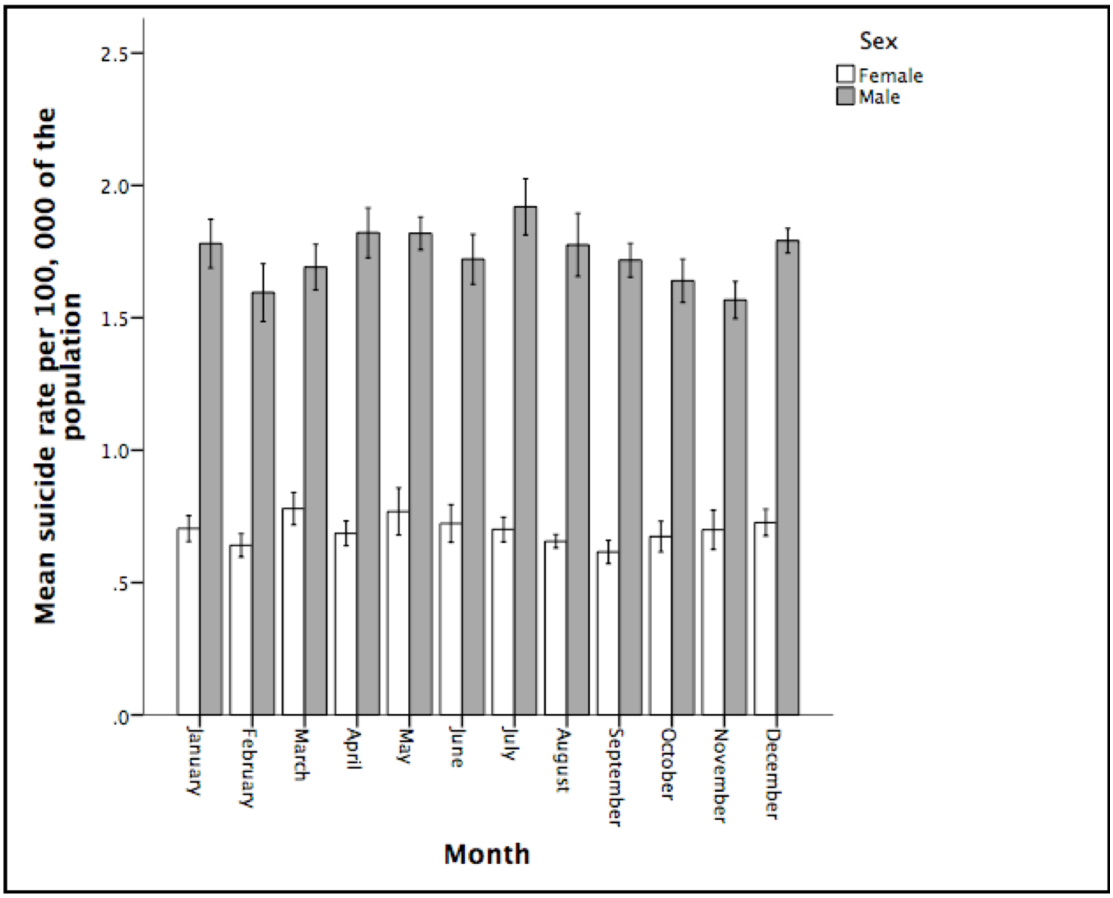

Figure 2. Mean Scottish suicide rates of men and women per 100, 000 population across the year. Error bars represent +- 1 SE.

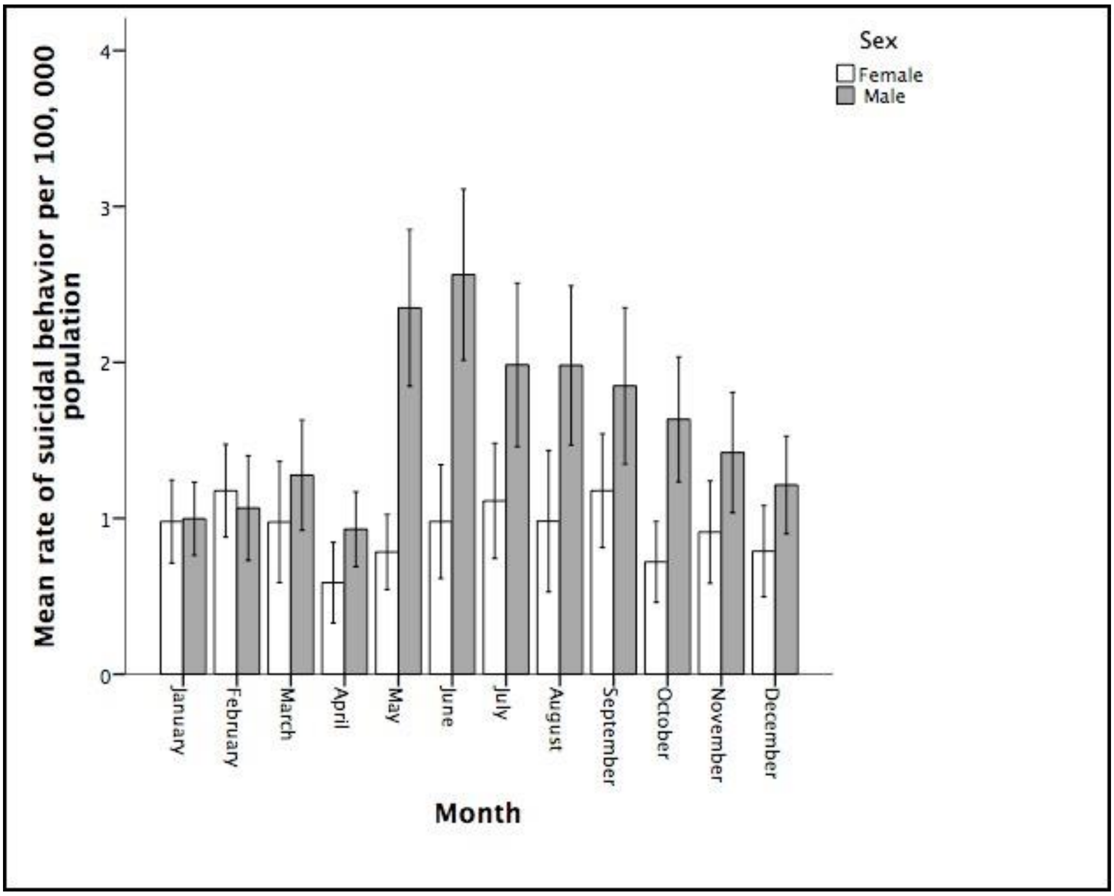

Figure 3. Mean rates of male and female suicidal behavior per 100, 000 population at the Tay Road Bridge across the year. Error bars represent +- 1 SE.

Table 1. Mean monthly rates of suicide for Scotland (2003-2013) and of suicidal behavior at the Tay Road Bridge (1968-2016) per 100, 000 of sex-specific populations, and meteorological variables across Scotland and at the weather station closest to the Tay Road Bridge (with standard deviations in parentheses).

	Scotland	Tay Road Bridge
Mean monthly male suicide rate/rate of suicidal behavior	1.74 (0.3)	1.61 (1.9)

Mean monthly female suicide rate/rate of suicidal behavior	0.7 (0.19)	0.93 (1.45)
Mean monthly maximum temperature (°C)	11.33 (4.14)	12.79 (4.54)
Mean monthly hours of sunshine	95.56 (38.57)	130.39 (50.26)
Mean monthly rainfall (mm)	85.03 (36.73)	61.11 (36.58)

Table 2. Showing coefficients (β with P-values in parentheses) for a multiple linear regression model testing relationships between month*sex interaction terms and suicide rate ($Adj\text{-}R^2 = 0.83$, $F(11, 263) = 51.37$, $p < 0.001$).

Sex*January	0.35 (<0.001)
Sex*February	0.28 (< 0.001)
Sex*March	0.31 (< 0.001)
Sex*April	0.36 (<0.001)
Sex*May	0.36 (< 0.001)
Sex*June	0.33 (< 0.001)
Sex*July	0.4 (< 0.001)

Sex*August	0.35 (<0.001)
Sex*September	0.33 (< 0.001)
Sex*October	0.3 (< 0.001)
Sex*November	0.27 (< 0.001)

Table 3. Model coefficients for multiple linear regression models testing (a) seasonality of rates of suicidal behaviour (Adj R^2 = 0.01, F(11, 479) = 1.23, p = 0.266), and adjusted for (b) maximum temperature (Adj R^2 = 0.006, F(12, 477) = 1.25, p = 0.246), (c) hours of sunshine (Adj R^2 < 0.001, F(12, 207) = 0.62, p = 0.824), and (d) rainfall (Adj R^2 = 0.01, F(12, 479) = 1.27, p = 0.236). Degrees of freedom depend upon availability of monthly data from Met Office historical archives.

	β (with P-value in parentheses)			
	(a)	(b) Adjusted for maximum temperature	(c) Adjusted for hours of sunshine	(d) Adjusted for rainfall
January	-0.002 (0.973)	-0.002 (0.968)	0.01 (0.317)	-0.002 (0.97)

February	0.02 (0.755)	0.01 (0.863)	0.13 (0.217)	0.01 (0.892)
March	0.02 (0.745)	-0.01 (0.837)	0.11 (0.39)	0.01 (0.892)
April	-0.04 (0.527)	-0.01 (0.213)	0.13 (0.334)	-0.05 (0.431)
May	0.09 (0.142)	-0.002 (0.98)	0.28 (0.102)	0.09 (0.167)
June	0.124 (0.046)	-0.003 (0.98)	0.25 (0.129)	0.12 (0.046)
July	0.09 (0.155)	-0.07 (0.643)	0.15 (0.318)	0.09 (0.142)
August	0.08 (0.212)	-0.07 (0.597)	0.27 (0.069)	0.08 (0.194)
September	0.08 (0.183)	-0.05 (0.711)	0.12 (0.32)	0.08 (0.217)

October	0.03 (0.646)	-0.05 (0.573)	0.12 (0.275)	0.04 (0.556)
November	0.03 (0.667)	-0.01 (0.924)	0.17 (0.088)	0.03 (0.659)
Maximum Temperature		0.21 (0.231)		
Hours of Sunshine			-0.18 (0.307)	
Rainfall (mm)				-0.06 (0.199)

Table 4. Showing coefficients (β with P-values in parentheses) for a multiple linear regression model testing relationships between month*sex interaction terms and suicide rate (Adj-R^2 = 0.06, $F(11, 479) = 3.84$, $p < 0.001$).

Sex*January	0.01 (0.909)
Sex*February	0.01 (0.771)
Sex*March	0.04 (0.403)

Sex*April	-0.003 (0.952)
Sex*May	0.16 (< 0.001)
Sex*June	0.19 (< 0.001)
Sex*July	0.12 (0.008)
Sex*August	0.12 (0.008)
Sex*September	0.1 (0.021)
Sex*October	0.08 (0.079)
Sex*November	0.05 (0.226)