Suicide Mortality Risk in Kermanshah Province, Iran: A County-level Spatial Analysis

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ABSTRACT

Background: Kermanshah province has one of the highest suicide rates in Iran. The aim of this study is to explore spatial variations in the relative risk of suicide across the counties of Kermanshah province.

Methods: This is an applied ecological study in which county-level counts of suicide deaths recorded by the forensic medicine organisation of Kermanshah province during the period March 21, 2006 to March 20, 2013 have been used. Following a Bayesian approach, Besag, York and Mollie’s (BYM) model was fitted to the number of suicide deaths of males, females and all persons to make inference about the relative risk of suicide across the counties of the province.

Results: Over the study period and based on 95% credible intervals, Kangavar, Harsin and Songor counties had significantly lower relative risks of suicide for both males and females, Salas-Babajani, Paveh, Javanrud and Ravansar counties had significantly lower relative risks of suicide only for males and Kermanshah county had a significantly higher relative risk of suicide only for males. The relative risk of suicide for the other counties were not significantly different from the province’s overall risk neither for males nor females.

Conclusion: The counties of Kermanshah province can be classified into four categories by the level of relative risk of suicide: low relative risk for both males and females, low relative risk only for males, high relative risk only for males and average relative risk. Findings from this study could be used to specify counties with priority for suicide prevention initiatives.

Key words: Relative Risk; Besag, York and Mollie’s model; Bayesian approach; Spatial Analysis; Suicide; West of Iran

INTRODUCTION

Due to differences in ethnicity, cultures, mental health conditions and socioeconomic characteristics, suicide mortality rates vary widely by different countries and regions [1, 2]. Identifying high-risk areas can explain the determinants of suicide from a different perspective than the individual-level risk factors and improve preventive measures [3]. For this reason, analysing the spatial heterogeneity of suicide mortality rates at national, regional and local levels has attracted the attention of many
researchers in the last few years [4-9]. Spatial statistics and disease mapping methods are used in such analyses in order to reveal areas with high suicide risk (clusters). More specifically, the Besag–York–Molliè (BYM) model is widely used in mapping of suicide risk [7, 8, 10, 11].

In Iran, the deaths by suicide showed an increasing trend in the past two decades [12, 13]. A recent national study estimated the mean national suicide mortality rate to be about 4.9 per 100000 population in 2010 and found a substantial heterogeneity across provinces and remarkably high suicide mortality rates in the western provinces of Iran [14]. In Kermanshah province, the most populated western province of Iran, the estimated suicide mortality rate is about two times more than the national average [14, 15].

Multiple factors associated with the risk of suicide at the individual level in Kermanshah province have been studied [16]. However, little has been done to identify spatial heterogeneity in risk of suicide across the counties of the province. The main aim in this study was to explore the pattern of suicide across the counties of Kermanshah province and to identify high-risk counties for men and women.

**METHODS**

**Study Population and Data Source**

Based on the 2011 National Census of Population and Housing, Kermanshah province with 1,945,227 population is the most populated province in the west of Iran. With an area of 25000 square kilometres, the province is divided into 14 counties which contain 31 cities and towns and 2793 villages with urbanisation rate = 70% [17]. Figure 1 shows the counties of Kermanshah province. The western counties (Qasre Shirin, Sarpole Zahab, Salas-Babajani and Paveh) share a border with Iraq.

In this study, county-level counts of suicide deaths in Kermanshah province were obtained from the dataset of completed suicide cases provided by the Forensic Medicine Organization (FMO) of Kermanshah province during the period March 21, 2006 to March 20, 2013 (based on Iranian calendar time). The FMO dataset has been described and analysed in a cross-sectional study to assess factors associated with the choice of suicide method [16]. Population of the province by county and gender were extracted from the 2011 national Census of Population and Housing data reported by the Statistical Center of Iran.

**Ethics Considerations**

Before receiving data, burial permit number, name and surname of the deceased were omitted due to respect to the principle of medical secrecy. No private information of the deceased who committed suicide were used in conducted analysis and obtained results and hence no informed consent was required for this study.

**Statistical Analysis**

Let \( Y \) and \( n \) denote, respectively, the observed number of completed suicide cases and population of
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The observed and estimated expected number of completed suicide cases in each county of Kermanshah province for males, females and all persons are given in Table 1. Table 2 summarises the posterior means, standard deviations, and 95% credible intervals for parameters of the fitted BYM models to the number of suicide deaths of males, females and all persons. The posterior mean of proportion of variance explained by the spatial random effect $\tau_i$, i.e. $\frac{\tau_i}{\tau_i + \tau}$, is 52.9% for males, 54.5% for females and 53.8% for all persons. This means that the county-specific random effect $\tau_i$ and the structured spatial random effect $\nu$ have nearly the same contribution to the total spatial heterogeneity of suicide risk across the province.

Figure 2 shows the map of posterior mean and probability of excess risk of the county-specific relative risk $\xi_i$. The posterior means of the county-specific relative risk are categorised into very low (0.3-0.75), low (0.75-0.95), medium (0.95-1.05), high (1.05-1.25) and very high (1.25-1.8) relative risk groups and the excess risk probabilities are categorised into low (0.0-0.25), medium (0.25-0.75) and high (0.75-1) probability groups. The maps reveal heterogeneity in the suicide mortality relative risk across the counties of Kermanshah province. It can be seen that for males, the northwestern counties (Salas-Babajani, Javanrud, Ravansar and Pavel) fall into the very low relative risk category. Thus, the risk of suicide mortality for males in these counties is in average, half of the overall province risk. This fact is also reflected in the probability of excess risk for males, which is low for these counties. On the other hand, Qazr-e Shirin, Sarpoleh Zahab, Islamabad-e Gharb, Kermanshah and Sahneh are counties with very high relative risks and high probabilities of excess risk. The risk of suicide mortality for males in these counties is, on average, 1.5 times more than the overall province risk.
For females, Sonqor, Harsin and Kangavar are counties with very low suicide mortality relative risks and low excess risk probabilities while Qasr-e Shirin, Sarpol-e Zahab, Dallahoo, Ravansar and Gilan-e Gharb have very high suicide mortality relative risks. Moreover, the probability of excess risk for Javanrud is high.

For all persons, Sonqor, Harsin, Kangavar, Paveh, Salas-Babajani and Javanrud are counties with low probabilities of excess risk and very low or low suicide mortality relative risks, Ravansar has medium relative risk and probability of excess risk and the rest of counties have high probabilities of excess risk and very high or high relative risks.

Instead of county-specific relative risk $\xi_i$, posterior mean and 95% credible interval for the total relative risk is presented.
risk $\theta$ of each county are presented in Table 3. If its corresponding 95% credible interval contains one, it can be inferred that the relative risk $\theta$ is not significantly (at the 0.05 level) different from one. Based on this argument, Salas Babajani (0.226), Paveh (0.351), Javanrud (0.420), Ravansar (0.458), Harsin (0.680), Kangavar (0.695) and Sonqor (0.713) for males, Kangavar (0.463), Sonqor (0.480) and Harsin (0.590) for females and Salas-Babajani (0.505), Paveh (0.566), Kangavar (0.588), Sonqor (0.604), Harsin (0.630) and Javanrud (0.714) for all persons have significantly less than one relative risks. On the other hand, Kermanshah county has significantly greater than one relative risk for males (1.186) and all persons (1.129).

**DISCUSSION**

As already noted, Kermanshah province had the second highest suicide mortality rate in the whole country [14]. In the present study, the aim was to identify and assess variations in the risk of suicide by gender across the counties of Kermanshah province. In this study, we found substantial gender inequality in the distribution of suicide mortality across the counties in Kermanshah province. Also we found that Kangavar, Harsin and Sonqor counties had significantly lower relative risks of suicide for both males and females, Salas Babajani, Paveh, Javanrud and Ravansar counties had significantly lower relative risks of suicide only for males and Kermanshah county had a significantly higher relative risk of suicide only for males over the study period. The relative risk of suicide for the other counties were not significantly different from the province’s overall risk neither for males nor for females. Thus, the counties of Kermanshah province can be classified into four categories by the level of relative risk: low relative risk for both males and females, low relative risk only for males, high relative risk only for males and average relative risk. In line with previous studies [15, 16], the results indicate gender differences in the risk of suicide.
across the counties of Kermanshah province. This finding is associated with an adverse experiences due to low socio-economic status of Kermanshah province in Iran [14].

This study provided the first evidence in Kermanshah province on the spatial heterogeneity of suicide mortality in the county-level. However, identifying the possible causes of this heterogeneity is beyond the scope of this paper and an issue that needs further research from different points of view. Such studies should take into account the impact of the Iran-Iraq war (1980-1988) on each county of Kermanshah province, as well as rapid urbanisation and socio-cultural transformation in the province [16, 24], which intensified conflicts between traditions and modernity. Nevertheless, findings from this study could be used to specify priority counties for suicide prevention initiatives.

Due to data limitations and unavailability, important county-level factors such as human development index and multidimensional poverty index were not included in the analysis. Also, lack of data prevented us from providing the relative risk of suicide by suicide method and age group. Hopefully, a more comprehensive study can be carried out when more information is available.

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### Conflict of Interest

The authors declare that they have no conflicts of interest in this study.

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