

# International comparison of death place for suicide; a population-level eight country death certificate study

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## Abstract

**Purpose** The places of death for people who died of suicide were compared across eight countries and socio-demographic factors associated with home suicide deaths identified.

**Methods** Death certificate data were analyzed; using multivariable binary logistic regression to determine associations.

**Results** National suicide death rates ranged from 1.4 % (Mexico) to 6.4 % (South Korea). The proportion of suicide deaths occurring at home was high, ranging from 29.9 % (South Korea) to 65.8 % (Belgium). Being older, female, widowed/separated, highly educated and living in an urban area were risk factors for home suicide.

**Conclusions** Home suicide deaths need specific attention in prevention programs.

**Keywords** Suicide · Location of death · Death certificate data · International comparison

## Introduction

Suicide research has focused on socio-demographic profiling and suicide methods [1–6]. Age and gender (female) [4, 6–9] and psychiatric disorders are well known factors; depression increases risk of suicide 11-fold [3, 7] and alcohol use [2, 4, 7, 10] is significantly associated with a first attempt at suicide. Where suicide deaths take place has not been a focus of attention. Understanding patterns in the place of suicide could provide highly relevant information for targeted prevention efforts [1, 4]. A home suicide death implies strong intentions to end one's life as compared to suicidal attempts in other places where there is a greater chance of exposure and intervention. Planned suicide attempts often involve medications which can be easily taken at home, as compared to unplanned suicide attempts using impulsive methods (e.g., jumping) [10]. Family

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members who discover a suicide death at home experience a more difficult bereavement [11, 12]. Suicide risk is also influenced by exposure to other suicide events [7] and home suicides may increase the risk of suicide among those who discover a suicide death at home. Home suicide deaths are thus of particular interest.

Cross-national comparisons help develop prevention and intervention programs [13]. Understanding cross-national patterns of where suicide deaths occur will provide new useful information. If the death place of suicide recorded on the death certificate is home, this reveals the place of suicide was home. Alternatively, the hospital as a death place suggests different suicide pathways such as failed attempts outside the home and with death occurring during or after hospital admission.

The aim of this study was to examine where suicide deaths occur and explore socio-demographic factors associated with home suicide deaths across eight countries.

## Methods

### Study design and data

For convenience, rather than explicit hypotheses, we selected eight countries with provided data for the International Place of Death study [14]. Those selected did not have a low number of suicides (to avoid statistical power issues) or large missing values: three European countries (Belgium, France, Czech Republic), one Asian country (South Korea), one Oceanic country (New Zealand), and three North-American countries (Mexico, USA, Canada). Country datasets of all 2008 deaths (only USA used 2007 deaths) were integrated into one international database.

### Population

All cases of suicide-related death, using the International Classification of Diseases 10 [ICD-10] codes (X60–X84, Y10–Y34) [2] were selected, and used to calculate the proportion of deaths due to suicide. These cases were retained for further analysis.

### Measures

Place of death comprised the categories of home, hospital, and nursing/care home in all countries except Mexico, where place of death was registered as home, hospital, or other. Independent variables were age (1–17, 18–29, 30–39, 40–49, 50–59, 60–64, 65–69, 70–74, 75–79, 80–84, 85 years+), education (elementary, middle school, high

school, higher than college), sex (female, male), marital status (unmarried, married, widowed, divorced/separated), degree of urbanization of the municipality of residence (urban, rural), and suicide method [2, 15] classified into five categories: poisoning (ICD-10 codes X60–X69 and Y10–Y19), hanging (X70 and Y20), firearms (X72–X74 and Y22–Y24), jumping from a high place (X80 and Y30), and all others (X71, X75–X79, X81–X84 and Y21, Y25–Y29, Y31–Y34). Poisoning suicide deaths were further divided into medications (ICD-10 codes X60–X64 and Y10–Y14), gases (X67 and Y17), pesticides (X68 and Y18), and all others (X65, X66, X69 and Y15, Y16 and Y19 [2]. The degree of municipal urbanization was determined for each country by their national or regional statistical offices/agencies.

### Statistical analysis

For each country separately, a multivariable binary logistic regression model was constructed to determine independent predictors of suicide at home (versus other places). The independent variables in each model were: age, sex, marital status, and urbanization. All models were checked for multicollinearity (tolerance and variance inflation factor collinearity statistics). All analyses were conducted using SPSS (version 22).

## Results

### Study population characteristics

Across the eight countries, 2.3 % of deaths were due to suicide, ranging from 1.4 % in Mexico to 6.3 % in South Korea (Table 1). Socio-demographic characteristics (age, gender, and educational attainment), suicide methods, and degree of urbanization are described in supplementary Table S1.

### Place of death

More than half of all suicides took place at home in all countries except South Korea (29.9 %). South Korea also had the highest percentage of suicide deaths in hospital (47.6 %), more than twice that of all other countries (Table 1). The proportion of suicide deaths occurring in long-term care settings ranged between 0.2 % (South Korea) to 2.2 % (New Zealand). More than half of suicide deaths from hanging occurred at home in all eight countries. Over 60 % of suicide deaths from poisoning were at home, except Mexico (26.8 %) and South Korea (21.2 %) (Table s2).

**Table 1** Place of suicide deaths and variables associated with a home suicide death in eight countries

	Belgium	France	Mexico	New Zealand	Canada	Czech Republic	South Korea	USA
Total deaths (≥1 years)	101,685	538,079	498,915	28,988	180,589	101,473	246,177	2,399,117
Number of suicides	1993	10,872	6750	538	3171	1592	15,530	34,691
Percentage of suicide deaths	1.96	2.02	1.35	1.86	1.76	1.57	6.31	1.45
Place of death (%)								
Hospital	9.70	12.30	17.10	8.20	16.10	12.30	47.60	16.60
Home	65.80	64.70	53.70	62.10	56.20	55.10	29.90	58.70
Nursing home/care home	0.80	1.00	0.00	2.20	0.50	2.10	0.20	0.30
Palliative care institution	NA	NA	NA	0.00	NA	NA	NA	0.10
Other	23.70	22.00	29.10	27.50	27.10	30.50	22.30	24.20
Factors associated with home suicide death vs all other places (odds ratios and 95 % confidence interval)								
Age								
1–17 years	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
18–29 years	0.77 (0.22–2.72)	0.99 (0.61–1.62)	0.69 (0.53–0.90)*	0.94 (0.37–2.39)	0.65 (0.39–1.10)	0.64 (0.19–2.22)	0.91 (0.55–1.50)	0.58 (0.47–0.71)*
30–39 years	1.20 (0.33–4.28)	1.32 (0.82–2.14)	0.72 (0.54–0.96)*	0.92 (0.35–2.42)	0.75 (0.44–1.29)	0.98 (0.28–3.38)	0.97 (0.59–1.61)	0.69 (0.56–0.85)**
40–49 years	1.18 (0.33–4.22)	1.43 (0.88–2.31)	0.67 (0.49–0.91)*	1.69 (0.63–4.50)	1.23 (0.72–2.11)	1.35 (0.38–4.74)	0.84 (0.50–1.40)	0.80 (0.65–0.99)*
50–59 years	1.15 (0.31–4.29)	1.61 (0.98–2.63)*	0.94 (0.63–1.40)	1.30 (0.43–3.97)	1.73 (0.96–3.10)	1.40 (0.39–4.99)	0.96 (0.56–1.63)	0.93 (0.74–1.16)
60–64 years	1.57 (0.42–5.87)	1.86 (1.14–3.03)*	1.07 (0.74–1.56)	1.75 (0.61–5.05)	2.05 (1.14–3.70)*	2.11 (0.60–7.47)	1.27 (0.75–2.14)	1.14 (0.92–1.43)
65–69 years	1.73 (0.45–6.68)	2.49 (1.51–4.11)*	1.65 (1.05–2.57)*	1.41 (0.41–4.92)	1.62 (0.86–3.07)	4.14 (1.09–15.70)*	1.55 (0.92–2.64)	1.68 (1.33–2.14)**
70–74 years	2.74 (0.67–11.11)	3.12 (1.88–5.17)*	2.55 (1.48–4.41)**	3.01 (0.64–14.13)	3.93 (1.82–8.50)**	2.35 (0.61–9.07)	1.86 (1.07–3.23)*	2.54 (1.97–3.27)**
75–79 years	2.48 (0.39–15.93)	2.53 (1.44–4.41)**	4.81 (1.74–13.27)*	0.12 (0.01–1.17)	1.67 (0.60–4.65)	1.86 (0.40–8.64)	2.69 (1.41–5.15)*	3.61 (2.47–5.27)**
80–84 years	0.28 (0.01–6.32)	1.81 (0.70–4.73)	c	c	c	c	2.23 (0.30–16.62)	1.42 (0.54–3.73)
85 years+	c	c	c	c	c	c	c	c
Gender								
Male (vs female)	1.25 (0.91–1.72)	0.87 (0.76–0.98)	0.47 (0.38–0.57)**	0.68 (0.42–1.09)	0.90 (0.72–1.12)	0.59 (0.40–0.86)*	0.34 (0.30–0.38)*	0.64 (0.59–0.69)*
Education								
Elementary	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Middle school	0.81 (0.48–1.36)	NA	1.12 (0.96–1.32)	NA	NA	0.96 (0.64–1.43)	1.19 (1.01–1.39)*	0.97 (0.90–1.05)
High school	1.12 (0.66–1.88)	NA	0.95 (0.59–1.53)	NA	NA	0.95 (0.48–1.86)	1.13 (0.88–1.45)	1.20 (1.03–1.40)*
Higher than college	0.84 (0.45–1.57)	NA	1.20 (0.76–1.91)	NA	NA	0.64 (0.42–0.97)*	1.27 (1.04–1.54)*	1.06 (0.98–1.15)
Marital status								
Unmarried	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

Table 1 continued

	Belgium	France	Mexico	New Zealand	Canada	Czech Republic	South Korea	USA
Married	1.38 (0.89–2.14)	1.05 (0.92–1.20)	1.16 (0.91–1.48)	NA	0.76 (0.60–0.96)*	0.83 (0.57–1.19)	1.19 (1.01–1.39)	0.97 (0.90–1.05)
Widowed	1.89 (0.93–3.81)	1.46 (1.16–1.84)**	1.18 (0.98–1.41)	NA	0.76 (0.45–1.31)	0.86 (0.55–1.35)	1.13 (0.88–1.45)	1.20 (1.03–1.40)
Divorced/ separated	1.67 (1.01–2.76)*	1.02 (0.86–1.21)	1.24 (1.02–1.50)*	NA	0.87 (0.65–1.17)	1.28 (0.61–2.69)	1.27 (1.04–1.54)	1.06 (0.98–1.15)
Urbanization								
Urban (vs. rural)	0.68 (0.43–1.08)	NA <sup>b</sup>	NA <sup>b</sup>	NA <sup>b</sup>	1.35 (1.10–1.66)*	NA <sup>b</sup>	0.92 (0.83–1.03)	NA <sup>b</sup>
Suicide method								
Poisoning	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Hanging	0.82 (0.45–1.48)	0.70 (0.59–0.83)**	1.99 (1.45–2.75)**	1.50 (0.92–2.46)	1.09 (0.88–1.37)	0.83 (0.52–1.33)	1.03 (0.89–1.19)	0.96 (0.88–1.05)
Firearms	0.50 (0.23–1.08)	0.67 (0.54–0.83)**	1.11 (0.76–1.61)	0.90 (0.40–2.03)	0.77 (0.57–1.04)	0.73 (0.38–1.41)	0.04 (0.01–0.33)*	0.88 (0.81–0.95)**
Jumping	0.04 (0.01–0.10)**	0.08 (0.07–0.11)**	0.18 (0.09–0.36)**	0.05 (0.01–0.40)*	0.23 (0.15–0.35)**	0.03 (0.01–0.07)**	0.06 (0.05–0.07)**	0.05 (0.04–0.07)**
Others	0.09 (0.05–0.16)**	0.11 (0.09–0.13)**	0.16 (0.12–0.23)**	0.39 (0.18–0.81)*	0.17 (0.13–0.24)**	0.24 (0.14–0.39)**	0.15 (0.13–0.18)**	0.18 (0.16–0.21)**

ns not significant, ref reference category

\*  $p < 0.05$ , \*\*  $p < 0.01$

<sup>a</sup> Sample sizes per country may not be equal to the total population due to missing data for certain independent variables. We checked for the influence of the inclusion vs. exclusion of the cases with missing data and found no difference in the results

<sup>b</sup> NZ: marital status not recorded on death certificates and hence not included in the model. Urbanization in Canada is coded as urban vs rural. Degree of urbanization was not available in the data of Czech Republic, New Zealand, the United States and Mexico. Educational attainment not recorded on death certificates in France, Netherlands, England, Wales, and New Zealand

<sup>c</sup> No cases of home suicide death within this age group

## Factors associated with home suicide deaths

Home suicide deaths were more likely at age 50+. In Mexico and USA, suicides <40 years old were less likely to occur at home. Adjusted for potential cofounders, suicide deaths of men were less likely than those of women to take place at home in the USA, Czech Republic, South Korea and Mexico. Higher education was associated with greater odds of suicide death occurring at home in South Korea and the USA; the opposite was true in the Czech Republic. In Canada, the likelihood of dying at home was higher in urbanized regions.

Being divorced/separated was associated with home suicide deaths in Belgium and Mexico. Widowers had a higher chance of home suicide death in France. Firearms were a less likely home suicide method in France, South Korea, and the USA. In Mexico, hanging was a more common home suicide death.

## Discussion

The likelihood of home suicide deaths varied across the eight countries, with a number of risk factors associated with each country. Belgium (65.80 %), France (64.70 %), and New Zealand (62.10 %) had the highest home suicide death rates, while the lowest rate was found in South Korea (29.9 %). An increased risk of home suicide death was more or less consistently (albeit with some country variation) among females, aged 50–80, and not married (divorced/separated, widowed, single). Our study confirmed previous research that home suicide deaths are associated with suicide method [7, 12], specifically poisoning and hanging. In seven countries, the majority of suicide deaths took place at home, with these posing challenges for prevention and intervention strategies. Strategies specifically focused on home suicide deaths are needed alongside general suicide prevention programs. Our findings also suggest that it is necessary to target specific groups at higher risk of home suicide deaths, such as men in rural areas (particularly within a context of high firearm availability) [16] and older females [2, 4, 8]. Possible strategies, as suggested by others [17], could include the use of available social or community-based resources such as religious groups, senior centers in the cities, and occupation unions or groups in rural areas such as farmers, as means to follow-up on and provide community support to risk groups continuously.

However, our cross-national and socio-demographic patterns in home suicide deaths require clarification about their meaning and impact. To better inform prevention strategies, further research is needed to determine what particular motives influence a decision to commit suicide,

including the discovery of a home suicide death. Cross-national research with more countries is also needed for explanations on variable home suicide death rates and risk factors.

Our study had limitations, notably differences in data certification and coding. Cultural differences could lead to suicide underreporting. Some home suicide deaths could be recorded as hospital deaths if transferred there. Death certificate data does not identify suicide attempts either.

## Conclusions

A majority of suicide deaths occur at home, with being females, older persons, and those not married at risk for home suicide deaths. These findings inform targeted prevention campaigns, including community-based strategies to prevent suicide attempts, particularly for at-risk groups for home suicide deaths. Despite certain uniform risk factors, it may be necessary to differentiate prevention program such as community-based programs for different targeted at-risk groups and different countries.

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## Compliance with ethical standards

**Conflict of interest** On behalf of all authors, the corresponding author states there is no conflict of interest.

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