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DOI:
10.1192/bjp.2017.32

Document Version
Accepted author manuscript

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Vincent Lorant PhD (1); Rianne de Gelder PhD (2); Dharmi Kapadia PhD (3); Carme Borrell PhD (4); Ramune Kalediene PhD (5); Katalin Kovács PhD (6); Mall Leinsalu PhD (7); Pekka Martikainen PhD (8); Gwenn Menvielle PhD (9); Enrique Regidor PhD (10); Maica Rodríguez-Sanz MSc (4); Bogdan Wojtyniak PhD (11); Bjørn Heine Strand PhD (12); Matthias Bopp PhD (13); Johan P. Mackenbach PhD (2)

Author Affiliations:

(1) Institute of Health and Society, Université catholique de Louvain, Brussels, Belgium

vincent.lorant@uclouvain.be

(2) Department of Public Health, Erasmus MC, Rotterdam, Netherlands

r.kraaijeveld-degelder@cbs.nl

j.mackenbach@erasmusmc.nl

(3) Cathie Marsh Institute for Social Research, University of Manchester, United Kingdom

Dharmi.Kapadia@manchester.ac.uk

(4) Agència de Salut Pública de Barcelona, Barcelona, Spain

cborrell.aspb@gmail.com

mrodri@aspb.cat

(5) Lithuanian University of Health Sciences, Kaunas, Lithuania

Ramune.Kalediene@lsmuni.lt

(6) Demographic Research Institute of the Central Statistical Office, Budapest, Hungary

kovacs@demografia.hu

(7) Stockholm Centre for Health and Social Change, Södertörn University, Huddinge, Sweden; and Department of Epidemiology and Biostatistics, National Institute for Health Development, Tallinn, Estonia

mall.leinsalu@sh.se

(8) Department of Sociology, University of Helsinki, Finland

pekka.martikainen@helsinki.fi

(9) Sorbonne Universités, INSERM, Institut Pierre Louis d'Epidémiologie et de Santé Publique (IPLESP UMRS 1136), Paris, France

gwenn.menvielle@inserm.fr

(10) Department of Preventive Medicine and Public Health, Universidad Complutense de Madrid, Spain

enriqueregidor@hotmail.com

(11) Department Centre of Monitoring and Analyses of Population Health, National Institute of Public Health, National Institute of Hygiene, Warsaw, Poland

bogdan@pzh.gov.pl

(12) Norwegian Institute of Public Health, Department on ageing, Oslo, Norway

BjornHeine.Strand@fhi.no

(13) Epidemiology, Biostatistics and Prevention Institute, University of Zürich, Switzerland,

matthias.bopp@uzh.ch

Manuscript word count: 3.142 words

Corresponding Author: Vincent Lorant, Institute of Health and Society, Université catholique de Louvain, Clos Chapelle-aux-champs 30 bte B1.30.15 à 1200 Woluwe-Saint-Lambert, Belgium (vincent.lorant@uclouvain.be)

Disclosure and acknowledgments

Conflict of Interest Disclosures: None reported.

Contributions: Vincent Lorant conceptualized the research question, performed the data analysis and drafted the manuscript. Johan P. Mackenbach designed the study and supervised the data collection. Vincent Lorant, Dharmi Kapadia, and Johan P. Mackenbach contributed to the research question. Johan P. Mackenbach, Dharmi Kapadia, and Rianne de Gelder contributed to the manuscript development. Rianne de Gelder, Carme Borrell, Ramune Kalediene, Katalin Kovács, Mall Leinsalu, Pekka Martikainen, Gwenn Menvielle, Enrique Regidor, Maica Rodríguez-Sanz, Bogdan Wojtyniak, Bjørn Heine Strand, Matthias Bopp prepared data and commented on the paper. All authors read, contributed to, revised, and approved the final manuscript.

Responsibility: Vincent Lorant had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Disclosure of potential conflicts of interest: none

Sources of funding and support:

- Vincent Lorant was in receipt of a FNRS grant number 2015/V 3/2/165 - IB/MAA - 10;
- The Demetriq project was supported by a grant (FP7-CP-FP no 278511) from the European Commission Research and Innovation Directorate General, as part of the "Developing methodologies to reduce inequalities in the determinants of health" (DEMETRIQ) project.

Role of funder: the sponsor had no role in the study design, in the collection, analysis, and interpretation of data, in the writing of the report, or in the decision to submit the article for publication.

Abstract

Background

Suicide has been decreasing over the last decade. However, we do not know whether socio-economic inequality in suicide has been decreasing as well.

Aim

We assessed recent trends in socio-economic inequalities in suicide in 15 European populations.

Method

The DEMETRIQ study collected and harmonized register-based data on suicide mortality follow-up of population censuses, from 1991 and 2001, in European populations aged 35-79. Absolute and relative inequalities of suicide according to education were computed on more than 300 million person-years.

Results.

In the 1990s, people in the lowest educational group had 1.82 times more suicides than those in the highest group. In the 2000s, this ratio increased to 2.12. Among men, absolute and relative inequalities were substantial in both periods and generally did not decrease over time, whereas among women inequalities were absent in the first period and emerged in the second.

Conclusions

The WHO plan for "Fair opportunity of mental wellbeing" is not likely to be met.

Conflict of Interest Disclosures: None reported.

Introduction

Suicide accounts for about one million deaths per year (1, 2) and is also one of the major causes of death among younger age groups. Over recent decades, suicide has decreased by an average of 26% in most World Health Organization (WHO) regions(2), including in Western countries(3, 4). [R2.1]We do not, however, know whether all socio-economic groups have benefitted from this decrease. Suicide is indeed more frequent in vulnerable groups such as the less educated, the poor, and those of a lower social class(5-9). So far, studies have been conducted in one country only(10, 11) or have had low statistical power(12). Given the wide variability of suicide mortality between countries, international comparative data are needed to create a better picture of the general evolution of socio-economic inequalities in suicide. The paper describes how inequalities in suicide have evolved over recent decades in 15 European populations aged 35-79 and analyses the role of socio-demographic covariates in these trends.

Methods

Data

We used data from the DEMETRIQ ("Developing Methodologies for Reducing Inequalities in the Determinants of Health") project, which was set up to describe trends in socio-economic inequalities in mortality across European countries. Socio-economic and socio-demographic data were obtained from the censuses in each country or regional area (hereafter, "population"), and matched with mortality registers. The populations included and the two periods compared are detailed in Table 1. The majority of the datasets originated from longitudinal mortality follow-up of a census in which socio-economic information on the population was recorded. Unlinked cross-sectional data, in which socio-economic information on the population came from the census and information on deaths from death certificates, were available for Spain-Barcelona, Hungary, Poland, and Estonia. Overall, more than 95% of deaths could be successfully linked to the census, [R1.4] except for Spain-Madrid, where only 80% of deaths could be linked and mortality rates were thus multiplied by the inverse of that proportion. All data came from national registries, except for Spain and Italy, where information was only available for certain regions. For these two populations, previous studies suggest that the inequalities in mortality observed in these regional populations are quite similar to the national ones(13-15). For England and Wales, a 1% random sample of the population was included; in Switzerland, non-nationals were not included. In Lithuania, cross-sectional data were available for the first period and longitudinal data for the second. Because cross-sectional data tend to overestimate inequalities in mortality, the estimates for the first period were adjusted downward, as explained elsewhere.(16)

To allow comparison, all data were harmonized. The individuals were classified by sex and in 5-year age groups from 35 to 79. Socio-economic status was measured by level of education and classified in three groups: low level of education (International Standard Classification for Education – ISCED, 0 to 2, up to lower secondary), medium level of education (ISCED 3-4, upper secondary), and high level

of education (ISCED 5+,tertiary education). Deaths were coded using ICD-8, 9, or 10. Suicides were identified with the codes for ICD-8 (E950-E959), ICD-9 (E950-E959), and ICD-10 (X60-X84, Y87.0). Education has the advantage over alternative indicators of socioeconomic position (such as income or occupation). Education is available for each individual (not the case for occupation or income), it is specific to each individual (which is not the case for income), it is acquired early in the lifecycle and thus less vulnerable to reverse causality; it is an important determinant of other socio-economic resources as it increases long-term expected income; finally, as it is ordinal is able to translate a gradient perspective (17).

Analysis

The analysis was carried out in four stages: (i) computation of inequalities, (ii) quantification and statistical testing of trends in inequalities, (iii) quantification and statistical testing of change in the structure of inequalities, and finally (iv) sensitivity analysis. Guidelines call for several measures of inequality, particularly for trend analysis(18). Here, four popular measures were used: the (absolute) rate difference (RD), the (relative) rate ratio (RR), the Relative Index of Inequality (RII), and the Slope Index of Inequality (SII). The rate difference is the age-standardized suicide mortality rate of the lowest educational group minus the age-standardized suicide mortality rate of the top educational group. It captures the importance of the inequality from a public health perspective. The rate ratio (RR) is the ratio of the same two mortality rates and captures the strength of the association between education and suicide. Rates were directly age- and sex-standardized, using the WHO-European Standard Population as reference. To these simple measures we added two measures of inequality that take into account changes in educational distribution over time (i.e. the reduction of the size of the less educated groups) [R1.3.] and differences in educational distribution across countries: the Relative Index of Inequality (RII) and the Slope Index of Inequality (SII). Both are based on the relative rank of each educational group, which was computed as the cumulative relative frequency of each group up to the mid-interval of the group, sorted by decreasing educational level.

[R1.3.] As a consequence, both measures capture the gradient of socio-economic inequalities in suicide over the whole population by fitting a slope between the outcome (suicide) and the exposure (the relative rank of each educational group). The RII is the ratio between the suicide rate among those with the lowest educational level (rank=1) and the suicide rate among those with the highest educational level (rank=0). The SII is the absolute version of the RII and is the difference in suicide mortality between the lowest and the highest educational level(19). Inequalities were computed for two periods: 1991–1995 and 2001–2005. Average "all-populations" inequalities were also computed, with suicide and number of person-years weighted so that each population-period combination had the same weight.

The second stage aimed to quantify and test change in each educational group. Suicide was regressed on education, period (dummy), and an interaction between period and education, using Poisson regression. The coefficients of the regression were then used to compute the rate ratio of suicide of the last period compared to the first period for each educational group. An overall model for all countries was also computed with a random coefficient at the country level and with each population having the same weight.

The third stage investigated whether the change in the association between education and suicide was moderated by socio-demographic factors associated with both suicide and education: sex, age, and geographical region(4, 8). We assessed how much these three socio-demographic components affected the change in the association between education and suicide between the first period and the second period, with four Poisson random effect models. Model 1 was the baseline model, with education controlled for age and sex; interaction models were then tested with education and sex (Model 2), education and age group (Model 3), and education and geographical region (Western Europe, Eastern Europe, Northern Europe, and Southern Europe, Model 4). These models included first-order, second-order and third-order terms as well as a random component at the country level; again, each population had the same weight.

In the final stage, we carried out two sensitivity analyses. Stage 3 was replicated only with countries known to have more reliable suicide data according to two recent benchmarking studies: [R1.5.]the first identified countries in which "injuries unknown whether intentional" represented a maximum of 20% of the number of suicides (20); the second compared the number of railway suicides as recorded in the official registers with the number of suicides declared by the European Railway Agency (21). The countries that performed better on these two criteria were Austria, Belgium, Finland, Hungary, Norway, and Spain. Step 3 was also replicated including deaths classified as "injuries – unknown whether intentional" (ICD10 = Y10-Y34), which generally correlates highly with the suicide rate at the country level and is likely to be covert suicide.(20)

Results

The age- and sex-standardized suicide rate differed strongly between countries, and was high in Eastern European populations, particularly in Hungary and Lithuania (>50 suicides per 100,000 person-years, Table 1). It was low in all Southern European populations, as well as in England and Wales (<=11 suicides per 100,000 person-years).

[Table 1 here]

In men (Supplementary Figure 1a), there was a clear gradient of decreasing suicide with higher education in both periods and in all countries. In women (Supplementary Figure 1b), the pattern was less clear, but noticeable gradients were found in Finland, Estonia, Lithuania, and Hungary.

[Supplementary Figures 1 here]

Trends in Inequalities

For men (Table 2), inequalities remained quite stable between the first and the second period, both in absolute (rate difference) and relative (rate ratio) terms. In the first period, those in the low education group were more likely to commit suicide than those in the high education group (RR, 2.17; 95%CI, 1.6-3.0). This ratio increased slightly one decade later (RR, 2.30; 95%CI, 1.7-3.1). Absolute inequalities fell in Finland, Hungary, and Switzerland, but rose in Lithuania and Poland. Relative inequalities increased in Belgium, Denmark, Hungary, Norway, and Poland, whereas they fell in England and Wales, Estonia, Finland, Madrid, and Switzerland. This pattern of change in inequalities was broadly confirmed by the relative index of inequality and by the slope index of inequality (supplementary online eTable 5).

For women (Table 3), absolute inequalities were low and generally non-significant in both periods. Most Eastern European populations had small but statistically significant inequalities, with more suicides among women in the low education group than among those in the high education group. In

all populations, combined absolute and relative inequalities increased slightly: the rate ratio increased between the first period (RR, 0.96; 95%CI, 0.8-1.2) and the second period (RR, 1.21; 95%CI, 0.9-1.6, *p* of change = 0.081). Absolute and relative inequalities among women rose particularly in Belgium, Finland, Lithuania, Norway, and Switzerland. Similar results were noted with the relative index of inequality and the slope index of inequality (supplementary online eTable 6).

[Tables 2 and 3 here]

Trends in suicide per educational group

The results of the Poisson regressions are presented in Supplementary eTable 7 (men) and Supplementary eTable 8 (women). Trends by educational group were very different between populations and by sex. In all populations combined, the rate of suicide among men was stable in all three education groups; in Lithuania, Denmark, and Hungary, however, the trend was less favorable among the least educated than among the most highly educated group of men. Among women, suicide decreased more among the most highly educated (RR, 0.76; 95%CI, 0.63-0.92) than among the least educated group (RR,0.81; 95%CI,0.67-0.98; χ^2=4.7, p<0.01). Of the 15 populations, 10 had a smaller decrease (or a greater increase) of suicide among the least educated than among the most highly educated group of women.

Trends in the structure of inequalities

Table 4 describes how sex, age group, and region moderated educational inequalities in suicide in the first and second periods. Rate ratios are presented for each period, combined with a formal test of the interaction between period and education and of the 3-terms interaction between period, education and socio-demographic variable (sex, age, and region). In the baseline Model 1, the low education group had 1.82 times more suicides than the high education group in the first period, and this ratio rose to 2.12 in the second period (F=21.6, p<0.001). Men in the low education group were more likely to commit suicide than men in the high education group in both periods (RR=2.14 and

RR=2.41, model 2), but the change between the two periods was not statistically significant. Younger age groups (<65y) were less likely to commit suicide in the first period but this was no longer true of the second period (Model 3, RR=0.79 vs RR=1.01, F=75.3, p<0.001). Compared to the higher education younger age group, the younger age group with low education was at greater risk of suicide in the second period than in the first period (Model 3, RR=1.81 *vs* RR=2.21, F=8.8, p<0.01). Model 3 also displayed a sharp decline in the F-test for change in educational inequalities (Model 3, F=8.4 vs Model 1 F=21.6), indicating that increasing educational inequalities were partly due to the younger age group within the low education group becoming more vulnerable: (2.12/1.82=1.16 in Model 1 *vs* 2.21/1.81=1.22 in Model 3). A change in the regional differences in suicide mortality was noticeable and statistically significant (Model 4, F=155.8, p<0.001). Compared to Southern European countries, Eastern European countries had a lower rate ratio in the second period than in the first (RR=2.79 vs RR=3.92, Model 4). Compared with those in the low education group in other regions, those in the low education group in Northern European countries were more at risk of suicide both in the first and second periods (RR=3.03 and RR=3.10).

Table 4 was replicated in a sub-group of populations (Austria, Belgium, Finland, Hungary, Norway, and Spain, supplementary online eTable 9) where suicide coding is more reliable. Overall, inequalities were smaller, but levels of significance and F-test patterns remained the same. The same interactions were found, with one difference: men in the low education group from Northern European countries were more at risk of suicide in the second period (RR=4.05) than in the first (RR=2.81).[R1.6.] The second sensitivity analysis added 10,693 deaths classified as "injury unknown whether intentional (UD)" to the number of suicides (supplementary online eTable 10). The ratio of UD to suicide was thus 12%, well below the benchmark of 20%. In this analysis, all rate ratios and F-tests were higher in the first period and in the second period. However, the F-test patterns were also quite similar to those found in the baseline analysis.

Discussion

This study is the first to assess trends in educational inequalities in suicide in Europe in populations aged 35-79. Among men, absolute and relative inequalities were substantial in both periods and generally did not decrease over time, whereas among women inequalities were absent in the first period and emerged in the second. However, the trend of inequality differed strongly between countries.

Interpretation

The results are in line with previous studies that found a protective effect of higher education on suicide in the U.S.,(22) Europe,(8) and Asia(12) and that educational inequalities in suicide were not decreasing(12). We identified three elements that explain this unfavorable trend, in relation to sex, age, and geographical region. One reason suicide inequalities have increased is that men have become more at risk of suicide over time and, at the same time, have come to be slightly less educated than women. This is consistent with previous studies which have shown that men are more vulnerable to suicide and also that the social consequences of a psychiatric disorder are greater for men than for women (23). Thus, as the proportion of men in the low education group is increasing, educational inequality is likely to increase as a consequence. [R1.7.]Other studies have also found socio-economic status to have a smaller effect on suicide in women than in men(9, 24). One possibility is that women are less vulnerable to adverse conditions, as compared to men, as evidenced by, e.g., the smaller effect of economic recessions on suicide in women compared to men(25). Another may be that education does not fully capture socio-economic status in women, as compared to men, particularly in relation to the labour market or that lower educated men are more likely to be single or divorced compared to women (26).

Second, we found that younger age groups became as likely to commit suicide as those aged 65+ in the second period, leaving young people in the low education group at greater risk of suicide in the second period than in the first. Western European countries underwent a dramatic educational

expansion after the Second World War, a trend that has benefited the younger age groups. Yet, paradoxically, this educational trend may have left the group of young people unable to keep up with this educational trend more vulnerable. As acknowledged by the OECD, the wage ratio of the most skilled to least skilled has widened between the 1980s and 2000s, and these trends were particularly noticeable in Eastern European countries(27, 28). A final explanatory factor is provided by regional differences: inequalities rose in some Northern and Eastern European countries but remained low in Southern European countries, as well as in England and Wales. From our analysis, it is not entirely clear why this is the case. As far as Eastern European countries are concerned, market reforms associated with the transition to a market economy may have affected the less educated to a larger extent than the more highly educated(29).

Finally, our study found that absolute inequalities did not decrease, which is different from the pattern for other causes of mortality(16). The persistence of absolute inequalities suggests that the benefits of mental health reforms or new mental health care interventions have not been shared by all socio-economic strata. Because mental disorder is one important contributor to suicide, early detection of and appropriate drug treatment of mental disorder(30) and coordination of mental health care, particularly after discharge, are strategies that may not only reduce the overall risk of suicide but – in the case of inequalities in access to care – may also widen suicide inequalities(31). For example, the introduction of selective serotonin reuptake inhibitors in the 1980s in the U.S. was associated with a reduction in the risk of suicide but also with an increase in inequality in suicide(32). This may also apply to broader organizational aspects of mental health care(33).

Limitations

This study has several limitations. Our data allowed us to describe educational inequalities and their trends over time but was lacking in information on the underlying factors of suicide. In particular, the role of psychiatric history, [R2.3.] or alcohol use was lacking, which would have been useful to ascertain the role of the psychiatric system or of the drinking culture in suicide inequalities,

particularly in eastern countries (34, 35). Other social resources such as social support, marital status, employment, and the welfare system have also been associated with lower suicide risk and may thus also contribute to educational inequalities in suicide (25, 26, 36, 37). Moreover, although education is acquired early in life, we cannot exclude the possibility that some risk factors for suicide are antecedent to primary education(38) and may explain why less educated people are more likely to die by suicide. The finding that educational inequalities are smaller among women than among men(22) also suggests that more research is needed in order to better understand the association between education and suicide. Another limitation is that the period covered does not include the 2008 economic crisis. Further research will be needed to study the effect of this crisis on educational inequalities in suicide. [R1.5/R2.4.] Finally, the comparison across countries is somewhat vulnerable to the reliability of suicide coding across countries. A previous benchmarking study compared railway suicide as recorded in official statistics with suicides reported by the European Railway Agency(21). It found that the ranking of countries by suicide rate changed when based on the latter source rather than the former, particularly when undetermined intent was added. However, our sensitivity analysis suggests this limitation has no major effect on our findings.

Our study suggests that the prospects of meeting the goals of the WHO Mental Health Action Plan are not good in several European populations, as less educated groups have remained more vulnerable to suicide. More attention to vulnerable men with lower educational levels needs to be a more explicit priority of mental health care systems and mental health policy.

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Table 1. Population, follow-up duration, number of person-years, number of suicides, age-standardized rate of suicide, % of each educational status, study of 15 European populations.

Population	First Period	Second Period	Number of suicides	Number of person years	Age-Standardized Rate of suicide (per 100,000)	Low education level (% of population)	Medium education level (%)	High education level (%)
Austria	1991	2001	2,037	7,945,153	25.8	37.8%	55.1%	7.1%
Belgium	1991-96	2004-05	8,750	31,901,326	27.2	63.7%	19.7%	16.6%
Denmark	1991-95	2001-05	6,271	25,442,235	24.6	48.1%	33.0%	18.9%
England & Wales	1991-96	2001-06	186	2,492,327	7.5	70.5%	11.3%	18.2%
Estonia	1987-91	1998-02	2,850	7,044,400	42.7	39.9%	45.0%	15.1%
Finland	1990-95	2000-05	8,694	26,729,054	32.1	45.0%	31.3%	23.8%
Hungary	1988-91	1999-02	21,905	41,608,036	53.5	69.1%	19.9%	11.0%
Italy(Turin)	1991-96	2001-06	557	4,978,734	11.0	67.5%	22.0%	10.4%
Lithuania	1988-90	2001-05	5,590	11,342,519	51.7	32.6%	51.2%	16.2%
Norway	1990-95	2001-06	2,747	16,989,909	16.0	34.7%	45.8%	19.5%
Poland	1991-93	2001-03	20,349	84,547,683	24.2	57.6%	31.7%	10.7%
Spain-Barcelona	1992-96	2002-06	767	8,637,575	8.9	64.2%	18.0%	17.7%
Spain-Basque Country	1996-01	2001-06	1,027	11,422,884	8.7	68.5%	17.0%	14.5%
Spain-Madrid	1996-97	2001-03	271	8,100,569	3.4	65.8%	17.2%	17.0%
Switzerland	1990-95	2000-05	7,553	27,923,117	27.0	28.0%	53.8%	18.1%
Total			89,554	317,105,521				

Table 2. Educational inequalities in suicide per population and period among men: rate difference and rate ratio, 15 European populations

Population	Suicide rate difference† and 95%CI					Suicide rate ratio† and 95% CI				
	1991–1995‡		2001–2005‡		*P* value §	1991–1995‡		2001–2005‡		*P* value §
All Populations¶	23.1	(22.1, 24.2)	24.0	(23.0, 25.1)	0.111	2.17	(1.6, 3.0)	2.30	(1.7, 3.1)	0.272
Austria	39.0	(29.1, 49.0)	29.0	(20.1, 37.8)	0.070	2.83	(1.9, 4.2)	2.66	(1.8, 3.9)	0.268
Belgium	13.7	(10.5, 16.9)	16.1	(12.2, 20.0)	0.173	1.43	(1.3, 1.6)	1.60	(1.4, 1.8)	0.015
Denmark	8.7	(0.5, 16.8)	10.7	(7.4, 14.0)	0.326	1.22	(1.1, 1.4)	1.58	(1.4, 1.8)	<.001
England-Wales	8.4	(3.3, 13.4)	7.0	(0.4, 13.6)	0.374	2.98	(1.2, 7.4)	1.92	(1.0, 3.8)	0.035
Estonia	60.7	(50.3, 71.2)	71.8	(58.2, 85.3)	0.104	3.53	(2.7, 4.7)	2.88	(2.3, 3.6)	<.001
Finland	37.6	(32.9, 42.3)	28.2	(24.1, 32.2)	0.001	2.21	(2.0, 2.5)	2.05	(1.8, 2.3)	0.019
Hungary	80.3	(75.9, 84.6)	74.8	(71.4, 78.2)	0.026	3.51	(3.2, 3.9)	4.67	(4.1, 5.3)	<.001
Italy-Turin	2.3	(-5.5, 10.2)	5.7	(0.4, 10.9)	0.246	1.22	(0.7, 2.0)	1.65	(0.9, 3.0)	0.140
Lithuania	54.0	(46.1, 61.9)	128.1	(115.2,141.1)	<.001	4.13	(3.0, 5.6)	3.94	(3.4, 4.6)	0.143
Norway	12.4	(7.7, 17.2)	13.1	(9.2, 17.0)	0.418	1.64	(1.3, 2.0)	1.88	(1.5, 2.3)	0.044
Poland	40.0	(38.0, 42.0)	44.8	(42.8, 46.7)	<.001	4.19	(3.7, 4.7)	4.54	(4.0, 5.1)	<.001
Spain-Barcel.	4.0	(0.1, 7.8)	7.0	(3.1, 11.0)	0.138	1.41	(1.0, 2.1)	1.80	(1.3, 2.6)	0.068
Spain-Basque	7.7	(4.4, 11.0)	8.2	(5.0, 11.4)	0.412	2.03	(1.3, 3.1)	2.25	(1.6, 3.3)	0.219
Spain-Madrid	3.8	(1.7, 5.9)	3.8	(1.6, 6.0)	0.489	3.04	(1.3, 7.1)	1.95	(1.1, 3.4)	0.017
Switzerland	31.6	(25.7, 37.6)	18.5	(13.5, 23.5)	<.001	1.87	(1.7, 2.1)	1.60	(1.4, 1.8)	0.001

† Rate difference is the standardized suicide mortality rate of the low-education group minus the standardized suicide mortality rate of the high-education group. The rate ratio is the ratio of these two rates.

‡ The period coverage varies per country. See supplementary tables for details.

§ P value of the difference between the first and the second period

¶ All-populations estimates are the pooled and weighted results of all deaths and person-years.

Table 3. Educational inequalities in suicide per population and period among women: rate difference and rate ratio, 15 European populations.

Populations	Rate difference† and 95%CI					Rate ratio† and 95% CI				
	1991–1995‡		2001–2005‡		*P* value §	1991–1995‡		2001–2005‡		*P* value §
All Populations ¶	-0.9	(-1.8, 0.0)	1.7	(1.1, 2.4)	<.001	0.96	(0.8, 1.2)	1.21	(0.9, 1.6)	0.081
Austria	2.5	(-8.1, 13.2)	3.2	(-3.2, 9.5)	0.461	1.16	(0.6, 2.3)	1.31	(0.7, 2.3)	0.371
Belgium	-7.6	(-10.9, -4.4)	-1.4	(-4.3, 1.4)	0.003	0.66	(0.6, 0.8)	0.90	(0.8, 1.1)	0.021
Denmark	-1.1	(-5.0, 2.9)	-0.2	(-2.4, 2.1)	0.350	0.90	(0.8, 1.1)	1.04	(0.8, 1.3)	0.145
England-Wales	-2.8	(-9.5, 3.9)	0.3	(-3.5, 4.1)	0.218	0.65	(0.2, 1.7)	1.15	(0.4, 3.6)	0.259
Estonia	8.5	(2.6, 14.3)	10.2	(3.8, 16.5)	0.353	1.42	(1.0, 2.1)	2.11	(1.3, 3.3)	0.012
Finland	1.1	(-2.2, 4.3)	5.5	(2.8, 8.2)	0.020	1.18	(1.0, 1.4)	1.42	(1.2, 1.7)	0.034
Hungary	6.1	(1.6, 10.7)	12.8	(10.6, 14.9)	0.005	1.34	(1.2, 1.6)	2.53	(2.1, 3.1)	<.001
Italy-Turin	-6.4	(-15.3, 2.4)	-2.4	(-7.3, 2.4)	0.218	0.51	(0.3, 1.0)	0.66	(0.3, 1.5)	0.391
Lithuania	4.1	(-0.8, 9.0)	23.4	(15.4, 31.3)	<.001	1.46	(0.9, 2.4)	2.79	(2.1, 3.8)	<.001
Norway	-3.7	(-7.2, -0.2)	0.9	(-1.8, 3.5)	0.021	0.72	(0.5, 1.0)	1.07	(0.8, 1.4)	0.044
Poland	5.4	(4.4, 6.5)	5.7	(4.7, 6.6)	0.386	2.46	(1.9, 3.1)	2.53	(2.1, 3.1)	0.338
Spain-Barcelona	1.7	(-0.8, 4.1)	2.9	(0.5, 5.2)	0.239	1.31	(0.7, 2.6)	1.84	(1.0, 3.3)	0.120
Spain-Basque	1.9	(-1.0, 4.8)	0.1	(-2.8, 3.1)	0.204	1.47	(0.7, 3.1)	1.14	(0.7, 1.9)	0.243
Spain-Madrid	0.2	(-1.2, 1.5)	1.1	(-0.4, 2.5)	0.178	0.76	(0.2, 2.3)	1.45	(0.6, 3.5)	0.170
Switzerland	-5.0	(-9.8, -0.3)	1.0	(-2.4, 4.4)	0.021	0.80	(0.6, 1.0)	1.12	(0.9, 1.4)	0.023

† Rate difference is the standardized suicide mortality rate of the low-education group minus the standardized suicide mortality rate of the high-education group. The rate ratio is the ratio of these two rates.

‡ The period coverage varies per country. See supplementary tables for details.

§ P value of the difference between the first and the second period

¶ All-populations estimates are the pooled and weighted results of all deaths and person-years.

[R1.1.]Table 4. Suicide risk according to education in 15 European populations in the first and second period, controlling for socio-demographic confounders: rate ratios and F-tests from the multilevel Poisson regression.

Models (§) and covariates	1991–1995†		2001–2005†		Interaction with period (#)	
	Rate ratio		Rate ratio		F-test	P value
	§	CI95%	§	CI95%		
Model 1: education, age, and sex						
Low education (ref=high education)	1.82	(1.75-1.88)	2.12	(2.04-2.19)	21.6	<.001
Medium education (ref=high education)	1.37	(1.32-1.42)	1.62	(1.57-1.68)		
Men versus women	3.02	(2.96-3.09)	3.61	(3.53-3.70)	115.2	<.001
Model 2: education, age, sex, and education*sex						
Main effects:						
Low education (ref=high education)	1.56	(1.50-1.63)	1.86	(1.79-1.94)	21.9	<.001
Medium education (ref=high education)	1.21	(1.16-1.26)	1.45	(1.40-1.51)		
Men versus women	2.56	(2.49-2.64)	3.24	(3.15-3.33)	126.0	<.001
Interaction terms:						
Low education group men(ref=High education group women)	2.14	(2.05-2.24)	2.41	(2.31-2.51)	3.2	0.367
Medium education group men (ref =High education group women)	1.69	(1.63-1.74)	1.82	(1.75-1.90)		
Model 3: education, age, sex, and education*age group						
Main effects:						
Low education (ref=high education)	1.82	(1.73-1.92)	2.05	(1.95-2.15)	8.4	<.001
Medium education (ref=high education)	1.43	(1.35-1.51)	1.51	(1.43-1.59)		
<65y versus 65y+	0.79	(0.76-0.83)	1.01	(0.97-1.05)	75.3	<.001
Interaction terms:						
Low education <65 (ref=High education 65+)	1.81	(1.74-1.88)	2.21	(2.13-2.30)	8.8	<.001
Medium education <65 (ref =High education 65+)	1.49	(1.45-1.54)	1.66	(1.59-1.72)		

Models (§) and covariates	1991–1995†		2001–2005†		Interaction with period (#)	
Model 4: education, age, sex, region, and education*region						
Main effects:						
Low education (ref=high education)	1.81	(1.73-1.88)	1.91	(1.84-1.99)	8.3	<.001
Medium education (ref= high education)	1.37	(1.31-1.44)	1.55	(1.48-1.62)		
Western Europe (WE, ref= Southern Europe-SE)‡	2.89	(1.41-5.93)	2.60	(1.27-5.33)	155.8	<.001
Eastern Europe (EE)‡	3.92	(1.81-8.50)	2.79	(1.29-6.05)		
Northern Europe (NE)‡	4.28	(2.09-8.77)	5.22	(2.55-10.7)		
Interaction terms:						
Low education WE versus high education SE	1.54	(1.44-1.65)	1.63	(1.52-1.74)	3.4	0.002
Low education EE versus high education SE	1.45	(1.37-1.55)	1.52	(1.42-1.63)		
Low education NE versus high education SE	3.03	(2.82-3.25)	3.10	(2.91-3.29)		

(§)Model 1 includes education, period, education*period, age group, sex, sex*period, and a country random component; Model 2 includes age group, sex, education, education*sex, period, period*sex, period*education, and education*sex*period; Model 3 includes age group, sex, education, period, education*age group, period*age group, period*education, and period*education*age group; Model 4 includes education, age group, sex, region, education*region, education*period, region*period, and education*region*period. All models include a random intercept at the country level and are weighted.

§ The rate ratios and their 95%CI were computed on the basis of the betas of the previous equations.

† The period coverage varies per country. See supplementary tables for details.

¶ 10-year age groups

(#) F-test of the interaction with period.

‡ Western Europe covers Belgium, the England-Wales, Switzerland, and Austria; Eastern Europe includes Hungary, Poland, Lithuania, and Estonia. Northern Europe includes Finland, Norway, and Denmark; Southern Europe includes Turin and the 3 Spanish populations.