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# Individual and contextual determinants of male suicide in the post-communist region: The case of Lithuania

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## Abstract

Over the three last decades, Lithuania has reported some of the highest male suicide rates in the world. This paper relies on longitudinal census-linked data for Lithuania covering the entire male population aged 30–64 years during the 2011–2017 period. The study uses multilevel modelling to examine the importance of the selected individual- and area-level contextual characteristics. One of the key findings is the persistence of a suicide disadvantage among males living in rural areas. This disadvantage could not be explained by major sociodemographic characteristics and remained statistically significant for those individuals who migrated to urban areas. Unlike some other studies, we found that socio-economic area-level characteristics retained their significance after controlling for the major individual-level characteristics. This evidence highlights the potential for policies aimed at improving area-level conditions.

**KEYWORDS**

contextual effects, determinants, Lithuania, multilevel modelling, suicide

## 1 | INTRODUCTION

Suicide is considered one of the most important causes of deaths that could be prevented by effective prevention programmes and access to mental health care and treatment (Naghavi et al., 2019). There are substantial differences in suicide rates between and within global regions, as well as between and within individual countries (Lorant et al., 2018; Mäki & Martikainen, 2007, 2012; Naghavi et al., 2019; Trgovac, Kedron, & Bagchi-Sen, 2015). One of the most striking global suicide hotspots has been identified in the countries of the former USSR, including in the three Baltic states, Russia, Belarus and Ukraine (Värnik & Wasserman, 2016). Among those countries, Lithuania represents the most extreme case, as it has one of the highest male suicide rates in the world (Gailienė, 2015; Naghavi et al., 2019). In 2016, Lithuanian males had a suicide mortality rate that was about 25% higher than the rates in neighbouring Latvia, Russia and Belarus; and that was twice as high as the rates in Poland,

Hungary and Estonia (World Health Organization [WHO], 2020). Although suicide prevention in Lithuania has high policy relevance, and has received considerable attention from the international and national research community, the NGO community and the media, there has, until recently, been no comprehensive national suicide prevention strategy in Lithuania (National Audit Office, 2017).

For suicide prevention to be effective, a comprehensive evidence basis is needed that identifies the population groups with the highest risk of suicide and provides information on the individual and contextual determinants of suicide. Such population-level studies are rare because they require comprehensive longitudinal data based on mortality follow-up of the entire population, and contextual information at the most detailed administrative division level. Prior cross-sectional aggregate-level studies on Lithuania and other former Soviet republics found that the very high national suicide rates in these countries could be largely explained by exceptionally high mortality among middle-aged rural males (Gailienė, 2015; Gailienė, Domanskiene, &

Keturakis, 1995). For example, data covering 2014–2017 showed that during this period, male suicide rates were six to seven times higher than the corresponding rates for females and that rural males had suicide mortality rates that were 60–80% higher than those of urban males (Institute of Hygiene, 2020). This rural suicide disadvantage coincides with the systematic persistence of excess rural mortality in Lithuania and in other former Soviet republics (Jasilionis, 2003; Statistics Lithuania, 2020). The urban–rural mortality divide, which began during the period of Soviet rule, has been attributed to a wide range of determinants, such as socio-economic disadvantages, poorer access to health care, excessive alcohol consumption and psychosocial factors (Jasilionis, 2003). The persistent urban–rural mortality gradient observed in Lithuania and other former Soviet republics contrasts with the urban–rural mortality gradient observed in many Western European countries that shows a notable mortality disadvantage in urban areas (Allan, Williamson, & Kulu, 2019; Jasilionis et al., 2007). However, an increasing 'rural mortality penalty' (excess rural mortality) has also been reported for the United States that tends to affect poorer rural counties with less educated white populations (Cosby et al., 2019).

Prior research on social differentials in cause-specific mortality in Lithuania has also identified other population groups with an excess risk of suicide: namely, individuals who are lower educated, non-married, unemployed, economically inactive, unskilled manual workers, farmers or ethnic Lithuanians (Jasilionis et al., 2007; Jasilionis & Stankuniene, 2012; Stumbrys, 2016). Some studies have also found a notable degree of variation in suicide mortality across the Lithuanian municipalities, which suggests that the local context plays an important role (Stumbrys, 2016).

The present study, which is based on longitudinal census-linked suicide mortality data covering the entire male population aged 30–64, extends the prior evidence in several ways. First, it provides a comprehensive assessment of the individual-level sociodemographic and socio-economic determinants of adult male suicide mortality vduring the most recent period for which data are available, 2011–2017. In particular, the study focuses on several dimensions of the rural suicide disadvantage and explores the question of whether lifetime migration from rural to urban areas reduces the risk of suicide. The study also examines to what extent the excess rural suicide mortality can be explained by compositional differences, including education and economic activity status. The second objective of the study is to estimate the importance of selected area-level contextual characteristics net of individual-level factors. Such a method can be used to determine whether the effects of area-level characteristics remain after accounting for the major individual-level sociodemographic and socio-economic characteristics. To our knowledge, this is the first study of suicide that employs multilevel modelling methodology and smallest area-level unit data not only for Lithuania but also for the Central and Eastern European region. Understanding the origins and the determinants of the male suicide crisis has important implications not only for Lithuania but also for other former Soviet republics that are still affected by persistent male suicide epidemics. The new evidence based on the data for the period following the financial crisis and the implementation of radical austerity measures may also be relevant to other countries facing challenges related to the economic crisis or its consequences.

## 2 | THEORETICAL BACKGROUND

### 2.1 | Sociodemographic and socio-economic determinants of suicide: Selection versus causal relationships

Individual- and area-level sociodemographic and socio-economic characteristics are important distal determinants of suicide, which should be considered along with well-known, more proximate psychiatric risk factors, including mental disorders or substance abuse (Li, Page, Martin, & Taylor, 2011; Page et al., 2014). Despite being associated with much lower relative risks, because lower socio-economic groups constitute large shares of national populations, socio-economic determinants produce a suicide burden at the population level that is as large as that of psychiatric factors (Li et al., 2011). Explanations of sociodemographic and socio-economic determinants of individual suicide risk usually distinguish between the direct and indirect selection and the social causation hypotheses. In the case of suicide, the health selection model would imply that people with social, behavioural and mental problems or psychiatric diseases have higher probabilities of staying in a lower socio-economic status group and even of downward social mobility (Blakely, Collings, & Atkinson, 2003; Gunnel, 2001; Shin, Han, & Kohzuki, 2010; Tiikkaja et al., 2016). At the same time, indirect selection mechanisms may act through early life conditions, including through the educational institutions individuals attend and the qualifications they obtain (Blane, Davey Smith, & Bartley, 1993; Turecki & Brent, 2016). Health selection may also be important when assessing the differences in the suicide risks of migrant and nonmigrant subpopulations.

On the one hand, migrants could be considered a selective group due to the healthy migrant effect, which implies that migrant populations have better health and lower mortality than natives (McDonald & Kennedy, 2004; Wallace & Wilson, 2019). However, at least some groups of migrants may be affected by elevated health (including mental health) risks. For example, it has been shown that internal migration within Canada is associated with an increased risk of suicide attempts (Yiannakoulias, Sanchez-Ramirez, Svenson, & Voaklander, 2016).

Causal hypotheses focus on the direct effects of socio-economic and sociodemographic individual status on suicide risk. Comparative studies have found evidence of persisting substantial or even increasing inequalities in suicide rates by education in Europe and the United States (Lorant et al., 2018). It has been argued that material circumstances related to lower socio-economic class may influence the increased risk of suicide. This relationship occurs via a set of restricting mechanisms, such as worse access to mental health care and poorer knowledge and resources for coping with stressful events and life challenges (Galobardes, Shaw, Lawlor, Lynch, & Davey

Smith, 2006). Individuals who belong to lower socio-economic groups are also more likely to have feelings of fatalism and to believe that they have less control over their lives (Grover et al., 2009; Mirowsky & Ross, 2003). In addition to these psychosocial factors, studies documenting the disadvantages of lower socio-economic groups have reported that the bodies of these individuals have a lower overall biological ability to respond to stressors (lower saliva cortisol response to stress; Kristenson, Kucinskiene, Bergdahl, & Orth-Gomér, 2001; Turecki & Brent, 2016). Other causal explanations have pointed to specific determinants of the higher prevalence of stress among adult males, such as a greater effort-reward imbalance at work (e.g., low prospects of a promotion, regardless of one's personal efforts; Siegrist, 2000, 2001). Psychological and sociological studies have highlighted the role of more subtle determinants, including people's family relationship histories and general attitudes towards suicide. Prevailing gender role models and concepts of masculinity can play an important role in male suicide risk and help-seeking behaviours. For example, it has been suggested that a masculinity culture that prevents men from seeking assistance and that leads them to blame themselves for their economic failures may be associated with the excess rural male suicide observed in Australia (Alston, 2012). Numerous studies have examined the relationship between excessive alcohol consumption and suicide risk. In particular, it has been shown that there is a relationship between depression, alcohol-related disorders and suicidal behaviour (Bagge, Littlefield, Conner, Schumacher, & Lee, 2014; Bray, 2006; Pompli et al., 2010). However, these relationships tend to vary across countries depending on drinking levels and patterns, control mechanisms and cultural peculiarities (Borges et al., 2017; Ramstedt, 2001; Room & Mäkelä, 2000). Religion and religiosity have long been recognised as important determinants of suicide at both individual and the macro(contextual) levels. Some studies have suggested that affiliation with the Catholic church is a stronger protective factor against suicide than the corresponding association with the Protestant church (Spoerri, Zwahlen, Bopp, Gutzwiller, & Egger, 2010). However, the Lithuanian case does not support such a pattern despite its population is predominantly Catholic (Gailienė, 2018).

## 2.2 | Evidence about the role of contextual (area-level) effects

There has been an ongoing debate about to what extent area or contextual characteristics might additionally contribute to the suicide risk net of the effects of individual-level variables. Some ecological studies have stressed that there are strong associations between socio-economic deprivation and other social problems and that suicide rates are elevated in deprived areas (Evans, Middleton, & Gunnell, 2004; Neeleman & Lewis, 1999). However, several studies that employed a multilevel design have provided contrary evidence about the importance of area-level effects. For example, studies from Northern Ireland and Denmark concluded that the excess suicide observed in socio-economically disadvantaged areas could

be explained, or at least attenuated, by individual- and household-level factors (Agerbo, Sterne, & Gunnell, 2007; O'Reilly, Rosato, Connolly, & Cardwell, 2008). The scarce findings on this this association from Lithuanian studies that explored municipality-level effects on cause-specific mortality (including suicides) were similar (Grigoriev, Jasilionis, Stumbrys, Stankūnienė, & Shkolnikov, 2017; Stumbrys, 2016).

The few studies that used a longitudinal design and multilevel modelling to examine this issue found at least a moderate effect of socio-economic deprivation or low social cohesion on individual suicide risk (Denney, Wadsworth, Rogers, & Pampel, 2015; Martikainen, Mäki, & Blomgren, 2004). This evidence also suggests that the area-level effects are usually smaller than those found for the corresponding characteristics at the individual level. It has also been shown that there may be some interactions between area- and individual-level characteristics (cross-level interactions). For example, individuals who have lower socio-economic status and live in more economically advantaged areas may be even more prone to excess mortality than similar individuals who live in more deprived areas (Winkleby, Cubbin, & Ahn, 2006).

It is possible that the relationship between area-level contextual variables and suicide risk is very different across countries with different levels of suicide and of overall mortality. However, to our knowledge, population-level evidence based on multilevel modelling, which would allow us to disentangle individual and area-level effects on mortality for the former communist countries with the highest suicide rates, is scarce. Several studies have used multilevel modelling approaches based on the national data for multiple countries. These studies attempted to explain mortality or health variations across the Central and Eastern European region. For example, using country- and period-specific suicide rates for 25 Central and Eastern European countries, Minagawa (2013) found a strong association between the degree and the timing of macrolevel structural changes (reforms) and variation in national suicide rates. Some survey-based multilevel studies have also uncovered area-level contextual effects on various health dimensions. For example, Bobak, Murphy, Rose, and Marmot (2007) reported that societal characteristics such as prosperity and corruption (but not income inequality) were significant predictors of poor self-rated health at the individual level and at the national level in 13 Central and Eastern European countries. Other studies for Russia have suggested that high levels of income inequality (measured at the contextual (regional or district) levels) can play an important role in poor individual subjective and physical health (McKeehan, 2000; Carlson, 2005). Finally, several multilevel studies have explored individual- and contextual-level determinants of alcohol consumption. A study based on multilevel data on 18,000 individuals and 2,027 communities in nine former Soviet republics found significant relationships between community-level civic participation and episodic heavy drinking among men (Murphy et al., 2014). Meanwhile, a study for Czechia found no associations between the area-level variables (percentage with university degree, percentage divorced, percentage without religion, percentage of non-Czech nationality, percentage unemployed and community size) and binge drinking nor

any significant relationships between the shares of the population who were divorced or non-religious and the frequency of consuming alcohol (Dzúrová, Spilková, & Pikhart, 2010).

## 3 | THE LITHUANIAN CONTEXT

Lithuania represents a compelling case for studying suicide determinants due to its unique historical and contemporary context. The start of the male suicide epidemic in Lithuania can be traced back to the early 1960s, which also marked the onset of the overall mortality crisis in the former USSR (Figure 1; Gailienė et al., 1995; Meslé, 2004; Jasilionis, Meslé, Shkolnikov, & Vallin, 2011). As in Russia, the peak in both all-cause mortality and suicide among men in Lithuania was in the mid-1990s (Gailienė, 2015). However, after a period of slow recovery during the second half of the 1990s, inconsistent changes were observed during the 2000s. While all-cause mortality was stagnating or even increasing during 2000–2007, suicide rates were decreasing. Since 2008, all-cause mortality has been systematically decreasing, whereas more significant progress in suicide mortality did not begin until 2013. During the financial crisis and the post-crisis austerity period (2008–2012), male suicide rates underwent some fluctuations and peaked in 2009 (Figure 1). Although progress has been made in recent years, Lithuanian males still have one of the highest mortality rates in the European Union and are in the worst



**FIGURE 1** Long-term trends in age-standardised death rates (SDRs) from suicide and all causes of death for Lithuanian, Russian, Polish and Swedish males, 1956–2017. The SDRs were calculated using the WHO 1976 European Standard Population. Sources: (1) The Human Cause of Death Database (2020), (2) The Institute of Hygiene (2020) and (3) WHO (2020)

position in terms of external cause mortality (WHO, 2020). According to the latest available WHO data, which are for 2015, Lithuania remains the firm leader in male suicide rates in the WHO European Region (WHO, 2020). As is the case in the majority of countries, suicide rates in Lithuania are much lower among females; and Lithuanian females also have much lower overall mortality than their male counterparts. The current male mortality disadvantage and record-level gender disparities in mortality in Lithuania and in other former Soviet republics originate from the period of communist rule and are attributable to a range of individual and contextual determinants, such as psychosocial stress, excessive alcohol consumption and macroeconomic factors, including industrialisation during the Soviet era and rapid mass privatisation during the 1990s (McKee, 2006; Shkolnikov et al., 2006; Stuckler, King, & McKee, 2009). For example, a study on gender disparities in suicide mortality has suggested that 66% of the observed gender difference in suicide can be explained by excessive alcohol consumption (Razvodovsky, 2017).

The recent changes in suicide mortality in Lithuania occurred in the context of several important changes in political and economic contexts: namely, joining the European Union in 2004, the economic boom in 2000–2007 and the severe financial crisis in 2008–2009. Although EU membership had notable benefits for Lithuania, such as investments in the country's infrastructure via structural assistance programmes, the spectacular growth in aggregated national and average individual incomes during the 2000–2007 period was far from sustainable. This economic boom was accompanied by very high and persistent or even increasing income inequality levels and poverty rates (Eurostat, 2020; Statistics Lithuania, 2020). These inconsistencies in the country's socio-economic development coincided with slow or non-existent progress in efforts to reduce premature mortality and growing mortality inequalities by socio-economic status (Jasilionis, Stankūnienė, & Baublytė, 2019). The economic boom of the 2000s ended abruptly in 2008 due to the global financial crisis. Lithuania was one of the hardest-hit countries globally, as its GDP per capita declined 15% in a single year, and its unemployment rates spiked (Eurostat, 2020; Juska & Woolfson, 2015; Statistics Lithuania, 2020). Thanks to stringent austerity measures introduced in 2009–2010, Lithuania quickly recovered and resumed its rapid economic growth. Indeed, by the second half of the 2010s, Lithuania was making strong progress towards EU average levels (Eurostat, 2020). According to the most recent data on GDP per capita (in PPS) for 2018, Lithuania had managed to overtake Greece and Portugal, as well as most of the new EU member states, such as Poland and Hungary (Eurostat, 2020). However, although the austerity policies helped to stabilise the economy, they had some negative consequences, including the emergence of persistently high emigration rates (Statistics Lithuania, 2020). The crisis and the subsequent period of austerity also had other adverse effects. For example, the labour market became more segmented, and a disproportionate burden was placed on non-public-sector low-skilled workers (Juska & Woolfson, 2015). Although Lithuania has made impressive progress based on its aggregated income measures, the country is still lagging in many areas of social development, as it has failed to adequately
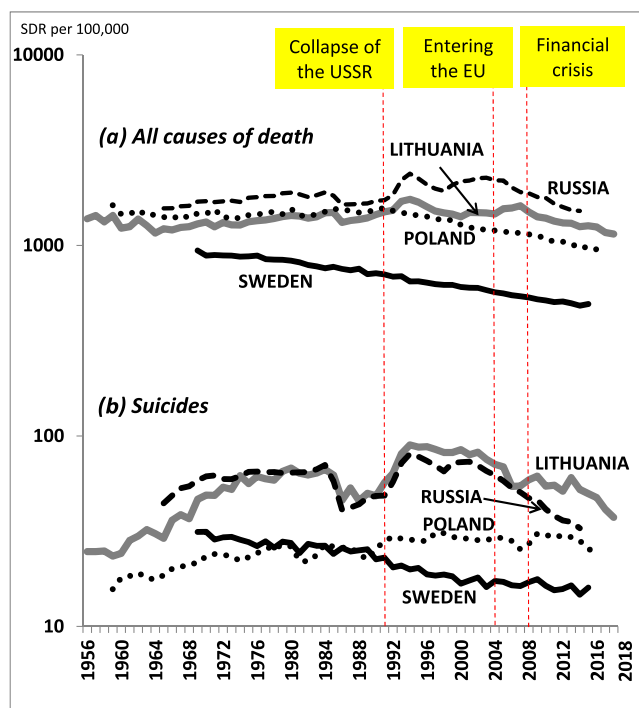
tackle extreme poverty and income inequality, and still spends too little on social support (Eurostat, 2020).

Effective mental health policies are essential contextual factors for reducing the suicide burden in a population (While et al., 2012). Although Lithuania has one of the highest male suicide rates in the world, the country has never had a comprehensive and effective national suicide prevention strategy (National Audit Office, 2017; Pūras et al., 2013). A public audit of Lithuania's suicide prevention efforts for the 2012–2015 period showed that coordination at the national level was lacking, that the planned prevention measures were poorly implemented and that there were substantial inequalities in access to services at mental health centres (National Audit Office, 2017). However, there is evidence that in the most recent years (2015–2019), notable improvements in suicide prevention measures and in mental health risk management have been made. Among these improvements are the expansion and the increased utilisation of primary mental health services, the retraining of medical personnel and the implementation of suicide prevention programmes at the municipality level (Kučinskaitė, 2018).

# 4 | DATA AND METHODS

## 4.1 | The Lithuanian census-linked dataset

In this study, we used an aggregated census-linked mortality dataset provided by Statistics Lithuania. The linkages between the individual 2011 census death records and emigration records between 1 March 2011 (2011 census) and 31 December 2017 were implemented by employees of Statistics Lithuania, who have permission to work with confidential individual data. The linkages were applied using personal identification numbers that are assigned to all permanent Lithuanian residents, including foreign citizens with long-term residential permits. Most of the resident population (99%), including ethnic Russians who immigrated during the Soviet period, have Lithuanian citizenship. The personal identification number is listed on all legal documents, including registers, vital records and census records. Of the death records issued between 1 March 2011 (2011 census) and 31 December 2017, 95% could be linked to the 2011 census records. Except for the variable urban–rural lifetime migration, all of the explanatory variables were time fixed (at the time of the census). Another exception was age, which was a time-varying variable that changed during each year of observation based on the individual's date of birth.

The implemented linkages allowed us to establish the census-based sociodemographic and socio-economic status of each person who died or emigrated during the observation period. The final dataset used for this study covers males aged 30–64 and includes 4.5 million person-years of population exposure and 2,832 suicide deaths (see Appendix A for detailed summary statistics). In order to follow data confidentiality policies, the individual data were converted into an aggregated multidimensional frequency table format that combines suicide deaths and population exposures and is split by individual-level sociodemographic and socio-economic variables from the 2011 census. The municipality- and area-level contextual characteristics were estimated by aggregating individual records according to the status reported in the 2011 census. Due to the very high negative net migration during the period of observation, emigration dates were taken into account, while estimating person-years of exposure. Only officially registered emigration events were considered. The completeness of the officially reported emigration data improved substantially following some administrative steps undertaken in 2009 (e.g., the introduction of obligatory fees for compulsory health insurance; Sipavičienė & Stankūnienė, 2011, 2013).

## 4.2 | Individual-level variables

The data used in this study cover males aged 30–64. Men younger than age 30 were excluded because changing the social status at these ages is very likely. All sociodemographic and socio-economic characteristics were fixed at the census baseline. The only exceptions were (a) urban–rural lifetime migration and (b) the age in complete years, which was defined as a time-varying categorical variable (that changed during each year of observation). The detection of changes in the age was possible thanks to the availability of information about the year and the month of birth for all of the individuals under study. Thus, suicide deaths and person-years of exposure were classified according to the Lexis rectangles covering ages 30 to 64 for each calendar year of observation. The final dataset is based on an aggregation of age- and year-specific suicide deaths and person-years of exposure across the entire period of observation from 1 March 2011 to 31 December 2017.

To measure the effects of other variables, we performed sensitivity analyses that examined whether the length of the observational period influenced the results. It turned out that restricting the observational period to 2 or 3 years did not lead to any notable changes.

The census-based individual variables include (a) the major sociodemographic and socio-economic variables (age, education, economic activity status, ethnicity and marital status) and (b) place of residence and migration characteristics (urban–rural place of residence at the 2011 census and lifetime urban–rural migration; before the census [beginning of observation]) and experience of living abroad. To avoid potential model misspecification caused by multicollinearity, the models never include more than one of these variables at each step. Following prior studies on Lithuania and Finland, we distinguished three very broad educational categories corresponding to completed education: *higher education* (at least 14 years), *secondary education* (10–13 years) and *lower than secondary education* (up to 9 years). The category of *secondary education* refers to completed general upper secondary school or to vocational/technical school or college (confirmed by a certificate signifying the completion of a general upper secondary education or a vocational certificate of upper secondary education). The category of lower than secondary or unknown education includes completed general or vocational basic education and primary education. According to sensitivity analyses conducted in prior studies (Shkolnikov et al., 2007), the lowest

educational category also includes individuals who have incomplete primary education (without a certificate), people who have no schooling but are literate, people who are illiterate and individuals whose educational status is unknown. The main motivation for including the latter small (accounting for 2% of the total census records) category in the lowest educational group came from the findings for (a) deceased individuals with unknown education (according to the population census), who were classified as having primary or lower education according to the information provided in their death records, and (b) the deceased individuals with unknown census-based education (Shkolnikov et al., 2007).

The second census-based socio-economic variable refers to economic activity status. For economically active males, it was possible to distinguish the following three categories: *employed*, *long-term unemployed* (never worked before the census) and *unemployed with working experience*. This variable also includes two economically inactive categories (*disabled* and *other inactive*) and the *unknown* category (1% of the total census records). Four conventional categories were distinguished for marital status: *married*, *never married*, *divorced* and *widowed*. Following prior studies showing the importance of ethnicity for mortality risk in Lithuania (Jasilionis et al., 2007), the ethnicity variable distinguished between four major ethnic groups: *Lithuanians*, *Russians*, *Poles* and *other ethnic groups*. This information was also fully complete (100%) in the census.

Previous studies on suicide mortality in Lithuania and other countries highlighted the importance of urban–rural residence and mainly found a rural disadvantage (Jasilionis et al., 2007; Jasilionis & Stankuniene, 2012). In our study, we tested three variables that refer to the place of residence at the time of the census, long-term urban–rural migration and immigration and return migration from foreign countries to urban and rural areas in Lithuania. We distinguished three broad categories for urban–rural place of residence at the time of the 2011 census: *big cities* (>50,000), *small cities* (<50,000) and *rural areas*. The variable that reflects long-term (lifetime) urban–rural migration was constructed from the following combinations of the place of residence and the place of birth categories: born in an urban area, lives in a large city; born in an urban area, lives in a small city; born in a rural area, lives in a rural area; born abroad, lives in a large city; born abroad, lives in a small city; born abroad, lives in a rural area; born in an urban area, lives in a rural area; born in a rural area, lives in a big city; and born in a rural area, lives in a small city. Given the importance of the international migration in Lithuania, we also accounted for migration experience by introducing a special census-based variable. This variable distinguished between individuals with and without international migration experience. This information was missing for 4.5% of males.

## 4.3 | Area-level variables

The 2011 census includes information about the place of residence at the ward level (the smallest administrative units in Lithuania) and at the municipality level. At the time of the census, there were 549 wards and 60 municipalities in Lithuania. The information on the municipality was 100% complete, whereas the information about the ward was randomly missing for 16% of the analysed cases. Nevertheless, we consider the ward to be the more appropriate unit to capture contextual differences, because substantial heterogeneity in sociodemographic and socio-economic characteristics may be hidden in some large municipalities. Therefore, we decided to keep the unknown ward as a separate artificial geographic unit. Following the literature, we have used the standard term 'area' when referring to ward-level variables.

Area-level variables were calculated from 2011 census data by aggregating individuals according to the selected characteristics. The selected contextual characteristics include measures of socio-economic conditions and deprivation, social cohesion and sociocultural context. The contextual variables reflecting socio-economic conditions and deprivation include the share of people with higher education and the unemployment rate. The shares of nonmarried people and of people with experience living abroad (high migration context) represent the social cohesion contextual variables. Finally, the share of individuals born abroad indirectly reflects the sociocultural context. These contextual variables were categorised into tertiles (low, medium and high), with each group containing a roughly equal number of observations within wards or municipalities.

## 4.4 | Statistical models

We used simple one-level and two-level multilevel Poisson regression models with a log link and logarithm of person-years set as an offset, while the suicide death counts were included as the dependent variable. The use of Poisson regression models is considered an optimal approach when dealing with count data, especially when the number of events is small, as in the case of suicide deaths. One-level Poisson regression has been used in numerous international and national studies that reported relative mortality rate ratios (MRRs) based on similar census-linked mortality datasets (Lorant et al., 2018; Martikainen et al., 2004). In our study, we first estimated Poisson regression suicide MRRs for the four major sociodemographic and socio-economic characteristics (education, economic activity status, marital status and ethnicity). They served as control variables for estimating the effects of place of residence and urban–rural migration. To account for confounding effects, we first ran models that controlled for age only (Model 1). In the next step, we ran Poisson regression separately while including each place of residence and migration variable and simultaneously including all four control variables.

To estimate the effects of area-level characteristics, we applied a Poisson regression multilevel model with random intercepts. This model was estimated using the R package lme4 and applying the function glmer (Bates, Maechler, Bolker, & Walker, 2019). The results were reported as suicide MRRs. The first step of the analysis was checking for the presence of statistically significant variation in suicide mortality across contexts (areas) using the model without explanatory variables (empty model). In addition, we estimated to what extent this variation was explained by (a) differences in age composition

(age-adjusted model), (b) age and four major individual socio-demographic and socio-economic characteristics and (c) all contextual characteristics. The remaining statistically significant variance indicated a potential analytical power of the unobserved individual and contextual characteristics. Finally, we examined the impacts of each of the area-level variables individually by fitting models (a) with age adjustment only and (b) with adjustment for age and four major sociodemographic and socio-economic variables. The use of a similar modelling strategy allowed us to assess the potential size of ecological effects without controlling for individual-level characteristics (except

age) and the extent to which each of the major individual characteristics explained these ecological effects.

## 5 | RESULTS

### 5.1 | Effects of individual-level characteristics

Table 1 provides the results of the Poisson regressions for four major individual-level sociodemographic and socio-economic variables for

**TABLE 1** Poisson regression suicide mortality rate ratios by age and four major sociodemographic variables; Lithuanian males aged 30–64, 30–49 and 50–64 years, 2011–2017

| | Ages 30–64 | | Ages 30–49 | | Ages 50–64 | |
| --- | --- | --- | --- | --- | --- | --- |
| | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| Age | | | | | | |
| 30–34 | 1.00 | 1.00 | 1.00 | 1.00 | - | - |
| 35–39 | 1.08 (0.09) | 1.07 (0.09) | 1.08 (0.09) | 1.06 (0.09) | - | - |
| 40–44 | 1.29*** (0.10) | 1.29*** (0.10) | 1.29*** (010) | 1.30*** (0.11) | - | - |
| 45–49 | 1.51*** (0.11) | 1.55*** (0.12) | 1.51*** (0.11) | 1.58*** (0.13) | - | - |
| 50–54 | 1.56*** (0.11) | 1.62*** (0.13) | - | - | 1.00 | 1.00 |
| 55–59 | 1.65*** (0.12) | 1.69*** (0.14) | - | - | 1.06 (0.07) | 1.05 (0.07) |
| 60–64 | 1.46*** (0.12) | 1.42*** (0.12) | - | - | 0.94 (0.07) | 0.90 (0.07) |
| Education | | | | | | |
| High (ref.) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Secondary | 2.74*** (0.18) | 2.14*** (0.15) | 3.24*** (0.32) | 2.56*** (0.26) | 2.29*** (0.21) | 1.76*** (0.17) |
| Lower than secondary | 4.35*** (0.32) | 2.67*** (0.21) | 5.54*** (0.57) | 3.49*** (0.38) | 3.19*** (0.35) | 1.92*** (0.22) |
| Economic activity status | | | | | | |
| Active, employed (ref.) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Active, unemployed (never had a job) | 4.31*** (0.26) | 3.06*** (0.19) | 4.56*** (0.35) | 3.18*** (0.26) | 3.97*** (0.38) | 2.83*** (0.28) |
| Active, unemployed (had a job) | 2.55*** (0.12) | 2.06*** (0.10) | 2.61*** (0.17) | 2.07*** (0.14) | 2.48*** (0.18) | 2.03*** (0.15) |
| Inactive, disabled | 2.76*** (0.18) | 2.03*** (0.13) | 2.59*** (0.28) | 1.74*** (0.20) | 2.80*** (0.22) | 2.18*** (0.18) |
| Other inactive | 2.28*** (0.16) | 1.86*** (0.14) | 2.53*** (0.28) | 2.01*** (0.22) | 2.11*** (0.20) | 1.78*** (0.17) |
| Unknown | 3.75*** (0.64) | 2.57*** (0.44) | 3.98*** (0.74) | 2.66*** (0.51) | 3.04** (1.25) | 2.02 (0.83) |
| Marital status | | | | | | |
| Married | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Never married | 2.07*** (0.10) | 1.42*** (0.07) | 1.92*** (0.12) | 1.33*** (0.08) | 2.34*** (0.20) | 1.58*** (0.14) |
| Divorced | 2.11*** (0.10) | 1.63*** (0.08) | 1.86*** (0.14) | 1.39*** (0.11) | 2.34*** (0.15) | 1.87*** (0.12) |
| Widowed | 2.26*** (0.28) | 1.76*** (0.21) | 2.16* (0.66) | 1.57 (0.48) | 2.36*** (0.31) | 1.90*** (0.25) |
| Ethnicity | | | | | | |
| Lithuanian | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Russian | 0.63*** (0.06) | 0.62*** (0.06) | 0.69** (0.09) | 0.66** (0.09) | 0.59*** (0.07) | 0.59*** (0.08) |
| Polish | 0.88 (0.07) | 0.82** (0.06) | 0.91 (0.10) | 0.83 (0.09) | 0.85 (0.10) | 0.81 (0.09) |
| Other | 0.42*** (0.07) | 0.46*** (0.07) | 0.36*** (0.09) | 0.40*** (0.10) | 0.46*** (0.09) | 0.50*** (0.10) |

*Note*: Model 1: controlled for age only; Model 2: controlled for age and four sociodemographic variables (education, economic activity status, ethnicity and marital status). Figures in the parentheses are standard errors.
Source: Own calculations based on the data provided by Statistics Lithuania.
*p < 0.05.
**p < 0.01.
***p < 0.001.

males aged 30–64, 30–49 and 50–64 years. Model 1, which additionally controlled only for age, examined the direct effects of each of the four variables, without considering the mediating effects of the remaining variables. As expected, both education and economic activity status were found to be strong predictors of male suicide risk. For example, the excess suicide mortality for males with lower than secondary education was shown to be four times higher for males aged 30–64 and five times higher for males aged 30–49 than for the reference group. The scale of the differentials (MRR was close to or exceeded four) was found to be similar in a comparison of long-term unemployed males (who never had a job) and employed males. A smaller MRR was found for unemployed males who reported having a job in the past and were inactive (both disabled and other). The strikingly large differentials observed for males with unknown activity status likely indicated that these men belonged to disadvantaged groups. Nonmarried males were found to have systematically higher (about twice as high) suicide mortality than married males, with excess mortality being slightly more pronounced among the older males (aged 50–64). Finally, the results showed that Lithuanian and Polish males had a suicide risk that was about 30–40% higher than that of Russian males. This disadvantage was even greater when these men were compared to the men belonging to all other ethnic groups.

Simultaneously controlling for all four sociodemographic and socio-economic variables (Model 2) generally did not change the pattern of the observed disparities reported in Model 1 (Table 1). The only exceptions were the findings that the differences between widowed males aged 30–59 and married males were statistically insignificant and that Polish males had lower suicide mortality than the Lithuanian group.

Table 2 reports the Poisson regression results for five selected variables reflecting urban–rural residential and migration status. Once again, Model 1 analysed the direct effects while controlling only for age, whereas Model 2, in addition to controlling for age, also controlled for education, economic activity status, marital status and ethnicity. As well as confirming the existence of a persisting rural disadvantage, the results of Model 1 indicated that small cities with a population of less than 50,000 were in a particularly unfavourable situation. For example, living in a small city and or a rural area at the time of the 2011 census was associated with a suicide risk that was 1.8 and 2.6 times higher compared with living in a big city with a population of more than 50,000. This disadvantage was found to be remarkably similar in both age subgroups of 30–49 and 50–64 years. Next, we estimated suicide MRRs for those individuals who had the same or similar (urban) place of residence types and those who had

**TABLE 2** Poisson regression suicide mortality rate ratios and by residential status and migration; Lithuanian males aged 30–64, 30–49 and 50–64 years, 2011–2017

| | Ages 30–64 | | Ages 30–49 | | Ages 50–64 | |
| --- | --- | --- | --- | --- | --- | --- |
| | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| Place of residence at the census | | | | | | |
| Large city | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Small city | 1.81*** (0.10) | 1.48*** (0.08) | 1.82*** (0.13) | 1.41*** (0.11) | 1.80*** (0.14) | 1.56*** (0.13) |
| Rural | 2.58*** (0.12) | 1.80*** (0.09) | 2.58*** (0.17) | 1.70*** (0.12) | 2.58*** (0.18) | 1.90*** (0.14) |
| Lifetime migration (between birth and census) | | | | | | |
| Born in an urban area, lives in a large city | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Born in an urban area, lives in a small city | 1.93*** (0.14) | 1.55*** (0.11) | 1.89*** (0.17) | 1.45*** (0.13) | 1.99*** (0.23) | 1.70*** (0.20) |
| Born in a rural area, lives in a rural area | 3.09*** (0.18) | 2.13*** (0.13) | 3.20*** (0.24) | 2.05*** (0.16) | 2.95*** (0.27) | 2.19*** (0.21) |
| Born abroad, lives in a large city | 1.13 (0.17) | 1.52** (0.24) | 0.78 (0.24) | 1.06 (0.34) | 1.25 (0.22) | 1.73** (0.33) |
| Born abroad, lives in a small city | 1.27 (0.23) | 1.42 (0.26) | 1.91* (0.51) | 1.96* (0.53) | 0.97 (0.24) | 1.16 (0.29) |
| Born abroad and lives in a rural area | 2.05*** (0.35) | 1.91*** (0.33) | 1.73 (0.56) | 1.51 (0.49) | 2.14*** (0.44) | 2.13*** (0.45) |
| Born in an urban area, lives in a rural area | 1.73*** (0.15) | 1.36*** (0.12) | 1.73*** (0.19) | 1.31* (0.14) | 1.73*** (0.25) | 1.42* (0.20) |
| Born in a rural area, lives in a big city | 1.21* (0.11) | 1.19* (0.11) | 1.44** (0.18) | 1.42** (0.18) | 1.05 (0.14) | 1.06 (0.14) |
| Born in a rural area, lives in a small city | 2.03*** (0.15) | 1.71*** (0.13) | 2.06*** (0.23) | 1.65*** (0.18) | 1.97*** (0.21) | 1.76*** (0.20) |
| Experience of living abroad | | | | | | |
| No experience | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Has experience | 1.04 (0.06) | 1.08 (0.06) | 0.93 (0.09) | 0.96 (0.09) | 1.13 (0.09) | 1.18* (0.09) |
| Unknown | 0.85 (0.08) | 1.14 (0.11) | 0.88 (0.11) | 1.17 (0.14) | 0.79 (0.13) | 1.07 (0.18) |

*Note*: Model 1: controlled for age only; Model 2: controlled for age and four sociodemographic variables (education, economic activity status, ethnicity and marital status). Figures in the parentheses are standard errors.
Source: Own calculations based on the data provided by Statistics Lithuania.
*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.

different place of birth and place of residence types at the time of the census. Unfortunately, for the place of birth, we were not able to distinguish between different types of urban areas (large and small cities). We found that those individuals who were born in an urban area and were living in a large city at the time of the census had substantially lower suicide mortality than the individuals who had all of the remaining combinations of the place of birth and the place of residence categories. Being born in a rural area and residing in a rural area at the time of the census was associated with the highest suicide risk. Except among the oldest age group (50–64), moving from a rural area to a large or a small city at some point in life did not appear to eliminate the elevated risk. Moving to a rural area (after being born in any urban area in Lithuania or a foreign country) was associated with a substantial increase in the risk of suicide. A very similar disadvantage could be observed for those individuals who were born in any urban area and were living in a small city at the time of the census (Table 2).

The results of Model 1 also suggest that there were no statistically significant differences between those individuals who were born in a foreign country and moved to a large Lithuanian city and those individuals who were born in an urban area and were living in a large city. Meanwhile, we observed an elevated risk of suicide among males who were born abroad and were living in a small city at the time of the census. However, this difference was found to be statistically significant only for younger adult males aged 30–49. Finally, Model 1 did not return any significant results for the effect of the experience of living abroad.

Controlling for the four major sociodemographic and socioeconomic characteristics in Model 2 led to significant and specific changes in the initially observed patterns of suicide risk across the three place of residence and migration variables. First, the results showed that educational, economic activity, marital status and ethnic differences together explained a large share of the excess suicide mortality among rural and small city residents. Second, accounting for these compositional differences led to an increased risk of suicide among foreign-born males who were living in a large city. At the same time, Model 2 showed no significant changes in the suicide MRRs for those individuals who were born abroad and were living in a rural area and those individuals who were born in a rural area and were living in a large city. Finally, further adjusting for sociodemographic and socioeconomic variables led to a statistically significant effect of having lived abroad on increased suicide risk among males aged 50–64.

## 5.2 | Effects of area-level characteristics

Table 3 reports the variance of random intercepts of male suicide risk across 550 areas (wards; including the unknown category). Accounting for age reduced the variance of the random intercept just by 3.6%, while additionally considering four major sociodemographic resulted in a 56% reduction of unexplained interindividual variation in suicide risk. Additionally, controlling for urban–rural residence led to a further 30 percentage point reduction of the variance (Table 3). Finally, incorporating into the model all of the contextual variables reduced

**TABLE 3** Variance of random effects obtained from Poisson regression multilevel models excluding and including the four major individual-level variables

| | Variance of random intercepts | Reduction in variance in relation to the empty model (%) |
|---|---|---|
| 1. Model without covariates (empty model) | 0.255*** | - |
| 2. Model controlling for age | 0.246*** | 3.6 |
| 3. (2) plus education, economic activity status, marital status, and ethnicity | 0.112*** | 56.2 |
| 4. (3) plus urban–rural place of residence | 0.037*** | 85.5 |
| 5. (4) plus all contextual variables | 0.020*** | 92.1 |

Source: Own calculations based on the data provided by Statistics Lithuania.
***$p < 0.001$.

random variation to a level at which only 8% of the variance remained unexplained due to the unobserved individual- and area-level characteristics.

Table 4 provides outcomes from the Poisson regression models, including area-level variables. The results from Model 1, which controlled for age only, suggested that the selected socio-economic, cohesion and sociocultural characteristics had significant direct effects at the area level. For example, the findings indicated that males who were living in the areas with the highest unemployment levels at the time of the census had an individual suicide mortality risk that was twice as high as that of males who were living in the areas with the lowest unemployment levels. Meanwhile, the individual suicide risk was found to be the lowest in the areas with the highest shares of highly educated males. These relationships were shown to persist (despite some decrease in the size of the effects) after controlling (a) for both education and economic activity status at the individual level (Model 2) and (b) both socio-economic variables and urban–rural residence at the individual level.

Similarly, even after controlling for ethnicity and the other four individual-level characteristics (Models 2 and 3), the results showed that residing in the areas with the highest shares of people born abroad was statistically significantly associated with a lower risk of suicide (Table 4). The effect of the share of nonmarried males, which was used as a proxy to measure social cohesion at the area level, was also shown to have significant associations, which suggests that the suicide risk was higher in the areas with a higher concentration of nonmarried males. Higher shares of non-Lithuanian ethnic groups were systematically associated with a reduced risk of suicide. Finally, the results from Model 1 indicated that the risk of suicide was lower among the males residing in the areas with medium or high shares of

**TABLE 4** Multilevel Poisson regression suicide mortality rate ratios by selected area-level characteristics; Lithuanian males aged 30–64 years, 2011–2017

|  | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| **Share of unemployed at the census** | | | |
| Low | 1.00 | 1.00 | 1.00 |
| Medium | 1.37*** (0.22) | 1.18* (0.16) | 1.05 (0.13) |
| High | 1.97*** (0.30) | 1.47*** (0.20) | 1.21** (0.17) |
| **Share of nonmarried males** | | | |
| Low | 1.00 | 1.00 | 1.00 |
| Medium | 1.55*** (0.26) | 1.29*** (0.18) | 1.22** (0.15) |
| High | 2.08*** (0.32) | 1.51*** (0.21) | 1.33*** (0.18) |
| **Share of people with higher education** | | | |
| Low | 1.00 | 1.00 | 1.00 |
| Medium | 0.69*** (0.08) | 0.81*** (0.09) | 0.84** (0.10) |
| High | 0.36*** (0.05) | 0.54*** (0.07) | 0.66*** (0.11) |
| **Share of people born abroad** | | | |
| Low | 1.00 | 1.00 | 1.00 |
| Medium | 0.69*** (0.09) | 0.76*** (0.08) | 0.82*** (0.09) |
| High | 0.45*** (0.07) | 0.58*** (0.09) | 0.73*** (0.11) |
| **Share of non-Lithuanians** | | | |
| Low | 1.00 | 1.00 | 1.00 |
| Medium | 0.85** (0.12) | 0.88* (0.11) | 0.95 (0.10) |
| High | 0.57*** (0.10) | 0.67*** (0.11) | 0.81** (0.13) |
| **Share of people with experience living abroad** | | | |
| Low | 1.00 | 1.00 | 1.00 |
| Medium | 0.62*** (0.09) | 0.77** (0.10) | 0.89 (0.11) |
| High | 0.83** (0.13) | 0.89 (0.12) | 0.95 (0.11) |

*Note*: Model 1: controlled for age only; Model 2: controlled for age and four sociodemographic variables (education, economic activity status, ethnicity and marital status); Model 3: controlled for age and four sociodemographic variables (education, economic activity status, ethnicity and marital status) and urban–rural place of residence at the 2011 census. Figures in the parentheses are standard errors.
Source: Own calculations based on the data provided by Statistics Lithuania.
*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.

people with experience of living abroad. However, after controlling for all individual-level variables, this relationship was no longer statistically significant.

## 6 | DISCUSSION AND CONCLUSION

### 6.1 | Main findings

This study makes several novel contributions and expands our knowledge about individual- and area-level determinants of male suicide in the post-communist region of Europe. We used a multilevel approach that took into account both individual- and area-level

characteristics based on aggregated information from the 549 smallest administrative units (wards). One of our most important findings was that all area-level characteristics (percentage of people who were unemployed at the census, percentage of nonmarried males, percentage of people with higher education, percentage of people who were born abroad and percentage of residents who were non-Lithuanians) except the share of people who had lived abroad retained their importance after controlling for the major sociodemographic and socioeconomic characteristics at the individual level. This evidence, which contradicts the findings of some recent ecological studies on other countries, indicates that policies aimed at improving area-level conditions are needed. For example, reducing the overall level of unemployment in the worst-performing areas may lead to a reduction in the individual risk of male suicide. Second, a very interesting and novel finding of our study was that a suicide disadvantage persists among males living in rural areas and small cities. Also striking was our observation that controlling for the major individual characteristics and lifetime migration to large cities did not eliminate this excess suicide risk related to being born in a rural area. This finding may indirectly suggest that health selection had no or only moderate effects. However, some selection effects could not be excluded, especially those related to intergenerational health selection mechanisms (Landstedt & Almquist, 2019; Willson & Shuey, 2019). But to check this hypothesis, we would need more comprehensive data that enabled us to identify and link the census records of parents and their children. Some health selection mechanisms may also be important in the case of socioeconomic characteristics. For example, a study for Finland found that there may be a selection effect for people with unstable employment during periods of low unemployment (Mäki & Martikainen, 2012).

At the same time, being born in an urban area or a foreign country and moving to a rural area was also found to be associated with elevated suicide risk. Our results confirmed that individual education, economic activity status and marital status had large effects on suicide risk. Our findings also highlighted the negative role of long-term unemployment (males who reported no prior work experience). Finally, the study showed that the predominantly Catholic Lithuanians and Poles had a much higher suicide risk than the Orthodox Russians and mixed religion category (the other ethnicity group). Although the individual and contextual variables considered in the analysis largely explained the risk of male suicide mortality, a small fraction of interindividual variation (8%) remained unexplained. This finding indicates the potential importance of unobserved variables.

Many studies that have looked at the historical origins of the suicide epidemics among Lithuanian men pointed to a long-term increase in suicide mortality in rural areas (Gailienė, 2018; Gailienė et al., 1995). There is evidence that the rise in suicide mortality in Lithuania started soon after the Soviet reforms in rural areas during the 1940s, 1950s and 1960s. These reforms led to massive changes in rural residential structures, rapid urbanisation and industrialisation, forced collectivisation and the almost complete elimination of private farms.

Furthermore, compared with urban areas, rural communities suffered more from Soviet-regime repressions and post-war atrocities, including mass deportations to Siberia and a long-lasting guerrilla war

with heavy casualties (Gailienė, 2015). Another wave of radical rural reforms aimed at dissolving collective farms and returning land to its original owners occurred in the 1990s. These land reforms were implemented during the severe economic crisis of the early 1990s, which also coincided with a spike in suicides at the national level that mainly affected the rural areas. Although socio-economic conditions in the country have improved considerably since the second half of the 1990s (except during the severe economic crisis of 2008–2009), male suicide mortality remains very high in Lithuania. This disadvantage is particularly striking given that Lithuania has one of the highest GDP per capita values in the CEE region, exceeding not only those of neighbouring Poland, Latvia, Russia and Belarus; but, more recently, those of Hungary and Slovakia as well (Eurostat, 2020). On the other hand, Lithuania has some of the highest income inequality and extreme poverty levels and some of the lowest social expenditure levels in the European Union (Eurostat, 2020).

It possible that rural men in Lithuania had far fewer chances (resources and skills) to escape from the negative consequences of the financial crisis and post-crisis austerity by migrating and finding temporary or long-term jobs abroad. The available evidence suggests that emigration rates were systematically lower among rural men, even after taking into account differences in composition by education and economic activity status (Klüsener, Stankūnienė, Grigoriev, & Jasilionis, 2015). Although the available official data do not show significant changes in population composition by urban–rural place of residence (the share of rural population remained unchanged at 32–33% since 1990), internal net migration figures suggest that there were large yearly outflows from rural to urban areas, mainly of the younger population aged 18–39 (Statistics Lithuania, 2020). This trend has also been confirmed by the much larger and more rapidly increasing dependency ratios and shares of older people in rural areas (Statistics Lithuania, 2020). These data indirectly indicate that a large proportion of rural men at working ages form a selective group who are failing to escape from particularly unfavourable contextual conditions.

The contradictory socio-economic context in Lithuania points to the complexity of the factors and the mechanisms that explain the suicide epidemic observed in that country. In addition to the effects of historical traumas and social transformations that have affected both older and younger cohorts, it is clear that overall poor mental health, psychosocial factors and certain cultural characteristics have contributed to the excess suicide among Lithuanian males, especially in rural areas. Among these factors are the persistence in Lithuania of a masculinity culture and of traditional gender role models (Tereškinas, 2014). The strong stigmatisation of suicide and mental health problems may also contribute to this unfavourable cultural context by causing people to avoid seeking help (Skruibis, Gelezelyte, & Dadašev, 2015). The prevailing masculinity culture in Lithuania coexists with ongoing problems with alcoholism, which is known to be one of the risk factors of suicide. According to the latest available estimates, levels of alcohol consumption in Lithuania continue to be among the highest in the world (WHO, 2018). Studies on Russia that have found similar levels of alcohol consumption have

suggested that alcohol plays an important role in explaining both the changes in suicide mortality and the gender gap in suicide (Razvodovsky, 2017).

The observed suicide disadvantage of rural males may also be related to the notable sex ratio imbalance, which has been especially pronounced at younger working ages. According to the data for 2017, the female-to-male ratio at ages 15–39 was only 0.83 in rural areas, whereas the corresponding figure for urban areas was 1.02 (Statistics Lithuania, 2020). This imbalance, together with other disadvantages such as lower incomes, may have made it especially difficult for rural men to form partnerships. This disadvantage appears to be particularly pronounced at ages 35 or older, with urban males in this age group having age-specific marriage rates that were 18–100% higher than those of rural males in 2011–2017 (Statistics Lithuania, 2020). A similar disadvantage for rural males in Lithuania was reported in a study on the probabilities of remarrying for divorced and separated individuals (Maslauskaitė & Baublytė, 2018).

Thus, in addition to having poor access to or a tendency to avoid mental health services (due in part to persisting strong stigmas related to mental illness), these men are unlikely to get adequate social and psychological support from their families. Although some improvements in suicide rates among this population have been observed very recently, more coordinated efforts are needed to strengthen overall mental health prevention, with a particular focus on suicide prevention. These efforts should be complemented by education campaigns designed to counteract prevailing stigmas regarding mental illness and to better promote the use of primary mental health care services.

## 6.2 | Strengths and limitations

One of the main advantages of this study is that we were able to use census-linked data covering the entire adult male population of Lithuania. These data allowed us to calculate nationally representative and statistically robust suicide rate ratios, even for small subnational groups. However, these data also have significant limitations. The first limitation is related to the relatively small number of individual- and area-level characteristics available from the census. Thus, we were not able to account for potentially important determinants, especially those related to psychosocial or cultural characteristics. These determinants should be assessed in future studies based on extensive survey follow-ups. The second limitation is related to the fixed characteristics at the census (except age). It is possible that some socio-economic or sociodemographic characteristics, such as economic activity status or marital status, that were derived from the census may have changed during the almost 7-year follow-up period. However, the sensitivity analyses we performed that restricted the observational period to 2 or 3 years did not significantly change the results.

Understanding the determinants of male suicide has important policy implications for Lithuania and for other countries that face male suicide epidemics. The current study highlights the potential for improving area-level conditions, which remain important predictors of male suicide, even after controlling for the major individual-level

characteristics. For the former Soviet republics, it is crucial to understand the determinants of persisting excess suicide mortality in rural areas, which seem to go beyond the conventional factors such as socio-economic disadvantages.

## CONFLICT OF INTEREST
We declare no conflicts of interest.

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## APPENDIX A

**TABLE A1** Suicide deaths and person-years of exposure by the selected individual-level variables; Lithuanian males aged 30–64 years, 2011–2017

| Variable | Deaths | | | Person-years of exposure | |
|---|---|---|---|---|---|
| | N | % | | N × 1,000 | % |
| Education | | | | | |
| High | 252 | 8.9 | | 1,063.8 | 23.6 |
| Secondary | 1,927 | 68.0 | | 2,789.5 | 61.8 |
| Lower than secondary | 653 | 23.1 | | 660.7 | 14.6 |
| Economic activity status | | | | | |
| Active, employed | 1,195 | 42.2 | | 3,050.6 | 67.6 |
| Active, unemployed (never had a job) | 370 | 13.1 | | 222.4 | 4.9 |
| Active, unemployed (had a job) | 662 | 23.4 | | 656.3 | 14.5 |
| Inactive, disabled | 322 | 11.4 | | 282.2 | 6.3 |
| Other inactive | 247 | 8.7 | | 275.6 | 6.1 |
| Unknown | 36 | 1.3 | | 26.8 | 0.6 |
| Marital status | | | | | |
| Married | 1,457 | 51.4 | | 3,012.3 | 66.7 |
| Never married | 694 | 24.5 | | 869.1 | 19.3 |
| Divorced | 609 | 21.5 | | 573.8 | 12.7 |
| Widowed | 72 | 2.5 | | 58.7 | 1.3 |
| Ethnicity | | | | | |
| Lithuanian | 2,485 | 87.7 | | 3,764.7 | 83.4 |
| Russian | 124 | 4.4 | | 291.3 | 6.5 |
| Polish | 181 | 6.4 | | 311.3 | 6.9 |
| Other | 42 | 1.5 | | 146.5 | 3.2 |
| Place of residence at the census | | | | | |
| Large city (>50 thou.) | 628 | 22.2 | | 1,783.6 | 39.5 |
| Small city (<50 thou.) | 767 | 27.1 | | 1,181.2 | 26.2 |
| Rural | 1,437 | 50.7 | | 1,549.1 | 34.3 |
| Lifetime migration (between birth and census) | | | | | |
| Born in an urban area, lives in a large city | 402 | 14.2 | | 1,238.6 | 27.4 |
| Born in an urban area, lives in a small city | 407 | 14.4 | | 647.3 | 14.3 |
| Born in a rural area, lives in a rural area | 1,193 | 42.1 | | 1,131.8 | 25.1 |
| Born abroad, lives in a large city | 51 | 1.8 | | 128.0 | 2.8 |
| Born abroad, lives in a small city | 33 | 1.2 | | 73.2 | 1.6 |
| Born abroad and lives in a rural area | 38 | 1.3 | | 52.1 | 1.2 |
| Born in an urban area, lives in a rural area | 206 | 7.3 | | 365.2 | 8.1 |
| Born in a rural area, lives in a big city | 175 | 6.2 | | 417.1 | 9.2 |
| Born in a rural area, lives in a small city | 327 | 11.5 | | 460.7 | 10.2 |
| Experience of living abroad | | | | | |
| No experience | 2,395 | 84.6 | | 3,808.2 | 84.4 |
| Has experience | 321 | 11.3 | | 480.0 | 10.6 |
| Unknown | 116 | 4.1 | | 225.8 | 5.0 |
| Total | 2,832 | 100.0 | | 4,513.9 | 100.0 |

Source: Own calculations based on the data provided by Statistics Lithuania.