Individual and contextual determinants of male mortality in Lithuania: a multilevel census-linked study

Domantas Jasilionis
Max Planck Institute for Demographic Research, Rostock, Germany
Konrad-Zuse-Str. 1, 18057 Rostock, Germany
Tel.: +49 381 2081 193
Fax: +49 381 2081 493
e-mail: jasilionis@demogr.mpg.de

Vlada Stankuniene
Institute for Demographic Research, Lithuanian Social Research Centre, Vilnius, Lithuania

Dalia Ambrozaitiene
Statistics Lithuania, Vilnius, Lithuania

Vladimir M. Shkolnikov
Max Planck Institute for Demographic Research, Rostock, Germany

Abstract

This study aims at assessment of the role of the selected individual and contextual determinants of mortality among Lithuanian males. The study uses the census-linked data for 2001-2005 covering 6.6 million person years and 72.5 thousand deaths for males aged 30-74. Random intercept Poisson regression was used to capture unobserved regional effects. The study found that the contextual variables were associated with individual mortality risks. In particular, unfavourable socioeconomic structures of municipalities were related to elevated mortality risk at the individual level. However, after controlling for selected major individual characteristics these area-level effects either became small or statistically insignificant. Interestingly, the share of divorced males had an opposite effect on mortality as compared to the same characteristic at the individual level. The results suggest that the regional variation in male mortality risk in Lithuania can be largely explained by the variation in the individual-level characteristics.

Introduction

Research on socio-demographic health inequalities is mostly based on individual characteristics and few "traditional" variables such as education, occupation, income, marital status, ethnicity/race or place of residence. The vast majority of the studies on socioeconomic mortality differentials ignore possible impact of unobserved factors (unobserved heterogeneity). The consequence of excluding unmeasured characteristics is biased estimates of "traditional" variables. For example, Hoffmann (2006) shows that unobserved heterogeneity leads to a large bias in measurement of socio-economic mortality differentials at older ages.

Studies examining the effects of area (contextual) characteristics on mortality have a long history. First, it is necessary to mention numerous ecological mortality studies looking at the relationships between area-specific socio-economic indicators and area-specific mortality rates. In this case, the area characteristics have been used as poor substitutes of information on socio-economic status of individuals. Such approach suffer from so called the ecological fallacy (Courgeau, 2007). More advanced and proper way allowing to estimate simultaneously the effects at the individual and area level is multilevel modeling. One of the most important advantages of the multilevel modeling is that it allows accounting for unobserved heterogeneity between contexts (since individuals are often nested within one context). Another advantage is that multilevel modeling allows measuring effects of some additional (contextual) characteristics.

It is important to note that most of the multilevel design studies on health determinants rely on survey data which often exclude the most vulnerable populations. Until now only few population-level studies using mortality as an outcome variable have been conducted in the Nordic countries (Martikainen et al., 2004; Kravdal, 2007). This study using census-linked data covering the entire population aims at assessment of the role of the selected individual and contextual determinants of male mortality among Lithuanian males. The following research questions are addressed in this study:

1) Are there statistically significant contextual effects in Lithuanian male population?
2) Are these contextual effects remain significant after controlling for individual characteristics?
3) What are effects of individual and contextual variables?

Data and methods

This study uses a census-linked dataset provided by Statistics Lithuania. The dataset is based on all records from the 2001 Population and Housing Census, and all death and emigration records for the period between July 1, 2001 and December 31, 2005. The data used for the current study cover all males aged 30-74, and include 6.6 million person years and 72.5 thousand deaths. The following individual-level variables were available: 1) Age, 2) Education (higher, secondary, lower than secondary or unknown), 3) Marital status (married, never married, divorced, widowed), 4) Ethnicity (Lithuanian, Russian, Polish, Other), 5) Urban- rural residence (Urban, Rural). The area-level (contextual) variables were constructed according to socio-economic (% receiving social support; % unskilled manual workers; % of population with high education; unemployed; % households with separate bath facilities; of urban population) and family cohesion (% of single

households; % of divorced males) characteristics of 60 municipalities in the 2001 census.

Random intercept Poisson regression (Generalized Linear Latent and Mixed Models (GLLAMM) application for count data) was applied in order to estimate both the importance of contextual effects and exact effects of individual and contextual variables (Rabe-Hesketh and Skrondal, 2005). Random intercept model assumes that only intercept may vary across different contexts, whereas effects of explanatory variables do not differ between contexts. The equation for Random intercept Poisson regression model with one individual-level and one contextual-level (municipality) explanatory variable is the following:

$$\ln y_{ij} = \ln(E_{ij}) + b_0 + b_1 x_{ij} + b_2 v_j + u_{0j} + \varepsilon_{ij},$$

where E_{ij} is population exposure, b_0 is overall intercept (grand mean), x_{ij} is individual-level explanatory variable, b_1 is the regression coefficient of individual-level explanatory variable, v_j is contextual-level explanatory variable, b_2 is the regression coefficient of contextual-level explanatory variable, u_{0j} is a micro-level error term, ε_{ij} is an estimate of contextual-level random residual (variance of area-level residual) indicating the average deviation from grand mean for individuals (*i*) nested within each context (municipality) (*j*). All models were tested using the LR test.

Results

Table 1 shows the changes in the estimate of the contextual-level random residuals after controlling for different sets of the individual-level variables. The estimate of total variance (Model 0) suggests that there are statistically significant contextual effects contributing to male mortality in Lithuania. The impact of contextual-level characteristics decreases by 20% if age variable is included into the model (Model 1). Further controlling for all available individual characteristics (age, education, marital status, ethnicity, and urban-rural residence) explain about 90% of the total mortality variation between contexts (municipalities) (Model 2). However, small but statistically significant contextual effects remain even after controlling for these major individual-level variables.

Table 2 illustrates the importance of individual-level variables for male mortality in Lithuania. In particular, education and marital status are very strong predictors of mortality risk. For example, low education group and divorced and never-married statuses are associated with 2-2.5 times higher mortality than in the respective reference groups (high education group and married status). These mortality differentials remain very notable also after controlling for all individual-level variables. Ethnicity and urban-rural residence show much smaller impact on male mortality (Table 2). In addition, after controlling for all variables, excess mortality of rural males notably decrease. Finally, controlling for contextual characteristics (e.g. % receiving social support) does not make a visible impact on the impacts of individual-level characteristics (Table 3).

Contextual-level variables show much smaller effects on male mortality (Table 4). Among socioeconomic characteristics of municipalities, the percentage of urban population, the share of highly educated people, and the proportion of households with separate bathroom facility contribute towards the reduction of mortality risk at the individual level. The share of people receiving social support and unemployment level are associated with the increased risk of mortality. Although the effects of the aforementioned variables are very small, they remain statistically significant after additional control for all individual variables (Table 4). Out of the two variables reflecting social cohesion within municipalities, only the share of divorced males remain statistically significant after additionally (to age) controlling for the remaining individual characteristics (education, marital status, ethnicity, and urban-rural residence). Contrary to the individual-level, the effect of this contextual-level variable is negative (i.e. contributing to the decrease of mortality risk).

Concluding remarks

The main study strength is the census-linked multilevel data covering the entire male population of Lithuania. Study limitations: 1) small number of variables for both individual and area levels; 2) possibly not fully accounted internal migration between municipalities. In order to address the second limitation, an additional sensitivity analysis with shorter period of observation (less than 2 years) was performed. However, the sensitivity analysis returned very similar results.

The key finding of the study is that the regional variation in male mortality risk in Lithuania can be largely explained by the variation in the individual-level characteristics. Selected municipality-level characteristics have small but statistically significant impact on male mortality in Lithuania. However, the effects of the majority of contextual variables become even smaller or statistically insignificant after controlling for all individual-level characteristics under study. At the same time we found very notable effects of individual-level characteristics such as education and marital status. It suggests that individual-level characteristics make a decisive influence on mortality risk despite specifics of context. Very contradictive findings concern opposite effects of family cohesion measures suggesting that residing in the areas with high percentage of divorced males is associated with lower mortality risk. However, such relationship was also found in other studies (Kravdal, 2007). It may suggest about differences in causal relationships and misinterpretation of effects of marriage on mortality risk at the individual level (Kravdal, 2007).

References

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Table 1. Estimates and levels of significance of variances of area-level residuals

Model 0 (intercept only)	**0.057** ***
Model 1 (controlled for age)	**0.045** ***
Model 2 (controlled for all individual variables)	**0.006** **

***p≤0.001; **p≤0.01; * p≤0.05

Table 2. Poisson regression coefficients of individual-level variables (Model 1: age-adjusted and Model 2: adjusted for all individual-level variables). Lithuanian men aged 30 -74, 2001-2005

	Model 1 Age-adjusted β	Model 2 Adjusted for all ind. vars. β
Education		
Higher (reference)	**0.000**	**0.000**
Secondary	**0.559*** **	**0.500*** **
Lower than secondary/unk.	**0.883*** **	**0.733*** **
Marital status		
Married (reference)	**0.000**	**0.000**
Never married	**0.845*** **	**0.735*** **
Divorced	**0.779*** **	**0.762*** **
Widowed	**0.637*** **	**0.574*** **
Ethnicity		
Lithuanian (reference)	**0.000**	**0.000**
Russian	**0.133*** **	**0.204*** **
Polish	**0.240*** **	**0.187*** **
Other	**-0.055****	**0.049****
Urban-rural residence		
Urban (reference)	**0.000**	**0.000**
Rural	**0.299*** **	**0.158*** **

***p≤0.001; **p≤0.01; * p≤0.05

Table 3. Poisson regression coefficients of individual-level variables (Model 1: adjusted for all individual variables and Model 2: additionally adjusted for % of receiving social support). Lithuanian men aged 30 -74, 2001-2005.

	Model 1 Adjusted for all ind. vars. β	Model 2 Adjusted for % receiving soc. sup. β
Education		
Higher (reference)	**0.000**	**0.000**
Secondary	**0.500*** **	**0.496*** **
Lower than secondary/unk.	**0.733*** **	**0.729*** **
Marital status		
Married (reference)	**0.000**	**0.000**
Never married	**0.735*** **	**0.736*** **
Divorced	**0.762*** **	**0.762*** **
Widowed	**0.574*** **	**0.574*** **
Ethnicity		
Lithuanian (reference)	**0.000**	**0.000**
Russian	**0.204*** **	**0.210*** **
Polish	**0.187*** **	**0.196*** **
Other	**0.049****	**0.056****
Urban-rural residence		
Urban (reference)	**0.000**	**0.000**
Rural	**0.158*** **	**0.149*** **

***p≤0.001; **p≤0.01; * p≤0.05

Table 4. Poisson regression coefficients of municipality-level (contextual) variables (Model 1: age-adjusted and Model 2: adjusted for all individual-level variables). Lithuanian men aged 30 -74, 2001-2005

	Model 1 Age-adjusted β	Model 2 Adjusted for all ind. vars. β
Socio-economic structure and living conditions		
% urban population	**-0.004*** **	**-0.001*** **
% receiving social support	**0.019*** **	**0.005*** **
% unskilled manual workers	**0.022*** **	0.001
% of population with high educati	**-0.019*** **	**-0.005*** **
% unemployed	**0.020*** **	**0.003*** **
% households with separate bath	**-0.007*** **	**-0.002*** **
Social cohesion (family cohesion/support)		
% of single households	**-0.024*** **	-0.002
% of divorced males	**-0.049*** **	**-0.011*** **

***p≤0.001; **p≤0.01; * p≤0.05