

# **EDUCATIONAL INEQUALITIES IN LATE-LIFE DEPRESSION ACROSS EUROPE: RESULTS FROM THE GENERATIONS AND GENDER SURVEY**

**Abstract** This study explores country- and gender-stratified educational differences in depression among older adults from 10 European countries. We examine inequalities in both absolute (prevalence differences) and relative (odds ratios) terms and in bivariate and multivariate models. We use cross-sectional, nationally representative data from the Generations and Gender Survey. The analysis comprises 27,331 Europeans aged 60–80. Depression is measured with a seven-item version of the Center for Epidemiologic Studies Depression (CES-D) scale. Findings show considerable between-country heterogeneity in late-life depression. An East-West gradient is evident, with rates of depression up to three times higher in Eastern European than in Scandinavian countries. Rates are about twice as high among women than men in all countries. Findings reveal marked absolute educational gaps in depression in all countries, yet the gaps are larger in weaker welfare states. This pattern is less pronounced for the relative inequalities, especially for women. Some countries observe similar relative inequalities but vastly different absolute inequalities. We argue that the absolute differences are more important for social policy development and evaluation. Educational gradients in depression are strongly mediated by individual-level health and financial variables. Socioeconomic variation in late-life depression is greater in countries with poorer economic development and welfare programs.

**Keywords:** educational inequalities, depression, older adults, Europe, comparative research

## **Introduction**

The prevalence of depressive symptoms is relatively high in older age groups (Zhao et al. 2012) and poses serious economic and social concerns for many countries worldwide (Sobocki et al. 2006; WHO 2008). Later-life depression is associated with decreased physical, cognitive and social functioning, and greater self-neglect, all of which are in turn associated with significant decrease in quality of life and increased mortality (Blazer 2003; Rodda et al. 2011). The prevalence of late-life depression is distributed unequally depending on socioeconomic resources (including education) (Chang-Quan et al. 2010; Lorant et al. 2003; Miech and Shanahan 2000). This pattern seems to exist in all countries, albeit to a greater extent in countries with poorer economic development and welfare programs. Findings suggest that adequate welfare support and health care systems may act as a buffer against, or postpone, the risk of depression in later life, especially in lower social strata (Knesbeck et al. 2007; Ladin 2008). According to the World Health Organization (2008), the type and structure of government and its social and economic policies affect the health of the impoverished more profoundly than other groups. Furthermore, since older people rely on the state for their daily needs more than younger people, differences in welfare programs may have larger effects on health inequalities among older than younger people.

There is, however, limited research on which types of society are effective at minimizing socioeconomic inequalities in mental health in later life. Assessing national differences in depressive symptoms and their distribution across social groups may provide valuable insight into macro-level influences on quality of life in older populations.

Educational gradients in late-life depression in Europe have been investigated with data from the first wave of the Survey of Health, Ageing and Retirement in Europe (SHARE). SHARE1 covered individuals aged 50+ in 11 countries from Northern Europe to the Mediterranean region (SHARE now covers 28 countries). First of all, findings show

considerable between-country heterogeneity in prevalence of later-life depressive symptoms (Ladin 2008). Lowest rates were found in Scandinavian countries (Denmark and Sweden), the Netherlands, and Austria, followed by Germany and France, whereas residents of Spain, Italy, and Greece reported the worst mental health (Castro-Costa et al. 2007; Ploubidis and Grundy 2009). Furthermore, the study shows that low prevalence goes together with low socioeconomic disparities in depression, with the smallest education-based disparities in Sweden and the largest in Spain and France (Ladin 2008; Ladin et al. 2010).

There are some notable gaps in the comparative European literature. First, there is a lack of research from Eastern European countries (Bobak 2009; Fryers et al. 2005). Little is thus known about the risk of late-life depression and its social distribution in some of the European countries with the largest socioeconomic disparities and the most severe challenges in caring for the material, social, and health needs of their older populations (Botev 1999). Second, there have been few mediational analyses, not only of Eastern Europeans but also of other older Europeans. There is thus limited understanding of the intermediate factors between education and depression and whether education has an independent effect once “downstream” factors such as health and financial situation are accounted for. Third, gender differences have been largely ignored. This is unfortunate as macro-level factors may influence health inequalities among men and women differently (Dahl and van der Wel 2013). For instance, as women tend to have lower income and more health problems, differences in the generosity of welfare programs may have larger effects on health inequalities among women than among men (Lundberg et al. 2008). A fourth limitation of the comparative literature is the relatively small sample size in some countries (Ladin et al. 2010).

Finally, there has been a strong reliance on relative inequalities without considering absolute levels and inequalities (Masseria 2009; O'Donnell 2009). Or, when both absolute and relative metrics are considered, there is often little explicit discussion of their differences and

also which should be of primary concern, especially when their results conflict. A recent expert review and proposal for measurement of health inequalities in the European Union concludes that “the odds ratios present the most adequate solution to the problem of measuring inequalities with respect to social categories” (Spinakis et al. 2011: 20). One problematic aspect of odds ratios, however, is that they are notoriously difficult to interpret (Hellevik 2009). What is more, relative differences depend strongly on the overall prevalence of the focal phenomenon (e.g. Eikemo et al. 2009). As Scanlan (2006) explains: when two groups differ in their susceptibility to an outcome, the rarer the outcome, the greater the (relative) disparity in experiencing the outcome and the smaller the (relative) disparity in avoiding the outcome. So if depression rates are low in a country, relative differences may tend to be high (and vice versa). It is thus important to recognize that the choice of inequality measure matters and that the choice can greatly influence the conclusions drawn (Hu et al. 2016; Mackenbach et al. 2015). Looking at both measures when examining social health disparities is always recommended (Mackenbach and Kunst 1997).

The present study aims to expand previous research by assessing the contribution of educational level on depressive symptoms in large samples of older men and women across 10 European countries, including countries from Central and Eastern Europe. We explore and compare absolute and relative inequalities. We also examine to what degree educational gradients in depression are mediated by a variety of life circumstances (e.g. marital status, health, and financial situation).

## ***Methods***

### *Data*

We use data from the Generations and Gender Survey (GGS) (Vikat et al. 2007). The survey forms part of the Generations and Gender Programme (GGP). The GGP is a system of national GGS surveys and contextual databases based on 19 countries. The programme aims

to improve the understanding of demographic and social developments and the factors that influence these developments. We restrict our analysis ( $n=27,331$ ) to respondents aged 60–80 from the 10 countries that implemented the depression measurement and independent variables; Belgium, Bulgaria, Czech Republic, France, Georgia, Lithuania, Norway, Romania, Russia, and Sweden. Data were collected between 2004 and 2012, using face-to-face interviews. It is worth noting that the Swedish and Norwegian GGS posed the questions about depressive symptoms in a postal questionnaire. Average response rate in the GGS is 68% (Table 1) (Fokkema et al. 2014).

### *Dependent variable*

*Depressive symptoms* are measured by a 7-item version of the 20-item Center for Epidemiologic Studies Depression (CES-D) scale (Radloff 1977). It was designed to identify depressive symptoms among the general population and is currently the most widely used instrument to measure depressive symptoms and estimate prevalence rates in population surveys (Shafer 2006). The CES-D has consistently shown itself to be reliable and valid in different populations, with adequate internal consistency and construct validity (McDowell 2006). The measurement equivalence of an 8-item version of this scale has been established among seniors from different European countries (Missinne et al. 2014).

The 7-item scale encompasses the following items: I felt that I could not shake off the blues even with help from my family or friends; I felt depressed; I thought my life had been a failure; I felt fearful; I felt lonely; I had crying spells; I felt sad. Respondents were asked to report how often they had felt like this during the past week: (0) seldom or never, (1) sometimes, (2) often, or (3) most or all of the time. A mean score index (0–21) was created ( $\alpha = .88-.92$ , pooled  $\alpha = .89$ ) in which higher scores indicate higher levels of depressive symptoms.

We use a dichotomous rather than a continuous outcome for depression. We use a cut-off of 6 to identify people with depressive symptoms, which matches the widely used cut-off point of 16 on the original CES-D scale with a range of 0–60 (Moor and Komter 2012). For ease of reading we use the term “depression” to denote depressive symptoms or depressed mood. We emphasize, however, that the scale was developed as a screening tool to identify persons at risk for clinical depression and that high CES-D scores do not indicate clinical depression.

### *Independent variables*

Education level was recorded using the International Standard Classification of Education (ISCED-97). Categories were recoded into three levels: low (ISCED 0-2; none, pre-primary, primary and lower secondary education), intermediate (ISCED 3-4; upper and post-secondary education) or high (ISCED 5-6; tertiary education).

We control for the respondents’ *age*, as older age is associated with less education and more depressive symptoms. We also include in the model some potential mediators of the association between education and depressive symptoms: marital status, number of children, disability, employment, and financial hardship. *Marital status* has the categories married or cohabiting, never-married, divorced, and widowed. We include the *number of (biological, step, or adopted) children* as children may represent an important source of social contact and support and thus act as a buffer against depression (Hansen 2012). We include a measure of *disability* (limited in ability to carry out normal everyday activities because of a physical or mental health problem or disability: no/yes), which captures the respondent’s functional health. We have excluded self-rated health because of potential conceptual overlap with depression. *Employed* (no/yes) is included as employment may reduce depression by giving structure to life and by providing supportive network ties and access to support. Rates of employment among persons aged 60–80 vary greatly in this sample, from about 30% of men

and 25% of women in Norway and Sweden to about 5% of men and less than 1% of women in several of the Eastern European countries. *Financial hardship* (perceived difficulties in making ends meet) ranges from 1 (great difficulties) to 5 (very comfortable). We chose not to use income as an indicator of financial situation because of the high rate of missing data.

### *Country profiles*

The sample includes 10 European countries that represent different regions and a wide variety of demographic and welfare profiles (see Table 1). Scandinavian countries are characterized by their high levels of welfare provision, universalism, and promotion of social equality (Hvinden 2010). Generous universal social protections systems assure basic social security coverage, access to health care, and adequate housing and income to older Scandinavians of all social strata. The Nordic countries have among the lowest old-age poverty rates in the world (Table 1) (Ogg 2005).

[Insert Table 1 about here]

By contrast, post-communist countries provide limited or no social security coverage (Iecovich et al. 2004; Levecque et al. 2011). The older and less educated in the population have been especially vulnerable to consequences of the shift to capitalism, as declining economies have led governments to cut pensions and social services (Botev 2012; EU and WHO 2002). An increasing number of Eastern European retirees also face severe financial strain due to rising inflation and decreasing value of pensions (Botev 1999). Old-age poverty rates thus tend to be very high in these countries (Table 1). The recent decrease in life expectancy and self-reported health among many older Eastern Europeans reflects a combination of unhealthy lifestyle and poor healthcare services as well as financial difficulties that prevent elderly people from accessing medical services (Lipsitz 2005).

Compared with Nordic and Eastern European countries, Belgium and France have medium levels of expenditure (% of GDP) on pensions and on care for elderly people (Eurostat 2016). A strong role for the family in welfare provision and moderate and low levels of old-age poverty also characterize these welfare states (Hvinden 2010; see also Table 1).

These macro-level differences are linked, with a clear East–West gradient on individual-level determinants of psychological well-being. For example, data from the GGS shows that self-rated health varies considerably, with better health in the Nordic countries, followed by Belgium and France, and with the lowest rating in the post-socialist group (Ogg 2005). Furthermore, older adults in the West are relatively more financially satisfied (Hansen and Slagsvold 2016a). In the Western countries, only 1–4% report having “great difficulties” in making ends meet—far fewer than in countries like Romania (20%), Russia (32%), Bulgaria (43%), and Georgia (43%). The living arrangements of older adults also vary considerably between countries, especially among women. Because of low life expectancy among men (Table 1), more women live alone in the Eastern European countries than elsewhere in Europe. The social network of older Eastern Europeans may also suffer due to decreasing fertility and increasing out-migration of younger adults (OECD 2012). Many older adults thus lack children and grandchildren to care for them, and when government provision falls short, they may lack resources to help them combat emotional problems.

### *Analytic strategy*

Inequalities are measured by means of absolute prevalence rate differences and relative odds ratios (OR). In multivariate models these statistics are analyzed by OLS regression and logistic regression technique, respectively. Using a linear probability model (OLS) on a binary outcome is often not recommended if the modelled probabilities are extreme (close to 0 or 1) (von Hippel 2015). This problem is not a concern in the current study, as the country-



specific prevalence of the outcome (depression) is moderate (10-40%). One concern with the use of OLS for binary outcomes is that the predicted probabilities may fall outside the range 0-1. This issue is mainly a concern for continuous variables and when the true probabilities are extreme (von Hippel 2005), and it is (as our results indicate) not a problem in the current analysis. Furthermore, OLS violates the homoscedasticity assumption. Again, this issue is less problematic with moderate probabilities, as heteroscedasticity is minor for probabilities between .20 and .80 (von Hippel 2005). Also, the homoscedasticity violation is of no consequence for the regression coefficient; it only affects the uncertainty estimate for the coefficient and thus the test of significance (Hellevik 2007; Pohlman and Leitner 2003). However, as Hellevik (2007) argues, this violation seems to be of little practical importance, as significance probabilities in the linear and loglinear models are nearly identical.

Analyses are run separately for men and women and for each country. Countries are sorted by their gross domestic product (GDP), as GDP is highly correlated with different indicators of national welfare (Table 1) and can thus be hypothesized to affect inequalities in depression. In the tables we indicate associations significant at  $p < .10$  level because of few respondents in some subgroups. However, we only treat associations at  $p < .05$  level as statistically significant. Cases with missing values (7% of the analytical sample) are deleted listwise.

## **Results**

Table 2 presents sample sizes by education, gender, and country. Note that sample sizes are quite small ( $n < 100$ ) among higher-educated women in Romania and the Czech Republic. The numbers indicate large country differences in educational level among people aged 60–80. After converting the numbers to percentages (not shown), rates of individuals with low (lower secondary or less) education are generally less than 30% in the countries of northwest Europe and 30–60% in the Eastern European countries, with higher rates among women than men in

all countries. The rates of lower educated vary from 22.7% (Norway) to 57.3% (Romania) for men and from 23.2% (Sweden) to 78.5% (Romania) for women. Average age is quite similar across gender and country subgroups, varying from 68 to 70 (not shown).

Table 2 also shows marked variation in prevalence of depressive symptoms. Prevalence rates are about twice as high among women than men in all countries, and far higher in Central and Eastern European countries than in North-Western European countries. Prevalence is highest in Georgia (21% of men and 41% of women) and lowest in Sweden (7% of men and 14% of women).

[Insert Table 2 about here]

Figure 1 (men) and Figure 2 (women) show rates of depressive symptoms by educational level of each country. Absolute educational gaps are markedly lower in North-Western than in Central and Eastern countries (see also Table 3). With only three educational groups we are unable to establish the shape of the association between education and depressive symptoms. Yet most patterns observed in Figure 1 and Figure 2 indicate that the association is linear or flattening out (i.e. that only minor differences exist between medium and high education).

[Insert Figure 1 about here]

[Insert Figure 2 about here]

Table 3 shows absolute inequalities (prevalence differences) in depressive symptoms. Education is associated with depressive symptoms in all countries, yet the strength of association is strongest in the Central and Eastern countries. Among men, the rate-difference between 'low' and 'high' educated varies from 17% in Georgia to 4% in Sweden. Among women, the rate-difference varies from 20% in Lithuania to 6% in Norway. While mid-range (vs. high) education tends to be unrelated to depression for men, mid-range education among women is associated with 9–12% higher rates of depressive symptoms in Russia, Czech

Republic, Georgia, and Lithuania. Table 3 also shows that, in a multivariate context, educational differences in depressive symptoms are mostly non-significant among men, and among women significant in Lithuania, Russia, and Georgia.

[Insert Table 3 about here]

[Insert Table 4 about here]

Table 4 presents relative inequalities for men and women. For men the relative inequalities are similar to the absolute inequalities, with larger gaps in the East. There are some notable exceptions, as ORs (low vs. high education) in Norway (2.4) and France (2.7) are very similar to those in Lithuania (2.3), Russia (2.3), and Romania (2.4). The highest ORs are observed in Georgia (2.9) and Bulgaria (3.5). An East–West divide is even less detectable among women: low vs. high education gaps in depression are almost identical in some Western (Norway, Sweden, and France) and Eastern (Russia, Romania, and Bulgaria) countries (ORs=1.6-1.9).

In a multivariate context, ORs decrease but remain significant in some countries. ORs for low education remain significant for men in Russia, Romania, Bulgaria, and Georgia, and for women in Lithuania and Georgia. Effects of mid-range (vs. high) education are no longer significant, except among men in Bulgaria and women in Lithuania and Georgia.

[Insert figures 3a–3d about here]

To explore whether educational inequalities in depression decreases in stronger welfare states, we plotted countries according to educational inequality in depression and GDP (which is strongly correlated with different welfare indicators, see Table 1). Figure 3a (men) and Figure 3b (women) plot countries according to magnitude of GDP and prevalence differences in depression between low and high education; Figure 3c and Figure 3d plot countries

similarly for ORs. As shown, absolute inequalities drop with higher GDP for men and women, whereas for the relative inequalities that pattern only holds for men.

## **Discussion**

In harmonized nationally representative data from 10 countries, we explore gender-stratified, absolute, and relative educational differences in late-life depression. We show the existence of an East–West divide not only in the prevalence of depressive symptoms but also with respect to educational disparities in these symptoms in Europe.

Depressive symptoms are up to three times as prevalent among seniors in the Eastern European countries than among those in the Nordic countries. Furthermore, in all countries examined, the prevalence is about twice as high among women than men. Among women, the prevalence ranges from 26–41% in Central and Eastern Europe, compared with 14–25% in North-Western Europe. Among men these rates are 13–21 and 7–10%, respectively. Findings likely attest to and reflect the unequal conditions of aging across Europe and indicate serious deficits in late-life quality of life in some European countries. We find that health problems and financial hardship are much more common in the East than the West and that these factors mediate a large part of the national depression gaps (cf. Hansen and Slagsvold 2016b). The higher risk of women accords with previous research and is explained—at least partly—by women’s higher rates of health problems, poverty, and widowhood (Van de Velde et al. 2010).

The fact that late-life depression varies systematically with different country-level welfare indicators suggests that social policies can have important effects on key social determinants of depression. More specifically, stronger welfare states may prevent or lower depressive symptoms by providing all social strata with better health care and social services, income and housing conditions, public transport, support to family carers, and better neighborhoods. There may also be positive spiral effects since non-depressed and happier people generally are

more socially engaged and prosocial in their behavior, which in turn may bolster mental health in their social network and community.

Macro-level factors may play an especially prominent role for people with fewer socioeconomic resources (Ladin 2008; Lundberg 2009). Although findings indicate marked educational gradients in depressive symptoms in all countries, the gradients are much steeper in the East than the West. Although women face a much higher risk of depressive symptoms, the social patterning of depression is quite similar for men and women. The largest contrast is observed between highly educated men in Scandinavia, only 4–5% of whom report depressive symptoms, and lower-educated Eastern European women, up to 45% of whom report depressive symptoms. Hence there is a “triple jeopardy” associated with being a woman, lower educated, and Eastern European.

In broad terms, the Scandinavian countries and the Eastern European countries represent the opposite ends on a spectrum of societal wealth, levels of social inequality, and welfare generosity in Europe. The smaller inequalities in depression in the Nordic countries suggest that the welfare state is a major determinant of the patterning of inequalities in mental health, and that policies may help to protect against the risk of depression or postpone problems leading to depressed mood. This pattern may be especially pronounced for those particularly dependent on the state to cover their basic needs; the older, the disabled, the less educated (especially when these characteristics coincide).

Cross-country patterns of inequalities differ when measured on absolute and relative scales. The *relative* educational inequalities show a weaker or less consistent pattern across regions and welfare states, at least among women. Why are absolute and relative inequalities different? Part of the reason seems to be the general tendency for relative measures to increase when the overall prevalence of a phenomenon decreases (Eikemo et al. 2009; Houweling et

al. 2007; Scanlon 2006). Hence, social planners may find it difficult, but not impossible (Eikemo et al. 2009), to achieve both low rates and low relative disparities.

Conclusions about success in decreasing inequality are apparently highly dependent on how we define health inequalities. For example, while Norway clearly has smaller absolute inequalities than Romania, the two countries come out very similarly in terms of relative inequalities. Based on absolute levels and inequalities, Norway is arguably more successful in terms of decreasing social inequality in depressive symptoms. We would expect most observers to assess the scenario in Norway as better than that in Romania, and to deem it progress if Romania, with time, was to display the pattern observed in Norway.

It seems that relative measures can be misleading for conclusions regarding welfare policies, at least if used as a single measure of inequality. In our view, absolute inequalities give a more accurate impression of what is going on in each country and are a better indicator of social progress. It also seems that absolute rates should matter most for people in lower socio-economic groups and that smaller absolute inequalities are preferable even if they coincide with large relative inequalities (Mackenbach 2015). Furthermore, as Lundberg (2009) argues, the remaining health inequalities in the Nordic countries are driven by the exceptionally low health risks among higher-educated individuals, a fact that is hardly a public health problem. Insofar as Nordic welfare policies have contributed to lower depression risks among higher social strata they must be regarded as a success, despite the fact that there are still inequalities that need our attention (Lundberg, 2009). Perhaps depression among more highly-educated elderly people is reaching a level below which it is difficult to decline further without new breakthroughs in prevention or treatment. In conclusion, we echo and support Mackenbach's (2015) reply to the question of whether we should aim to reduce relative or absolute inequalities: "Well, both if possible, but count your blessings when only absolute inequalities go down."

Are there independent and unexplained effects of education once “downstream” correlates of education are accounted for? Educational gradients are, across all countries, partly mediated by known predictors of depression, and in particular health problems and financial hardship. In some countries there is substantial unexplained educational variation in depression, which suggests that education may have a direct effect (“knowledge effect”) on depression. Education may give access to knowledge resources and skills relating to healthy life style, health-damaging behaviors, and opportunities and rights regarding access to health services (Vöörman and Helemae 2015). A different interpretation is that there are intervening variables unaccounted for. For example, because of data limitations, we were unable to account for the tendency of higher social strata to have a larger and more supportive social network (Pinquart and Sörensen 2001). Another factor concerns feelings of control. It is well documented that societal changes since the 1990s have engendered feelings of lack of control among many Eastern Europeans (Carlson 1998; Lundberg et al. 2007). These feelings and their impact on depression may be more serious in lower social strata.

This study has a number of other limitations. We are, for example, unable to explore the role of welfare state spending. To what extent and by what mechanisms can welfare state spending affect depression and the socioeconomic variation thereof? To answer such questions we need more countries to analyze and adopt a multilevel analytical framework. We are also limited in that we are analyzing only one time point. Although education is normally completed in early adulthood, we may not completely avoid reverse causation problems. Depression among older adults could be related both to education and to mental health in adolescence and early adulthood. Although the literature indicates that causation is more important than selection processes (Dudal and Bracke 2016), we cannot ignore that part of our findings might result from selection effects. Also, there is likely important between-country variation, especially among the Eastern European countries, that we have not addressed. Post-

socialist countries exhibit great diversity in terms of economic development and reforms, welfare provisions, and public expenditure on social care for older people (Botev 2012).

Furthermore, the study's broad international scope raises issues of data comparability. Despite extensive harmonization efforts (Vikat et al. 2007), country comparisons may be biased by differences in data collection, population coverage, operationalization, and time-period covered. One potential caveat concerns the different timing of data collection with respect to the economic recession. Social gradients in depression may be affected by how strongly the country is hit and by the timing of data collection with respect to the peak of the crisis (usually around 2008–2010). This influence on the overall conclusions should be limited, however, as only two countries (Belgium and Sweden) collected the bulk of the data after 2008. We are also concerned that different response rates, because they affect selection bias, may influence our findings. Because of the inevitable selection of healthier individuals in surveys, prevalence of depression is likely underestimated. In addition, because in all countries investigated lower-educated people are underrepresented (Fokkema et al. 2014), there may be a stronger selection bias in lower-educated groups. This may contribute to underestimate educational gradients in depression. More importantly, this bias may be stronger in countries with lower response rates. However, the fact that some of the countries with the lowest response rates (Lithuania, Czech Republic, and Russia) have gradients similar to that of other countries in the same region suggests that this potential caveat is unlikely to affect our main conclusions.

Another potential caveat concerns the cross-national equivalence of the depression measure and the threshold used to indicate depression. Although the CES-D appears to be highly reliable and valid across cultures, the cross-national measurement invariance of the scale has not been established for the scale version and countries in the GGS. The wide cross-national variability in prevalence in depression and educational differences thereof are



presumed to result from substantive factors, yet they could also reflect measurement factors such as differences in the construct and threshold for depression.

The reader should also be aware of potential methodological weaknesses with regard to the multivariate analyses. Caution is warranted due to the non-collapsibility of the odds ratios, which has implications for the adjusted odds ratios and their comparability across countries. Due to non-collapsibility, odds ratios may change value (from unadjusted to adjusted models) even in the absence of statistical mediation, especially when the outcome is moderate-high (the non-collapsibility effect disappears as the baseline risk approaches 0) (Hauck et al. 1998). The size of the adjusted odds ratios should thus be treated with caution (particularly in countries with high depression rates). The reader should also be aware of limitations of the OLS approach to mediation. Because of its correlational design, the direction of causality is unknown and unobserved variables could be responsible for the proposed effects. Further, OLS is unable to control for measurement error. We are unable to estimate the form, magnitude, and influence of measurement error in this study. Overall, as argued, the above limitations do not seem to threaten the validity of our main findings.

Despite its shortcomings, we believe the present study has many strengths that help make it a unique and important contribution. Among those strengths is the fact that the analysis is based on data derived from a large, population-based study from 10 European countries, including several countries from the under-researched Eastern Europe. Another advantage is the assessment of depressive symptoms by means of an established and validated instrument, and the attention to both absolute and relative inequality.

On that basis our findings have important implications for gerontologists, practitioners, and policymakers. This study shows an East–West divide, with higher rates of late-life depression and associated educational gradients in the East. Developing policies and interventions that effectively target the structural and immediate determinants of inequalities

in depression should thus be a priority (Mackenbach et al. 2008). Inequalities may be reduced, for example, by improving educational opportunities, income distribution, health-related behavior, and opportunities for effective and affordable treatment. For Eastern European countries at a time of great economic strain, it will be a challenge to keep reduction of health inequalities as a high governmental priority, but this challenge needs to be met if both population health and health inequalities are to be improved. Our findings also indicate that initiatives to address health inequalities in the East should pay particular attention to gender as the risk of depression among lower educated Eastern European women is up to ten times higher than that of higher educated men in North-Western Europe.

## References

- Blazer DG (2003) Depression in late life: Review and commentary. *J Gerontol a-Biol*, 58: 249-265.
- Bobak M (2009) CEE countries: Data availability and methodological issues. *Eurohealth*, 15:14-16.
- Botev N (1999). The political economy of population ageing. *Eur J Popul*, 15:204-205.  
doi:10.1023/A:1006276131182
- Botev N (2012) Population ageing in Central and Eastern Europe and its demographic and social context. *Eur J Ageing* 9:69-79. doi:10.1007/s10433-012-0217-9
- Carlson P (1998) Self-perceived health in East and West Europe: Another European health divide. *Soc Sci Med*, 46:1355-1366. doi:10.1016/S0277-9536(97)10093-4
- Castro-Costa E, Dewey, M, Stewart, R, Banerjee, S, Huppert, F, Mendonca-Lima, C, Prince, M. (2007). Prevalence of depressive symptoms and syndromes in later life in ten European countries: the SHARE study. *Br J Psychiatry*, 191:393-401.  
doi:10.1192/bjp.bp.107.036772
- Chang-Quan H, Zheng-Rong, W, Yong-Hong, L, Yi-Zhou, X, Qing-Xiu, L (2010) Education and risk for late life depression: A meta-analysis of published literature. *Int J Psychiat Med*, 40:109-124. doi:10.2190/Pm.40.1.I
- Dahl E, van der Wel, KA (2013) Educational inequalities in health in European welfare states: A social expenditure approach. *Soc Sci Med*, 81:60-69.  
doi:10.1016/j.socscimed.2012.12.010
- d'Uva TB, O'Donnell O, van Doorslaer E (2008) Differential health reporting by education level and its impact on the measurement of health inequalities among older Europeans. *Int J Epi*, 37:1375-1383.

- Dudal P, Bracke, P (2016) Absolute and relative educational inequalities in depression in Europe. *Int J Public Health*. doi:10.1007/s00038-016-0837-5
- Eikemo TA, Skalicka, V, Avendano, M (2009) Variations in relative health inequalities: Are they a mathematical artefact? *Int J Equity Health*, 8 (32). doi:10.1186/1475-9276-8-32
- EU, WHO (2002) Health status overview for countries of central and eastern Europe that are candidates for accession to the European Union. Copenhagen: WHO.
- Eurostat (2016) Social protection statistics. Eurostat database.
- Fokkema T, Kveder, A, Liefbroer, A (2014) Report and recommendations for sample and data adjustment procedures. GGP (deliverable).
- Fryers T, Melzer, D, Jenkins, R, Brugha, T (2005) The distribution of the common mental disorders: Social inequalities in Europe. *Clin Pract Epidemiol Ment Health*, 1:14. doi:10.1186/1745-0179-1-14
- Hansen T. (2012). Parenthood and Happiness: A review of folk theories versus empirical evidence. *Soc Ind Res*, 108:29-64. doi:10.1007/s11205-011-9865-y
- Hansen T, Slagsvold, B (2016a) Late-life loneliness in 11 European countries: Results from the Generations and Gender Survey. *Soc Ind Res*, 124:1-20.
- Hansen T, Slagsvold, B (2016b) Depression among seniors in Western and Eastern Europe. *Scand Psychologist* (submitted).
- Hauck W, Anderson S, Marcus S (1998) Should we adjust for covariates in nonlinear regression analyses of randomized trials? *Contr Clin Trials*, 19: 249–256.
- Hellevik O (2009) Linear versus logistic regression when the dependent variable is a dichotomy. *Qual Quant*, 43:59-74. doi:10.1007/s11135-007-9077-3
- Houweling TA, Kunst, AE, Huisman, M, Mackenbach, JP (2007) Using relative and absolute measures for monitoring health inequalities: Experiences from cross-national analyses on maternal and child health. *Int J Equity Health*, 6, 15. doi:10.1186/1475-9276-6-15

- Hu Y, van Lenthe, FJ, Borsboom, GJ, Looman, CW, Bopp, M, Burstrom, B, Mackenbach, JP (2016) Trends in socioeconomic inequalities in self-assessed health in 17 European countries between 1990 and 2010. *J Epi Comm Health*, 70:644-652. doi:10.1136/jech-2015-206780
- Hvinden B (2010) The Nordic welfare model and the challenge of globalisation. In Böss, M (ed) *The nation state in transformation: Economic globalisation, institutional mediation and political values*. Århus: University Press
- Iecovich E, Barasch, M, Mirsky, J, Kaufman, R, Avgar, A, Kol-Fogelson, A (2004) Social support networks and loneliness among elderly Jews in Russia and Ukraine. *J Marr Family*, 66:306-317. doi:10.1111/j.1741-3737.2004.00022.x
- Knesebeck OV, Wahrendorf, M, Hyde, M, Siegrist, J (2007) Socio-economic position and quality of life among older people in to European countries: Results of the SHARE study. *Ageing Soc*, 27:269-284.
- Ladin K (2008) Risk of late-life depression across 10 European Union countries: Deconstructing the education effect. *J Aging Health*, 20:653-670. doi:10.1177/0898264308321002
- Ladin K, Daniels, N, Kawachi, I (2010) Exploring the relationship between absolute and relative position and late-life depression: Evidence from 10 European countries. *Gerontologist*, 50:48-59. doi:10.1093/geront/gnp065
- Levecque K, Van Rossem, R, De Boyser, K, Van de Velde, S, Bracke, P (2011) Economic hardship and depression across the life course: The impact of welfare state regimes. *J Health Soc Behav*, 52:262-276. doi:10.1177/0022146510394861
- Lipsitz LA (2005) The elderly people of post-soviet Ukraine: Medical, social, and economic challenges. *J Am Geriatr Soc*, 53:2216-2220. doi:DOI 10.1111/j.1532-5415.2005.00488.x

- Lorant V, Deliege, D, Eaton, W, Robert, A, Philippot, P, Anseau, M (2003) Socioeconomic inequalities in depression: A meta-analysis. *Am J Epidemiol*, 157:98-112.  
doi:10.1093/Aje/Kwf182
- Lundberg J, Bobak, M, Malyutina, S, Kristenson, M, Pikhart, H (2007) Adverse health effects of low levels of perceived control in Swedish and Russian community samples. *Bmc Public Health*, 7. doi:Artn 31410.1186/1471-2458-7-314
- Lundberg O (2009) How do welfare policies contribute to the reduction of health inequalities? *Eurohealth*, 15:24-27.
- Lundberg O, Yngwe, MA, Stjerne, MK, Elstad, JI, Ferrarini, T, Kangas, O, Fritzell, J (2008) The role of welfare state principles and generosity in social policy programmes for public health: An international comparative study. *Lancet*, 372:1633-1640.  
doi:10.1016/S0140-6736(08)61686-4
- Mackenbach JP (2015) Should we aim to reduce relative or absolute inequalities in mortality? *Eur J Public Health*, 25:185-185. doi:10.1093/eurpub/cku217
- Mackenbach JP, Kulhanova, I, Menvielle, G, Bopp, M, Borrell, C, Costa, G, Lundberg, O (2015) Trends in inequalities in premature mortality: A study of 3.2 million deaths in 13 European countries. *J Epi Comm Health*, 69:207-217.
- Mackenbach JP, Kunst, AE (1997) Measuring the magnitude of socio-economic inequalities in health: An overview of available measures illustrated with two examples from Europe. *Soc Sci Med*, 44:757-771. doi:10.1016/S0277-9536(96)00073-1
- Mackenbach JP, Stirbu, I, Roskam, AJ, Schaap, MM, Menvielle, G, Leinsalu, M, Kunst, AE (2008) Socioeconomic inequalities in health in 22 European countries. *N Engl J Med*, 358:2468-2481. doi:10.1056/NEJMsa0707519
- Masseria C (2009) Health inequality: Why it is important and can we actually measure it? *Eurohealth*, 15:4-7.

- McDowell I (2006) *Measuring health: A guide to rating scales and questionnaires*. New York: Oxford University Press.
- Miech RA, Shanahan, MJ (2000) Socioeconomic status and depression over the life course. *J Health Soc Behav*, 41:162-176. doi:10.2307/2676303
- Missinne S, Vandeviver, C, Van de Velde, S, Bracke, P (2014) Measurement equivalence of the CES-D 8 depression-scale among the ageing population in eleven European countries. *Soc Sci Res*, 46:38-47. doi:10.1016/j.ssresearch.2014.02.006
- Moor N, Komter, A (2012) Family ties and depressive mood in Eastern and Western Europe. *Demographic Res*, 27:201-232.
- Niedzwiedz C, Katikireddi, SV, Pell, J, Mitchell, R (2014) Socioeconomic inequalities in the quality of life of older Europeans in different welfare regimes. *Eur J Public Health*, 24:364-370.
- O'Donnell O (2009) Measuring health inequalities in Europe: Methodological issues in the analysis of survey data. *Eurohealth*, 15:10-14.
- OECD (2012) *International migration outlook 2014*. OECD Publishing.
- Ogg J (2005) Social exclusion and insecurity among older Europeans: The influence of welfare regimes. *Ageing Soc*, 25:69-90. doi:10.1017/S0144686X04002788
- Pinquart M, Sörensen, S (2001) Influences on loneliness in older adults: A meta-analysis. *Basic Appl Soc Psychol*, 23:245-266.
- Ploubidis GB, Grundy, E (2009) Later-life mental health in Europe: A country-level comparison. *J Gerontol B-Psychol*, 64:666-676. doi:10.1093/geronb/gbp026
- Pohlman, JT, Leitner, DW (2003) A comparison of ordinary least squares and logistic regression. *Ohio J Science*, 103: 118-125.
- Radloff LS (1977) The CES-D scale: A self-report depression scale for research in the general population. *Appl Psychol Meas*, 1:385-401.

- Rodda J, Walker, Z, Carter, J (2011) Depression in older adults. *Brit Med J*, 343. doi:Artn D521910.1136/Bmj.D5219
- Scanlon JP (2006) Can we actually measure health disparities? *Chance*, 19:47-51.
- Shafer AB (2006) Meta-analysis of the factor structures of four depression questionnaires: Beck, CES-D, Hamilton, and Zung. *J Clin Psychol*, 62:123-146.
- Sobocki P, Jonsson, B, Angst, J, Rehnberg, C (2006) Cost of depression in Europe. *J Ment Health Policy*, 9:87-98.
- Spinakis A, Anastasiou, G, Panousis, V, Spiliopoulos, K (2011) Expert review and proposals for measurement of health inequalities in the European Union – Full report. Luxembourg: European Commission Directorate General for Health and Consumers.
- Van de Velde S, Bracke, P, Levecque, K (2010) Gender differences in depression in 23 European countries. Cross-national variation in the gender gap in depression. *Soc Sci Med*, 71:305-313. doi:10.1016/j.socscimed.2010.03.035
- Von Hippel, P (2015) Linear vs. Logistic Probability Models: Which is Better, and When? *Statistical Horizons* (accessed 15 January 2017 from [statisticalhorizons.com](http://statisticalhorizons.com)).
- Vikat A, Speder, Z, Beets, G, Billari, FC, Buhler, C, Desesquelles, A, Solaz, A (2007) Generations and Gender Survey (GGS): Towards a better understanding of relationships and processes in the life course. *Demographic Res*, 17:389-439.
- Vöörman R, Helemae J (2015) Educational inequalities in self-rated health: Whether post-socialist Estonia and Russia are performing better than ‘Scandinavian’ Finland. *Cent Eur J Public Health*, 23:8-13.
- WHO (2008) Closing the gap in a generation: Health equity through action and the social determinants of health. Geneva: WHO.



Zhao KX, Huang, CQ, Xiao, Q, Gao, Y, Liu, QX, Wang, ZR, Xie, YZ (2012) Age and risk for depression among the elderly: A meta-analysis of the published literature. *Cns Spectr*, 17:142-154. doi:10.1017/S1092852912000533

**Table 1** Country characteristics: demographic and economic indicators (countries ordered by size of GDP)

	Norway	Sweden	Belgium	France	Czech	Lithuania	Russia	Romania	Bulgaria	Georgia
Life expectancy at birth										
Men	78.3	78.9	77.6	77.4	74.0	64.9	61.8	69.7	69.5	69.3
Women	82.7	83.0	83.0	84.4	80.3	77.2	74.2	77.2	76.6	76.7
Life expectancy at age 65										
Men	17.4	17.8	16.9	18.2	15.2	12.9	11.7	14.0	13.2	13.1
Women	20.6	20.6	20.5	22.5	18.6	17.9	16.1	17.2	16.4	15.7
Sex ratio, age 65+ (males per female) <sup>a</sup>	0.76	0.85	0.72	0.74	0.67	0.53	0.44	0.68	0.68	0.66
Fertility rate (TFR)	1.9	1.9	1.8	2.0	1.4	1.4	1.4	1.3	1.4	1.8
Net migration rate (in-migrants per 1000 population) <sup>b</sup>	7	5	6	2	6	-10	3	-1	-2	-7
Poverty rate age 65+ <sup>c</sup>	9.7	16.5	17.8	9.4	5.8	19.4	NA	15.4	28.2	NA
GINI (after taxes and transfers) <sup>d</sup>	25.8	24.3	33.0	32.7	26.2	37.6	42.3	31.2	28.2	42.1
GDP per capita PPP (in US\$)	49416	43709	33544	30595	23223	16400	14706	11062	10571	4586

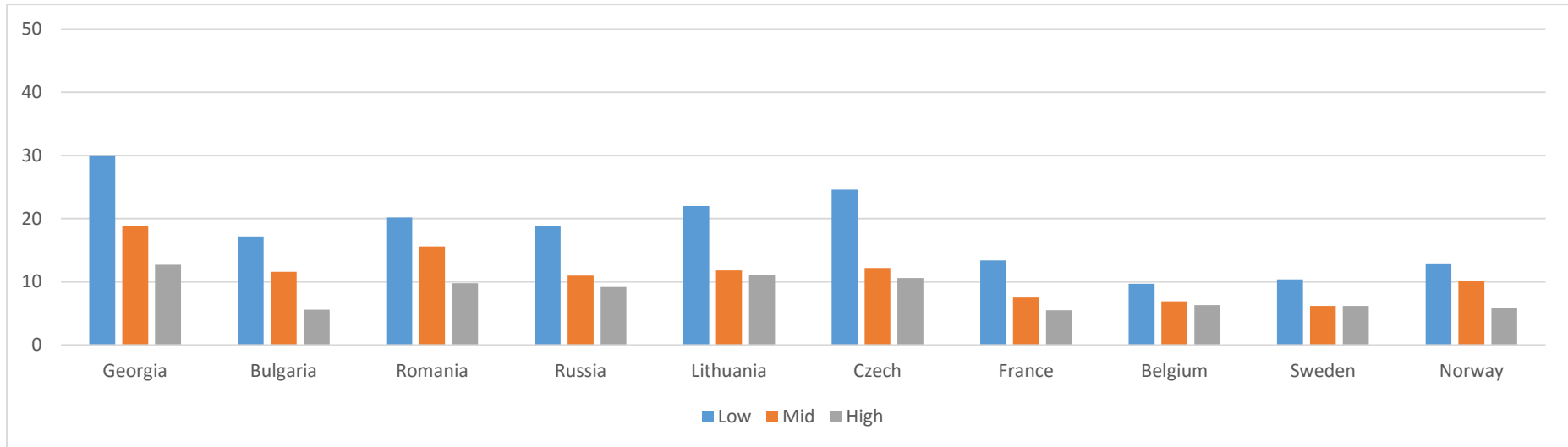
Public health expenditure (% of GDP)	7.5	7.4	7.0	8.7	5.8	4.5	3.5	3.8	4.2	1.5
Public pensions expenditure (% of GDP)	7.8	11.8	10.7	13.3	8.2	6.6	NA	6.4	7.3	NA

Source: Generations and Gender Survey, Contextual Database 2005–2008; <sup>a</sup> Central Intelligence Agency (CIA) World Factbook 2014; <sup>b</sup> United Nations, World population prospects 2014; <sup>c</sup> Eurostat 2013–2014; <sup>d</sup> The World Bank 2008–2013.

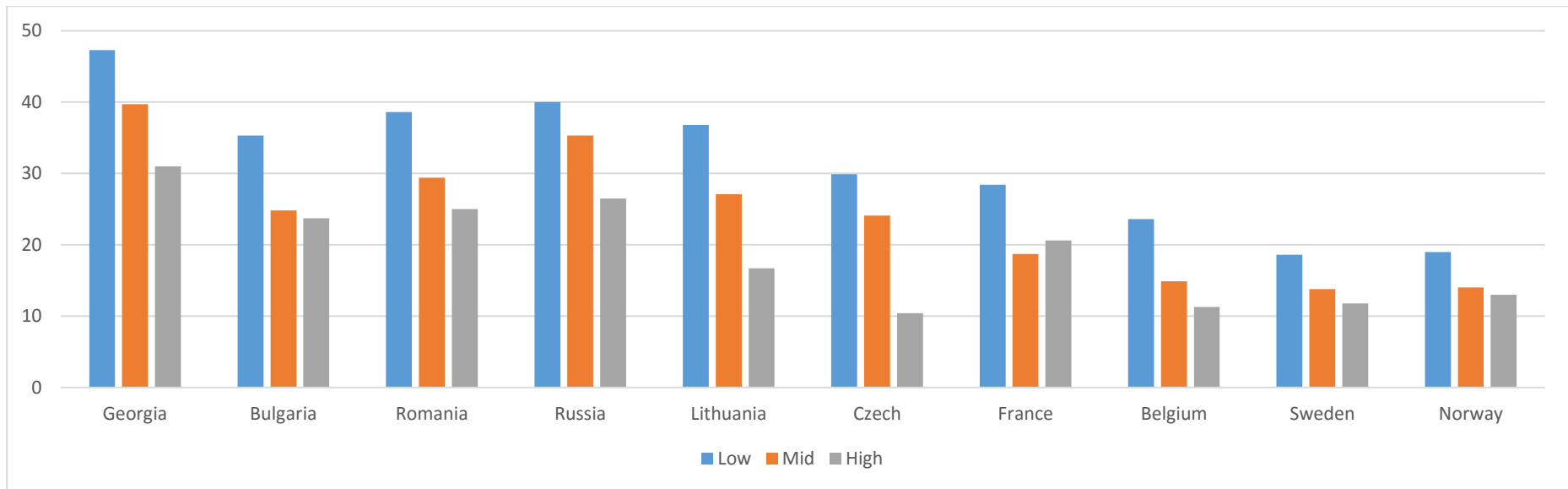
Notes: NA=Not available.

**Table 2** Country-specific response rates (RR), sample sizes by gender and education, and rates of depressive symptoms (age 60–80)

	RR (%)	Sample sizes by education—Men (N)				Sample sizes by education—Women (N)				Depressive symptoms (%)	
		Low	Medium	High	Total	Low	Medium	High	Total	Men	Women
Belgium	41.8	413	220	240	873	494	202	205	901	8.0	19.0
Bulgaria	74.9	617	396	250	1263	681	386	178	1245	13.4	30.7
Czech	42.0	252	643	152	1047	532	666	68	1266	14.7	25.8
France	66.3	614	386	182	1182	936	358	155	1449	10.2	25.2
Georgia	71.5	291	417	221	929	476	663	268	1407	20.9	40.6
Lithuania	36.3	732	416	205	1353	754	584	193	1531	17.2	30.6
Norway	60.4	425	933	511	1869	527	911	410	1848	9.6	14.9
Romania	97.0	949	584	123	1656	1540	347	76	1963	17.8	36.5
Russia	44.8	377	238	218	833	902	456	585	1943	14.2	34.6
Sweden	54.6	352	662	337	1351	330	628	464	1422	7.3	14.1
Total	67.5	5022	4895	2439	12356	7172	5201	2602	14975	14.0	29.8



**Figure 1** Rates of depression (%) by education (low, mid-range, high) and country: men aged 60–80 (countries ordered by size of GDP)



**Figure 2** Rates of depression (%) by education (low, mid-range, high) and country: women aged 60–80 (countries ordered by size of GDP)

**Table 3** Unadjusted and adjusted OLS of depression (0/1) on education, by country and gender (countries ordered by size of GDP)

	Men				Women			
	Unadjusted model		Adjusted model <sup>a</sup>		Unadjusted model		Adjusted model <sup>a</sup>	
	Low education	Mid-range education	Low education	Mid-range education	Low education	Mid-range education	Low education	Mid-range education
Norway	0,07 **	0,04 *	0,03	0,02	0,06 *	0,01	0,03	0,00
Sweden	0,04 †	0,00	0,02	0,00	0,07 *	0,02	0,03	0,00
Belgium	0,04	0,01	-0,01	-0,01	0,12 **	0,03	0,06 †	-0,01
France	0,08 **	0,02	0,04	-0,01	0,08 *	-0,02	0,04	-0,05
Czech	0,15 **	0,03	0,05	0,00	0,18 **	0,12 *	0,09 †	0,07
Lithuania	0,11**	0,01	0,03	-0,02	0,20 **	0,11 **	0,11 **	0,09 *
Russia	0,09 **	0,01	0,06 *	0,00	0,14 **	0,09 **	0,07 *	0,04 †
Romania	0,11 **	0,06 †	0,06 †	0,03	0,14 *	0,04	0,02	-0,02
Bulgaria	0,10 **	0,04 †	0,06 *	0,04	0,09 **	-0,02	0,01	-0,04
Georgia	0,17 **	0,06 †	0,09 *	0,03	0,16 **	0,09 *	0,13 **	0,07 *
Pooled	0,10**	0,03**	0,04 **	0,01	0,14**	0,06**	0,07 **	0,02 *

Notes: High education is used as reference category; <sup>a</sup> Multivariate model adjusting for age, disability, financial hardship, children, and marital status; † < .10; \* p< .05; \*\* p< .01.

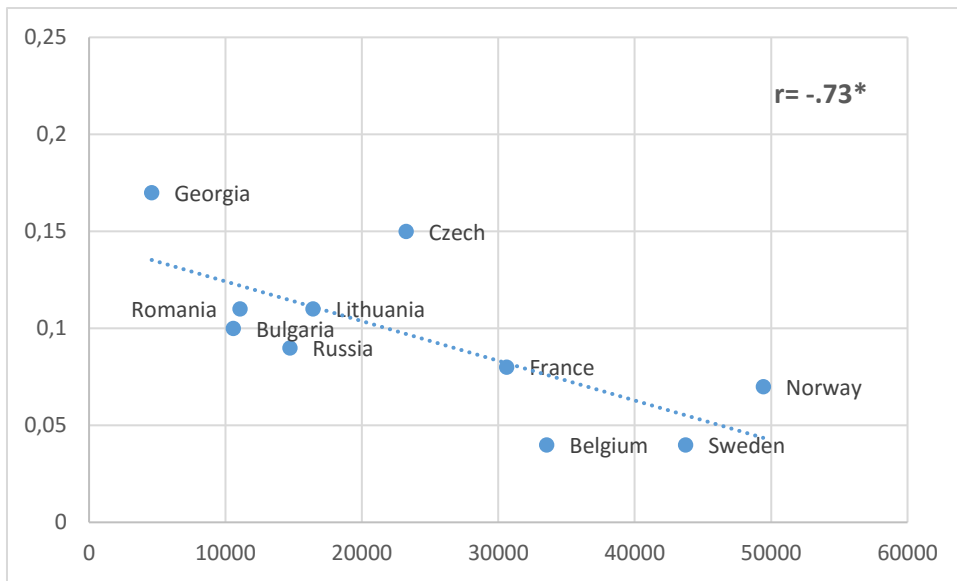


**Table 4** Bivariate and multivariate odds ratios of depression by education and country (countries ordered by size of GDP)

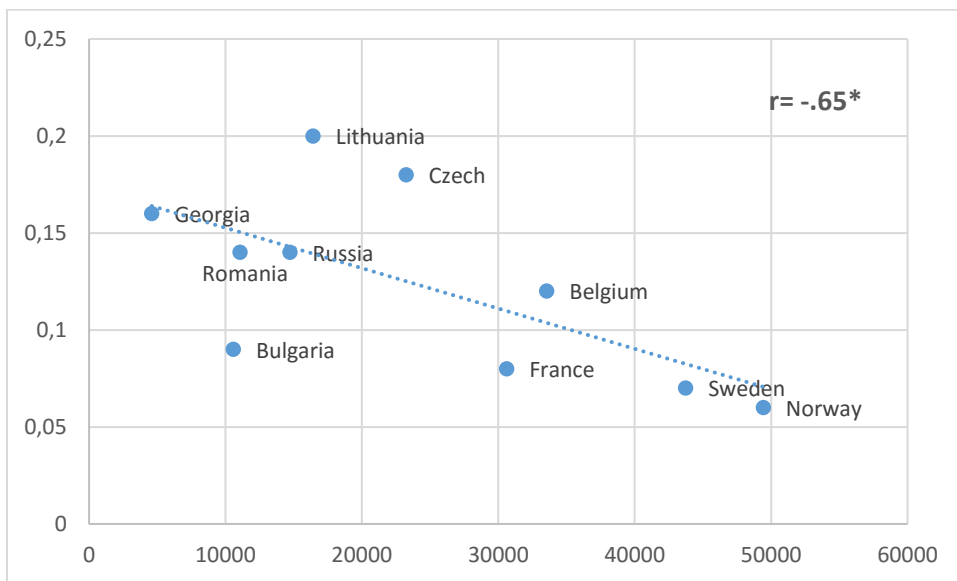
	Men				Women			
	Unadjusted model		Adjusted model <sup>a</sup>		Unadjusted model		Adjusted model <sup>a</sup>	
	Low education	Mid-range education	Low education	Mid-range education	Low education	Mid-range education	Low education	Mid-range education
Norway	2,36 **	1,82 *	1,59 †	1,58 †	1,57 *	1,09	1,22	0,92
Sweden	1,76 †	1,01	1,33	1,21	1,71 *	1,20	1,10	1,01
Belgium	1,61	1,10	1,00	0,83	2,42 **	1,37	1,61 †	1,07
France	2,65 **	1,40	1,82	1,00	1,53 *	0,89	1,26	0,75
Czech	2,75 **	1,17	1,60	0,95	3,66 **	2,73 *	2,09 †	1,96
Lithuania	2,27 **	1,08	1,32	0,87	2,91 **	1,86 **	2,09 **	1,82 *
Russia	2,31 **	1,22	2,00 *	1,02	1,86 **	1,52 **	1,38 *	1,25
Romania	2,35 **	1,71 †	2,00 *	1,64	1,90 *	1,25	1,16	0,87
Bulgaria	3,50 **	2,21 *	2,69 **	2,27 *	1,76 **	1,06	1,09	0,79
Georgia	2,94 **	1,61 *	2,00 **	1,39	2,00 **	1,47 *	1,96 **	1,46 *

Pooled	2.51 **	1,62 **	1,73 **	1,32 **	2,45 **	1,49 **	1,53 **	1,19 *
--------	---------	---------	---------	---------	---------	---------	---------	--------

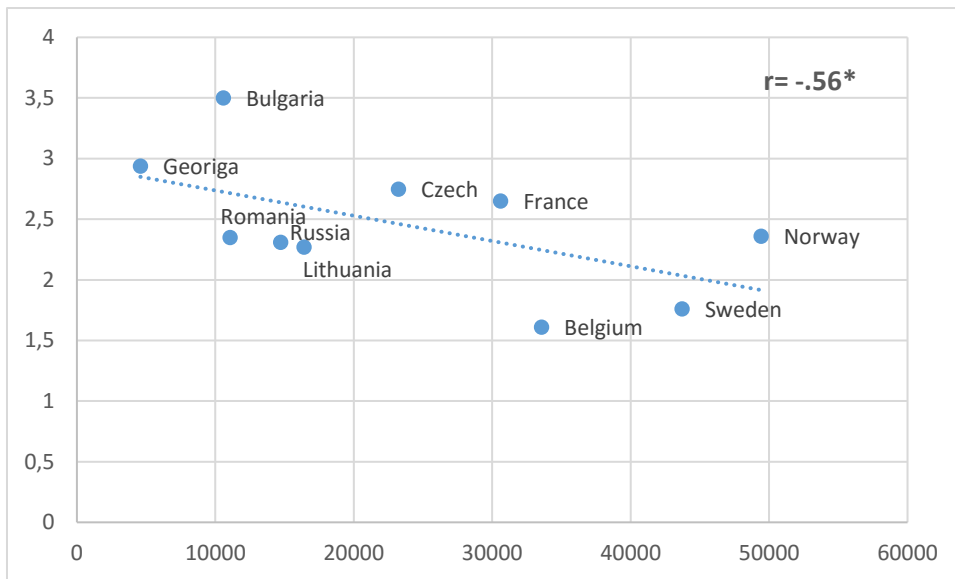
Notes: High education is used as reference category; <sup>a</sup> Multivariate model adjusting for age, disability, financial hardship, children, and marital status; † < .10; \* p< .05; \*\* p< .01.



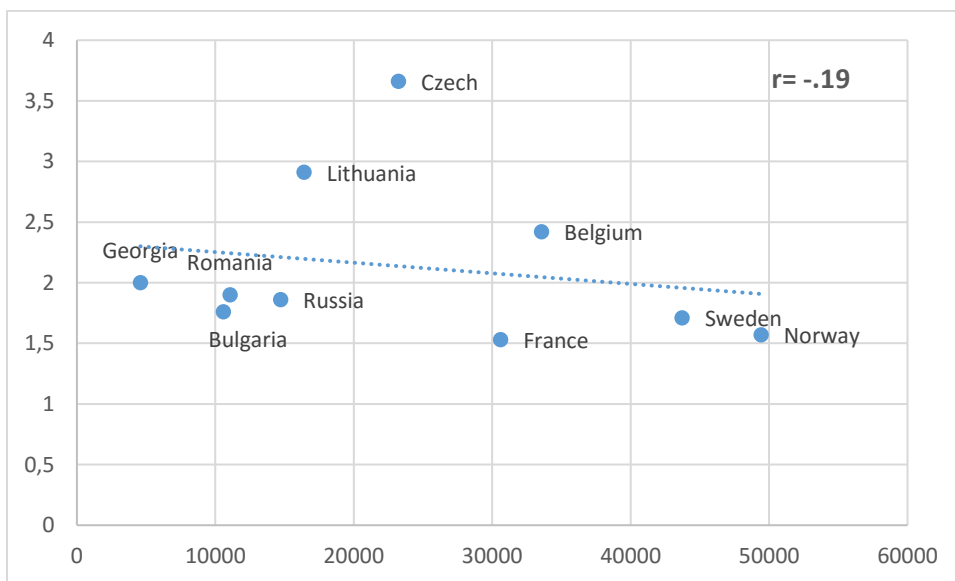
**Figure 3a** Relationship between GDP (x-axis) and the prevalence difference of depression (low vs. high education): men



**Figure 3b** Relationship between GDP (x-axis) and the prevalence difference of depression (low vs. high education): women



**Figure 3c** Relationship between GDP (x-axis) and ORs of depression (low vs. high education): men



**Figure 3d** Relationship between GDP (x-axis) and ORs of depression (low vs. high education): women