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Original Research Article

Ethnic variation in self-rated health–mortality association: Results from a 17-year follow-up study in Estonia

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ABSTRACT

Background and aim: Previous research has highlighted the role of self-rated health (SRH) as an important predictor of mortality. With substantial ethnic differences in SRH and mortality reported in Estonia, this study aims to examine the ethnic variation in SRH–mortality association in this setting.

Materials and methods: The baseline data come from the nationally representative 1996 Estonian Health Interview Survey. Individual records of 3983 respondents in the 25–79 age group were linked with mortality data with 17 years follow-up time. The association between SRH and all-cause mortality was analyzed using the Cox regression for two ethnic groups and separately for men and women.

Results: Among ethnic Estonians, both men and women with bad or very bad SRH had about 60% higher mortality compared to those with good or very good SRH even after adjustment for age, socioeconomic and health-related variables. In contrast, SRH did not predict mortality among non-Estonian men and women. A strong and universal inverse association with mortality was found for personal income. Education (among men) and occupation (among women) predicted mortality only among non-Estonians, whereas ever smoking was associated with mortality in Estonian men and women. Overweight women had lower mortality risk compared to women in normal weight category.

Conclusions: We found considerable ethnic variation in SRH–mortality association and in socioeconomic predictors of mortality. Further research, preferably focusing on cause-specific mortality and reporting heterogeneity of SRH could potentially shed further light on ethnic differences in SRH–mortality association in Estonia and more generally on socioeconomic inequalities in mortality in Eastern Europe.

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1. Introduction

Self-rated health (SRH), a commonly used measure of individual health status, has proven to be a reliable and valid predictor of subsequent mortality [1] even after controlling for a wide range of objective health markers [2,3]. Poor SRH at the baseline has been associated with elevated mortality risk also in studies with 20–30 years of follow-up data [4,5]. Although the association with mortality indicates the biological basis underlying subjective health evaluations, previous research suggests that socioeconomic variables influence SRH, in that adverse socioeconomic profiles are generally associated with poorer health assessment. This observation generally extends to the association between SRH and mortality but the results have varied between the studies. While some studies have shown little to no variation in SRH–mortality association by occupational class [6], education [5], or income [7], substantial socioeconomic differences have been reported by others [8–10].

It is well documented that ethnic or racial minorities tend to report poorer health than general population. While a range of individual and social characteristics can influence health evaluation frameworks [11], the lower health ratings of ethnic minorities have also been attributed to the differences in socioeconomic status [12,13]. The magnitude of socioeconomic inequalities has been found to be larger for baseline SRH than for subsequent mortality [14]. Similarly, the previous research has shown that ethnic minorities often report worse baseline SRH but have similar risk of mortality compared to general population [10,15,16]. At least partly, these variations can be explained by socioeconomic and cultural differences in subjective health assessments [16–19]. Given the claims for nearly universal association between SRH and mortality outcomes [20], the likely ethnic differences in SRH–mortality association have remained relatively little researched.

Previous studies from Eastern Europe [21–23] have reported large socioeconomic inequalities in SRH. In Estonia, belonging to a minority ethnic group, being low educated or having low personal income were independently related to poor SRH [24]. Similarly strong educational and ethnic gradient has been reported for mortality, although the magnitude of the association varied by causes of death [25,26]. Only few studies have looked the association between SRH and mortality in this setting. A Dutch–Lithuanian comparative study [27] found that poor SRH predicted mortality risk in both cohorts even after adjustment for a wide range of socio-demographic variables and cardiovascular risk factors. Similar association was reported for Russia [28]. A recent study [29] from Estonia, while analyzing predictors of mortality by levels of SRH, found that ethnicity was related to mortality only for good SRH. Although these results generally confirm that SRH predicts mortality risk also in Eastern Europe, the possible variation in the association between SRH and mortality in different ethnic groups has, to the best of our knowledge, not been investigated in this setting.

This study aims to further explore SRH–mortality association in Estonia and extends on the findings of previous studies reporting large socioeconomic disparities in SRH and mortality in Eastern Europe. More specifically the study will assess whether the association between SRH–mortality varies between ethnic Estonians and other ethnic groups. Furthermore, we will analyze which socioeconomic and health-related determinants may explain the SRH–mortality association in both ethnic groups.

2. Materials and methods

2.1. Data

The baseline data for this longitudinal study come from the Estonian Health Interview Survey (EHIS), a nationally representative cross-sectional survey among 15–79 year olds, carried out as face-to-face interviews in Estonian or in Russian between November 1996 and February 1997. In total, 4711 interviews were completed with adjusted response rate of 84.3%. Details on the survey are available elsewhere [30]. For vital status, the data were linked to the Population Registry using personal ID numbers with the date of death or emigration marking the end of follow-up. The respondents were followed up for max 17.3 years, until December 31, 2013. During the follow-up time, 115 individuals had emigrated. The overall attrition rate was 1.2%, with main reason being missing records in the Population Registry; these cases were right censored in the analysis. Current study uses data of 3983 respondents who were 25–79 years old at baseline (1778 men and 2205 women). Of those respondents, 1465 had died during the follow-up (965 deaths among ethnic Estonians and 500 deaths in other ethnic groups). The study protocol was approved by the Tallinn Medical Research Ethics Committee (Approval No. 456; 14.11.2013).

2.2. Measures

A single question: ''How would you evaluate your health status?'' was used to measure SRH and the response options were trichotomized into categories of (1) very good/good, (2) average, and (3) bad/very bad self-rated health. Respondents' socio-demographic characteristics covered age (at the baseline), gender and ethnicity. Ethnicity is based on self-reported ethnic identity and was aggregated into subcategories of (1) Estonians and (2) other ethnic groups (hereafter called non-Estonians), where Russians, Ukrainians and Belarusians had the largest share. Education, income, and occupation were used to specify respondents' socioeconomic status at the baseline. Education indicates the highest level of education obtained and was categorised as (1) tertiary (with 15–16 years of schooling on average), (2) upper secondary (10–14 years), and (3) lower secondary or less education. Income refers to the average personal monthly net income (converted from *kroons*) and was divided into quartiles with the cut-off points of 144.2, 72.4 and 58.8 Euros respectively. Occupation is based on the main occupational class during respondents working life and was dichotomised as (1) non-manual, and (2) manual occupation using the ISCO-88 classification. Baseline health status was measured by (1) not having or (2) having a limiting long-standing illness, a chronic disease/health problem affecting coping with everyday activities. Smoking variable differentiated (1) never smokers, and (2) ever smokers, referring to current or previous regular smoking. BMI was

calculated from respondents' self-reported height and weight and was categorised as (1) normal (BMI = 18.5–24.9 kg/m^2), (2) underweight (BMI < 18.5 kg/m^2), (3) overweight (BMI = 25–29.9 kg/m^2), and (4) obese (BMI ≥ 30 kg/m^2).

2.3. Statistical analysis

The association between SRH and mortality in two ethnic groups was assessed by Cox regression. For Cox models, the proportionality of all covariates was tested beforehand using log-minus-log survival plots. Three regression models were fitted thereafter. Model 1 was adjusted for age only. Model 2 included SRH, age and socioeconomic variables of education, income, and occupation. Model 3 was additionally adjusted for health-related indicators (limiting long-standing illness, smoking status and BMI). Data were analyzed separately for men and women and the results are presented as hazard ratios (HR) with 95% confidence intervals (CI). Overall survival by SRH categories was analyzed using Kaplan–Meier survival curves. The statistical analyses were conducted using SPSS Statistics for Windows, version 22.0 (IBM Corp. 2013) and RStudio.

3. Results

Table 1 shows the baseline sample characteristics of the 25–79-year-old respondents in 1996. The proportion of deaths during the follow-up was higher among those with lower baseline SRH, older respondents, men, respondents with lower education, income, by those in manual occupations, having limiting long-standing illness and higher BMI. The mean survival time varied from 15.9–15.4 years in respondents with very good or good SRH to 10.8–10.6 years among those with bad or very bad baseline SRH respectively among Estonians and non–Estonians. Differences in survival by SRH categories (Fig. 1) were found statistically significant ($P < 0.0001$) for both ethnic groups.

The findings of the survival analysis indicate that among men (Table 2), the SRH was associated with mortality risk only among Estonians in age-adjusted analysis (Model 1). Estonian men with bad or very bad SRH had a HR of 2.22 (95% CI, 1.67–2.96) compared to men with good or very good SRH. Adjustment for socioeconomic variables (Model 2) attenuated

Table 1 – Characteristics of the study sample in the 25–79 age group at baseline.

	Total number (n = 3983)	Estonians, % (n = 2642)	Non-Estonians, % (n = 1341)	Less-than-good SRH, %	Deaths, %
Self-rated health					
Very good/good	1273	35.1	26.5	NA	18.0
Average	2073	50.2	56.8	NA	38.7
Bad/very bad	609	14.7	16.7	NA	67.7
Age					
25–39	1054	26.8	25.7	42.1	5.2
40–59	1315	31.7	35.7	67.4	21.6
60–79	1614	41.5	38.6	85.1	69.8
Gender					
Men	1778	44.6	44.7	64.5	40.6
Women	2205	55.4	55.3	70.5	33.7
Ethnicity					
Estonian	2642	NA	NA	64.9	36.5
Non-Estonian	1341	NA	NA	73.5	37.3
Education					
University	577	15.8	11.9	51.0	22.5
Upper secondary	1982	46.3	56.7	60.3	23.6
≤Lower secondary	1422	37.9	31.3	85.4	60.9
Income quartiles					
I (highest)	1013	27.5	23.0	50.0	13.3
II	948	24.4	23.9	64.6	28.4
III	991	24.4	27.2	81.9	60.8
IV (lowest)	955	23.7	25.9	78.2	48.0
Occupation					
Non-manual	1936	50.4	46.0	63.6	28.6
Manual	2023	49.6	54.0	72.0	44.6
Limiting illness					
No	3439	86.6	85.8	63.7	30.8
Yes	544	13.4	14.2	95.4	74.6
Smoking					
Never	2136	54.0	53.1	71.7	38.1
Ever	1842	46.0	46.9	63.3	35.2
BMI					
Normal	1801	46.3	45.5	61.5	31.9
Underweight	63	1.9	1.1	69.4	31.7
Overweight	1396	36.0	35.0	70.0	39.4
Obese	655	15.8	18.5	81.4	45.2

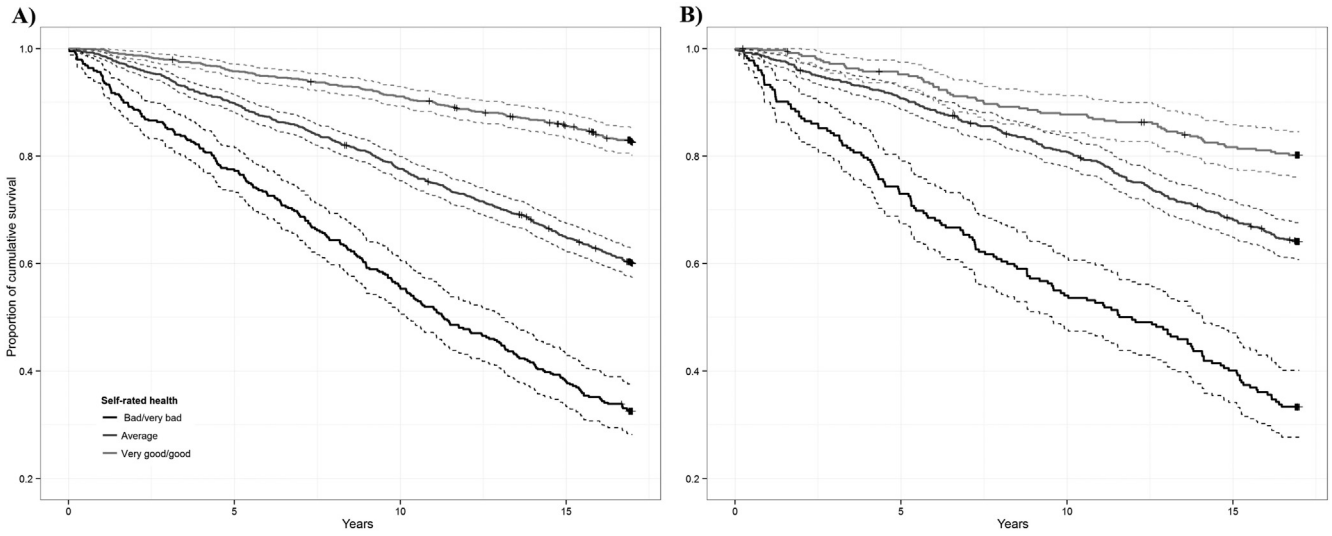

Fig. 1 – Survival by categories of baseline self-rated health among Estonians (A) and non-Estonians (B).

Table 2 – Hazard ratios (HR) with 95% confidence intervals (CI) for all-cause mortality by ethnicity, among men in the 25–79 age group at baseline.

	Estonians			Non-Estonians		
	Model 1 HR (95% CI)	Model 2 HR (95% CI)	Model 3 HR (95% CI)	Model 1 HR (95% CI)	Model 2 HR (95% CI)	Model 3 HR (95% CI)
Self-rated health						
Very good/good	1.00	1.00	1.00	1.00	1.00	1.00
Average	**1.37 (1.08–1.75)**	1.21 (0.94–1.55)	1.16 (0.90–1.49)	1.05 (0.74–1.49)	0.97 (0.68 – 1.37)	0.94 (0.66–1.34)
Bad/very bad	**2.22 (1.67–2.96)**	**1.74 (1.29–2.33)**	**1.57 (1.14–2.16)**	1.40 (0.92–12.13)	1.14 (0.74–1.74)	0.99 (0.63–1.55)
Age						
Age (cont.)	**1.08 (1.08–1.09)**	**1.07 (1.06–1.08)**	**1.07 (1.06–1.08)**	**1.08 (1.06–1.09)**	**1.07 (1.06–1.09)**	**1.07 (1.06–1.09)**
Education						
University		1.00	1.00		1.00	1.00
Upper secondary		0.97 (0.67 – 1.39)	0.96 (0.66–1.38)		**1.73 (1.01–2.96)**	**1.73 (1.01–2.97)**
≤Lower secondary		1.13 (0.75–1.69)	1.14 (0.76–1.71)		**1.98 (1.10–3.57)**	**2.09 (1.15–3.77)**
Income quartiles						
I (highest)		1.00	1.00		1.00	1.00
II		**1.54 (1.11–2.14)**	**1.42 (1.02–1.98)**		**1.56 (1.06–2.30)**	**1.52 (1.03–2.24)**
III		**1.60 (1.14–2.23)**	**1.56 (1.12–2.18)**		1.30 (0.88–1.92)	1.24 (0.86–1.84)
IV (lowest)		**2.12 (1.51–2.99)**	**2.06 (1.47–2.90)**		**1.92 (1.27–2.90)**	**1.84 (1.22–2.80)**
Occupation						
Non-manual		1.00	1.00		1.00	1.00
Manual		1.29 (0.89–1.62)	1.15 (0.85–1.55)		1.16 (0.80–1.69)	1.10 (0.75–1.62)
Limiting illness						
No			1.00			1.00
Yes			1.18 (0.92–1.52)			1.32 (0.93–1.87)
Smoking						
Never			1.00			1.00
Ever			**1.47 (1.19–1.82)**			1.14 (0.84–1.54)
BMI						
Normal			1.00			1.00
Underweight			1.25 (0.45–3.44)			1.33 (0.32–5.57)
Overweight			1.00 (0.81–1.22)			0.87 (0.66–1.15)
Obese			1.02 (0.77–1.34)			0.88 (0.57–1.34)

Bold indicates statistically significant associations (p0.05) between predictor variables and all-cause mortality.
Model 1 is adjusted for age.
Model 2 is adjusted for age, SRH, education, income and occupation.
Model 3 is adjusted for age, SRH, education, income, occupation, limiting long standing illness, smoking status and BMI.

Table 3 – Hazard ratios (HR) and 95% confidence intervals (CI) for all-cause mortality by ethnicity, among women in the 25–79 age group at baseline.

	Estonians			Non-Estonians		
	Model 1 HR (95% CI)	Model 2 HR (95% CI)	Model 3 HR (95% CI)	Model 1 HR (95% CI)	Model 2 HR (95% CI)	Model 3 HR (95% CI)
Self-rated health						
Very good/good	1.00	1.00	1.00	1.00	1.00	1.00
Average	**1.56 (1.20–2.03)**	**1.49 (1.14–1.95)**	**1.53 (1.16–2.02)**	1.03 (0.66–1.61)	1.07 (0.68–1.68)	1.02 (0.63–1.65)
Bad/very bad	**2.07 (1.54–2.76)**	**1.87 (1.39–2.52)**	**1.60 (1.16–2.20)**	**1.77 (1.11–2.83)**	**1.78 (1.11–2.83)**	1.48 (0.89–2.46)
Age						
Age (cont.)	**1.11 (1.10–1.12)**	**1.10 (1.09–1.11)**	**1.10 (1.08–1.11)**	**1.09 (1.08–1.11)**	**1.08 (1.07–1.10)**	**1.09 (1.07–1.10)**
Education						
University		1.00	1.00		1.00	1.00
Upper secondary		0.89 (0.61–1.28)	0.88 (0.61–1.29)		1.47 (0.78–2.78)	1.31 (0.69–2.49)
≤Lower secondary		1.05 (0.72–1.54)	1.11 (0.76–1.63)		1.17 (0.61–2.83)	1.01 (0.52–1.95)
Income quartiles						
I (highest)		1.00	1.00		1.00	1.00
II		**1.80 (1.02–3.14)**	**1.97 (1.10–3.54)**		1.35 (0.45–4.06)	1.36 (0.45–4.12)
III		**2.07 (1.19–3.59)**	**2.20 (1.25–3.89)**		**3.17 (1.13–8.86)**	**3.27 (1.16–9.19)**
IV (lowest)		**2.20 (1.26–3.86)**	**2.26 (1.27–4.02)**		**3.42 (1.22–9.58)**	**3.53 (1.25–9.95)**
Occupation						
Non-manual		1.00	1.00		1.00	1.00
Manual		1.09 (0.90–1.34)	1.05 (0.86–1.29)		1.22 (0.91–1.63)	**1.38 (1.02–1.86)**
Limiting illness						
No			1.00			1.00
Yes			**1.68 (1.35–2.10)**			**1.73 (1.27–2.37)**
Smoking						
Never			1.00			1.00
Ever			**1.36 (1.06–1.73)**			1.17 (0.77–1.79)
BMI						
Normal			1.00			1.00
Underweight			1.50 (0.81–2.79)			1.70 (0.40–7.30)
Overweight			**0.80 (0.65–0.99)**			**0.70 (0.50–0.97)**
Obese			0.96 (0.75–1.22)			0.95 (0.68–1.31)

Bold indicates statistically significant associations (p0.05) between predictor variables and all-cause mortality.
Model 1 is adjusted for age.
Model 2 is adjusted for age, SRH, education, income and occupation.
Model 3 is adjusted for age, SRH, education, income, occupation, limiting long standing illness, smoking status and BMI.

the association of SRH and mortality among Estonians. After additional adjustment for health-related variables (Model 3), Estonian men with bad or very bad SRH had a HR of 1.57 (95% CI, 1.14–2.16) for mortality compared to those with good or very good SRH. Important ethnic variation was also found in the association between socioeconomic and health-related variables and mortality. In mutually adjusted analysis (Model 3), educational level predicted mortality only among non-Estonians where men with the lowest education had a HR of 2.09 (95% CI, 1.15–3.77) compared to the university graduates. Personal income was related to mortality in both ethnic groups. Estonian men in the lowest income quartile had a HR of 2.06 (95% CI, 1.47–2.90) and non-Estonian men in the same income category had HR 1.84 (95% CI, 1.22–2.80) for mortality compared to the highest income group. Statistically significant effects between ever smoking and mortality were found only for Estonian men in mutually adjusted analysis (Model 3) (HR = 1.47, 95% CI 1.19–1.82).

Among women (Table 3), the SRH predicted mortality in both ethnic groups in age-adjusted analysis (Model 1). Estonian women with bad or very bad SRH had HR 2.07 (95% CI, 1.54–2.76) for mortality compared to women with good or very good SRH, among non-Estonian women the HR was 1.77 (95% CI, 1.11–2.83). Adjustment for socioeconomic variables (Model 2) attenuated the association of SRH and mortality among Estonian women but not among no-Estonians. After introduction of health-related variables (Model 3), SRH–mortality association (HR = 1.60; 95% CI, 1.16–2.20) remained statistically significant only among Estonian women. Differently from men, education was not associated with mortality in adjusted models in none of the ethnic groups, at the same time when income showed even stronger association in both groups. Estonian women in the lowest income quartile had HR 2.26 (95% CI, 1.27–4.02) and non-Estonian women in the same income category had HR 3.53 (95% CI, 1.25–9.95) for mortality compared to women in the highest income quartile. Compared to non-manual occupations, manual work increased mortality risk by 40% among non-Estonian women. The presence of limiting long-standing illness and among Estonian women also ever smoking remained associated with subsequent mortality. In fully adjusted model, overweight was associated with reduced mortality risk among Estonian (HR = 0.80; 95% CI, 0.65–0.99) and non-Estonian (HR = 0.70; 95% CI, 0.50–0.97) women compared to those with normal BMI.

4. Discussion

This study analyzed the ethnic differences in SRH–mortality association and found that SRH predicted subsequent mortality only among ethnic Estonians. Irrespective of gender, Estonians with bad or very bad baseline SRH had about 60% higher mortality risk compared to respondents with very good or good SRH even after adjustment for socioeconomic and health-related covariates. Although non-Estonian women (but not men) with bad or very bad SRH had nearly 80% higher mortality risk in age-adjusted analyses, adjustment for socioeconomic and health-related variables attenuated the SRH–mortality association to non-significant level. Apart from low personal income that invariably predicted higher mortality in men and women from both ethnic groups, the results also emphasize considerable ethnic differences in socioeconomic and health-related variables as predictors of mortality.

Several studies [8,9,14] have emphasized the role of individual socioeconomic status as an important effect-modifier in SRH–mortality association. Previous research from Estonia [24] showed that Russians had higher odds for poor self-rated health compared to ethnic Estonians even after adjustment for educational level, occupation and income. In our study, socioeconomic status explained only part of the SRH–mortality association and the effect on mortality varied considerably by indicator and by ethnicity of the respondent. Although lower educational level has been related to higher mortality in numerous studies [25,28], our data showed that this association was statistically significant only among non-Estonian men. Similarly, the manual occupation was related to mortality only among non-Estonian women pointing that socioeconomic position may have higher predictive power on mortality among non-Estonians. Considering the rapid societal changes in the 1990s in Eastern Europe, the strong graded universal association between the 1996 baseline income and mortality even during up to 17 years of follow-up, is remarkable. In this, our results are consistent with a recent study [10] where education predicted mortality only in minority racial and ethnic groups whereas income level presented a distinct gradient. In contrast to the early transition period, the occupational mobility showed relatively little changes from the mid-1990s in Estonia with personal income becoming more closely related to ones' occupation [31] which may explain the relatively larger impact of income on mortality compared to other socioeconomic indicators. The pronounced effect of personal income may indicate that the better start-up position has had a strong and long-lasting impact on social differentiation on economical basis in Eastern European context.

Earlier research [1] suggests that self-rated health predicts mortality even after adjustment for other health-related covariates although the association is often reduced. Similar tendencies were also found in our data where adjustment for limiting illness, smoking and BMI further weakened the SRH–mortality association in both ethnic Estonians and non-Estonians (among women only). SRH–mortality association tends to be stronger among men, particularly in the ''poor'' SRH subgroup [20]. This can be explained by gender differences in conceptualizing and assessing health status, namely that men relate their SRH more with physical health and therefore co-morbid illnesses and SRH refer to similar concept [32]. This could also explain why long-standing illness was no longer related to mortality among men when SRH (and other co-variates) were added to the model in our study. Smoking is known to be a powerful predictor for several causes of death and is contributing to the inequalities in mortality [33]. In our study, having ever smoked predicted mortality only among ethnic Estonians, although previous research from Estonia [26,34] has shown higher incidence and mortality rate for lung cancer among non-Estonian men. Further analysis on cause-specific mortality might explain these discrepancies. As information on baseline smoking was based on self-reports, the reporting bias may have affected the sensitivity of the variable, however, the bias is less likely to differ by ethnicity. BMI presented an inverse association with mortality, with overweight women having significantly lower mortality risk compared to their peers with normal BMI. This finding is consistent with a recent meta-analysis [35] reporting lower hazard ratios for all-cause mortality among overweight persons compared to persons with normal BMI level. Possible explanations could relate to greater likelihood of receiving optimal medical treatment by overweight patients [36] but also to cardio-protective metabolic effects of increased weight [37].

One possible explanation to ethnic differences in SRH–mortality association could relate to the reporting heterogeneity of SRH. As indicated by previous studies, the SRH may provide useful insights into social and cultural differences in defining health and illness and account for some ethnic variation in SRH [18]. It has been shown that ethnic/racial variation between SRH and subsequent mortality was mostly explained by the difference in the ''fair'' SRH and to a lesser extent by the ''poor'' SRH at the baseline [16]. The higher prevalence of ''fair/average'' SRH among non-Estonians in our data could indicate that the gradation from positive to negative health is less discriminative among non-Estonians. This is supported by findings from two recent study from United States [17,19] where the SRH ratings of Black and Hispanic respondents were less predictive of their subsequent mortality risk compared to Whites due to less distinctive differences between excellent and lower SRH categories. In such circumstances, the subjective health ratings may not correspond to levels of ''true health'' and result in systematic over- or underestimation of ones' health status. Although previous studies from USA [12,38,39] seem to support the reporting heterogeneity explanation, the ethnic differences in SRH–mortality association in this study cannot be attributed only to cultural differences in health assessment, as SRH–mortality association varied also between non-Estonian men and women.

Another possible explanation to ethnic differences in SRH–mortality association may relate to the variance in cause-specific mortality which we were not able to test in this study. Previous research [26] has shown considerable ethnic differences in cause-specific mortality in Estonia. Preventable causes of death explained about 60% of total ethnic life expectancy gap whereas conditions related to alcohol and substance use represented the largest proportion of such causes of death [40]. Alcohol-related pathophysiological changes may result in chronic effects on organs but alcohol

may also contribute to mortality in direct (alcohol poisoning) and indirect (injuries and violence) ways [41]. In latter cases, the deaths may not have been preceded by ill-health. For example, a study in Russia [28] found that smoking and alcohol consumption predicted mortality but not worse subjective health with frequent drinkers reporting better health than moderate consumers. Higher mortality from external causes of death may thus explain why SRH was not associated with overall mortality among non-Estonians in this study.

Our study has some strengths and limitations. One of the strengths of this study is the focus on the SRH–mortality association, which is still relatively little researched in Eastern Europe. The use of longitudinal data to study socioeconomic disparities in mortality in Eastern Europe is another major advantage, as such data are only recently to become available in this setting. Finally, the very low overall attrition rate adds further credibility to the data that have been used. The respondents' socioeconomic and health characteristics were assessed only at the baseline. Some of these characteristics may change in time. For example, it has been found that about 40% of respondents changed their self-rating over the follow-up period [42]. Similarly, due to the rapid social and economic changes since the 1990s in Estonia, there could be considerable changes in respondents' average income. However, we do not know if this has also affected their ranking in social hierarchy that could possibly affect our results. The proportion of population with tertiary education has also increased over time. As we excluded respondents younger than 25 years we consider that educational level mostly remained constant in the study sample, thus not affecting the results. However, we cannot entirely exclude some misclassification bias in our results because of the variability in these factors over time. Although the category of non-Estonians consists mostly of the respondents with Russian as a native language, the cultural heterogeneity of this group is evident. Finally, some research suggests that SRH–mortality association is stronger in short term [3,43]. However, the additional analyses (data not shown) using 5-year follow-up to examine the ethnic variation in overall survival and SRH–mortality association, did not alter the results.

5. Conclusions

This study contributes to the existing literature by analyzing the SRH–mortality association in respect to ethnicity in the Eastern European context. Although the findings are generally in accordance with previous literature, we found considerable ethnic variation in SRH–mortality association and in socioeconomic predictors of mortality for two ethnic groups. Further research, preferably focusing on cause-specific mortality and reporting heterogeneity of SRH could potentially shed further light on ethnic differences in SRH–mortality association in Estonia and more generally on socioeconomic inequalities in mortality in Eastern Europe.

Authors' contribution

R.R. and M.L. designed the study. R.R. ran the statistical analyses and wrote the first draft of the paper. Both authors revised the paper, provided critical comments and approved the final version of the paper.

Conflict of interest

The authors state that they have no any conflict of interest.

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