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Seven years' mortality in Roma and non-Roma patients after coronary angiography

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Background: Ethnicity is associated with differences in clinical course and outcomes of cardiac disease, often in association with a poorer socioeconomic position. The aim of this study was to compare the mortality after coronary angiography (CAG) of Roma and non-Roma patients matched for education and adjusted for gender and age. **Methods:** In total, 816 patients were included in the study (167 Roma and 649 non-Roma). Data on socio-demographic background, disease history, use of drugs, coronary findings and type of treatment were obtained from medical records. Mortality was assessed up to seven years after CAG. Kaplan–Meier curves of mortality were plotted, and differences between the Roma and non-Roma patients were assessed using log-rank tests, matched for education and adjusted for gender and age. **Results:** Mortality after CAG was significantly higher among Roma than non-Roma (log-rank test $\chi^2 = 7.59$, $P < 0.01$) and remained so after matching for education and adjustment for gender, age, history of previous myocardial infarction and abnormal CAG (hazard ratio: 2.07, 95% confidence interval: 1.13–3.82). **Conclusion:** Mortality after CAG is higher among Roma, and this is not due to differences in age, gender or education. These results warrant further reconsideration of the management of Roma cardiac patients.

Introduction

Cardiovascular diseases are the leading cause of death in developed countries,[1] thus causing a great need for evidence on contributing factors. Ethnicity is one of the factors that were found to be associated with different mortality rates.[2–4] This association could be partially explained by the differences found in the occurrence of risk factors of coronary artery disease,[5,6] whereas the below average socioeconomic status (SES) of many ethnic minorities also contributes.[7,8]

Roma ethnicity was associated with higher mortality and higher occurrence of cardiovascular diseases risk factors in several studies across predominantly Eastern Europe,[3,9–13] where the majority of the Roma population is concentrated. Estimates on the share of the Roma in the Slovak population vary from 2.0% according to the last Population and house census in the Slovak Republic in 2011[14] to 7.2% according to Vano.[15] Previous studies in Slovakia found a higher mortality among Roma than non-Roma, a higher prevalence of cardiovascular medical risk factors[16–20] and a lower SES.[21] Evidence on the association of SES with worse health outcomes regarding cardiovascular diseases is lacking for Roma.

Therefore, the aim of this study was to compare mortality after coronary angiography (CAG) in Roma and non-Roma patients matched for education and adjusted for gender and age.

Methods

Patients

A total of 946 consecutive adult Roma and non-Roma patients who underwent routine elective CAG in the East Slovakian Institute for Cardiac and Vascular Diseases, Kosice, Slovakia, in the years 2001–11 were asked to participate in our study. We did not collect response data for the first 82 Roma patients. Of the remaining

864 patients, 91 were excluded because of the exclusion criteria [mental disorders, infectious endocarditis, acute myocardial infarction (MI) and severe valve disease]. Of the eligible patients, 39 (5.1%) refused to participate, yielding 734 participants (response 94.9%) plus the first 82, i.e. 816. The study was approved by the local Ethics Committee, including written informed consent. Each patient provided a signed informed consent form prior to the study.

Procedures and measures

We collected data on socio-demographic background, disease history, use of drugs, coronary findings and type of treatment. Socio-demographic data concerned age, gender and level of education (low, elementary school and middle school without school leaving examination; middle, with school leaving examination or high education—with a university degree). Ethnicity was measured based on each patient's declaration and identification by the doctor. In the case of a mismatch, the opinion of a third person (a head nurse) was decisive. We did not have a single case when a patient declared himself or herself as non-Roma but the doctor thought the opposite.

History of the disease concerned previous MI, arterial hypertension, diabetes mellitus, dyslipidaemia and the use of drugs—betablockers, statins and nitrates. Information on the personal medical history and medication was taken from medical records following international guidelines.[22] Coronary findings were assessed from the CAG. The type of therapeutic intervention following the CAG [conservative pharmacological treatment, percutaneous coronary intervention or coronary artery bypass grafting (CABG)] was determined by cardiologists based on the results of CAG and clinical status, independently of participation in this study. The severity of the coronary heart disease (CHD) was evaluated using the Canadian Cardiovascular Society (CCS) and New York Heart Association classifications and by the number of diseased coronary vessels found in the CAG. We then collected data about patients' mortality from the Central Registry of the Health Care Surveillance Authority of the Slovak Republic from 1 up to 7 years after CAG, to maximally utilize the entire cohort.

Statistical analyses

As the first step, we assessed background and clinical characteristics of the Roma and non-Roma patients. Differences were statistically tested using the *t*-test for continuous variables and the χ^2 test or Fisher exact test, when appropriate, for categorical variables. Values of $P < 0.05$ were considered statistically significant. Kaplan–Meier curves of mortality were then plotted, and log-rank tests between the Roma and non-Roma group of patients were computed. We next matched Roma and non-Roma for education on the group level (low, middle, high educated) because of missing data on education in 78 Roma patients. We had data on education for 89 Roma and all non-Roma, so we imputed the distribution of known Roma education to the whole Roma group and then matched Roma 1:2 with non-Roma to control for SES. We used three models in Cox regression analyses: in Model 1, we tested the crude effect of ethnicity and in Model 2, we adjusted for gender, age and age-squared. Including both age and age-squared as adjustment for this combination of measures of age has been shown to provide the best adjustment at the dispense of the fewest degrees of freedom.[23] In Model 3, we additionally adjusted for history of previous MI and abnormal CAG. All statistical analyses were performed using SPSS 18.

Results

Baseline characteristics of the study population are presented in table 1 ($N = 816$). There were 167 Roma and 649 non-Roma patients. Roma patients were significantly younger, less frequently women and more frequently had a positive history of MI and a negative history of arterial hypertension than non-Roma patients. There were significantly more current smokers among Roma patients. Roma had angina pectoris in CCS class IV more frequently and a higher use of nitrates. Though there were no differences in the occurrence of dyslipidaemia, Roma patients were treated by statins significantly less often. There were significantly fewer normal CAGs among Roma but no differences regarding the type of treatment after CAG. We found a significant difference in the mean length of follow-up between Roma with known education and matched non-Roma (32.2 ± 27.5 versus 47.5 ± 26.4 months, respectively). The Cox regression analysis controlled for these differences in the length of follow-up.

During the follow-up period of 7 years, 79 patients died, 732 remained alive and 5 could not be reached for follow-up. The crude mortality was significantly higher in Roma patients ($\chi^2 = 7.59$, $P < 0.01$). In the next step, we matched patients according to their educational level to examine whether the higher mortality in Roma could be explained by education. The all-cause mortality of the Roma was then still higher when compared with the non-Roma group of patients [hazard ratio (HR): 1.93, 95% confidence interval (CI): 1.09–3.40]. Additional adjustment for gender, age and age^2 increased the relative differences, HR: 2.34, 95% CI: 1.28–4.27 (figure 1 and table 2). Adjustment for history of previous MI or of an abnormal CAG did not influence the estimates of excess mortality in the Roma group of patients. Additional Cox regression analysis adjusted for age, gender, education, history of previous MI and abnormal CAG on only Roma with known education and all non-Roma yielded similar hazard rates. These reached statistical significance in the first two models but not in the third model probably due to the smaller number of Roma patients.

Discussion

The aim of this study was to compare the mortality in Roma patients who underwent CAG with non-Roma patients who underwent CAG, matched for educational level and adjusted for gender, age, history of previous MI and abnormal CAG. The 7 years' all-cause mortality in Roma patients was significantly higher and remained so after adjustment for the aforementioned potential confounders.

We found higher mortality among Roma, which is in line with the findings of Nozdrovicky,[18] Ginter *et al.*,[16] Bogdanovic et al.[9] and Kohler *et al.*[3] These studies reported higher mortality in Roma but without adjusting for age, gender or education.[18] Ginter *et al.*[16] found a 2.5-times higher unadjusted mortality in Roma males than in non-Roma, as well as a higher prevalence of cardiovascular risk factors among Roma than non-Roma in Slovakia. In Serbia, overall mortality has been shown to be higher in Roma than in the majority population, but the cardiovascular morbidity was significantly lower.[9] Roma ethnicity studies are usually restricted to one or two smaller districts in one country with a small sample size, with only a few studies analysing socio-economic factors.[24] Kohler *et al.*[3] found a higher mortality in the Roma minority in Bulgaria, which was not explained by their lower SES. Sepkowitz[25] described a shorter life expectancy in the Roma population than in the non-Roma population in Slovakia, Bulgaria and Czech Republic.

Differences were found in the mortality among other ethnicities as well.[4] Borrell *et al.*[2] observed the mortality to be lower among Hispanic women than among non-Hispanic white women. On the other hand, Feder *et al.*[26] did not find any difference in mortality between south Asian and white participants among patients appropriate for revascularization, though south Asians were less likely to receive CABG. In our sample, we did not observe any differences regarding the type of treatment following CAG.

Table 1 Baseline characteristics of the study population by ethnicity ($N = 816$)

	Roma ($N = 167$)	Non-Roma ($N = 649$)	Roma with known education ($N = 89$)	Non-Roma matched to all Roma (as in first column) ($N = 334$)
Socio-demographic data				
Age (years)	**52.1 ± 8.3**	**57.8 ± 7.4*** **	**53.9 ± 6.7**	**57.9 ± 7.3*** **
Gender (female/male)	**29.3%/70.7%**	**38.7%/61.3%***	**29.2%/70.8%**	**43.7%/56.3%***
Education		***		NS
Low education	**96.6%**	**55.8%**	96.6%	96.4%
Middle education	**2.2%**	**21.0%**	2.2%	2.4%
High education	**1.1%**	**23.2%**	1.1%	1.2%
Mean length of follow-up (months)	51.9 ± 32.3	47.9 ± 26.8	**32.2 ± 27.5**	**47.5 ± 26.4*** **
Smoking status (current smoker)	**58(35.2%)**	**59(9.3%)*** **	**30(33.7%)**	**37(9.8%)*** **
History of the disease				
Previous MI	**99(60.0%)**	**253(39.7%)*** **	**55(63.2%)**	**146(44.0%)****
NYHA III–IV	17(17.7%)	56(20.8%)^{NS}	7(24.1%	40(24.5%)^{NS}
CCS IV	**11(9.7%)**	**9(2.8%)****	2(5.3%)	2(1.1%)^{NS}
Dyslipoproteinaemia	99(59.6%)	348(55.2%)^{NS}	47(53.4%)	175(52.9%)^{NS}
Arterial hypertension	**109(65.7%)**	**519(81.9%)*** **	**62(70.5%)**	**273(82.7%)****
Diabetes mellitus	46(27.7%)	198(31.1%)^{NS}	26(29.5%)	111(33.4%)^{NS}
Use of drugs:				
Betablockers	97(75.8%)	424(82.8%)^{NS}	39(78.0%)	227(83.8%)^{NS}
Statins	**60(46.9%)**	**355(69.3%)*** **	33(66.0%)	190(70.1%)^{NS}
Nitrates	**105(82.0%)**	**328(64.1%)*** **	**40(80.0%)**	**178(65.7%)***
Coronary findings				
One-vessel disease	34(28.3%)	117(24.3%)^{NS}	8(17.8%)	63(23.6%)^{NS}
Two-vessel disease	31(25.8%)	125(26.0%)^{NS}	13(28.9%)	74(27.7%)^{NS}
Three-vessel disease	40(33.3%)	123(25.6%)^{NS}	**17(37.8%)**	**59(22.1%)***
Left main disease	3(1.8%)	31(4.8%)^{NS}	3(3.4%)	18(5.4%)^{NS}
Normal CAG	**17(10.2%)**	**185(28.5%)*** **	**10(11.2%)**	**93(27.8%)****
Type of treatment				
Pharmacotherapy	36(21.7%)	175(27.0%)^{NS}	24(27.0%)	91(27.2%)^{NS}
PCI/stent	36(21.7%)	175(27.0%)^{NS}	24(27.0%)	91(27.2%)^{NS}
CABG	17(37.0%)	119(25.3%)^{NS}	17(37.0%)	59(23.0%)^{NS}

NS, not significant; NYHA, New York Heart Association; PCI, percutaneous coronary intervention.
*$P < 0.05$.
**$P < 0.01$.
***$P < 0.001$.

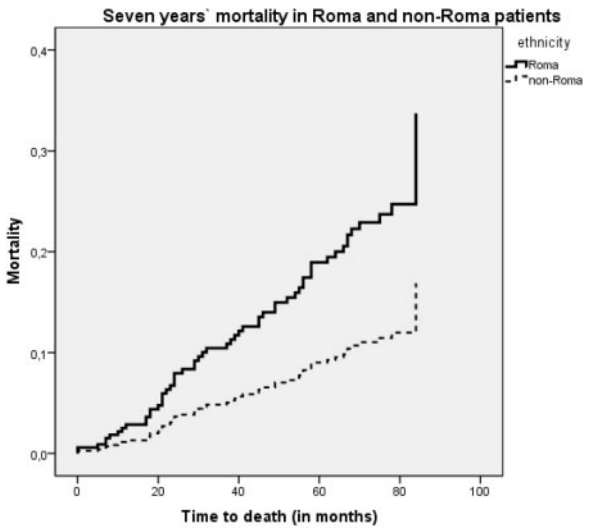

Figure 1 Seven-year all-cause mortality of Roma and non-Roma patients who underwent CAG matched for education and adjusted for gender, age and age^2

Table 2 Results of Cox regression analysis of ethnicity and 7-year all-cause mortality adjusted for gender, age, age^2, a history of previous MI and of abnormal CAG in a sample of Roma and non-Roma who underwent CAG matched for the education: hazard ratio (HR), CIs, significance of the model change (smc) and coefficient of determination (R^2) ($N = 501$)

Models	HR	95% CI	smc	R^2
Model 1 ($\chi^2 = 5.31$*)				0.01
Ethnicity (Roma vs. non-Roma)	**1.93**	**1.09–3.40***	*	
Model 2 ($\chi^2 = 9.50$)				0.02
Ethnicity (Roma vs. non-Roma)	**2.34**	**1.28–4.27****	NS	
Age	**1.06**	**0.78–1.44***	NS	
Age^2	1.00	1.00–1.00	NS	
Gender (male vs. female)	1.04	0.58–1.86	NS	
Model 3 ($\chi^2 = 12.35$)				0.03
Ethnicity (Roma vs. non-Roma)	**2.07**	**1.13–3.82***	NS	
Age	1.07	0.79–1.45	NS	
Age^2	1.00	1.00–1.00	NS	
Gender (male vs. female)	0.91	0.50–1.65	NS	
Previous MI (yes vs. no)	1.21	0.70–2.11	NS	
Abnormal CAG (yes vs. no)	2.60	0.88–7.69	NS	

NS, not significant; HR, hazard ratio; smc, significance of the model change; R^2, coefficient of determination.
*$P < 0.05$.
**$P < 0.01$.
***$P < 0.001$.

A lower educational level explained some of the higher mortality after CAG among Roma but only partially. This contradicts the hypothesis that low SES is the only reason for their increased mortality. We might consider that other factors play a role in this finding, such as genetic factors, a lower compliance of the Roma patients to medication, worse access to health care services, bad housing conditions, inadequate nutrition, culture, language problems with healthcare professionals or discrimination.

The excess mortality that the Roma have after matching for educational level might be explained by differences in their medical

factors. We found fewer normal CAGs, a more frequently positive history of previous MI and worse CCS symptoms in Roma patients, and thus we expected a diagnosed CHD that might lead to increased mortality to be more frequent. The percentage of normal coronary angiograms in the non-Roma group of elective patients (28.5%) was in line with previous reports.[27,28] The lower use of statins as one of the major drugs used in primary and secondary prevention of CHD in the Roma patients might also contribute to the higher mortality in this group. Vozarova de Courten *et al.*[19] reported a higher incidence of type 2 diabetes mellitus and metabolic syndrome, but in our study, we did not observe any difference between the groups of patients regarding diabetes mellitus and dyslipidaemia. On the contrary, the lower occurrence of arterial hypertension in the Roma group of patients contradicts the hypothesis of their worse health status.

Strengths and limitations of the study

This prospective, single major cardiac centre study presents unique data on the long-term mortality of a rather large sample of Roma patients who underwent CAG and the influence of SES on it and on a comparison group from the majority population living in the same region. An additional strength of this study is its relatively high response rate. Moreover, loss to follow-up over the years was very low.

One of the limitations is the lack of knowledge of the cause of death in patients, making it impossible to distinguish between cardiac and non-cardiac mortality in the studied population. Among the limitations is the missing information on education in a part of the Roma group. We tried to solve this problem by imputing the missing data and then performing an analysis with matching. There is evidence on the generally low educational level of the Roma population in Slovakia, which is in accordance with our data.[21] Data on the ejection fraction as one of the prognostic factors were lacking for a rather large part of the study population (28.7%); therefore, we did not present them.

Implications

This study adds more insights into the understanding of the health status differences in Roma cardiac patients compared with non-Roma cardiac patients. The higher mortality among Roma, which could be partially explained by their worse clinical status at the time of CAG, call for a more aggressive approach in the primary as well as secondary prevention and treatment of cardiovascular diseases in the Roma population. A higher mortality among Roma which cannot be explained only by the lower SES of this minority calls for further investigation in this field. Results must be verified in a larger sample and followed-up for a longer period to allow for generalization. Other factors influencing the higher mortality in Roma patients than their health status and SES, such as the severity of the coronary heart disease or ejection fraction, have to be further investigated. This study was conducted in patients with stable CHD, implying that these findings cannot automatically be applied on patients with unstable forms of CHD. Future research has to confirm or refute whether the same concerns acute coronary syndromes.

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Conflicts of interest: None declared.

Key points

- Only a few studies dealing with the outcomes of cardiovascular diseases in Roma were published by now.
- Mortality after coronary angiography is higher among Roma patients and this cannot be fully explained by their low socioeconomic status.
- These findings need to be confirmed and call for better prevention strategies and improvement of the medical treatment in the high risk Roma cardiac patients.

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Risk of respiratory hospitalization and death, readmission and subsequent mortality: scottish health and ethnicity linkage study

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Background: Limited and dated evidence shows ethnic inequalities in health status and health care in respiratory diseases. **Methods:** This retrospective, cohort study linked Scotland's hospitalization/death records on respiratory disorders to 4.65 million people in the 2001 census (providing ethnic group). For all-respiratory diseases and chronic obstructive pulmonary disease (COPD) from April 2001 to 2010 we calculated age, country of birth and Scottish Index of Multiple Deprivation (SIMD) adjusted risk ratios (RRs), by sex. We calculated hazard ratios (HRs) for death following hospitalization and for readmission. We multiplied ratios and confidence intervals (CIs) by 100, so the reference Scottish White population's RR/HR = 100. **Results:** RRs were comparatively low for all-respiratory diseases in Other White British (84.0, 95% CI 79.6, 88.6) and Chinese (67.4, 95% CI 55.2, 82.3) men and high in Pakistani men (138.1, 95% CI 125.5, 151.9) and women (132.7, 95% CI 108.8, 161.8). For COPD, White Irish men (142.5, 95% CI 125.3, 162.1) and women (141.9, CI 124.8, 161.3) and any Mixed Background men (161, CI 127.1, 203.9) and women (215.4, CI 158.2, 293.3) had high RRs, while Indian men (54.5, CI 41.9, 70.9) and Chinese women (50.5, CI 31.4, 81.1) had low RRs. In most non-White groups, mortality following hospitalization and readmission was similar or lower than the reference. **Conclusions:** The pattern of ethnic variations in these respiratory disorders was complex and did not merely reflect smoking patterns. Readmission and death after hospitalization data did not signal inequity in services for ethnic minority groups.

Introduction

Respiratory diseases are dominant health problems.[1,2] Globally, for example, chronic obstructive pulmonary disease (COPD) was the third ranking cause of death, and ninth for years of life lost in 2010. Other respiratory disorders are also top ranking causes of death and years of life lost.[1]

As most urban societies have become ethnically diverse, and risk factors for respiratory disease vary by ethnic group, we would expect a sizeable and growing literature on ethnicity and respiratory health.[3] Yet, with the main exceptions of tuberculosis[4] and asthma,[5] the evidence is sparse, especially in Europe. This may be because, for most respiratory problems, ethnic minority groups are perceived to have similar, and sometimes lower, risks of disease than