

- 16 Swedish National Central Bureau of Statistics. Regionale indelningar i Sverige. Stockholm, Sweden: Swedish National Central Bureau of Statistics, 2003.
- 17 Agresti A. *Categorical Data Analysis*, 2nd edn. Hoboken, NJ: John Wiley & Sons, Inc., 2002.
- 18 Giskes K, Kunst AE, Ariza C, et al. Applying an equity lens to tobacco-control policies and their uptake in six Western-European countries. *J Public Health Policy* 2007;28:261–80.
- 19 Patja K, Hakala SM, Bostrom G, et al. Trends of tobacco use in Sweden and Finland: do differences in tobacco policy relate to tobacco use? *Scand J Public Health* 2009;37: 153–60.
- 20 Schaap MM, Kunst AE, Leinsalu M, et al. Effect of nationwide tobacco control policies on smoking cessation in high and low educated groups in 18 European countries. *Tob Control* 2008;17:248–55.
- 21 Zhou M. Segmented assimilation: issues, controversies, and recent research on the new second generation. *Int Migr Rev* 1997;31:975–1008.
- 22 Bhat C, Narayan KL. Indian diaspora, globalization and transnational networks: the South African context. *J Soc Sci* 2010;25:13–23.
- 23 Ny P, Dykes AK, Molin J, Dejin-Karlsson E. Utilisation of antenatal care by country of birth in a multi-ethnic population: a four-year community-based study in Malmo, Sweden. *Acta Obstet Gynecol Scand* 2007;86:805–13.
- 24 Osypuk TL, Subramanian SV, Kawachi I, Acevedo-Garcia D. Is workplace smoking policy equally prevalent and equally effective among immigrants? *J Epidemiol Community Health* 2009;63: 784–91.
- 25 Shelley D, Nguyen N, Peng CH, et al. Increasing access to evidence-based smoking cessation treatment: effectiveness of a free nicotine patch program among Chinese immigrants. *J Immigr Minor Health* 2010;12: 198–205.
- 26 Sundquist K, Johansson LM, DeMarinis V, et al. Posttraumatic stress disorder and psychiatric co-morbidity: symptoms in a random sample of female Bosnian refugees. *Eur Psychiatry* 2005;20:158–64.
- 27 Delic-Ovcina L. The case of adult Bosnian Muslim male refugees in Chicago: current health behavior outcomes and PTSD symptomatology [dissertation]. Urbana, Illinois: University of Illinois at Urbana-Champaign, 2010.
- 28 Bethel JW, Schenker MB. Acculturation and smoking patterns among Hispanics: a review. *Am J Prev Med* 2005;29:143–48.
- 29 Ceballos M, Palloni A. Maternal and infant health of Mexican immigrants in the USA: the effects of acculturation, duration, and selective return migration. *Ethn Health* 2010;15:377–96.

.....
European Journal of Public Health, Vol. 24, No. 1, 127–133

© The Author 2013. Published by Oxford University Press on behalf of the European Public Health Association. All rights reserved.
 doi:10.1093/eurpub/ckt058 Advance Access published on 31 May 2013

Myocardial infarction incidence and ischemic heart disease mortality: overall and trend results in repatriates, Germany

Andreas Deckert¹, Volker Winkler¹, Christa Meisinger^{2,3}, Margit Heier^{2,3}, Heiko Becher¹

1 Institute of Public Health, Division Epidemiology and Biostatistics, University of Heidelberg, Heidelberg, Germany
 2 Central Hospital of Augsburg, MONICA/KORA Myocardial Infarction Registry, Augsburg, Germany
 3 Helmholtz Zentrum München, German Research Center for Environmental Health, Institute of Epidemiology II, Neuherberg, Germany

Correspondence: Andreas Deckert, Institute of Public Health, University of Heidelberg, Im Neuenheimer Feld 324, 69120 Heidelberg, Germany, tel: +49 6221 5637260, fax: +49 6221 565948, e-mail: a.deckert@uni-heidelberg.de

Background: The burden of cardiovascular diseases (CVDs) is much more pronounced in Eastern Europe, a spatial gradient within Europe still exists. However, former studies showed a significantly lower CVD mortality of German repatriates from the Former Soviet Union compared with the German population. **Methods:** All-cause, CVD and ischemic heart disease (IHD) standardized mortality ratio (SMR), IHD standardized incidence ratio and annual age-standardized mortality and acute myocardial infarction (AMI) incidence rates were calculated in a retrospective cohort. Time trends were investigated by loess regression. **Results:** A total of 6378 German repatriates were observed from 1990 to 2010, accumulating 92 149 person-years. We observed a lower all-cause mortality [SMR = 0.86 (0.75, 0.98)] in females and CVD mortality [International Statistical Classification of Diseases and Related Health Problems, version 10 (ICD) 10: I00–I99; SMR = 0.82 (0.65, 1.03)] and IHD mortality (I20–I25) [SMR = 0.84 (0.60, 1.15)] in males. In contrast, AMI incidence was significantly higher in male repatriates [standardized incidence ratio = 1.30 (1.02, 1.65)]. Whereas in the general population, mortality rates of CVD, IHD and AMI incidence have continuously decreased over time, the pattern in the repatriates was not as clear. In male repatriates, mortality rates seemed to be lower after immigration and remained rather constant. Incidence rates possibly exceed Germans rates by now. **Conclusions:** A possible historical repatriates' IHD advantage shown in former studies has disappeared. The increasing AMI incidence in (male) repatriates might demonstrate the delaying onset of the impact of changes in the CVD risk profile due to migration. Health politics and the health system should be sensitized and take care of the development of IHD mortality and AMI incidence among the repatriates.

Introduction

Since the beginning of the 90s and the collapse of the Former Soviet Union (FSU), the majority of a large ethnic German sub-population (the so-called German repatriates) migrated back

to Germany, adding up to about 2 million persons between 1990 and 2007 who originated from FSU.¹

Large differences in cardiovascular disease (CVD) mortality rates exist between Eastern and Western Europe. In 2005, for instance, age-standardized CVD mortality rates were up to six-fold higher in

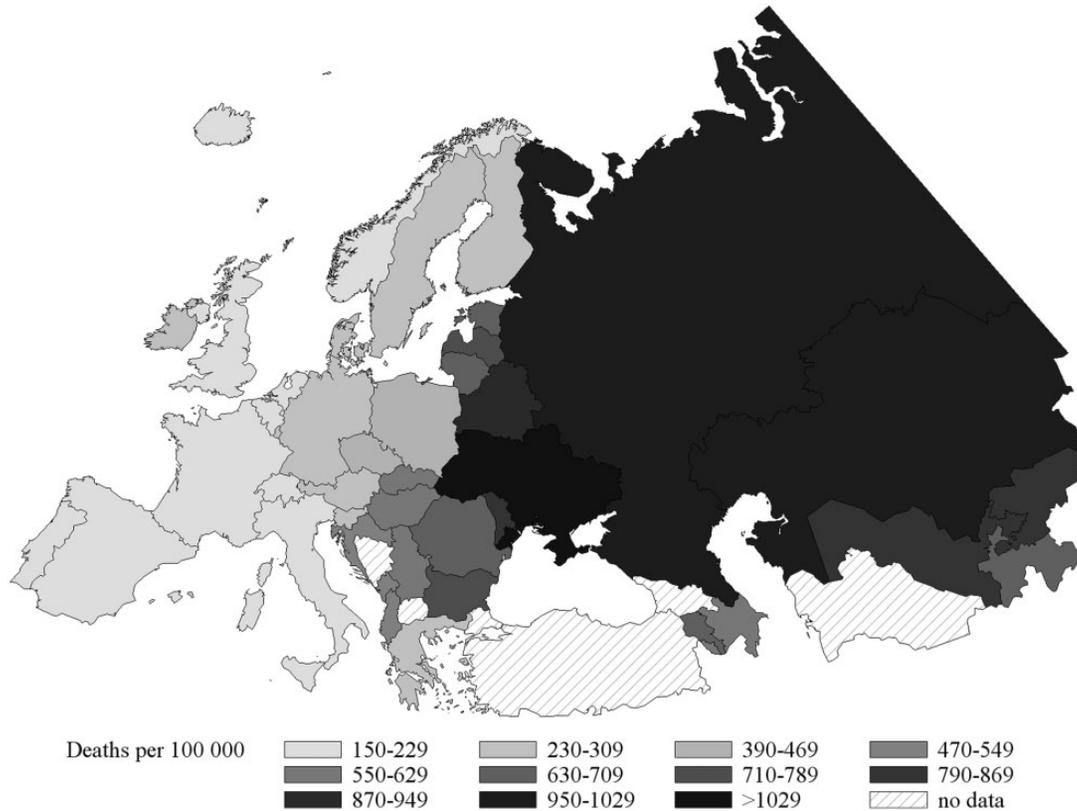


Figure 1 CVD mortality in males in Europe in 2008 age-standardized according to the WHO European standard population (ICD 10: I00–I90). Values of 2004 imputed: Albania; values of 2005 imputed: San Marino, Tajikistan and Uzbekistan; values of 2006 imputed: Belgium and Denmark; values of 2007 imputed: Azerbaijan and Switzerland

Eastern (highest rates: males in Kazakhstan 1078/100 000, females in the Republic of Moldova 683/100 000) than Western (lowest rates in France: males 174/100 000, females 102/100 000) Europe.² The update of the European mortality pattern of CVD for 2008 (figure 1) shows that the east–west decline remained virtually unchanged. The rate ratios between Russia and Germany were 3.7 for males and 3.0 for females in 2008.

These differences are mainly due to different risk profiles, particularly lifestyle habits.^{3–5} Binge drinking and chain smoking are common in FSU; both CVD risk factors show worldwide highest prevalence there.^{6–9} Red meat and saturated fat consumption combined with low fruit and vegetable intake are widely disseminated as well.^{10,11} Additionally, not only the societal living conditions in the FSU but also socioeconomic problems the repatriates are confronted with in high-income target countries might account for developing CVD.^{12,13}

The German repatriates shifted from a specific setting in Russia to different environmental and societal conditions in Germany. Hence, they experienced phases of different health transitions in their course of life, where they were exposed to changing risk factors.^{14,15} It was assumed that the German repatriates pursued lifestyles similar to the origin FSU population temporarily after migration to Germany. Additionally, migration is often related to psychosocial and long-term mental stress and is known to be etiologic for psychiatric disorders, which could affect CVD occurrence.^{16,17} In contrast, usually younger, and therefore healthier, persons tend to emigrate, which can induce a selection bias.¹⁸ However, this so-called healthy migrant effect may not play an important role here, as there is some evidence that the German repatriates emigrated almost completely.¹⁹ Data of a former cohort in North-Rhine-Westphalia showed that mostly complete family associations migrated, thus hardly any selection occurred.²⁰

Owing to their origin, higher CVD and ischemic heart disease (IHD) mortality rates in the repatriates were expected, at least in the first years after arrival in Germany. Surprisingly, initial studies reported considerably and significantly lower overall mortality, mainly driven by a lower CVD mortality.^{20,21}

The area of Augsburg, South Germany, is a community where a high number of repatriates migrated to between 1990 and 1999. Additionally, in Augsburg, the study platform KORA (Cooperative Health Research in the Region of Augsburg) has been established. Within this framework, a population-based Myocardial Infarction Register (MIR) has been set up. This allows the analysis of both IHD mortality and myocardial infarction incidence.^{22,23}

In this article, we present the overall, CVD (ICD 10: I00–I99) and IHD (ICD 10: I20–I25) mortality and myocardial infarction incidence as well as time trends in the Augsburg cohort of German repatriates from the FSU.

Methods

Data sources and study population

Mortality and myocardial infarction incidence follow-up was done retrospectively by assessing the German repatriates' individual vital status and linking these data with disease and mortality data from comparison populations.

Cohort inclusion criteria were the origin from FSU with the officially recognized status of being a German repatriate according the Federal Refugee Act of Germany. Using the population register of Augsburg, we identified 6378 repatriates, who migrated to the area of Augsburg from the FSU in the period from 1 January 1990 to 31 December 1999. Vital status was ascertained through local population registries within the observation period from 1990 to 10 May 2010. In case of a deceased person, we requested an

anonymous copy of the death certificate from the responsible local health authority within Germany. The MIR coded the causes of death according to ICD 10 (Supplementary figure S1 shows the study population flow chart).

Annual data of causes of death and population figures of the general German population were obtained from the Web site of the German Federal Health Monitoring Information System.²⁴

The MIR provided data on myocardial infarction incidence and IHD mortality. Since 1984, all cases of fatal and non-fatal acute myocardial infarctions (AMI) of the 25–74-year-old study population in the region of Augsburg (about 600 000 inhabitants; about 400 000 in the range of 25–74 years of age) have been continuously registered. Data sources for hospitalized patients include 10 hospitals. Methods of case finding and diagnostic classification of events have been described elsewhere.^{23,25} In brief, cases of initially non-fatal AMI are interviewed during their hospital stay using a standardized questionnaire, and further data is recorded by chart review. Fatal AMI, that is, out-of-hospital deaths and in-hospital deaths within 24 h, cases are identified through the regional health offices by checking all death certificate diagnoses suspect for IHD as main cause of death. Deaths from AMI were validated by autopsy reports, chart review and information from the last treating physician.²⁵ An incident event is defined as one in a patient without a history of AMI.

Up to 31 July 2009, the MIR incidence data were validated and completed when performing the analyses.

We identified first-ever AMI by linking the cohort with the MIR and calculated standardized incidence ratios (SIR) and age-specific and age-standardized incidence rates. Linkage was done with the variables sex, initials of the names and date of birth. Repatriates were considered at risk during the time registered as living within the study region and within the age frame of 25–74 years of age. End of follow-up was set to time of event (obtained from the matching with the MIR), date of moving out of study region, date of death or 31 July 2009.

Statistical analyses

Person-year (PY) calculations were done using a macro developed in the software SAS.²⁶ Standardized mortality ratio (SMR) analyses were performed for overall mortality and the ICD 10 groups I00–I99 (CVD) and I20–I25 (IHD). As the MIR population (basis of the SIR analysis) is age-restricted, we calculated the SMRs both with the German rates considering all ages and restricted to MIR age frame (25–74 years of age) as reference. We chose the German rates as baseline rather than the specific Augsburg rates because the German rates, based on a larger population, are more stable and because the Augsburg all-cause mortality was similar to the overall German rates. Additional SMR analyses corrected for missing death certificates where ICD coding was not possible.^{27,28}

SIRs were calculated for AMI using the rates of the MIR as reference.

Because the SMR and SIR give an overall summary measure only, and do not consider trends over time, we analyzed age-standardized mortality and incidence rates over time as well, in comparison with the corresponding reference populations. For better comparability with earlier MIR publications,²⁹ we chose the German population of 2002 as standard population. When standardizing to the European Population, the rates are approximately 15% lower. Calculations were done separated by sex.

Trends in IHD mortality and AMI incidence rates were modelled with a non-parametric locally weighted polynomial regression model (known as loess) to smooth the rates.³⁰ This method allows displaying a trend in presence of local outliers. We omitted the first 2 years because few PYs accumulated in this period.

All analyses were done using SAS[®] System 9.2 (SAS Inc., Cary/NC).

Results

Mortality

The German repatriates in Augsburg show a similar age distribution as observed in other studies, with the most PYs aggregated in young age groups.²¹ Difference in sex median age was 3 years (females: 30 years, males: 27 years) at immigration time and 4 years (females: 46 years, males: 42 years) at end of observation (Germany: 45.2 in females, 42.6 in males; estimates of 2009).

The sex composition of the repatriates (47.5% male) differs from the general population (49% male in 2009) but is similar to the FSU, where the difference between both sexes reaches 7% in some parts of the countries (table 1).^{31,32} Overall, about 92 000 PYs accumulated in the study population. The migration was relatively constant from 1990 to 1999 (reported in Supplementary table S1). Up to 10 May 2010, altogether 487 deaths were observed, of which 90 were related to IHD (ICD 10: I20–I25) and 199 to the general group of CVD (ICD 10: I00–I99). In 18 (3.7%) cases, no death certificate, and thus no cause of death was available. Only 134 (2.1%) persons were lost to follow-up.

For overall mortality, SMR estimates less than 1 were observed, significant in females only [SMR_{males} = 0.96, 95% confidence interval (CI; 0.85, 1.09); SMR_{females} = 0.85, 95% CI (0.75, 0.97); table 2]. Regarding CVD and IHD mortality, a lower mortality compared with the general German population was observed in males, although it was not significant. Adjusting for ICD code missing owing to unavailable death certificates (3.7% of all deaths), the SMRs and corrected CIs moved slightly towards higher numbers, but the effects in general remained the same.

The SMR estimates restricted to the MIR age frame were similar to the results based on all ages but showed wider CIs (reported in Supplementary table S2).

Incidence of myocardial infarction

Altogether, we observed 86 first-ever AMI (fatal and non-fatal) in the repatriates until 31 July 2009. The observed number of PYs was lower than in the SMR analyses because out-migrated individuals were no longer under observation and thus not under risk (table 1). The resulting AMI SIR was 1.30 (95% CI: 1.02, 1.65) in male repatriates and 0.92 (95% CI: 0.60, 1.43) in females (table 2).

Time trends

Time trends of the age-standardized IHD mortality and incidence rates are displayed in figure 2, together with the rates of the general German population and the MIR, respectively, and the smoothed rates of the German repatriates derived from loess modelling.

For both mortality and incidence, there was a significant average yearly decline of about 3.2 and 1.6%, respectively (both sexes combined), in the reference populations. Owing to limited sample size, the picture is not as clear in the repatriates. In male repatriates, the results suggest that the repatriates may have had lower IHD mortality rates in the 90s, when the cohort members arrived in Germany, but adapted to the German rates by now. Females seemed to have slightly higher mortality rates in comparison with the general population at any time. In both sexes, the area under the curve ratio corresponds to the overall SMR estimate.

In incidence, male repatriates had slightly lower AMI rates in the beginning of the observation period, but their situation seem to worsen in recent years. In females, the smoothed curve is similar to the German rates for many years. Here as well, the area under the curve ratio corresponds to the SIR findings.

Discussion

To our knowledge, this is the first study in which in addition to the overall and CVD mortality, both IHD mortality and AMI incidence

Table 1 Characteristics of the German repatriates from FSU in the Augsburg region

Characteristic	N	%	Person-years	Overall deaths	Death certificate missing	ICD 10 I20–I25	ICD 10 I00–I99
Mortality follow-up (all ages; end of follow-up 10 May 2010)							
Sex							
Males	3031	47.5	43 658	251	10	40	80
Females	3347	52.5	48 491	236	8	50	119
Vital status							
Deaths	487	7.6	4285	487	18	90	199
Lost to follow-up	135	2.1	958				
Alive	5756	90.3	86 906				
Total	6378		92 149	487	18	90	199
Incidence follow-up (limited to Myocardial Infarction Registry study region; 25–74 years of age; end of follow-up 31 July 2009)							
Sex							
Males	2345	47.8	23 903	125	0	20	36
Females	2564	52.2	27 174	73	1	11	25
Vital status							
First AMI ^a	86	1.8	693	26			
Lost to follow-up	79	1.6	431				
Deaths ^b	172	3.5	1234	172			
Event-free	4572	93.14	48 719				
Total	4909		51 077	198		31	61

^aAcute myocardial infarction.^bAll-cause deaths except first acute myocardial infarction.**Table 2** SMRs for overall mortality, CVD and IHD mortality and SIRs for AMI of German repatriates from Augsburg region compared with different reference populations

Cause of death	Sex	Obs.	Exp.	Person-years ^a	Ratio (95% CI)	Corrected ratio (95% CI) ^a
SMR ^b						
Overall	Females	236	276.1	48 491	0.85 (0.75, 0.97)	
	Males	251	261.1	43 658	0.96 (0.85, 1.09)	
I00–I99 (CVD)	Females	119	124.8	48 491	0.95 (0.79, 1.14)	0.99 (0.80, 1.21)
	Males	80	97.8	43 658	0.82 (0.65, 1.02)	0.85 (0.66, 1.09)
I20–I25 (IHD)	Females	50	46.1	48 491	1.08 (0.80, 1.43)	1.12 (0.81, 1.52)
	Males	40	47.7	43 658	0.84 (0.60, 1.14)	0.87 (0.61, 1.22)
SIR ^c						
AMI ^d	Females	20	21.68	27 174	0.92 (0.60, 1.43)	
	Males	66	50.82	23 903	1.30 (1.02, 1.65)	

^aAdjusted for missing death certificates.²⁷^bReference population: general German population, all ages.^cReference: acute myocardial infarction rates of the Myocardial Infarction Register, ages 25–74.^dAcute myocardial infarction.

Bold values: significant results.

were investigated in German repatriates. Whereas earlier studies have shown surprisingly lower overall and CVD mortality compared with the autochthonous population, we have been able to enhance the picture with a longer observation period and by presenting AMI incidence results.

Overall, the lower all-cause mortality in males was not as strong as described earlier, but in females, the effect was still significant. We observed a lower CVD mortality particularly in males, thus confirming previous results, although the effect appeared less pronounced and not significant. In deaths caused by IHD, males showed a similar pattern to that reported previously. In women, the effect was somewhat different from former findings, but not significant. The SMR estimates only slightly changed after adapting to the MIR age range definition, which mainly induced extended CIs owing to a lower number of events available.^{20,21}

In contrast to CVD and IHD mortality, a significantly higher overall rate of first-ever AMI was observed in male repatriates, which was primarily driven by higher AMI rates in the last years of observation.

The population composition in Augsburg is different from the general German population. The proportion of citizens with foreign nationalities living in Augsburg city is 17% compared with

8.7% in Germany overall (2009). As adjacent smaller cities report much lower numbers of foreigners, the register region average is about 11%.³¹ The proportion of persons with migration history overall (including the repatriates) is estimated to be about 41% in Augsburg, compared with 19.6% in Germany.^{33,34} The proportion of German repatriates originating from FSU and living in Augsburg city is 8.4% (2009; Amt für Statistik und Stadtforschung, personal communication). The higher proportion of persons with migration history could perhaps result in lower overall AMI incidence in the Augsburg region. The integration of German repatriates into the labour market has proven to be difficult, with the highest unemployment rates observed in the upper educational levels. In 2004, 28.6% of the German repatriates in Bavaria were unemployed, in contrast to 14.9% of the foreigners and 6.6% of the Germans.³⁵ A lower socioeconomic position is known to be linked with CVD risk factors; unemployment can be accompanied by lifestyle changes such as increased tobacco consumption.¹³ Hence, in the German repatriates, the long-term negative effect of the sudden fall to constant lower socioeconomic position might have started to outweigh a possible positive migration effect, what could explain the higher AMI incidence in comparison with the average of the Augsburg region.

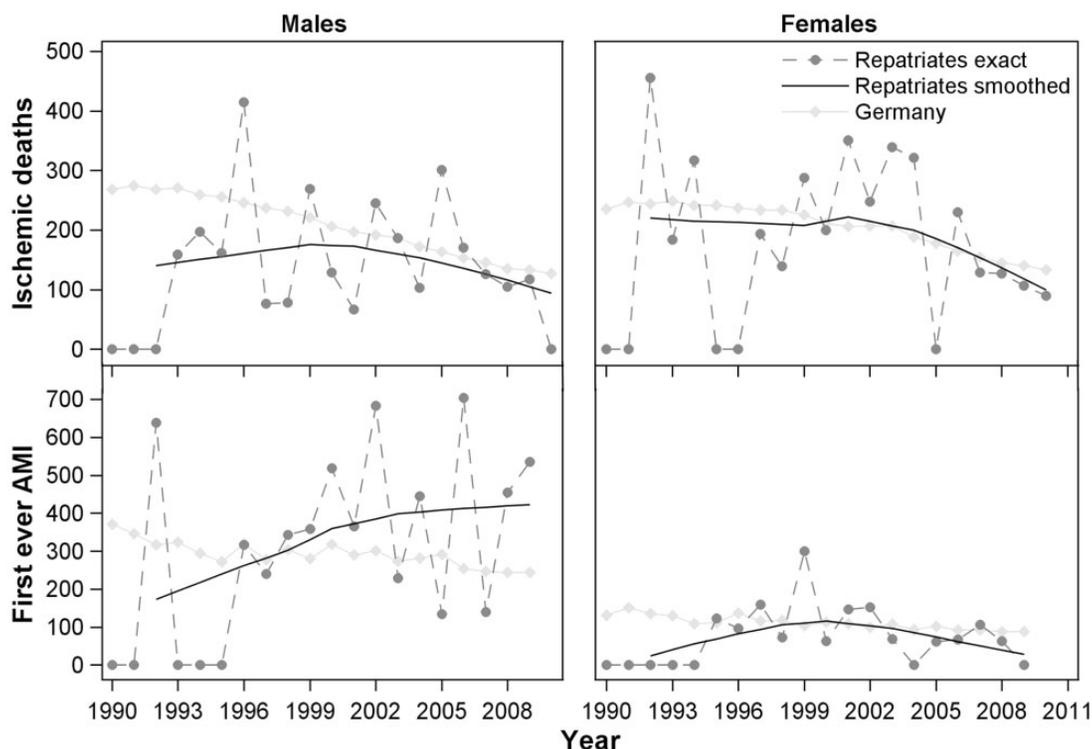


Figure 2 Calendar year-dependent I20–I25 mortality rates (top; all age groups included) and AMI incidence rates (bottom; 25–74 years of age), both standardized to the general German population of 2002

This study found some indications for a different course in male repatriates' IHD mortality and AMI incidence in comparison with the reference populations. Whereas in the German population, the IHD mortality has been declining over the past decades with an average yearly decline of about 3.7% in males and 2.7% in females, the pattern in the repatriates is less clear. Although the relatively low sample size precludes generalization of the results, the smoothed curve in male repatriates up to 2002 is in line with findings from a former study where nearly constant but, compared with the general population, significantly lower CVD mortality rates (in which IHD plays a major role in) have been reported.³⁶ Regarding AMI incidence, in contrast to the general German population, the course in male repatriates even appears to have possibly deteriorated in the recent years. Owing to the high variability of the rates from year to year, the non-parametric loess regression is a good means to present temporal trends. However, in consequence of the compromises made in modelling here, the results regarding the time trends have to be interpreted in a descriptive manner only.

This study has several limitations to be considered. The study population size was limited by the locally available cohort. Hence, CIs of most of the SMR and SIR estimates cover a wide range.

The linking procedure with the MIR could theoretically have led to an incorrect match. However, the probability of such an error is low because besides the initials of the names, the exact date of birth was part of the linkage.

First-ever AMI happening outside of the MIR region might not be registered if a person moves back to the study region and completion of the patient history might be impossible. However, because only a few ($n = 49$) German repatriates moved out and resettled back later, it can be assumed that this effect is negligible.

SMRs and IHD mortality time trend calculations were done using the rates of the general German population, whereas SIRs and AMI incidence trends were referring to the rates of the MIR population. But, even though the CVD/IHD death rates reported by the MIR are slightly higher compared with the general German population, they

follow the same trend.²⁹ Hence, the combined interpretation of IHD death rates and AMI incidence is not biased owing to different reference populations.

The strength of this study lies in the long observation period of a closed cohort living in a localized region in Germany, which limits the number of unknown influential parameters on time trends and enables a direct comparison with the local autochthon population. Taking into account that the German AMI incidence estimates are based on the MIR population, the cohort located in Augsburg is an advantage when calculating and interpreting the SIR.

It is very probable that the study cohort identified in the population register represents the fully possible cohort meeting the inclusion criteria. Hence, the results do not refer to a specific repatriates' subgroup only, like persons with low socioeconomic status for instance.

The less pronounced mortality effect seen in Augsburg in comparison with former studies probably results from the longer observation period, which may have led to a convergence of the rates towards the end of the period.^{20,21} However, if the mortality and incidence time pattern differ in the cohort and the reference population, as a few pointers suggest in our analysis, then an overall SMR or SIR might be insufficiently informative because it masks the temporal development.

Even though the (male) repatriates seem to have a lower CVD and IHD mortality in comparison with the general German population in SMR analyses spanned from 1990 to 2010, the time trends of the IHD mortality suggest that a possible former advantage of the male repatriates, as observed in previous studies, has changed into an equivalent situation by now.

In the general population, possibly risk reduction owing to changes in lifestyle habits may have influenced the CVD and IHD mortality decrease. Additionally, statins are increasingly prescribed to prevent CVD. However, a recent study in Denmark showed an inequitable distribution of statin applications primarily in high-risk individuals in lower risk socioeconomic subgroups.³⁷ Such inequalities in statin therapy application could have contributed to

the increasing AMI incidence in male repatriates. But no data were available to assess their socioeconomic risk status. However, in females, a similar pattern was not observed.

Razum and Twardella (2002) attributed the frequently lower CVD mortality of first-generation migrants in high-developed host countries to different progresses in the health transition in the country of origin and the host country and different time lags in cause-specific mortality subject to changing risk factors.¹⁵ Whereas a reduced risk for infections in the host country could drastically lower infectious disease mortality within a short period after immigration, the higher exposure to CVD risk factors might become apparent many years later. Transferred to the repatriates, this might indicate that the German repatriates had healthier lifestyles with regard to CVD risks in FSU compared with the ethnic Russians. This hypothesis is underpinned by findings of a recent study where significant lower alcohol consumption in repatriates in Germany is reported, for example.³⁸ The increasing AMI incidence in (male) repatriates on the other hand might demonstrate the delaying onset of the impact of changes in the CVD risk profile due to migration. However, both the study size and observation period are probably too small to observe a similar impact on IHD mortality.

Conclusions

Previously reported results on overall and CVD-related mortality in German repatriates were largely confirmed in this study. However, a possible historical advantage seems to have disappeared in recent years, and the rates of the repatriates and the general German population may have converged. Regarding AMI incidence, male repatriates suffered more frequently from first-ever AMI overall in comparison with the general population, with steadily deteriorating rates in the recent years. Health politics should be sensitized and should contemplate to implement screening programmes specifically targeted to repatriates, for example.

Supplementary data

Supplementary data are available at *EURPUB* online.

Acknowledgements

The authors thank Mrs Robin Nesbitt for proofreading the manuscript and improving the English.

A.D. procured the data, performed the analyses and drafted the manuscript. V.W. helped in the analyses and verified the SAS coding. M.H. and C.M. performed the MIR record linkage, provided MIR data and distributed knowledge about the MIR CVD and AMI detection algorithm and the medical background. H.B. conceived the study and contributed to the calculations. All authors contributed in writing the manuscript and read and approved the final version.

Ethics approval

The ethics committee of the medical association of Bavaria has approved the research proposal. As this study is for the public benefit and only register-based data and anonymous copies of death certificates were used, no informed consent had to be obtained from the subjects.

Funding

German Research Foundation (GK 793/3, BE 2056/9-1). The KORA research platform and the MONICA Augsburg studies were initiated and financed by the Helmholtz Zentrum München, German Research Center for Environmental Health, which is funded by the German Federal Ministry of Education, Science, Research and

Technology and by the State of Bavaria. Since the year 2000, the myocardial infarction data collection is co-financed by the German Federal Ministry of Health to provide population-based myocardial infarction morbidity data for the official German Health Report (www.gbe-bund.de).

Conflicts of interest: None declared.

Key points

- Previously reported results on lower all-cause and CVD-related mortality in German repatriates were largely confirmed in this study.
- But, AMI incidence was significantly higher in male German repatriates.
- Time trends showed differences between German repatriates and the general German population.
- A possible historical advantage in the German repatriates may have transformed to a worse situation by now.
- Health politics and the health system should be sensitized and take care of the development of IHD mortality and AMI incidence among the German repatriates.

References

- 1 Bundesverwaltungsamt Köln. Spätaussiedlerstatistik, 2010. Available at: http://www.bva.bund.de/DE/Aufgaben/Abt___III/Spaetaussiedler/spaetaussiedler-node.html_nnn=true (14 June 2012, date last accessed).
- 2 Deckert A, Winkler V, Paltiel A, et al. Time trends in cardiovascular disease mortality in Russia and Germany from 1980 to 2007 - are there migration effects? *BMC Public Health* 2010;10:488.
- 3 Costanzo S, Di Castelnuovo A, Donati MB, et al. Wine, beer or spirit drinking in relation to fatal and non-fatal cardiovascular events: a meta-analysis. *Eur J Epidemiol* 2011;26:833–50.
- 4 Chow CK, Lock K, Teo K, et al. Environmental and societal influences acting on cardiovascular risk factors and disease at a population level: a review. *Int J Epidemiol* 2009;38:1580–94.
- 5 Costanzo S, Di Castelnuovo A, Donati MB, et al. Cardiovascular and overall mortality risk in relation to alcohol consumption in patients with cardiovascular disease. *Circulation* 2010;121:1951–9.
- 6 McKee M, Bobak M, Rose R, et al. Patterns of smoking in Russia. *Tob Control* 1998; 7:22–6.
- 7 Rehm J, Rehn N, Room R, et al. The global distribution of average volume of alcohol consumption and patterns of drinking. *Eur Addict Res* 2003;9:147–56.
- 8 Puddey IB, Rakic V, Dimmitt SB, Beilin LJ. Influence of pattern of drinking on cardiovascular disease and cardiovascular risk factors—a review. *Addiction* 1999;94: 649–63.
- 9 Bobak M, McKee M, Rose R, Marmot M. Alcohol consumption in a national sample of the Russian population. *Addiction* 1999;94:857–66.
- 10 Ginter E. Cardiovascular risk factors in the former communist countries. Analysis of 40 European MONICA populations. *Eur J Epidemiol* 1995;11:199–205.
- 11 Popkin B, Zohoori N, Kohlmeier L, et al. Nutritional risk factors in the Former Soviet Union. In: Bobadilla JL, Costello CA, Mitchell F, editors. *Premature Death in the New Independent States*. Washington, DC: National Academy Press, 1997: 314–35.
- 12 Adler NE, Ostrove JM. Socioeconomic status and health: what we know and what we don't. *Ann N Y Acad Sci* 1999;896:3–15.
- 13 Manrique-Garcia E, Sidorchuk A, Hallqvist J, Moradi T. Socioeconomic position and incidence of acute myocardial infarction: a meta-analysis. *J Epidemiol Community Health* 2011;65:301–9.
- 14 Spallek J, Zeeb H, Razum O. What do we have to know from migrants' past exposures to understand their health status? a life course approach. *Emerg Themes Epidemiol* 2011;8:6.
- 15 Razum O, Twardella D. Time travel with Oliver Twist—towards an explanation for a paradoxically low mortality among recent immigrants. *Trop Med Int Health* 2002;7: 4–10.

- 16 Schneider RH, Walton KG, Salerno JW, Nidich SI. Cardiovascular disease prevention and health promotion with the transcendental meditation program and Maharishi consciousness-based health care. *Ethn Dis* 2006; 16(3 Suppl 4):S4–26.
- 17 Fuchs M. Soziokulturelle Identifikation von Aussiedlern 15 Jahre nach der Einreise. Grenzlose Gesellschaft. Beiträge zu den Sektionen und ad hoc-Gruppen des 29. Kongresses der Deutschen Gesellschaft für Soziologie, 2000.
- 18 Jasso G, Massey DS, Rosenzweig MR, Smith JP. Immigrant Health: Selectivity and Acculturation. Critical perspectives on racial and ethnic differences in health in late life, Natl Academy Washington DC, 2004, 227–66.
- 19 Bundeszentrale für politische Bildung, editor. *Aussiedler*, Vol. 267. Franzis' print&media GmbH, München 2000.
- 20 Winkler V. *Specific aspects of the health profile of German migrants from the Former Soviet Union*. PhD thesis. Institute of Public Health, University of Heidelberg, 2008.
- 21 Becher H, Razum O, Kyobutungi C, et al. Mortality of immigrants from the Former Soviet Union: results of a cohort study. *Dtsch Arztebl* 2007;104:1655–61.
- 22 Holle R, Happich M, Löwel H, et al. KORA—a research platform for population based health research. *Gesundheitswesen* 2005;67(Suppl 1):S19–25.
- 23 Meisinger C, Hörmann A, Heier M, et al. Admission blood glucose and adverse outcomes in non-diabetic patients with myocardial infarction in the reperfusion era. *Int J Cardiol* 2006;113:229–35.
- 24 Statistisches Bundesamt. Gesundheitsberichterstattung des Bundes, 2010. Available at: www.gbe-bund.de (14 June 2012, date last accessed).
- 25 Löwel H, Lewis M, Hörmann A, Keil U. Case finding, data quality aspects and comparability of myocardial infarction registers: results of a south German register study. *J Clin Epidemiol* 1991;44:249–60.
- 26 Hammer GP. Makros zur Berechnung von Personenjahren in epidemiologischen Studien. In: Proceedings der 15 Konferenz der SAS-Anwender in Forschung und Entwicklung. Shaker Verlag, Aachen 2011: 223–32.
- 27 Rittgen W, Becker N. SMR analysis of historical follow-up studies with missing death certificates. *Biometrics* 2000;56:1164–9.
- 28 Bruns R. Schätzen und statistische Inferenz für das SMR bei fehlenden Todesursachen. Diploma thesis. Institute of Public Health, University of Heidelberg, 2000.
- 29 Löwel H, Meisinger C, Heier M, Hörmann A. The population-based acute myocardial infarction (AMI) registry of the MONICA/KORA study region of Augsburg. *Gesundheitswesen* 2005;67(Suppl 1):S31–7.
- 30 Cleveland WS, Devlin SJ. Locally weighted regression: an approach to regression analysis by local fitting. *J Am Stat Assoc* 1988;83:596–610.
- 31 Statistisches Bundesamt. Regionaldatenbank Deutschland: Bevölkerungsstand nach Geschlecht und Nationalität, 2009. Available at: <https://www.regionalstatistik.de/genesis/online;jsessionid=A16A000B9A434F221891528CC15D9E9F?operation=abrufabelleAbrufen&selectionname=173-41-4&levelindex=1&levelid=131942962325&index=11> (14 June 2012, date last accessed).
- 32 CIA-The World Factbook. Available at: <https://www.cia.gov/library/publications/the-world-factbook/geos/rs.html> (14 June 2012, date last accessed).
- 33 Augsburg Allgemeine Zeitung. Daten und Fakten: Migranten in Augsburg, 2010. Available at: <http://www.augsburger-allgemeine.de/augsburg/Daten-und-Fakten-Migranten-in-Augsburg-id8403596.html> (14 June 2012, date last accessed).
- 34 Statistisches Bundesamt. *Bevölkerung und Erwerbstätigkeit: Bevölkerung mit Migrationshintergrund – Ergebnisse des Mikrozensus 2009*. Reihe 2.2. Wiesbaden: Statistisches Bundesamt, 2010: 7.
- 35 Brück-Klingberg A, Burkert C, Seibert H, Wapler R. *Spätaussiedler mit höherer Bildung sind löfiers arbeitslos*. IAB Kurzbericht, 2007: 8.
- 36 Ronellenfisch U, Kyobutungi C, Becher H, Razum O. All-cause and cardiovascular mortality among ethnic German immigrants from the Former Soviet Union: a cohort study. *BMC Public Health* 2006;6:16.
- 37 Wallach-Kildemoes H, Diderichsen F, Krasnik A, et al. Is the high-risk strategy to prevent cardiovascular disease equitable? A pharmacoepidemiological cohort study. *BMC Public Health* 2012;12:610.
- 38 Kuhrs E, Winkler V, Becher H. Risk factors for cardiovascular and cerebrovascular diseases among ethnic Germans from the former Soviet Union: results of a nested case-control study. *BMC Public Health* 2012;12:190.