ORIGINAL ARTICLE

An Inter-State Comparison of Cardiovascular Risk Factors in Germany

Towards an Explanation of High Ischemic Heart Disease Mortality in Saxony-Anhalt

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SUMMARY

Background: For years, the state of Saxony-Anhalt has had one of the highest mortality rates from ischemic heart disease among all federal states in Germany. In this article, we provide an overview of the prevalence of known risk factors for ischemic heart disease across the German states and discuss possible artefacts in mortality statistics.

Methods: On the basis of data from a selective literature review and from official statistics, we compare, if available, age-standardized prevalences of diabetes, obesity, increased waist circumference, metabolic syndrome, and cigarette smoking across the German states. We also present statistics on completion of schooling, dropping out of school, and unemployment.

Results: Saxony-Anhalt was in first or second place among German states for all of the risk factors considered. It was also among the leaders in the percentage of school dropouts (14.1%), and, in 2011, it had the lowest percentage of persons educated to matriculation level (19.2%). The unemployment rate in Saxony-Anhalt was 11.5% in 2012, one of the highest rates in Germany. Even after unclear and unknown causes of death are taken into account, the high mortality from ischemic heart disease in Saxony-Anhalt (153.3 per 100 000 person years) cannot be attributed completely to an artefact.

Conclusion: The high prevalence of risk factors and the unfavorable profile of social factors are consistent with the observed high mortality from ischemic heart disease in Saxony-Anhalt. There is an urgent need for lasting prevention strategies on all levels—societal, behavioral, and clinical.

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Saxony-Anhalt has one of the highest mortality rates from myocardial infarction and ischemic heart disease among the German states (1). In 2011 the age-standardized mortality rate (Federal Republic of Germany, 1987 standard) due to ischemic heart disease was 158/100 000 person years (International Classification of Diseases, 10th edition[2]; ICD-10:I20-I25), whereas the national rate was 103/100 000 person years. This means that the rate in Saxony-Anhalt was 53% above the national average for Germany (www.gbe-bund.de, accessed 9 February 2014).

In principle, three factors provide possible explanations for this state of affairs in Saxony-Anhalt:

- The prevalence of risk factors for ischemic heart disease is particularly high
- Healthcare provision for patients with ischemic heart disease is particularly deficient
- Methodological artifacts—for example, errors in the cause of death statistics—have resulted in artificially high mortality figures.

The healthcare provision for patients with myocardial infarction is currently under study in the context of the newly founded regional myocardial infarction registry of Saxony-Anhalt (Regionales Herzinfarktregister in Sachsen-Anhalt, RHESA; www.medicin.uni-halle.de/RHESA). Initial results are expected in the summer of 2014.

A comprehensive overview of state-specific prevalences of risk factors for ischemic heart disease is thus far lacking. In order to assess the importance of preventive measures, such a study is urgently required. This article aims to provide an overview of the population based prevalences of established risk factors for ischemic heart disease. As explanatory factors exist for these risk factors—for example, unemployment and low educational status—we will also compare their prevalences in the inter-state comparison. Furthermore, we will discuss ideas about artifacts that might contribute to the highest national mortality due to ischemic heart disease.

Materials and methods

Publications and data sets were suitable for this article if prevalences of risk factors for ischemic heart disease were documented by federal state. In the context of a selective literature search and after reviewing official

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TABLE 1

Prevalences of risk factors for coronary heart disease in Germany, and ranking Nos 1–3 in the inter-state comparison (in square brackets)*

Federal state	Diabetes		Smoking		Arterial hypertension		Obesity		Increased waist circumference		Metabolic syndrome	
		%		%		%		%		%		%
Schleswig-Holstein		8.0		28.2		24.7		20.3		36.0		17.3
Hamburg		7.5		27.0				21.4		30.5		17.2
Bremen		9.5	[2]	31.4		23.4		19.8		34.2		16.4
Lower Saxony		9.4		27.1				24.3	[2]	40.4		19.2
North Rhine–Westphalia		10.8		27.7		26.8		23.0		37.5		19.5
Hesse		10.5		25.6		24.9		21.6		35.6		18.5
Rhineland-Palatinate		11.2		26.4		27.2		21.7		37.8		19.9
Saarland		9.4		26.8		28.1		23.3		38.3		19.7
Baden-Württemberg		11.1		23.3		22.7		20.0		33.4		18.6
Bavaria		12.1		23.9		24.1		23.0		35.7		19.6
Brandenburg	[3]	13.8		29.3	[3]	31.7	[2]	26.1	[3]	39.6	[3]	22.0
Berlin		12.1		31.3		20.6		23.1		33.2		18.5
Mecklenburg–Western Pomerania		13.2	[1]	32.2	[1]	32.4	[3]	25.2		36.7	[2]	23.2
Saxony	[1]	15.8		25.8		31.3		21.6		33.4		20.2
Saxony-Anhalt	[2]	14.7	[2]	31.4	[2]	31.9	[1]	28.3	[1]	42.1	[1]	23.5
Thuringia		11.4		28.6				23.9		38.4		20.7
Federal Republic of Germany		11.4		26.5		25.6		22.8		36.5		19.8

*All prevalences are age-standardized except for arterial hypertension; for the prevalence of arterial hypertension, mean rates for men and women are given; Prevalences for hypertension for the states of Schleswig-Holstein and Hamburg, Bremen and Niedersachsen, and Saxony-Anhalt and Thuringia were combined; Data in square brackets: The highest prevalence was given a No 1 ranking, the next highest prevalence or rate a No 2 ranking, etc.

statistics (Federal Statistical Office of Germany, Robert Koch Institute), age-standardized prevalences, if available, of arterial hypertension, diabetes, obesity, increased waist circumference, metabolic syndrome, and cigarette smoking were compared by federal state. Similarly, data about school leaving certificates/qualifications, school dropout statistics, and unemployment were researched by federal state.

Obesity, increased waist circumference, and metabolic syndrome

The GEMCAS study was a nationwide cross-sectional study of the prevalence of several risk factors for ischemic heart disease in primary care. By using a random sample, general practices were drawn, and the doctors (general practitioners or specialists in internal medicine) were asked to recruit during one morning all patients ≥ 18 years—if possible—into the study, independently of their reason for attending the practice.

In October 2005, 35 869 patients from 397 out of Germany's 438 rural districts and urban districts were included in the study. The study components included the following measurements: body mass index (BMI), waist circumference (cm), arterial hypertension, and a venous blood specimen for the purpose of analyzing blood glucose and serum lipids. Obesity was defined as

a BMI ≥ 30 kg/m². The metabolic syndrome was defined according to a slightly modified 2004 definition from the American Heart Association (AHA) and the National Heart, Lung, and Blood Institute (NHLBI) as (3):

- Waist circumference >102 cm in men and >88 cm in women
- Systolic blood pressure ≥ 130 mm Hg or diastolic blood pressure ≥ 85 mm Hg
- Fasting blood glucose ≥ 5.6 mmol/L (100 mg/dL) or haphazard blood glucose ≥ 11.1 mmol/L (200 mg/dL) or diabetes mellitus
- Triglycerides ≥ 1.7 mmol/L (150 mg/dL), (5) HDL cholesterol <1.03 mmol/L (40 mg/dL) in men and <1.29 mmol/L (50 mg/dL) in women.

Medication for arterial hypertension or dyslipidemia was not included in the AHA/NHLBI definition of 2004 (4, 5).

Smoking

The microcensus includes a nationwide sample of 1% of the general population. Selected persons are asked about health aspects, among others, by using a computer-assisted telephone interview. Taking into account the random sampling plan, these self-reported data can then be extrapolated to the population (www.

TABLE 2

Prevalences of unemployment, high school completion, and school dropouts without final certificates in Germany, and rankings 1–3 in the inter-state comparison (in square brackets)*

Federal state	Unemployment (2012)		Higher-education entrance qualification (2011)		School dropouts without final certificate (1992)		School dropouts without final certificate (2012)	
		%		%		%		%
Schleswig-Holstein		6.9		26.2		9.8		7.2
Hamburg		7.5		41.6	[2]	11.5		6.6
Bremen		11.2		33.7		9.1		4.7
Lower Saxony		6.6		25.0		10.6		5.5
North Rhine–Westphalia		8.1		29.8		6.9		5.1
Hesse		5.7		31.9		9.2		5.0
Rhineland-Palatinate		5.3		25.5		9.1		5.3
Saarland		6.7		24.1		9.1		5.3
Baden-Württemberg		3.9		28.2		7.3		4.3
Bavaria		3.7		25.4		8.7		4.7
Brandenburg		10.2		25.4		8.4		7.1
Berlin	[1]	12.3		40.5	[3]	11.1		6.6
Mecklenburg–Western Pomerania	[2]	12.0	[2]	20.2		10.3	[1]	12.2
Saxony		9.8		23.6		9.9	[3]	9.6
Saxony-Anhalt	[3]	11.5	[1]	19.2	[1]	14.1	[2]	11.2
Thuringia		8.5	[3]	22.0		9.3		7.5
Federal Republic of Germany		6.8		27.8		8.9		5.6

*Higher-education entrance qualification (university or technical university): inverse rankings, that is, the state with the lowest proportion receives a No 1 ranking, etc; proportions for men and women after excluding persons still attending school or who did not comment on their school education; data in square brackets: the highest prevalence received a No 1 ranking, the next highest prevalence a No 2 ranking, etc.

gbe-bund.de, accessed 9 February 2014). The latest microcensus that collected information on smoking dates back to 2009.

Arterial hypertension

From July 2008 to June 2009, 12 114 women and 9 148 men aged 18–100 years provided detailed information about their health status in the context of a national telephone survey (telephone survey conducted by the Robert Koch Institute). Participants who responded “yes” to the following two questions were considered hypertension patients: “Has a doctor ever diagnosed you with high blood pressure or hypertension?” and “Have you had high blood pressure within the past 12 months?” Persons were also considered hypertension patients if they responded “yes” to the question: “Is your high blood pressure currently treated with medication?” (6).

School leaving qualifications, school dropout statistics, and unemployment

Unemployment rates by federal state for 2012 were made available by Germany’s Federal Employment Agency (Bundesagentur für Arbeit) (7). The most re-

cent education data for the population came from the 2011 microcensus (8). We requested data on school leaver statistics from the Federal Statistical Office.

Cause of death statistics

The cause of death statistics documented by the Federal Statistical Office were used for the comparison between federal states (www.gbe-bund.de, accessed 9 February 2014). Differences in the documentation habits of doctors performing necropsies may cause problems if coronary heart disease is narrowly defined. For this reason, differently wide-ranging definitions for heart disease are used to calculate the age-standardized mortality figures: myocardial infarction and re-infarction (ICD-10: I21–I22), ischemic heart disease (ICD-10: I20–I25), diseases of the circulatory system (ICD-10: I00–I99), and overall mortality (ICD-10: A00–T98).

Statistical methods

In this article, we present age-standardized prevalences. Age standardization allows us to compare prevalences between states without the age structure—likely to be different in different states—distorting the results

TABLE 3

Age-standardized mortality rates (cases per 100 000, men and women) in the inter-state comparison for 2012 and ranking positions 1–3 in the inter-state comparison (in square brackets)*

Federal state	Cause of death ICD-10	Myocardial infarction and reinfarction		Ischemic heart disease		Circulatory diseases		Ill-defined and unknown causes of mortality		Overall mortality	
			I21–I22		I20–I25		I00–I99		R95–R99		A00–T98
Schleswig-Holstein			30.5		83.6		274.6		14.6		725.5
Hamburg			39.1		86.1		222.9		35.5		696.3
Bremen			46.5		87.8		270.0		12.9		740.2
Lower Saxony			49.3		110.8		274.1		13.4		729.7
North Rhine–Westphalia			41.3		83.3		255.9		35.1		742.1
Hesse			39.1		97.8		246.7		15.3		687.8
Rhineland-Palatinate			46.9		109.5		276.7		7.6		726.4
Saarland			51.9	[3]	133.4		281.8		19.0		763.3
Baden-Württemberg			42.6		88.5		236.1		5.0		641.8
Bavaria			45.9		98.1		266.0		8.5		693.0
Brandenburg		[1]	69.7		131.1		303.5		17.0		752.6
Berlin			44.7		89.7		225.0		51.7		706.0
Mecklenburg–Western Pomerania			53.8	[2]	133.6	[2]	307.4		10.9	[2]	776.7
Saxony		[3]	56.5		130.5		302.5		9.9		718.8
Saxony-Anhalt		[2]	65.9	[1]	153.3	[1]	335.8		9.1	[1]	802.7
Thuringia			51.9		115.6	[3]	305.1		8.4	[3]	770.1
Federal Republic of Germany			46.1		100.7		265.5		17.7		715.8

*All rates were age-standardized by using the population standard Germany 1987 (www.gbe-bund.de; accessed 9 February 2014); data in square brackets: the highest rate was given a No 1 ranking, the second highest rate a No 2 ranking, etc.

(9). Prevalences were exclusively published as crude rates by the Robert Koch Institute only for arterial hypertension. However, age differences between Germany's states are not big: the mean age of the 2008 population of Baden-Württemberg was 42.2 years (youngest population), whereas the mean population age in Saxony-Anhalt was 45.9 years (oldest population). All age-standardized prevalences were standardized by using the population standard (Germany, 31 December 2004). The state-specific data determined per risk factor or cause of death were sorted by size and ranked. The highest or least favorable prevalence or rate was given a No 1 ranking, the next highest or second favorable prevalence or rate was given a No 2 ranking, and so on. Only the first three rankings are specifically laid out in the tables.

Results

Table 1 lists the age-standardized prevalences of the risk factors for ischemic heart disease by federal state. For all presented risk factors the prevalences in the population of Saxony-Anhalt were ranked as No 1 or No 2. Especially for obesity and waist circumference—for both of which Saxony-Anhalt came in first

place—the distance to the No 2 ranking was about 2 percentage points each (Table 1).

In 1992 as well as 20 years later, Saxony-Anhalt was among the top rankings regarding students who leave school without a leaving certificate. The proportion of persons with a higher-education entrance qualification (technical university or university) in the 2011 microcensus in Saxony-Anhalt was 19.2%, lower than in any other German state. Unemployment rates in Saxony-Anhalt in 2012 were among the highest in all of Germany (Table 2).

The cause of death statistics for 2012 show that Saxony-Anhalt comes first for overall mortality, disorders of the circulatory system (ICD-10: I00–I99), and ischemic heart disease (ICD-10: I20–I25). The state takes second place only for myocardial infarction and re-infarction (ICD-10: I21–I22) (Table 3). This observation also applies for men and women separately (eTables 1, 2). A notable observation concerns the above average mortality rates in Berlin, Hamburg, and North Rhine–Westphalia for the cause of death “Ill-defined and unknown causes of mortality” (R95–R99). If 50% of these rates were added to the death rates owing to ischemic heart disease (ICD-10: I20–I25), then Saxony-Anhalt would assume the No 1 ranking for this death rate without any change.

Simplified multilevel model of risk factors for ischemic heart disease

Discussion

In Saxony-Anhalt, the prevalences of all risk factors for ischemic heart disease that were under study are among the highest. This finding is an important part of the explanation of Germany's highest mortality due to ischemic heart disease in this federal state. Among the socially disadvantageous factors, it is noteworthy that Saxony-Anhalt has one of the worst unemployment rates in Germany. Furthermore it has the lowest proportion of adults that have a higher-education entrance qualification. In 1992 and 2012, Saxony-Anhalt held one of the top positions regarding the proportion of school leavers without a school leaving certificate. Saxony-Anhalt's No 1 ranking in mortality due to ischemic heart disease cannot be explained by means of statistical artifacts from the cause of death statistics nor by differently high death rates due to "ill-defined and unknown causes of mortality."

East Germany's generally higher prevalences of risk factors for ischemic heart disease were also observed in the available population-based cohort studies. A comparison of the age-standardized (Germany, 2000) prevalence of hypertension in 25–64 year olds in Augsburg and Greifswald showed that the prevalence of hypertension was much higher in Greifswald than in Augsburg (men: Greifswald 57%, Augsburg 32%; women: Greifswald 32%, Augsburg 23%) (10). The resident population of Halle (age group 45–83 years) showed the highest age-standardized (Germany, 2000) prevalences of hypertension nationwide (men 79%, women 71%) (11). A comparative analysis of the prevalences of diabetes in persons aged 45–74 showed that Halle (12.0%) and Greifswald (10.9%) had the highest prevalences, and the prevalences in the Rhine-Ruhr area (Heinz Nixdorf Recall Study: 7.2%, Dortmund Health Study 9.3%) and in Augsburg (5.8%) were lower (12). The high prevalence of obesity and the unfavorable body fat distribution in people in Saxony-

Anhalt was also found in the population-based cohort studies (KORA-S4, Heinz Nixdorf Recall Study, SHIP-0, CARLA). In men and women aged 45–74, the largest measurements for waist circumference were observed in Halle (men: 103.6 cm; women: 95.6 cm). Interestingly, in this comparison the mean BMI values in men were very similar in these studies (range 28.2–28.8 kg/m²). Detailed analyses have shown that even in persons with comparable BMI measurements, the waist circumference measurements in the population of Halle are notably larger than in the other populations (13).

The high prevalences of risk factors in Saxony-Anhalt can be interpreted only within a larger and social context. The *Figure* provides an overview of a simplified multilevel model of risk factors for ischemic heart disease (modified from Kaplan et al. 2000 [14]). Level 1 exerts an influence on level 2. This, in turn, affects level 3. Ultimately, the factors at level 3 exert influence on the triggering of ischemic heart disease. Factors at level 1 are further upstream within the temporal sequence of factors at levels 1–3, and factors at level 3 are further downstream. The biomedical risk factors presented in this article are to be considered as downstream factors in the context of the different levels of risk factors. Lifestyle factors are further upstream, as are education and socioeconomic factors of the population, all of which affect the prevalence of risk factors.

With regard to the presented social factors, Saxony-Anhalt is in a particularly invidious situation. Observational studies have shown that threatened and existing unemployment as well as a low educational status are determinants of lifestyle factors and therefore of risk factors for ischemic heart disease (15–19). Data from the German Federal Health Survey (DEGS) from 2008 to 2011 show that prevalences of smoking, obesity, diabetes, depressive symptoms, diagnosed depression, and physical inactivity are notably higher in persons of low socioeconomic status (20).

A clinical preventive approach to lowering mortality due to ischemic heart disease in Saxony-Anhalt includes improved detection of persons with unidentified hypertension, diabetes, or dyslipidemia, and the systematic treatment of such newly identified patients. Furthermore, optimal adjustment of the treatment of patients with known hypertension, dyslipidemia, or diabetes is also important (21). Population based cohort studies in Germany have shown that the proportions of persons with undetected hypertension, diabetes, or dyslipidemia are substantial. Furthermore, it has been observed that optimal blood pressure regulation was unsuccessful in a large proportion of patients with known and treated arterial hypertension (10, 11, 22).

In addition to the clinical preventive approach, a sociopolitical approach in the sense of prevention "at source" is worth considering. This includes tightening the non-smoking law in the state of Saxony-Anhalt, as well as political measures against unemployment and low educational status. Legal measures to protect

non-smokers might act as a signal in terms of the social acceptability of smoking (23). Saxony-Anhalt's law for the protection of non-smokers, last changed on 14 July 2009, under §4 includes exception rules for single-room restaurants and pubs of less than 75 square meters and for discotheques that persons younger than 18 are not allowed to access. Such businesses can provide strictly separated smoking rooms. An absolute smoking ban without exemptions was not introduced in Saxony-Anhalt, nor was it in several other states.

Although no confirmed conclusions are possible at this time regarding the effect of the smoking ban in public places on rates of myocardial infarction (owing to methodologically diverse approaches and differently long observation periods), a meta-analysis that included all studies on the effect of smoking bans on hospital admission rates due to myocardial infarction that had been published to October 2011, showed an estimated average reduction in this rate by 11% after smoking bans were introduced (24). The high unemployment rate in Saxony-Anhalt and the comparatively high proportion of students leaving school without a final certificate can be tackled politically only very slowly—if at all. For this reason, prevention measures that have a beneficial effect on individual behaviors—as well as measures that result in optimal treatment for known patients with hypertension, diabetes, or dyslipidemia, as well as those who have yet to be identified—are urgently needed (21).

Limitations

Our compilation of prevalences is subject to several limitations. Self-reports of arterial hypertension in the context of the telephone health survey 2009 are likely to have resulted in an underestimate of the true prevalence of arterial hypertension. The KORA (1999–2001) and SHIP (1997–2001) studies showed (age ranges 25–74 years) that the age-standardized (Germany, 2000 standard) proportion of persons with arterial hypertension who were unaware that they had hypertension was 42–45% in men and 26–29% in women (22). Results of the CARLA Study on Halle's resident population aged 45–83 showed that 35% of men and 19% of women with raised blood pressure were unaware of this fact (25). As far as self-reported data on smoking are concerned, it can also be assumed that survey studies will report an underestimate of the true prevalence. It is, however, implausible to assume that the extent of the underestimate is dependent on the federal state. The cohort studied in the GEMCAS Study was a large nationwide sample of patients who consulted their primary care physicians. As about 92% of adults in Germany consult their primary care physician at least once within a year (26), the sample could be assumed to reflect a high degree of coverage. When the authors of the GEMCAS Study compared their study data with those from the German Federal Health Survey (DEGS) and the microcensus, they did not find any differences for BMI distribution, smoking, or socioeconomic status (27), although they did for age and sex. These differ-

ences do, however, not affect our analyses in this article because of the standardization.

Conclusion

In conclusion, the presented data give a coherent picture: The high prevalences of risk factors for ischemic heart disease that are associated with unfavorable social factors are consistent with the high mortality rates due to ischemic heart disease in Saxony-Anhalt. Artifacts resulting from the cause of death statistics cannot satisfactorily explain regional differences in mortality due to ischemic heart disease in Germany. Evidence based, lasting prevention strategies are urgently needed that affect all levels of prevention:

- Prevention at societal level (politicians)
- Preventing harmful behaviors (physicians and other healthcare professionals), and
- Clinical prevention (physicians).

This is the only approach by which a medium-term reduction of the high mortality due to ischemic heart disease in Saxony-Anhalt may be delivered. The discussion in this article also similarly applies to Mecklenburg–Western Pomerania.

Conflict of interest statement

Prof A Stang has received funding for setting up the regional registry of myocardial infarction for Saxony-Anhalt (RHESA) and has been supported by the German Heart Foundation, the Federal Ministry for Labor and Social Affairs (BMAS), the Ministry of Sciences and Economics Affairs for Saxony-Anhalt, the AOK statutory health insurance fund, and the ikk gesund plus statutory health insurance fund.

M Stang declares that no conflict of interest exists.

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KEY MESSAGES

- Saxony-Anhalt has had one of Germany's highest mortality rates due to ischemic heart disease for years.
- An inter-state comparison of age-standardized prevalences of the risk factors for ischemic heart disease shows that Saxony-Anhalt is one of the states with the highest rates.
- Saxony-Anhalt is also among the top few states regarding the social factors that affect these prevalences (school leavers without final certificate/qualification, low rate of persons with higher-education entrance qualification, high unemployment).
- Artifacts of cause of death statistics (for example, diverging definitions of heart disease and the rate of ill-defined and unknown causes of mortality) do not provide a plausible explanation of the high mortality rate due to ischemic heart disease.
- Lasting prevention strategies at all levels are urgently needed: prevention at societal level, prevention of harmful behaviors, and clinical prevention.

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ORIGINAL ARTICLE

An Inter-State Comparison of Cardiovascular Risk Factors in Germany

Towards an Explanation of High Ischemic Heart Disease Mortality in Saxony-Anhalt

Andreas Stang, Maximilian Stang

eTABLE 1

Age-standardized mortality rates (cases per 100 000, men only) in the comparison between German states in 2012 and ranking 1–3 in the comparison between German states (in square brackets)*

Federal state	Cause of death ICD-10	Myocardial infarction and reinfarction		Ischemic heart disease		Circulatory diseases		Ill-defined and unknown causes of mortality		Overall mortality	
			I21–I22		I20–I25		I00–I99		R95–R99		A00–T98
Schleswig-Holstein			31.5		80.7		220.9		16.5		632.5
Hamburg			40.3		81.5		185.7		39.8		622.4
Bremen			50.0		91.8		233.3		14.4		687.8
Lower Saxony			51.3		107.2		226.3		16.3		658.1
North Rhine–Westphalia			41.4		79.7		208.0		39.3		663.5
Hesse			40.7		95.5		196.7		18.3		601.2
Rhineland-Palatinate			47.7		104.3		223.2		9.2		640.9
Saarland			55.5	[3]	128.2		238.8		19.6		690.7
Baden-Württemberg			42.8		85.6		191.1		6.3		564.1
Bavaria			48.0		97.0		214.6		10.2		610.8
Brandenburg		[1]	71.9		125.4		249.3		21.9		701.2
Berlin			43.9		82.6		181.7		52.3		630.4
Mecklenburg–Western Pomerania			57.9	[2]	129.0	[2]	261.6		15.6	[2]	746.1
Saxony		[3]	61.7		128.3	[3]	257.4		13.5		681.1
Saxony-Anhalt		[2]	69.9	[1]	146.5	[1]	281.1		13.4	[1]	770.6
Thuringia			58.2		116.1		255.4		11.2	[3]	719.9
Federal Republic of Germany			47.6		97.3		216.7		20.5		642.4

*All rates were age-standardized by using the population standard Germany 1987 (www.gbe-bund.de; accessed 9 February 2014); Data in square brackets: the highest rate was given a No 1 ranking, the next highest rate a No 2 ranking, etc.

eTABLE 2

Age-standardized mortality rates (cases per 100 000, women only) in the comparison between German states in 2012 and ranking 1–3 in the comparison between German states (in square brackets)*

Federal state	Cause of death ICD-10	Myocardial infarction and reinfarction		Ischemic heart disease		Circulatory diseases		Ill-defined and unknown causes of mortality		Overall mortality	
			I21–I22		I20–I25		I00–I99		R95–R99		A00–T98
Schleswig-Holstein			26.3		77.5		309.9		11.9	[3]	770.5
Hamburg			34.2		82.7		244.9		28.8		727.4
Bremen			38.6		74.9		288.3		11.1		745.9
Lower Saxony			41.7		101.7		300.7		9.6		746.9
North Rhine–Westphalia			37.2		78.4		285.9		29.1		770.2
Hesse			33.1		88.1		279.2		11.6		725.9
Rhineland-Palatinate			41.3		102.8		310.9		5.6		760.3
Saarland			43.5	[3]	126.4		304.2		17.8		786.0
Baden-Württemberg			37.9		80.7		262.5		3.4		671.2
Bavaria			38.8		88.1		298.5		6.3		727.2
Brandenburg		[1]	60.5		124.6	[2]	336.8		11.3		750.2
Berlin			41.9		89.3		255.2		47.6		740.3
Mecklenburg–Western Pomerania			45.1	[2]	127.1	[3]	332.4		5.9		757.1
Saxony		[3]	46.4		121.4		326.8		6.0		709.4
Saxony-Anhalt		[2]	57.0	[1]	148.5	[1]	370.1		4.2	[1]	787.4
Thuringia			26.3		77.5		309.9		11.9	[2]	770.5
Federal Republic of Germany			40.0		93.6		295.4		14.0		739.5

*All rates were age-standardized by using the population standard Germany 1987 (www.gbe-bund.de; accessed 9 February 2014); Data in square brackets: the highest rate was given a No 1 ranking, the next highest rate a No 2 ranking, etc.