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Original article

Hospital admission rates and case-fatality for cardiovascular diseases in Western Norway, 1992–2001

Abstract

Background. The Western Norway Cardiovascular Registry was established to facilitate epidemiologic research on a national level before the recent advent of the Norwegian Patient Register with personal identification. Hospital admission rates, and case-fatality were compared with regional mortality rates for cardiovascular diseases.

Material and methods. The register contains data on 231 857 patients with cardiovascular diseases or diabetes mellitus admitted to hospitals in Western Norway (Rogaland, Hordaland and Sogn og Fjordane) 1972–2002. The hospital data were supplemented with data from the Norwegian Causes of Death Register (personal identification number was used to link up the information).

Results. The admission rates for cardiovascular diseases increased moderately in Western Norway from 1992 through 2001. At the same time a marked reduction was seen in mortality rates for these diseases. For acute first-time myocardial infarction, the admission rates decreased slightly from 1992 through 2000, and then increased in 2001. Case-fatality from acute infarction was substantially reduced throughout the decade, most notably for those aged 65 years or more. Among those who died of acute infarction the first 24 hours, the fraction who died outside of hospital was high (78.3 %).

Interpretation. Hospital admission rates for cardiovascular diseases do not parallel the simultaneous decrease in mortality rates. The Regional Register of Cardiovascular Diseases demonstrates the possibilities for etiological research and the limitation of mortality statistics alone.

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Since 1970, cardiovascular mortality (box 1) has decreased with more than 50 % in Norway and other Scandinavian countries (1, 2). A combination of several factors may have contributed to fewer patients acquiring disease (prevention) and/orfewer deaths (treatment) (2).

Until recently, Norway has been the only Nordic country that has not had a national patient register with personal identification, where diagnoses from hospital stays could be registered. This has constituted a serious hindrance to both aetiological research and quality assurance of health services, and is an explanation for lack of knowledge on cardiovascular morbidity in Norway (3, 4). In order to obtain good quality data on incidence and frequency of these diseases, The Western Norway Cardiovascular Registry (WENOCARD) was established (*www.uib.no/hks/*).

In this article we use data from WENOCARD (for 1992–2001) to analyse changes in cardiovascular mortality rates in the light of incidence changes of these diseases (as measured by hospital admission rates). We present the overall rates for diseases in the circulatory system and specifically for acute myocardial infarction (AMI). Case-fatality rates for AMI both out-of-hospital and after admission (box 1) are also shown.

Material and methods

WENOCARD has retrieved patient administrative data directly from the somatic hospitals in Western Norway (Rogaland, Hordaland and Sogn og Fjordane) and mortality data from the Norwegian Causes of Death Register at Statistics Norway.

WENOCARD

In 1999, the WENOCARD project was granted dispensation from confidentiality rules by the Norwegian Board of Health Supervision, concession from the Data Inspectorate, and approval from the Regional Committee for Medical and Health Research Ethics (REK West) to establish a historic register for hospital admissions for cardiovascular disease in the Western Norway Regional Health Authority (RHA). The register is defined as a research project and has no concession for continuous data collection.

Data collection and requirement specifications

Patient administrative data were collected for all persons admitted to a hospital in Rogaland, Hordaland and Sogn og Fjordane (Western Norway RHA [RHA West]) with a

Main message

- Until recently, Norway has been the only Nordic country that has registered diagnoses from hospital stays in patient registers without person identification. The Storting has recently passed an act that will render the Norwegian Patient Register personidentifiable.
- WENOCARD was set up for epidemiological research.
- Mortality rates for cardiovascular disease have declined in the period 1992–2001, but the admission rates for cardiovascular disease have not.
- WENOCARD shows the possibilities for aetiology research of diseases in the circulatory system in the Norwegian population.

Box 1

- *Mortality/mortality rates:* number of AMI deaths per 100 000 inhabitants in the course of a defined time period, usually a year.
- *Case fatality rate:* Number of persons diagnosed as having a specified disease (e.g. AMI) who die as a result of that illness within a given time period (e.g. 28 days) among all persons diagnosed with that illness (A measurement of prognosis expressed as a percentage).

registered diagnosis or procedure code related to cardiovascular disease or diabetes, dating back to when the various hospitals began to register data and continuing to 1 July 2002. Admissions with the following diagnoses (primary and secondary) codes have been counted: diseases of the circulatory system (International Classification of Diseases ICD-8/9: 390–459; ICD-10: I00-I99) and diabetes (ICD-8/9: 250; ICD-10: E10-E14).

When the diagnostic criteria have been met, information has been retrieved for all subsequent hospital stays whatever the diagnosis. For most hospitals the data material goes back to the 1980s. Haukeland University Hospital has data as far back as 1972, but data from Haraldsplass Hospital only go back to 1991 and those from Nordfjord Hospital to 1992. During the period 1972–2002 there have been different systems of patient administration at these hospitals and different means of classifying diagnoses and medical procedures. This has led to a time-consuming comparison and quality assurance of data from the various hospitals. We have, for example, validated information in WENOCARD against the Norwegian Patient Register.

Validation against the Norwegian Patient Register

We have compared admissions and procedures related to cardiovascular disease in the period 1999–2001 registered in WENOCARD, with corresponding information (anonymously registered) in the Norwegian Patient Register for admitted patients living in Rogaland, Hordaland and Sogn og Fjordane. There is almost perfect agreement between data in WENOCARD and the Norwegian Patient Register for most diagnoses. For primary diagnoses in the category «diseases of the circulatory system» (I00-I99), discrepancies in the number of admissions are less than 3 % for all the hospitals, except for those in Nordfjord and Lærdal (4.8 % of the total material), where WENOCARD lacks information about 19 % of the admissions in Nordfjord and 54 % of those in Lærdal in 1999. If we also include secondary diagnoses, the discrepancy is less than 2 % for all hospitals in the period 1999–2001.

The existence of personal identification numbers has enabled us to link information from the Causes of Death Register to all registered persons up to and including the year 2002. Such linkage was not possible to perform with the anonymous information in the previous Norwegian Patient Register.

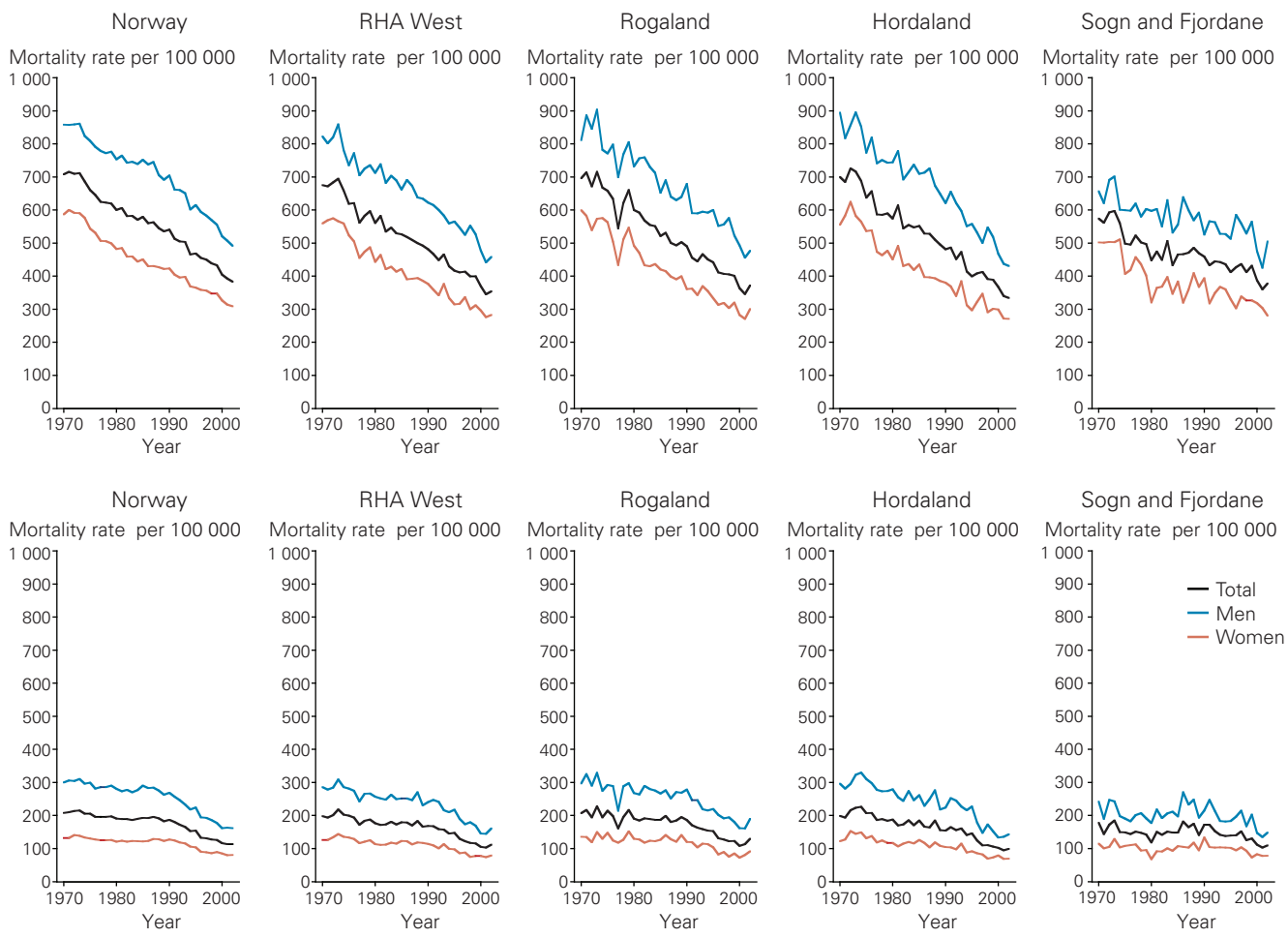

Figure 1 *Age-standardized mortality rates for diseases in the circulatory system (top row) and AMI (bottom row): for the entire country; for RHA West; for each county (Rogaland, Hordaland, Sogn og Fjordane); for men, women and both sexes combined. Based on data from Statistics Norway and WENOCARD 1992–2001*

Table 1 Cardiovascular disease and diabetes in Rogaland, Hordaland and Sogn og Fjordane (RHA West). Primary diagnoses and procedures on hospital admission 1972–2002 registered in WENOCARD

Hospital	Period	No. of registered persons with a primary diagnosis	No. of persons with a procedure code (not out-patients)	No. of primary diagnoses	No. of primary diagnoses 390–459 and I00-I99	No. of procedure codes (not out-patients)
Haukeland University Hospital	1972–2002	108 965	57 717	420 863	138 057	226 431
Haraldsplass Deaconal Hospital	1991–2002	26 194	8 748	52 835	21 118	18 792
Stord Hospital	1989–2002	10 245	4 205	32 871	11 447	8 774
Voss Hospital	1989–2002	7 170	3 254	18 946	7 832	8 899
Odda Hospital	1988–2002	5 400	3 195	15 157	6 195	6 584
Hordaland total		128 859	69 592	540 672	184 649	269 480
Sogn and Fjordane Central Hospital, Førde	1986–2002	17 997	8 222	60 505	18 221	23 476
Lærdal Hospital	1988–2002	6 061	2 871	16 772	6 793	6 543
Nordfjord Hospital	1992–2002	4 964	2 043	12 674	4 806	4 553
Sogn and Fjordane total		26 555	12 498	89 951	29 820	34 572
Haugesund Hospital	1986–2002	22 739	11 019	79 588	28 920	29 196
Stavanger University Hospital	1980–2002	67 558	33 474	242 768	82 393	119 579
Rogaland totally		87 639	46 653	322 356	111 313	148 775
Total		231 857	122 255	952 979	325 782	452 827

Case ascertainment

Admission numbers for each year of discharge, by hospital and county, were counted for each discharge diagnosis group. Outpatient diagnoses were not included. In certain cases the patient has had two hospital stays where the admission date for the second stay has been the same as the discharge date for the first stay. We have chosen to interpret this as the patient having been readmitted the day of discharge, and we count such cases as two separate admissions. If a patient has been moved from one hospital to another, the admission is counted for both hospitals. Table 1 shows that there are 231 857 patients in WENOCARD. Some of the patients have been admitted to several hospitals so that the total sum is lower than the sum of the number of patients at each hospital. One or more procedures have been registered for a total of 122 255 patients. The database has 952 979 registered primary diagnoses and among these 325 782 have codes designating cardiovascular disease.

In this article we have focused on diseases of the circulatory system, ischaemic heart disease (ICD 8/9: 410–414; ICD-10: I20-I25) and acute myocardial infarction (AMI) (ICD 8/9: 410; ICD-10: I21-I22). For AMI we have tried to distinguish between first-time heart attacks and repeat attacks, as WENOCARD has longitudinal data on individual patients. First-time heart attacks are defined as the first registered admission with AMI (ICD 8/9: 410 and ICD-10: I21-I22) as the primary or secondary diagnosis in WENOCARD, or with the same diagnosis codes registered as the underlying cause of death in the data from Statistics Norway. The ICD 10 codes I21 (first-time AMI) or I22 (repeat AMI) were first used in 1999. This means that we have at least seven years' observation time in the register (1992–98) to detect any previously registered heart attack. Knowledge of repeated events in the register led to a reclassification of heart attacks; 3.1 % of first-time heart attacks had been coded wrongly as code I22, and 9.6 % of repeat attacks as I21.

The incorrect use of infarction codes I21 and I22 is also confirmed by a current validation project at the Department of Cardiology, Haukeland University Hospital. For codes 412/I25.2 (old myocardial infarction) we have chosen to keep the classification repeat heart attacks even if the diagnoses were registered before or together with the first registration of an acute infarction in WENOCARD. The patient could have had their first attack before the start of complete registration in WENOCARD in 1992. A new admission with heart attack occurring more than 28 days after the first attack was defined as a repeat attack, while a new admission with the diagnosis AMI within 28 days after a previous acute infarction did not

Table 2 Age-standardized case-fatality of first-time acute myocardial infarction (AMI) by age for men, women an both sexes combined in RHA West registered in WENOCARD 1992–2001

	Total (≥ 35 years)		35–64 years		≥ 65 years	
	1992	2001	1992	2001	1992	2001
Day 0–27, all registered[1]						
Total	43.5	32.6	19.6	15.6	50.7	37.8
Men	44.5	32.7	19.6	14.9	52.1	38.1
Women	42.4	32.6	21.3	18.3	48.8	36.9
Day 1–27, hospitalized						
Total	22.6	19.2	4.7	4.4	28.1	23.7
Men	24.0	19.4	3.9	4.4	30.1	23.9
Women	22.5	18.8	10.2	4.7	26.2	23.1
Day 0, all registred[1]						
Total	28.9	17.4	15.6	11.8	33.0	19.1
Men	29.0	17.5	16.3	11.1	32.9	19.4
Women	27.5	17.7	12.3	14.3	32.1	18.8
Day 0, hospitalized						
Total	8.0	4.4	4.0	2.3	9.3	5.0
Men	7.4	3.7	3.6	2.2	8.5	4.2
Women	8.7	5.1	6.0	2.8	9.5	5.8

[1] The sum of all hospitalized AMIs based on data from WENOCARD and all fatal AMIs without hospitalization based on data from the Causes of Death Register

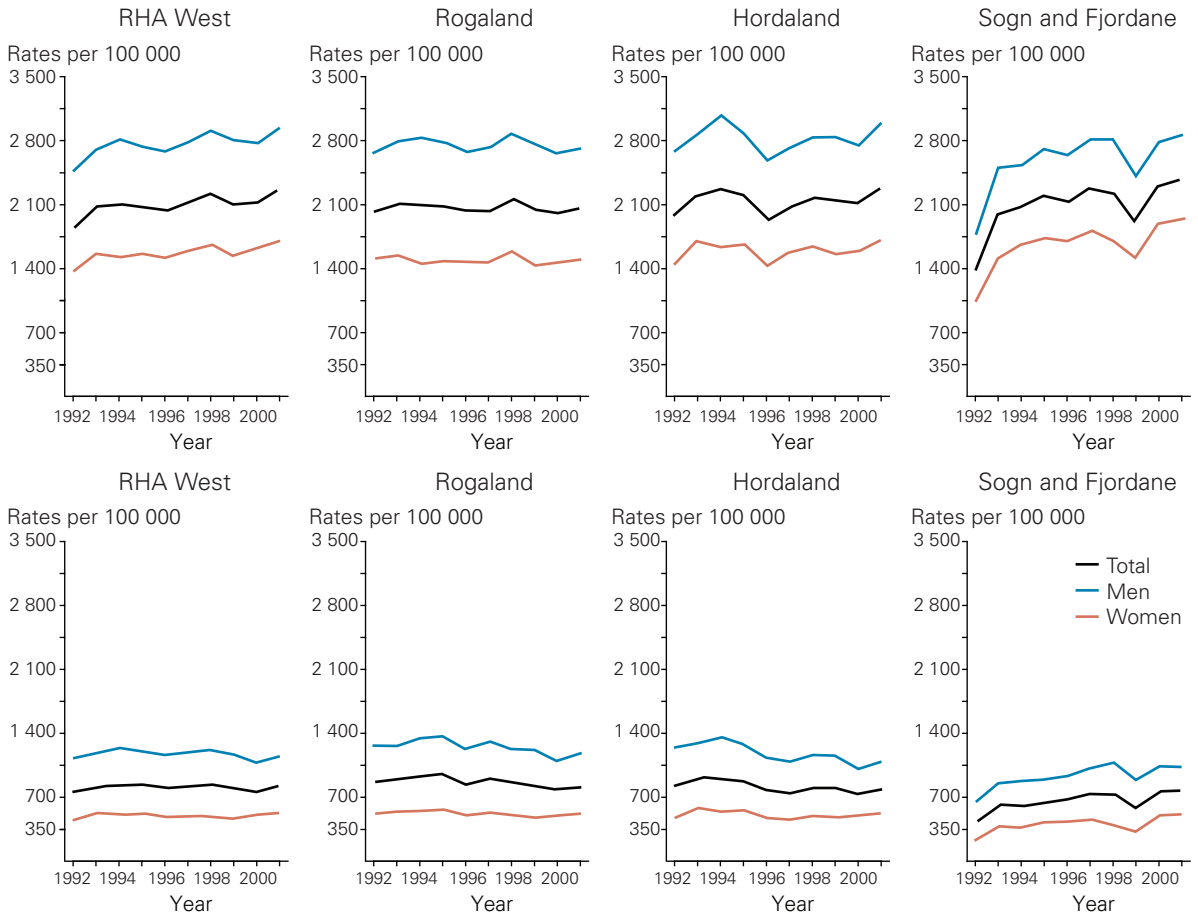

Figure 2 *Age-standardized hospital admission rates per 100 000, by county for men, women and both sexes combined for diseases in the circulatory system (top row) and ischaemic heart disease (bottom row) as primary diagnoses. Standard population is defined by Norwegian Standard 2000. Source: WENOCARD 1992–2001.*

count as a new AMI. We assumed that the coding of the infarction represented the event for the previous admission, as provided for according to ICD-10.

Admission rates

County admission rates are defined as the number of admitted patients with a permanent residence in Rogaland, Hordaland and Sogn og Fjordane per 100 000 inhabitants in these counties per year in the period 1992–2001. Information on the population was given by Statistics Norway. The rates are age-adjusted with the Norwegian population in the year 2000 as the standard population.

Mortality rates

The mortality rates for Norway and for Rogaland, Hordaland and Sogn og Fjordane for the period 1970–2002 are from the Norwegian Causes of Death Register. We have calculated mortality rates per 100 000 inhabitants and age-specific rates in 5-year age groups (0–4; 5–9; …; 95–99; 100+) for men and women within the various geographical areas. We have calculated the age-adjusted mortality rates for both sexes combined and for each sex separately by using the mean population of Norway at the beginning and at the end of the year 2000 divided into 5-year age groups as a standard population (direct age-adjusted mortality rates). Combined rates and sex-specific rates in 5-year age groups have been weighed against the same standard population and summarized for all age groups.

Case-fatality for acute myocardial infarction

We have calculated the case-fatality rates for first-time AMI for persons 35 years or older. The calculations have been done separately for hospitalized cases and for all registered cases. The term «all registered myocardial infarctions» includes the sum of all hospitalized cases based on WENOCARD information and all fatal cases without hospitalization based on data from the Causes of Death Register. Case-fatality was calculated from Day 0 (acute case-fatality), for the interval 0–27 days (total 28-day case-fatality) and for the interval 1–27 days where we excluded those who died without being admitted or died in hospital on the day of the heart attack. Case-fatality, expressed as a percentage, has been calculated for men and women in the age groups 35–64 years and ≥ 65 years and are directly age-adjusted with the number of infarction cases in RHA West in the year 2000 in 10-year age groups as the standard. We also calculated the proportion of prehospital deaths on the day of the heart attack among all deaths registered as AMI the first day, and among all deaths on the day with registered myocardial infarction within 28 days.

Results

Mortality rates for diseases in the circulatory system

Age-standardized mortality rates for diseases in the circulatory system showed a clear decline in RHA West as well as in Norway as a whole (fig 1, top row). In 1970 the rate for both sexes combined in RHA West was 675 per 100 000 inhabitants. It fell to 370 per 100 000 inhabitants around the year 2000. We observed a corresponding decline in rates for Rogaland and Hordaland. Sogn og Fjordane had a lower rate at the start in 1970, 574 per 100 000, but the same rate

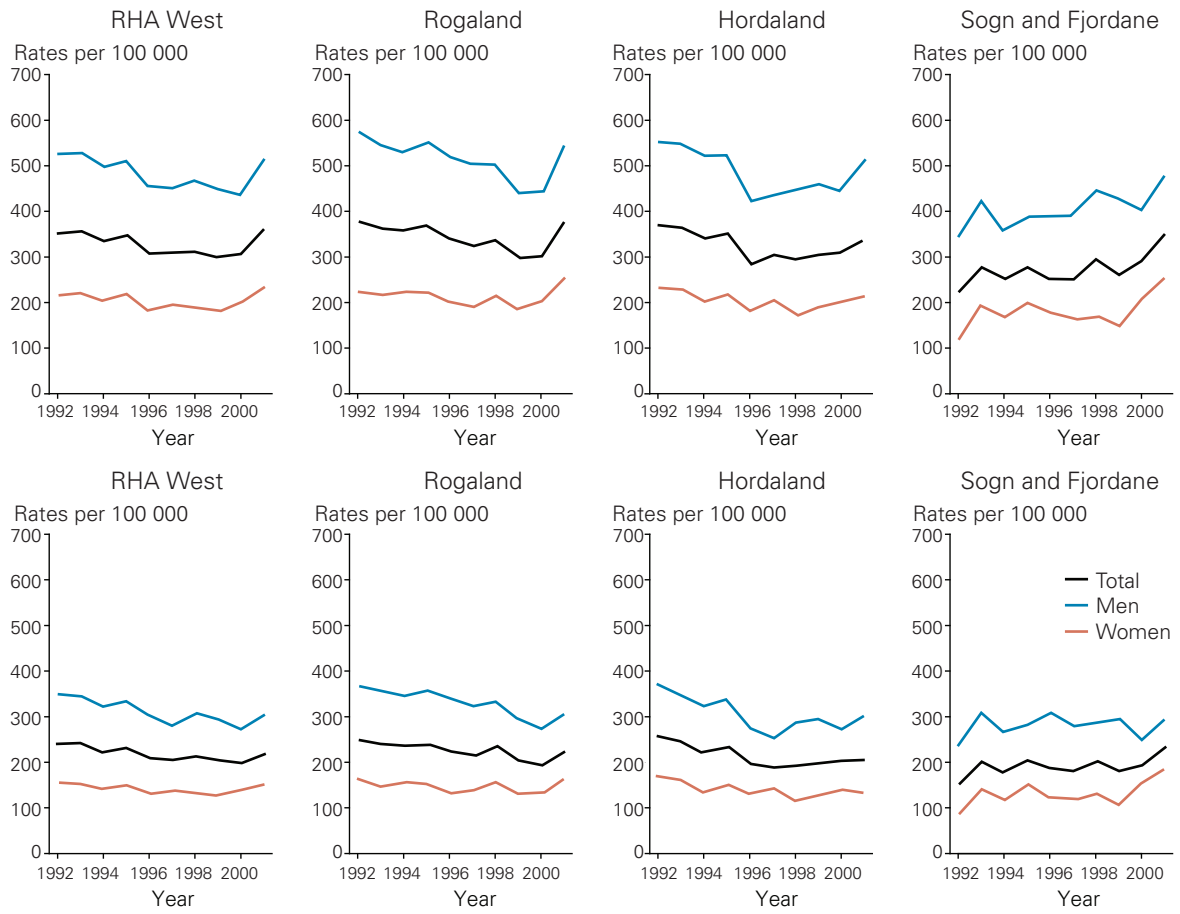

Figure 3 *Age-standardized hospital admission rates per 100 000 for AMI (top row) as primary or secondary diagnosis and first-time AMI (bottom row), by county for men, women and both sexes combined . Standard population is defined by Norwegian Standard 2000. Source: WENOCARD 1992–2001.*

around the year 2000 as in the other two counties. Men had higher mortality rates than women throughout the whole observation period. We saw a corresponding halving of the rates for AMI throughout the same 30-year period (fig 1, bottom row).

Admission rates for diseases of the circulatory system

Age-standardized rates for admissions due to diseases in the circulatory system showed a weak but even increase for RHA West totally (fig 2 top row), but was mainly explained by a more than 50 % increase in admission rate for Sogn og Fjordane. For the other two counties the rates were stable: about 2 000 per 100 000. The rates for men and women showed a corresponding pattern, although the rates for men were higher. The admission rates for ischaemic heart disease showed a weak reduction in Rogaland and Hordaland, but in Sogn og Fjordane there was a slight increase for ischaemic heart disease (fig 2, bottom row).

In the period 1992–2000, there was a decline in the rates for first-time AMI as a primary or secondary diagnosis (fig 3, bottom row), from 242 admissions per 100 000 for both sexes combined to 202 per 100 000. This trend was seen in all the geographical areas but was less marked in Sogn og Fjordane, which had a lower rate in 1992 (155 per 100 000) than in 2001 (232 per 100 000). In general, it seems as if the reduction in admission rates for heart attacks was greater for men. In 2001 there was a slightly higher admission rate.

Case-fatality for first-time AMI

Case-fatality among patients with first-time AMI in RHA West declined in the period 1992–2001 (fig 4, tab 2). Case-fatality within 28 days declined from 43.5 % to 32.6 % (fig 4a). Equivalent data, by sex and age, showed that the improvement in prognosis was primarily in the age group ≥ 65 years. Case-fatality for days 1–27 was low and unchanged throughout the period for hospitalized middle-aged patients: 4.7 % and 4.4 %. It showed a weak decline among the oldest patients: from 28.1 % to 23.7 % (fig 4b). Case-fatality the actual day of infarction for all registered cases throughout these 10 years, was reduced from 28.9 % to 17.4 % (fig 4c). There was less alteration in case-fatality for hospitalized patients: from 8.0 % to 4.4 % (fig 4d).

The proportion of fatal first AMIs within 24 hours that were out-of-hospital (not shown in figures or tables) was unchanged from 1992 to 2001 (78.3 % to 78.3 %). This proportion was high both in the age group 35–64 years (77.8 % to 82.2 %) and 65 years and older (78.5 % to 76.9 %). If we use number of all deaths within the first 28-days after infarction, 53.4 % died out-of-hospital the day of infarction in 1992 and 44.5 % in 2001. This proportion was high and unchanged for middle-aged patients (62.3 % to 62.4 %), but it was lower and showed a decline for the oldest patients (50.7 % to 39.1 %).

Discussion

Data from WENOCARD for 1992–2001 show that whereas the mortality rates for AMI fell dramatically, the admission rates for AMI declined less. AMI case-fatality was reduced for hospitalized patients the first 28 days, but there was little change in case-fatality on the actual day of infarction.

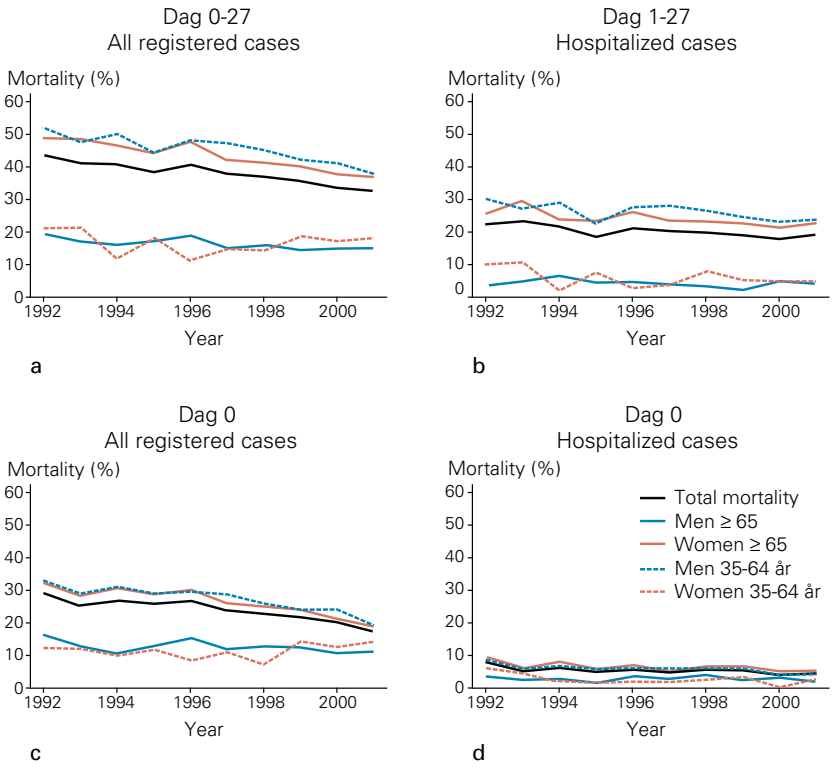

Figure 4 *Age-standardized case fatality rates for first-time acute myocardial infarction (AMI) (a) all registered cases 0–27 days; (b) hospitalized cases 1–27 days; (c) all registered cases day 0; (d) hospitalized cases day 0. (First-time AMIs are the sum of all registered first-time hospitalized AMIs from WENOCARD 1992–2001 and fatal outpatient AMIs from the Causes of Death Register).*

Incidence and mortality

The decreasing mortality rates for diseases of the circulatory system in general and for AMI in Norway and in RHA West correspond with equivalent declines observed in the other Nordic countries (1, 5–7) and other North European countries (*www.who.dk/hfadb*). The decline can probably be attributed to a combined effect of changes in incidence and prognosis, but the size of the contributions from prevention, improved emergency treatment and secondary prophylaxis is still being discussed (6, 7).

In WENOCARD we found that the admission rates for diseases in the circulatory system (entered as primary diagnosis) did, in fact, increase somewhat during the observation period 1992–2001. The rates for admission with ischaemic heart disease and AMI, however, showed a marked decline. If we included ischaemic heart disease as a secondary diagnosis, the incidence increased in the observation period (not shown in the figures). Presumably, better emergency treatment and secondary prophylaxis has led to the patients living longer with the disease and in connection with admission for another disease, a cardiovascular diagnosis was registered. We can therefore expect that the prevalence of cardiovascular disease will increase in the years ahead.

The decline in admissions for first-time AMI (based on figures in WENOCARD) corresponds well with the only population-based study of hospitalized AMI patients in Norway (8). However, the authors, who based their study on data from the anonymous Norwegian Patient Register 1991–2000, were not able to distinguish between first-time AMI and repeat attacks. Moreover, AMI-related deaths occurring outside hospital were not included. The true incidence of first-time AMI could not be calculated. The increase in AMI admissions from the year 2000 in our study can be explained by introducing new diagnostic biomarkers in the diagnostic criteria from 2000. A number of patients admitted with acute chest pain had in fact suffered an infarction according to the new biomarkers (9). Updating the register from 2001 will show whether there was a true increase in AMI admissions. In Sogn og Fjordane we found an increase in AMI admissions throughout the entire observation period 1992–2001. This may perhaps be explained by differences in lifestyle as well as treatment between the three counties in the beginning of the 1990s.

AMI case-fatality

By including out-of-hospital AMI deaths, we could calculate prehospital and in-hospital case-fatality for AMI. In the period 1992–2001 there was little change in 1–27-day case-fatality for the youngest patients (35–64 years), from 4.7 % to 4.4 %, but it was reduced by 16 % in the oldest patients (≥ 65 years). Days 1–27 reflect, to a large degree, changes in emergency treatment and secondary prophylaxis. Although the acute case-fatality on the infarction day is epidemiologically important, it has been claimed that case-fatality post-infarction day is a better measure for comparing changes over time and between countries (10). Validation studies from neighbouring countries such as Finland, Denmark and Sweden (11, 12) have clearly shown that infarction diagnoses ascertained from patient registers are largely in agreement with data validated in specific projects such as the MONICA studies (13).

The proportion of out-of-hospital AMI deaths is higher in the age group 35–64 years, even if the data are less certain because of the lower number of infarctions. Our data are largely in agreement with studies from other countries (6) and underline that AMI case-fatality in young people can be reduced through prevention and better emergency treatment. The reduced case-fatality seen in Finland was the results of fewer deaths outside hospital (6), while similar data from Sweden also indicate improved survival after hospitalization (14).

A change in case-fatality may also be due to changing diagnostic criteria. Recent data from Finland and other countries indicate that the use of new biomarkers (troponin I/T), combined with a new definition of AMI, increases the registered incidence of AMI by up to 80 % (15). Patients with registered infarction according to the new criteria were often older and had diabetes. They had less ST elevation requiring thrombolysis or primary percutaneous coronary angioplasty and about 60 % higher one-year case-fatality compared to patients diagnosed according to both the new and old criteria. The higher case-fatality among these AMI patients corresponds only partly with the results from two English studies (16, 17). It should be noted that the proportion treated with revascularization was low in the Finnish study, which included patients in the period 1997–2002.

Person-identifiable disease register

Our work illustrates the possibilities of patient follow-up in a person-identifiable disease register. For example, an AMI can be classified as first-time or repeat attack, and the proportion of patients dying from disease can be calculated (case-fatality). Neither the Norwegian Patient Register nor the Causes of Death Register provide fully adequate data for quality assurance, aetiology and surveillance of cardiovascular diseases, which are among the most prevalent diseases in Norway. The Norwegian Patient Register currently receives consecutive data from all patient administrative data systems in hospitals. Until now, this nation-

wide register has not been person-identifiable, as it is in Denmark («Landspatientregisteret») and Sweden («Slutenvårdsregisteret»). It has not been possible to link information on anonymous data in the Norwegian Patient Register internally in the register or externally to the Causes of Death Register. So, in Norway, we have not been able to follow the same patient through more than one admission or hospital, or know if the patient died as a result of the disease or treatment or for some other reason. In the future, such follow-up will be possible because the Storting (Parliament) has decided that the Norwegian Patient Register shall be a person-identifiable disease register.

WENOCARD was set up to obtain new knowledge about cardiovascular disease. The register provides good aetiological outcome data for follow-up of cohorts in the general population (18) or as a part of medical quality registers, and it gives important epidemiological information about prevalence, incidence, treatment and prognosis after for example AMI (4).

Conclusion

We find a decline in mortality rates for cardiovascular disease concomitant with unchanged hospital admissions for the same diseases in the same period. This may partly be due to changes in diagnostic criteria for AMI, a lower threshold for admissions and/or the increasing prevalence of cardiovascular disease resulting from better treatment. These first results from WENOCARD show the possibilities for aetiology research within diseases of the circulatory system in the Norwegian population, and for quality control and planning of treatment capacity at the individual hospitals.

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Literature

1. Juel K. Dødeligheden i Danmark gennom 100 år: Danskerne lever længere, men hvorfor 3–4 år kortere end svenske mænd og franske kvinder. København: Statens Institut for Folkesundhed, 2004.
2. Pedersen JI, Tverdal Aa, Kirkhus B. Kostendringer og dødelighetsutvikling av hjerte- og karsykdommer i Norge Tidsskr Nor Lægeforen 2004; 124: 1532–6.
3. Nasjonalt register over hjerte- og karsykdommer. Behov og løsning. Oslo: Nasjonalt folkehelseinstitutt, 2002.
4. Lie M, Iversen SG, Tell GS et al. På høy tid med et nasjonalt hjerte- og karregister. Tidsskr Nor Lægeforen 2006; 124: 367–8.
5. Abildstrom SZ, Rasmussen S, Rosen M et al. Trends in incidence and case fatality rates of acute myocardial infarction in Denmark and Sweden. Heart 2003; 89: 507–11.
6. Salomaa V, Ketonen M, Koukkunen H et al. Decline in out-of-hospital coronary heart disease deaths has contributed the main part to the overall decline in coronary heart disease mortality rates among persons 35 to 64 years of age in Finland: the FINAMI study. Circulation 2003; 108: 691–6.
7. Sigfusson N, Sigurdsson G, Agnarsson I et al. Declining coronary heart disease mortality in Iceland: contribution by incidence, recurrence and case fatality rate. Scand Cardiovasc J 2002; 36: 337–41.
8. Reikvam A, Hagen TP. Markedly changed age distribution among patients hospitalized for acute myocardial infarction. Scand Cardiovasc J 2002; 36: 221–4.
9. Myocardial infarction redefined – a consensus document of The Joint European Society of Cardiology/American College of Cardiology Committee for the redefinition of myocardial infarction. Eur Heart J 2000; 21: 1502–13.
10. Rasmussen S, Abildstrom SZ, Rosen M et al. Case-fatality rates for myocardial infarction declined in Denmark and Sweden during 1987–1999. J Clin Epidemiol 2004; 57: 638–46.
11. Madsen M, Davidsen M, Rasmussen S et al. The validity of the diagnosis of acute myocardial infarction in routine statistics: A comparison of mortality and hospital discharge data with the Danish MONICA registry. J Clin Epidemiol 2003; 56: 124–30.
12. Pajunen P, Kuokkunen H, Ketonen M et al. The validity of the Finnish Hospital Discharge Register and Causes of Death Register data on coronary heart disease. Eur J Cardiovasc Prev Rehab 2005; 12: 132–7.
13. Tunstall-Pedoe H, Kuulasmaa K, Mahonen M et al. Contribution of trends in survival and coronary event rates to changes in coronary heart disease mortality: 10-year results from 37 WHO MONICA Project populations. The Lancet 1999; 353: 1547–57.
14. Wilhelmsen L, Rosengren A, Lappas G. Relative importance of improved hospital treatment and primary prevention. Results from 20 years of the Myocardial Infarction Register, Göteborg, Sweden. J Intern Med 1999; 245: 185–91.
15. Salomaa V, Koukkunen H, Ketonen M et al. A new definition for myocardial infarction: what difference does it make? Eur Heart J 2005; 26: 1719–25.
16. Pell JP, Simpson E, Rodger JC et al. Impact of changing diagnostic criteria on incidence, management, and outcome of acute myocardial infarction: retrospective cohort study. BMJ 2003; 326: 134–5.
17. Trevelyan J, Smith SCH, Mattu RK. Impact of the recommendations for the redefinition of myocardial infarction on diagnosis and prognosis in an unselected United Kingdom cohort with suspected cardiac chest pain. Am J Cardiol 2004; 93: 817–21.
18. Nurk E, Tell GS, Vollset SE et al. Plasma total homocysteine and hospitalizations for cardiovascular disease. The Hordaland study. Arch Intern Med 2002; 162: 1374–81.

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