

The New Old Epidemic of Coronary Heart Disease

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ABSTRACT

Objectives. This study quantified the consequences for prevalence of increased survival of coronary heart disease (CHD) in the Netherlands from 1980 to 1993.

Methods. A multistage life table fitted observed mortality and registration rates from the nationwide hospital register. The outcome was prevalence by age, sex, period, and disease state.

Results. The prevalence of CHD from 1980 to 1993 was 4.4% (men, aged 25 to 84 years) and 1.4% (women, aged 25 to 84 years). Between 1980–1983 and 1990–1993, the incidence changed little, but age-adjusted prevalence increased by 19% (men) and 59% (women).

Conclusions. Sharply decreasing mortality but near-constant attack rates of CHD caused distinct increases in prevalence, particularly among the elderly. (*Am J Public Health.* 1999; 89:379–382)

Coronary heart disease (CHD) is the leading cause of death in the Netherlands, as in the rest of the world.¹ The costs for CHD are increasing rapidly, faster than medical costs for other causes in the Netherlands.² Part of this increase seems to be the result of expanding health care needs. Mortality rates are declining steeply, but hospital admission rates are increasing.³ As more patients survive acute myocardial infarction, more are eligible for intervention or remain at risk for recurrent infarction or congestive heart failure.⁴

In this study we estimated the changing prevalence of CHD as a consequence of the changing disease history. An incidence-prevalence-mortality model describes a simplified CHD history: flows of incidence and mortality determine pools of surviving patients.⁵ We will show that the decreasing CHD mortality is causing hospital admission rates to rise and quantify the resulting marked increase in the prevalence of survivors.

Methods

Data

The incidence-prevalence-mortality model uses as input the number of patients discharged with the diagnosis of acute coronary event (*International Classification of Diseases [ICD] codes 410–411*) by age, sex, period (1980–1993), and outcome (fatal or nonfatal), and the number of deaths according to the vital statistics by age, sex, period, and cause of death.³ The hospital register is used nationwide, and in nearly all recognized cases of acute CHD the patient is hospitalized.^{6,7} The causes of death considered are acute CHD (*ICD codes 410–411*), chronic CHD (*ICD codes 412–414*), other cardiovascular disease (*ICD codes 390–409; 415–459*), and all other causes of death. Age-

and sex-specific rates were calculated by using the midyear population of the Netherlands as person-years, and rates and ratios were age-adjusted to the average Dutch population of 1980 to 1993.

Model

Figure 1 illustrates the concept. A life table population is subject to an incidence of acute coronary events and a risk of dying from cardiovascular disease other than CHD. Patients experiencing an acute coronary event who die before or after admission to the hospital are counted as having acute coronary death or fatal outcome. If they survive, they move to a second stage, the population with a history of an acute coronary event. Here they are subject to a risk of recurrent acute coronary events, a risk of dying from late CHD, and an increased risk of dying from other cardiovascular diseases. If they survive, they move to a third life table stage, the population with a history of multiple infarctions. Here they are subject to an increased risk of recurrence, death from CHD, or death from cardiovascular disease. In all stages, healthy or diseased, the life table population remains exposed to a risk of dying from noncardiovascular causes.

The life table estimates an incidence by calculating back from the observed attack and mortality rates and from the estimated probabilities of recurrence. These are the core assumptions of the calculations:

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1. A history of coronary disease increases the risk of new CHD events and of other cardiovascular disease.⁸

2. Survival after a recurrent event is less certain than after the first event.^{9,10}

3. Survival is heavily age dependent.⁹

4. Survival, compared with that of a reference population, improves over time.^{8,10}

By applying Dutch population data to the age-, sex-, and period-specific life table event rates, we calculated expected numbers and minimized the variance between the expected and observed numbers of events with this model. We compared expected prevalences with the observed prevalences in the Rotterdam study,¹¹ and we calculated ranges using sensitivity analysis, with varying recurrence probabilities within plausible boundaries. A full description of all assumptions and of the probabilities used is available in an appendix to this article at our Internet website (<http://www.eur.nl/fgg/mgz/>); a spreadsheet sample of the multistage life table is available from the first author on request.

Results

Table 1 and Figure 2 present input and results. Age-standardized admission rates increased between 1980–1983 and 1990–1993 by 28% among women and by 9% among men, but they decreased slightly among younger men (–6%). Mortality rates declined by 26% and 30%, respectively, with

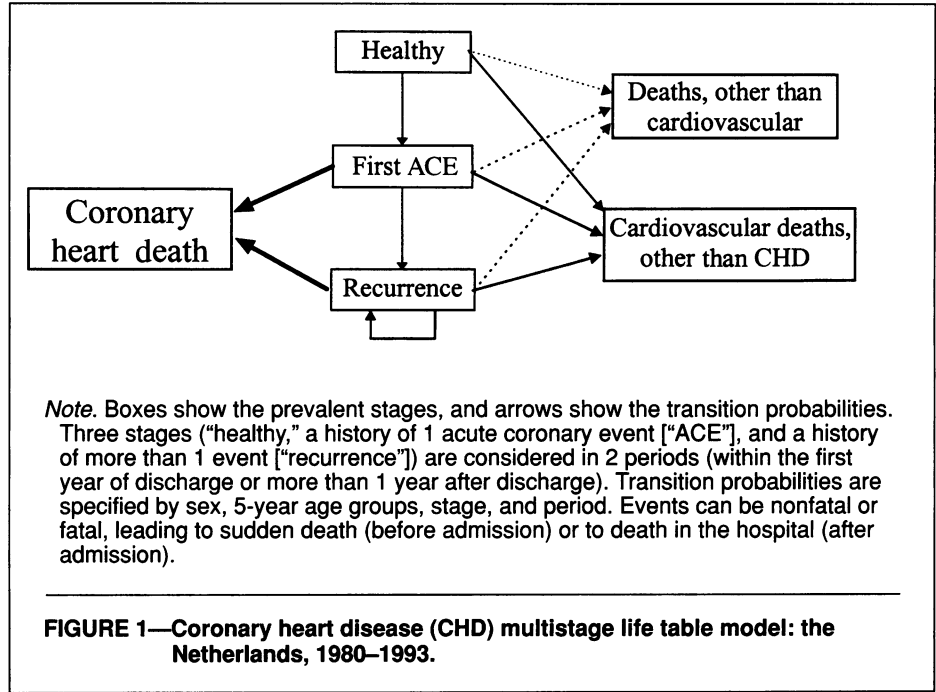


FIGURE 1—Coronary heart disease (CHD) multistage life table model: the Netherlands, 1980–1993.

an even more pronounced decline among younger men.

The estimated age-standardized incidence of first acute coronary events changed little between 1980–1983 and 1990–1993; among younger men (<60 years), this incidence decreased by 10% (range: –14% to –6%), but among younger women (<60 years), this incidence increased by 9% (range: 5% to 13%). The higher admission rates are almost entirely

attributable to the lower mortality, which in turn is almost entirely the result of improving prognosis; the change in incidence is negligible.

The average prevalence in survivors increased sharply, predominantly among the elderly: from 12% in the early 1980s to 16% in the early 1990s in men older than 60 years and from 3.3% to 5.5% in women older than 60 years. Over 10 years, the absolute number of survivors increased by

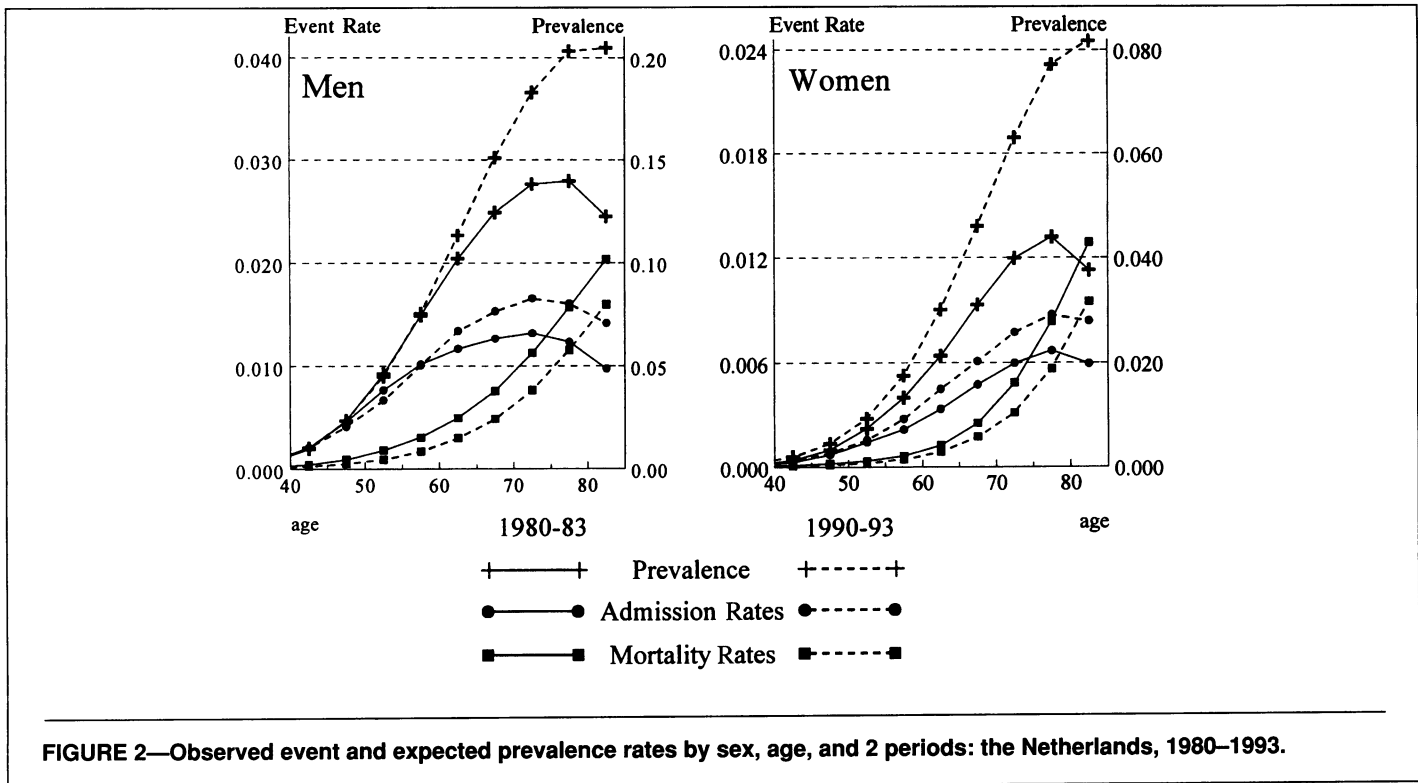


TABLE 1—Coronary Heart Disease (CHD) in the Netherlands, 1980–1983 and 1990–1993

	Men					
	1980–1983 (16.8 Million Person-Years)		1990–1993 (19.4 Million Person-Years)		Change From 1980–1983 to 1990–1993, %	
	No.	Rates	No.	Rates	No.	Rates
Observed						
Discharges						
25–59 y	38 608	2.95	42 190	2.77	9.3	–6.1
60–84 y	45 263	12.21	63 543	15.00	40.4	22.9
Deaths						
25–59 y	11 048	0.85	7 306	0.48	–33.9	–43.2
60–84 y	43 603	11.76	37 269	8.80	–14.5	–25.2
Attacks						
25–59 y	45 831	3.51	46 845	3.08	2.2	–12.2
60–84 y	71 433	19.27	84 184	19.88	17.9	3.2
					Change From 1980–1983 to 1990–1993, %	
	Rates (Sensitivity Limits)		Rates (Sensitivity Limits)		No.	Rates
Estimated						
Incidence						
25–59 y	2.92 (2.86, 2.98)		2.62 (2.56, 2.68)		4.6	–10.1
60–84 y	14.9 (14.5, 15.4)		15.8 (15.2, 16.5)		21.2	6.1
Prevalence						
25–59 y	18.0 (17.6, 18.4)		17.7 (17.4, 18.1)		14.8	–1.3
60–84 y	122.2 (116.2, 128.5)		157.5 (150.2, 165.3)		47.3	29.0
	Women					
	1980–1983 (17.6 Million Person-Years)		1990–1993 (20.2 Million Person-Years)		Change From 1980–1983 to 1990–1993, %	
	No.	Rates	No.	Rates	No.	Rates
Observed						
Discharges						
25–59 y	6 981	0.57	9 793	0.66	40.3	15.9
60–84 y	18 218	5.08	27 468	6.77	50.8	33.2
Deaths						
25–59 y	2 167	0.18	1 727	0.12	–20.3	–34.1
60–84 y	18 743	5.73	15 587	4.35	–16.8	–24.1
Attacks						
25–59 y	8 384	0.68	10 893	0.73	29.9	7.4
60–84 y	29 168	8.44	36 012	9.16	23.5	8.6
					Change From 1980–1983 to 1990–1993, %	
	Rates (Sensitivity Limits)		Rates (Sensitivity Limits)		No.	Rates
Estimated						
Incidence						
25–59 y	0.56 (0.55, 0.57)		0.61 (0.60, 0.62)		26.3%	9.4%
60–84 y	6.89 (6.79, 7.01)		7.16 (6.96, 7.39)		18.0%	3.9%
Prevalence						
25–59 y	3.10 (3.04, 3.16)		3.89 (3.81, 3.98)		45.1%	25.7%
60–84 y	33.2 (31.8, 34.8)		55.3 (53.0, 57.9)		89.2%	66.6%

Note. Discharges (with diagnosis of acute coronary event), deaths (CHD death in vital statistics), and attacks (the sum of fatal and nonfatal events) are observed. Rates are per 1000 person-years, age standardized to the population of 1980–1993. The years lived by the coronary event-free population (incidence) or by the total population (all other rates) are the denominators. Confidence limits (not shown) are very small; the sensitivity limits are obtained by varying the recurrence probabilities within plausible upper and lower limits (see text).

36% for men and by 81% for women because of the lower coronary mortality and the aging of the population.

Discussion

The incidence-prevalence-mortality model combines available administrative

data about admission rates and death rates with parsimonious assumptions in a stationary multistage model to calculate expected prevalences for patients with a history of a single or a recurrent acute coronary event. The results show increased heart disease morbidity in the recent past in the Netherlands; that is, the expected incidence has remained nearly constant, but mortality has

declined rapidly. Patients surviving to older ages fill the gap between constant incidence and decreasing mortality, given that they are at risk for further coronary and other cardiovascular disease. As a result, the nation's health care needs are rising.

These results might be biased by the nature of the data or by the assumptions made to complete the model. Although we

used administrative data, there were no financial incentives to register a particular diagnosis, and trends in the myocardial infarction rates in such administrative hospital register data compare well with trends in epidemiological studies.¹² Registration as "acute coronary event" depends on the patient's awareness and the doctor's diagnostic acuity and ability to decide between competing choices. Indeed, it is likely that the increased awareness of the fact that women are also at risk for CHD is partly attributable to the increase in clinical incidence.^{7,13,14} Among men, however, awareness has been high, and admission rates correspond well with epidemiological event rates.⁷

Is there ancillary evidence that the true incidence of CHD has changed? Surveys of risk factors in the Netherlands show little change over this period.¹⁵ However, the post-World War II female birth cohorts took up smoking in large numbers and are now arriving at middle age. The increased detection of more benign cases and the evolving smoking epidemic among women of the baby boom generation suggest a true increase in the incidence of CHD. Several epidemiological studies have researched CHD mortality in the developed world in relation to the improved treatment options available.^{10,16,17} Because many survivors will lead satisfactory lives, this marks a triumph in modern (heart) health care. However, the marked decline of mortality has resulted in large pools of CHD survivors; as a result, combined with the aging of the population, health care needs are increasing sharply. □

Contributors

All 3 authors contributed substantially to the conception and design of the study and to interpretation of the data. L. Bonneux analyzed the data and implemented the multistage lifetables. J. J. Barendregt constructed these tables and verified their correct use. L. Bonneux drafted the paper, and J. J. Barendregt and P. J. van der Maas made comments on it. All are guarantors for the integrity of the study.

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