Shifting abdominal aortic aneurysm mortality trends in The Netherlands

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Objective: **Mortality from abdominal aortic aneurysm (AAA) in developed countries has decreased since the late 1990s. Our objective was to get an insight of mortality trends in The Netherlands for AAA disease.**
Methods: **Data of all AAA deaths (1980 to 2010) were collected from the Dutch cause of death register. Cause of death was divided in two groups: with the mention of rupture and without the mention of rupture. Data were standardized and divided into three age groups (55-69, 70-84, and ≥85 years). Mortality rates per 100,000 were analyzed for both sexes and for each age group. Significant points of change were identified using joinpoint regression analysis.**
Results: **Total standardized AAA mortality increased from 1980 (1062 deaths) until 1995 (1728 deaths), followed by a decline until 2010 (930 deaths). This decline was most prominent in men. Deaths without mention of rupture showed an increase from 1980 until 2010. The age of AAA death was higher in women (79.2 in 1980 and 82.1 in 2010) than in men. This difference declined as the age of death from AAA increased from 72.1 in 1980 to 77.9 years in 2010 in men. Decline in AAA mortality was first seen in the young age group (55-69 years) and then seen consecutively older age groups.**
Conclusions: **Mortality from AAA is declining due to a reduction in deaths from ruptured AAAs. This was first observed in the young age groups. Men died more often and at a lower age. (J Vasc Surg 2015;61:642-7.)**

Developed countries have shown a decrease in abdominal aortic aneurysm (AAA) deaths since the late 90s.[1-3] This may be due to improved treatment and favorable changes in risk factors, such as a reduction in smoking, and to increased use of cardiovascular drugs[4-6] and increased elective repair.[1-4] In The Netherlands, we see similar changes in treatment and risk factors. Unfortunately, there is no active AAA screening program in The Netherlands, and we have no insight in the prevalence of AAA. Our objective was to obtain insight in AAA mortality trends in The Netherlands; therefore, we determined mortality rates from AAA deaths with and without the mention of rupture. We evaluated all mortality data from 1980 until 2010 and compared trends for three different age groups for both sexes.

METHODS

Mortality from AAA in The Netherlands was investigated from 1980 to 2010. For this period, the cause of death was registered using the World Health Organization International Classification of Diseases International Classification of Diseases and Related Health Problems (ICD), Ninth Revision codes until 1996 and ICD-10 since. Included were abdominal aneurysm, ruptured (441.3/I71.3); abdominal aneurysm, without mention of rupture (441.4/I71.4); aortic aneurysm of unspecified site, ruptured (441.5/I71.8); and thoracoabdominal aneurysm, without mention of rupture (441.7/I71.9). Aortic aneurysms of unspecified site were included because these are most likely to be abdominal. A complete distribution of the different groups for 1980 and 2010 is shown in Supplementary Table I (online only).

Anonymous data regarding cause of death and the discrimination between deaths in and out of the hospital were acquired from the cause of death register the Statistics Netherlands. Statistics Netherlands obtains the data through an obligatory reporting system that obligates the treating doctor or the municipal coroner of a deceased person to document one underlying and up to three secondary causes of death on a death certificate (B statement). The "secondary" and "tertiary causes of death" were originally introduced to enable analyses of multidisease patterns. The location of death (in or out of the hospital) and the time span between different causes are also noted on the B statement. The B statement is sent directly to Statistics Netherlands and is collected for statistical purposes only. The causes of death recorded in the B statement are analyzed and translated by a professional of the Statistics Netherlands into one cause of death and coded according to the ICD. The primary cause of death is the disease that starts the chain of events that eventually leads to the patient's death. When an AAA rupture is mentioned, the coder will choose "abdominal aneurysm, ruptured" as the cause of death. When an AAA rupture is not specifically mentioned, the coder will choose "abdominal aneurysm without mention of rupture."

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Data were stratified by year, sex, and 5-year age bands. The AAA mortality rate for each year, defined as the total number of AAA deaths in each age group of patients aged ≥55 years per 100,000, was standardized to the Dutch population of 2010 as provided Statistics Netherlands.

To identify points in time where a significant change of the age- and sex-specific trend in mortality occurred, joinpoint regression analysis[4-7] was performed with Joinpoint 3.5.2 software provided by the U.S. National Cancer Institute Surveillance Research Program (2011). For every period, the linear slope of the trend and probability value of the final model of the joinpoint regression analysis, the absolute minimum and maximum observed number of deaths, and the minimum and maximum observed AAA mortality rates per 100,000, were as tabulated. Furthermore, the change in observed AAA mortality rate per 100,000 per period [(AAA mortality rate last year of period − AAA mortality rate first year of period)/AAA mortality rate first year of period] was calculated. Finally, we present three age-specific graphs showing the observed and modeled AAA mortality rates per 100,000 from 1980 to 2010; age groups were 55 to 69 years, 70 to 84 years, and ≥85 years. The dots in the age-specific graphs represent the observed number of deaths per 100,000 from 1980 to 2010. The line in each age- and sex-specific graph represents the final model from the joinpoint regression analysis.

Smoking was analyzed for both sexes in two age groups, 50 to 64 years and ≥60 years, as provided by Stivoro, the Dutch expert center for tobacco use prevention. Commissioned by Stivoro, a shifting and distributed sample was taken weekly with ∼20,000 participants annually. Until 1989, interviews were per household with a paper questionnaire, from 1990 until 2001 interviews were conducted per person using a laptop (Computer-Assisted Assisted Personal Interviewing), and from 2001 and onwards, questionnaires were completed online (source www.trimbos.nl, accessed August 12, 2014).

Approval for the use of the anonymized patient data was covered by a general agreement with Statistics Netherlands. No informed consent was needed from the patients, and no separate ethical approval was necessary for the use of these data. All analysis were performed according to the privacy legislation in The Netherlands.[8]

The default settings in R 3.0.2 software (http://www.r-project.org) were used to analyze the data and model the locally weighted regression curves[9] in Fig 1 and in the Supplementary Fig (online only).

RESULTS

Between 1980 and 2010, 31,917 patients died of an AAA, of which 31,447 (98.5%) were aged ≥55 years. For every period, the absolute number of AAA deaths by sex, age group, and AAA type are presented in the Table.

Total age-adjusted AAA mortality increased between 1980 (1062 deaths [12.8 deaths/100,000]) and 1995 (1728 deaths [21.0 deaths/100,000]), followed by a decline until 2010 (930 deaths [11.2 deaths/100.000]). From 2000 to 2010, AAA deaths declined 43% in men and 17% in women. The AAA male-to-female mortality ratio is changing. The ratio in 1980 was >3:1 and steadily declined to >2:1 in 2010 (Fig 2).

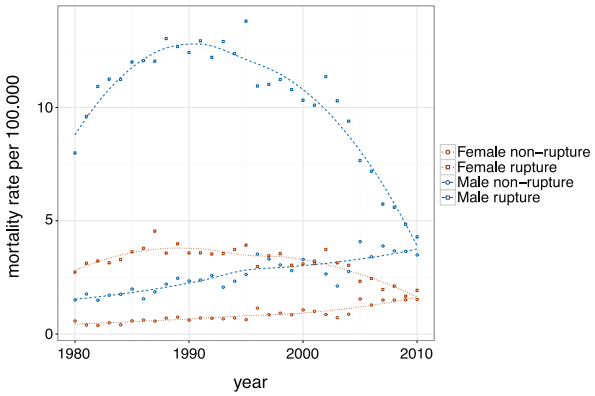

Fig 1. Abdominal aortic aneurysm (AAA) standardized mortality rates in The Netherlands per 100,000 from 1980 to 2010. The year of standardization is 2010. Subgroups are made for rupture and nonrupture in men and women. For each group, a locally weighted regression curve was added for smoothing the variability in measurements.

Joinpoint regression on standardized mortality rates (Fig 3) showed that the decline started in 1988 in young AAA patients (55-69 years) and was followed in later years (2002) in older patients (70-84 years). The oldest group (≥85 years), however, did not show a decline in mortality. The average age at which people died from AAA increased. From 1980 until 2010, women died at an older age (79.2 [standard deviation {SD}, 9.7] years in 1980, 82.1 [SD, 8.8] years in 2010) compared with men. However, this difference decreased as the age of death from AAA in men increased from 72.1 (SD, 9.7) years in 1980 to 77.9 (SD, 9.0) years in 2010.

AAA with mention of rupture. Death due to ruptured AAA is more common than AAA deaths without the mention of rupture. After a steady increase since 1980, mortality due to ruptured AAA decreased since the millennium (Fig 1). Standardized rates showed that deaths due to rupture decreased 46.4%, from 13.42 per 100,000 in 2000 to 6.22 per 100,000 in 2010. This trend was observed in men (41.6%) and in women (62.2%). The share of deaths in (60%) and out (40%) of the hospital remained equal between 1980 and 2010 for all ruptured AAAs. Joinpoint regression (Fig 3, *A*; Supplementary Table II, *A*, online only) showed that the decline in mortality due to ruptured AAA started in the youngest age group in ∼1990 and was evidently followed in later years (2003) in older patients (70-84 years). In contrast, an evident decline was not present in the oldest group (≥85 years).

AAA without mention of rupture. Between 1980 and 2010, standardized mortality rates showed that AAA deaths without mention of rupture increased from 2.08