Ethnic Inequalities in Mortality in the Netherlands

And the Role of Socioeconomic Status

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Ethnic Inequalities in Mortality in the Netherlands
and the Role of Socioeconomic Status

Etnische verschillen in sterfte in Nederland
en de rol van sociaal-economische status

Proefschrift

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Contents

Publications and manuscripts reprinted in this thesis

Chapter 2: Bos V, Kunst AE, Keij-Deerenberg IM, Garssen J, Mackenbach JP. Ethnic Inequalities in age- and cause-specific mortality in The Netherlands. Int J. Epidemiol. 2004; 33(5):1112-9.

Chapter 3: Bos V, Alabady K, Mackenbach JP, Kunst AE. Refugee mortality in the Netherlands, a population based study. Submitted

Chapter 4: Ho L, Bos V, Kunst AE. Differences in Cause of Death Patterns between Native Dutch and Persons of Indonesian Descent living in the Netherlands. Submitted

Chapter 5: Bos V, Kunst AE, Garssen J, Mackenbach JP. Consistent relation between duration of residence and immigrant mortality only observed in some immigrant groups; a study on mortality by duration of residence among Turkish, Moroccan, Surinamese and Antillean/Aruban immigrants living in the Netherlands. Submitted

Chapter 6: Stirbu I, Mackenbach JP, Bos V, Kunst AE. Ethnic differences in avoidable mortality. Submitted

Chapter 7: Mackenbach JP, Bos V, Andersen O, Cardano M, Costa G, Harding S, Reid A, Hemström O, Valkonen T, Kunst AE. Widening inequalities in mortality in Western Europe. Int J Epidemiol. 2003;32(5): 830-837

Chapter 8: Bos V, Kunst AE, Mackenbach JP. Sociaal-economische sterfteverschillen in Nederland: een analyse op basis van buurtgegevens. TSG, 2002; 80(3):158-165.

Chapter 9: Bos V, Kunst AE, Mackenbach JP. De omvang van sociaal-economische sterfteverschillen gemeten op buurtniveau: vergelijking met schattingen op basis van informatie op individueel niveau. In: Stronks K, ed. Sociaal-economische gezondheidsverschillen 5: van verklaren naar verkleinen, Den Haag: ZonMW, 2001: 8-20.

Chapter 10: Bos V, Kunst AE, Garssen J, Mackenbach JP. Socioeconomic inequalities in mortality within ethnic groups in the Netherlands, 1995-2000. J Epidemiol Community Health. 2005; 59 (4):329-35

For other publications and manuscripts by the author see page 207.

1

Introduction

1.1 Background

Studies on the health of ethnic minority populations can provide clues about the aetiology of diseases, can shed light on fundamental health inequalities that exist within one country and may therefore be informative for people responsible for the provision and planning of health care(1). For these reasons, a considerable number of studies on ethnic inequalities in health have been performed during the last few decades(2-9).

Mortality figures are an interesting source of information on the health of ethnic minorities because they are objective figures that can provide a broad image of the health situation of group of interest. Surveys form an alternative source of information on the health of ethnic minorities. These have, however, as a disadvantage that they are susceptible to distortion due to cultural differences in reporting behaviour (10).

In Table 1.1 we summarise the results of a review of migrant mortality performed in 2003 by McKay, Macintyre and Ellaway[a] (4). The picture that emerges from this review is one of gross variations between studies. Migrants did not seem to have a consistently higher or lower mortality than the native population of the host country and did also not seem to have a consistently higher or lower mortality than the native population of the countries of origin. This holds both for total/cardiovascular mortality and for cancer mortality.

Table 1.1 Migrant mortality compared to mortality among native inhabitants of the host country and compared to mortality among inhabitants of the country of origin(4).

	Number of studies in which migrant mortality is		
	Better	Similar	Worse
Compared to native inhabitants of host country			
total/cardiovascular mortality	10	4	12
cancer mortality	10	6	7
Compared to inhabitants in the country of origin			
total/cardiovascular mortality	7	5	5
cancer mortality	5	7	6

This does not imply that ethnic inequalities in mortality are small, but rather, that that the direction of the inequalities differs between ethnic groups and causes of death. In the United Status, black men have for example been reported to have an 8-year shorter life expectancy than white men. There, the life expectancy for black men has remained at a nearly constant level between 1980 and 1996, while it increased among white men(11). In

[a] Groups included in this review originated both from western and non-western countries of origin and migrated to industrialised countries.

New Zealand, Maori have been reported to have a 10 years shorter life expectancy than people of Anglo-European descent(12). Mortality rates for some other ethnic minority populations have, in contrast, been reported to be more favourable than for white inhabitants. This is for example the case for Latino's and Asian Americans living in the US and for Caribbeans in the UK(2, 13, 14). In these groups, the reported migrant mortality risk is sometimes only 50% of the risk of the white population(14). Ethnic differences in cause specific mortality may also be large, even in cases where differences in all cause mortality between ethnic groups are small. For Pakistani living in the UK for example, strongly elevated rates of mortality from ischemic heart disease and strongly reduced mortality rates from lung cancer and suicide have been found. Their total mortality figures have, however, been reported to be equal to that of whites(2).

In 1999, the year that we started conducting the studies that we report on in this thesis, information on the health of ethnic minorities living in the Netherlands was incomplete. Information that was obtained in health interview surveys often showed a worse self-reported health for ethnic minorities(15, 16) but this may have been due to cultural differences in reporting behaviour. There were some studies available on migrant mortality. These found elevated levels of perinatal deaths among ethnic minorities(17, 18), elevated levels of mortality among infants and children of foreign origin (19-21), elevated levels of mortality for Surinamese (20, 21), Turkish males and females and for Moroccan females(22). They observed a reduced mortality for Moroccan males(22). But because these studies were carried out at the local level(20, 23), covered only few age groups(18, 19), excluded groups that were of foreign origin but that had Dutch nationality(22), and covered only some of the largest immigrant groups, they failed to provide a detailed overview of patterns of mortality among ethnic minority groups living in the Netherlands. The international literature did also not provide information on the basis of which we could predict what the situation in the Netherlands would be. There was therefore a need to describe ethnic inequalities in mortality in the Netherlands.

The lack of sufficient information about ethnic inequalities in mortality in the Netherlands was related to insufficiencies in data needed to study ethnic differences in mortality adequately. In the Netherlands, we do not have a census. Instead we have a municipal population register and cause of death register. Up till 1995, the possibilities to identify people of foreign origin correctly in these registers were limited. From 1995 onwards, it became possible to link information of the municipal population register to the cause of death register and to identify people within these registers on the basis of country of birth of subject and both parents. In the year 2000 mortality figures for 6 years were available. This provided large enough numbers to perform analyses on ethnic inequalities in cause specific mortality.

These are the circumstances that led to the formulation of a research project about ethnic inequalities in mortality in the Netherlands. This thesis contains a number of studies that result from this research project. In this thesis we aim to describe the size and patterns of ethnic inequalities within the Netherlands and to make inferences about the explanation

of the observed mortality differences. We hereby specifically focus on the role of socioeconomic status. We do this by making use of an indicator of socioeconomic status at the level of the neighbourhoods, which we evaluate thoroughly.

While performing the studies reported in this thesis, results on ethnic inequalities in mortality in the Netherlands became available from other studies as well. These showed an elevated infant mortality among children of foreign origin(24, 25) a higher life expectancy among people of Mediterranean origin than among native Dutch living in Amsterdam(26), a strongly elevated homicide mortality among Antilleans immigrants(27), and an elevated mortality among male asylum seekers(28).

1.2 Ethnic minority groups living in the Netherlands

In 2004, 10% of the population that lived in the Netherlands is of non-western origin[b] (see Table 1.2). Another 9% of the population consist of people originating from western countries (i.e. Europe, Northern America, Japan and Oceania). In this thesis we compare levels of mortality of people of non-western origin (including Indonesia) with those of native the native Dutch population.

Between 1946 and 1963, there were several migration waves from the former Dutch East Indies to the Netherlands. These were related to the end of the Japanese occupation of Indonesia, to the independence of Indonesia, to colonial politics and the incorporation of New Guinea. There were big migration waves from Surinam to the Netherlands in 1975, the year Surinam gained independence, and in 1979/1980, which was related to a military coup and to perceived restrictions in obtaining residency permits for the Netherlands. This group is ethnically diverse and consists of persons who in turn originate from West Africa (30%), India (37%), Java (15%), and China (1,5%), and persons of mixed origin. The Dutch Antilles and Aruba are still part of the Netherlands. Between 1955 and 1985 there has been a relatively constant and mainly work-related migration of people from these isles to the Netherlands. Due to an economic recession in the isles, migration from the Dutch Antilles and Aruba increased after 1985. In the 1960s and 1970s, Turkish and Moroccan men came, initially at a temporal base, to the Netherlands as labour migrants. Only one third of the Turkish men and one fifth of the Moroccan men did in the end return to their country of origin. Of those who decided to stay permanently, the majority had their wives and children came over to the Netherlands from the mid 1970s onwards(31).

b Country of origin is defined according to the definition that is used by Statistics Netherlands. A person is considered to be of foreign origin if at least one parent was born abroad. A person is considered native Dutch when (s)he is born in the Netherlands and both parents are born in the Netherlands.

Table 1.2 Number of inhabitants of the Netherlands according to country of origin (restricted to countries of origin that are studied in this thesis)(29, 30)

Country of origin	Number of inhabitants (*1000)	Country of origin (continued)	Number of inhabitants (*1000)
Dutch	13154	Nigeria	7
		Sudan	8
Turkey	341	Ethiopia	10
Morocco	295	Somalia	28
Surinam	321	Iraq	42
Dutch Antilles and Aruba	129	Iran	28
		Afghanistan	34
Indonesia	401	Vietnam	17

The arrival of people from other non-western countries is largely asylum migration and took predominantly place after 1975. After 1977, people fled from Ethiopia for the Marxist-Leninist regime and people from Sudan tried to escape the famine. Nigerians left the country as a consequence of the Civil War that took place from 1967 to 1970. After the Shah was overthrown in 1979, mainly westerly oriented Iranians left their country. Refugees from Vietnam came between 1979-1989 to the Netherlands as a consequence of the fall of Saigon in 1975. In the 1980's the number of asylum seekers increased. In the early 1990s people came from Somalia and Yugoslavia followed from the mid 1990's onwards by people from Afghanistan and Iraq(29, 31-36).

1.3 Mechanisms contributing to ethnic inequalities in mortality

Research of migrant's health was for quite some time black box research in which the causal pathways were not specified. This has the potential harm of suggesting that groups are themselves responsible for the (dis)advantage they experience(37). Without information about determinants of ethnic inequalities in mortality, no effective interventions to reduce these inequalities can be developed. The precise explanation of ethnic inequalities in mortality is, however, for a considerable part still unknown. There is therefore a great need studies for studies that illuminate the pathways leading to ethnic inequalities in mortality.

The literature on migrant mortality often compares the mortality rates in migrants to the mortality rates in the host population, and sometimes also to the mortality rates observed in the country of origin. The idea is that migrant health is influenced by the cumulative exposure to determinants that are related to the host country and to determinants that are related to the country of origin. We therefore hypothesised that

levels of mortality among ethnic minority groups living in the Netherlands are in-between levels of mortality in the Netherlands and levels of mortality in the country of origin. Life expectancies in the countries of origin of most non-western immigrants living in the Netherlands are lower than that of the Netherlands (see Figure 1.1). This provided us with the hypothesis that levels of mortality of non-western ethnic minority groups living in the Netherlands are higher than that of the native Dutch population.

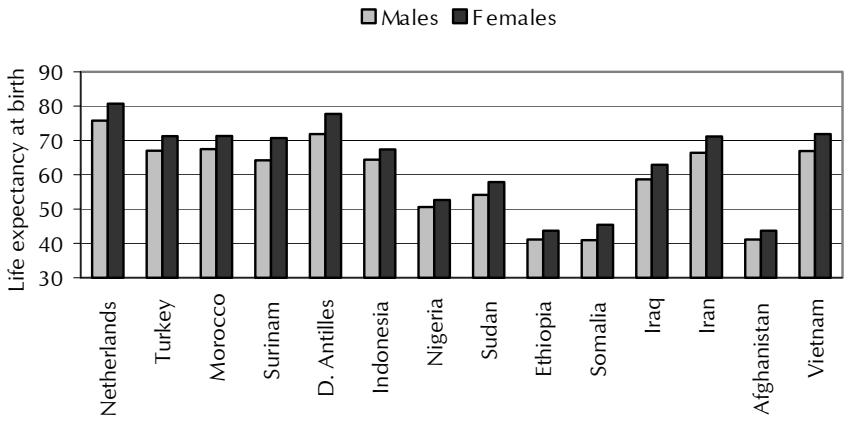

Figure 1.1 Life expectancy at birth in 2001 (Dutch Antilles: 1986-1991) in the Netherlands and in the countries of origin according to sex (45, 46)[c].

The contribution of a number of specific determinants to ethnic variations in mortality have been studied in the last few decades. These determinants include socioeconomic status, lifestyle factors, the healthcare system, genetics, early life exposure and discrimination. In this thesis we make inferences about the contribution of most of these determinants to ethnic inequalities in mortality. Here, we shortly introduce their possible role.

Ethnic minority populations often have a lower socioeconomic status than the native population of the host country. A low socioeconomic status has shown to be related to an elevated mortality. Socioeconomic inequalities are therefore often thought to underlie ethnic inequalities in mortality(3, 38-40). Ethnicity is related to lifestyle factors such as fat, fruit and vegetables intake, smoking and physical exercise. Because these factors are related to health-outcomes, differences in lifestyle factors are likely contribute to ethnic

c These are tentative figures published by the World Health Organisation. The WHO did not provide figures for the Dutch Antilles and Aruba. The here reported life expectancy for the Dutch Antilles is published by Central Bureau of Statistics of the Dutch Antilles and only applies to isle of Curaçao, where 70% of the population of the Dutch Antilles lives.

inequalities in mortality(41-44). The healthcare system may also play a role. Unequal access opportunities and sub optimal quality of services have been suggested to contribute to ethnic inequalities in mortality(47, 48). Differences in genetic susceptibility may also play a role, for example, through their influence on risk factors such as diabetes(49, 50). The influence of genetic predisposition is however complex and for most diseases this factor is likely to interact with other determinants such as the environment. Because early life exposure to detrimental circumstances has shown to be a risk factors for cardiovascular diseases in adulthood(51, 52), just being born in another country may also contribute to ethnic inequalities in mortality. Lastly, as experiences of racial discrimination seem widespread among ethnic minority populations, and as discrimination seems to be related to health, ethnic inequalities in mortality may also be related to the adverse effects of discrimination(38, 53).

In addition to these specific determinants, ethnic inequalities in mortality may be related to artefacts and/or to selection effects. Due to the relatively high mobility of ethnic minority groups, the registration of the population at risk and the numbers of death may be incomplete in ethnic minority groups. The accuracy of indicators of demographic factors may also differ between groups. This may result in numerator-denominator biases(54-57). Selection effects are also important when considering ethnic inequalities in mortality. These include the selective immigration of healthy people (the 'healthy migrant effect') and the selective emigration of relatively (un)healthy people. In case of unhealthy people emigrating, this has been called the 'salmon bias'(14, 58). The contribution of artefacts and selection effects are also considered in this thesis.

1.4 This thesis

This thesis is about the association between ethnicity and mortality. We approximated ethnicity by making use of information on country of birth of subject and both parents. A discussion of the advantages and disadvantages of this proxy is provided in chapters 2 and 11.

The studies that are presented in this thesis are undertaken from a public health perspective. This implies that they focus on inequity, and not, for instance, on the aetiology of diseases. In this thesis, ethnic inequalities in health are interpreted as being a part of, and (partly) caused by, 'other' inequalities between ethnic groups living in the Netherlands. We hereby zoom in on socioeconomic inequalities. We also take into account differences in demographic characteristics such as age, sex and marital status, and, by looking at cause specific mortality differentials, we attempt to make inferences about the role of lifestyle factors and the health care system. Furthermore, we study the contribution of artefacts and selection effects are also considered in this thesis.

In this thesis we address the following two research questions:

1) **What is the size and pattern of ethnic inequalities in mortality in the Netherlands?**

2) **What role do socioeconomic status and other factors play in explaining ethnic inequalities in mortality in the Netherlands?**

Chapters 2, 3 and 4 describe sex-, age-, and cause-specific differences in mortality between native Dutch and a number of ethnic minority groups living in the Netherlands. Chapter 2 deals with mortality differences between native Dutch and Turkish, Moroccan, Surinamese and Antilleans/Arubans[d], chapter 3 with mortality differences between native Dutch and refugees originating from Nigeria/Sudan/Ethiopia[d], Somalia, Iraq, Iran, Afghanistan and Vietnam, and chapter 4 with mortality differences between native Dutch and people of Indonesian descent.

In chapter 5 we examined the role of the healthy migrant effect and adoption of health related behaviours of the host country. We studied this by looking at mortality of Turkish, Moroccans, Surinamese and Antilleans/Arubans in relation to their duration of residence in the Netherlands. Decreasing mortality with increasing duration of residence has been considered as evidence that acculturation has taken place, while increasing mortality with increasing duration of residence has been considered as evidence that health selection has taken place. In chapter 6 we examined the contribution of the health care system to ethnic inequalities in mortality. We studied this by looking at ethnic differences in avoidable mortality.

In chapter 7 we examined the extent to which socioeconomic inequalities in mortality are still a relevant problem in a range of European countries. In chapters 8 and 9 we examined if and how socioeconomic inequalities in mortality within the Netherlands can be studied by making use of data at the neighbourhood level. Based on the outcomes of this evaluation, we studied the effect of adjustment for mean neighbourhood income in analyses that relate ethnicity to mortality. We did this for ethnic inequalities in all cause mortality, (chapters 2, 3 and 4), for migrant mortality in relation to duration of residence (chapter 5) and for ethnic inequalities in avoidable mortality (chapter 6).

Variations in the strength of the relation between socioeconomic status and mortality can influence the extent to which socioeconomic inequalities can determine ethnic differences in mortality. We therefore examined in chapter 10 whether the size of socioeconomic inequalities in mortality strength varies between ethnic groups.

In chapter 7 we made use data on mortality by educational level and occupational class among men and women from national longitudinal studies in Finland, Sweden, Norway, Denmark, England/Wales, and Italy (Turin). In chapters 2-6 and 10 we used routinely collected data from the Dutch municipal population registers and the Dutch

[d] These groups have been combined in the analyses.

cause of death registers for the period 1995 through 2000. In chapter 8 and 9 we used data from the cause of death register for the year 1995. The data on socioeconomic status that apply to the Netherlands and that are used in this thesis come from databases that are routinely generated by Statistics Netherlands. These are 'key figures on boroughs and neighbourhoods 1995' and the 'Regional Income study 1994'. In chapter 9 we made, in addition, use of data from the GLOBE study.

We used Poisson regression analysis to estimate ethnic and socioeconomic inequalities in mortality. This technique assumes that the data follow a Poisson distribution, a distribution that is encountered when counting numbers of events. It relates count dependent variables, in this case the number of persons who died, to an offset variable, in this case numbers of person years. Ethnicity was used as an independent variable in chapters 2-6. Socioeconomic status was used as an independent variable in chapter 7-10. Regression analyses were generally done with and without adjustment for differences in marital status, region, degree of urbanisation and, where applicable, socioeconomic status. In addition, we calculated directly standardised mortality rates for all studied ethnic group. We used direct standardisation because this allowed us to compare mortality rates for one ethnic minority group with that of another group. The applied standard population varied between studies (see paragraph 2.3, 3.2 and 4.3 for a more detailed description). In some cases we also calculated life expectancies by means of abridged life table analyses.

In chapter 11 we discuss strengths and weaknesses of the data that we used, provide an overview of the results, interpret what we observed and give implications for policy and research.

2

Mortality Differences between native Dutch and People of Turkish, Moroccan, Surinamese, and Antillean/Aruban Origin

Bos V, Kunst AE, Keij-Deerenberg IM, Garssen J, Mackenbach JP
Int J. Epidemiol. 2004; 33(5):1112-9

Abstract

Background By describing ethnic differences in age- and cause-specific mortality in the Netherlands we aim to identify factors that determine whether ethnic minority groups have higher or lower mortality than the native population of the host country.

Methods We used data for the years 1995 through 2000 from the municipal population registers and cause of death registry. All inhabitants of the Netherlands were included in the study. The mortality of persons who themselves or whose parent(s) were born in Turkey, Morocco, Surinam or the Dutch Antilles/Aruba was compared to that of the native Dutch population. Mortality differences were estimated by Poisson regression analyses and by directly standardised mortality rates.

Results Compared to native Dutch men, mortality was higher among Turkish (RR=1.21, CI=1.16-1.26), Surinamese (1.24, 1.19-1.29) and Antillean/Aruban (1.25, 1.15-1.36) males, and lower among Moroccan males (0.85, 0.81-0.90). Among females, inequalities in mortality were small. In general, mortality differences were influenced by socioeconomic and marital status. Most minority groups had a high mortality at young ages and low mortality at older ages, a high mortality from ill-defined conditions (which is related to mortality abroad) and external causes, and a low mortality from neoplasms. Cardiovascular disease mortality was low among Moroccan males (0.51, 0.44-0.59) and high among Surinamese males (1.13, 1.05-1.21) and females (1.14, 1.06-1.23). Homicide mortality was elevated in all groups.

Conclusion Socioeconomic factors and marital status were important determinants of ethnic inequalities in mortality in the Netherlands. Mortality from cardiovascular diseases, homicide and mortality abroad was of particular importance for shifting the balance from high towards low all-cause mortality.

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2.1 Introduction

Results of studies examining the association between ethnicity and mortality in the UK and the US are varied, showing low mortality for some groups and high mortality for others(2, 3, 59). This occurs ins spite of the fact that populations in non-western countries of origin almost universally have higher mortality rates than populations in countries of destination(60).

To reduce excess mortality in ethnic minority or majority groups, one needs to understand the factors that determine these mortality differentials. In some studies, socioeconomic inequalities have been reported to explain ethnic differences in mortality, but other studies suggest that they only have a minimal effect(39). The healthy migrant effect, the unhealthy re-migrant effect, racism, differences in genetic susceptibility and differences in health-related behaviours are other candidate explanations of ethnic differences in mortality, but the extent to which these factors explain the inequalities is unclear.

Looking at other national settings than the UK and the US can possibly help us to disentangle this myriad of explanations. In the Netherlands, about 10% of the population consists of persons of non-western origin(61). This group primarily consists of Turkish, Moroccans, Surinamese and Antilleans/Arubans. Turkish and Moroccan men came as labour migrants to the Netherlands in the 1960s and 1970s and were later followed by their wives and children. The migration of the Surinamese population is mainly related to the political developments in Surinam and peaked in 1975 and 1980. The Surinamese population is ethnically diverse and consists of persons who in turn originate from West Africa (30%), India (37%), Java (15%), and China (1,5%), and persons of mixed origin. The Antillean and Aruban population consists predominantly of blacks descending from West Africa, whites and persons of mixed origin, and its migration to the Netherlands has been relatively stable over time. These minority groups show some important similarities and differences with minority groups in other countries. The mortality patterns of these groups are, however, less well documented than abroad. Previous studies were carried out at the local level, used nationality as a proxy of ethnicity, and/or combined persons originating from different countries into one category(22, 26).

This is the first study that provides an overview of age- and cause-specific inequalities in mortality by country of birth of subject and both parents for the Netherlands. It includes information on marital status, neighbourhood income, region, and degree of urbanisation. We used these data to identify factors that determine whether minority groups have higher or lower mortality than the Dutch majority.

2.2 Data

We used data for the years 1995 through 2000 from the cause of death registry and the municipal population registers (GBA), which provided data on all inhabitants of the Netherlands with a legal status. These registers were linked on personal identification number. Persons were allowed to enter the study (through birth or immigration) throughout the study period (open cohort design). Of each inhabitant, the amount of person time was calculated. We took into account the (multiple) date(s) of entry into the registry and the (multiple) date(s) of leaving the registry. The event of interest was death. All persons included in the population registry that die should be included in the cause of death registry, irrespective of whether the death occurred in the Netherlands or abroad. Thus, mortality of persons who die abroad are, to a certain but unknown extent, included in the cause of death registry, as long as they do not officially (r)emigrate. Persons who unofficially emigrate but who are nonetheless lost in an administrative sense, are included in the Dutch population registry as 'administratively excluded'. By making assumptions on the mortality level of the latter we were able to estimate numbers of persons who die abroad but who are not included in the mortality registry (see Discussion – limitations).

Table 2.1 ICD-codes for included causes of death

	ICD 9 (1995)	ICD 10 (1996-2000)
Infectious diseases	001 – 139	A00 - B99
Neoplasms all	140 – 239	C00 - D48
lungcancer	162	C33 - C34
stomach cancer	151	C16
breast cancer	174 – 175	C50
Cardiovascular diseases	390 – 459	I00 - I99
IHD	410 – 414	I20 - I25
other	420-429	I30 – I52
CVA	430 – 438	I60 - 69
Dis. of respiratory system.	460 – 519	J00 - J99
Ill defined conditions	780 – 799	R00 - R99
Other diseases	All remaining	All remaining
External causes	E800 - E999	V01- Y89
suicide	E950 - E959	X60 - X84
homicide	E960 - E969	X85 -Y09

The causes of death are coded according to ICD 9 in 1995, and according to ICD 10 in 1996-2000 (Table 2.1). Of deaths that took place abroad, the cause is almost never established. These deaths are categorised under ill-defined conditions. Among Turkish and

Moroccans, 80% of deaths within this category took place abroad, among Surinamese and Antilleans/Arubans 50%, and among Dutch 13%.

We used country of birth of subject and both parents to approximate ethnicity. We applied the standard definition of foreigners of Statistics Netherlands and considered a person to be Non-Dutch if at least one parent was born abroad(62). Therefore, this study includes persons who migrated to the Netherlands themselves and persons who were born in the Netherlands with at least one parent born abroad.

Five-year age-categories were used. All data were tabulated according to sex, date of birth, country of birth, country of birth of both parents, 6-digit post code and marital status (unmarried, married, widowed or divorced). With 6-digit post code, we linked our data to a file that contained information on region (West, East, South and North), degree of urbanisation (address-density per square kilometre classified into five categories) and socioeconomic status (mean household equivalent income of neighbourhoods classified into deciles that each contained 10% of person years). Although our indicator of socioeconomic status is an ecological measure, it was able to demonstrate socioeconomic differences in mortality and it proved to be relatively robust for confounding(63) (64).

2.3 Statistical Analysis

We estimated the size of relative mortality differences between the minority groups and the native Dutch population by means of Poisson regression analyses (using Stata version 7). We related the number of deceased to the amount of observed person time as offset variable, and to country of origin as independent variable. All mortality rate ratios were adjusted for differences in age structure. Regression analyses were done with and without adjustment for differences in marital status, region, degree of urbanisation and socioeconomic status. These variables were included in the regression analyses as categorical variables.

The mortality level of each ethnic group was measured by means of directly age-standardised mortality rates. Since the ethnic minority population in the Netherlands is still quite young, we used the sum of the studied minority populations in the Netherlands as standard population. Absolute differences in mortality rates between minority groups and native Dutch were calculated for total and cause-specific mortality. Life expectancies were calculated by means of abridged life table analyses.

2.4 Results

Minority groups were younger than the Dutch population (Table 2.2). Turkish and Moroccans were often married, while Surinamese and Antilleans/Arubans were frequently single. All minority groups lived more frequently in neighbourhoods with a low socioeconomic status.

Table 2.2 Background characteristics by ethnicity and sex

	Dutch	Turkish	Moroccans	Surinamese	Antilleans/ Arubans
MALES					
Number of Person Years (*1000)					
0-19 year	9,350	373	343	295	108
20-39 year	11,985	366	282	310	109
40-64 year	12,582	156	146	191	45
65+ year	4,677	9	9	21	3
Total	38,594	905	781	816	265
Number of deaths					
0-19 year	5,139	303	270	165	66
20-39 year	9,381	362	256	414	145
40-64 year	69,140	1023	601	1269	246
65+ year	285,222	346	198	1047	119
Total	368,882	2,034	1,325	2,895	576
Percentage of population					
unmarried (30-49 years)	25,5	6,7	13,2	36,5	53,1
living in West	30,5	35,4	39,9	42,5	38,7
living in urban areas	17,6	21,1	21,4	22,9	21,4
living in low income areas	16,4	58,7	56,1	50,8	43,7
FEMALES					
Number of Person Years (*1000)					
0-19 year	8,944	352	330	285	104
20-39 year	11,544	324	235	348	106
40-64 year	12,350	126	98	208	51
65+ year	6,754	10	4	37	7
Total	39,592	812	667	879	268
Number of deaths					
0-19 year	3,525	223	196	108	39
20-39 year	5,599	152	107	227	77
40-64 year	42,969	343	231	694	161
65+ year	317,889	233	87	1366	210
Total	369,982	951	621	2,395	487
Percentage of population					
unmarried (30-49 years)	16,8	3,3	3,9	30,8	44,5
living in West	30,3	36,4	40,8	44,0	40,5
living in urban areas	17,3	21,1	20,6	22,5	21,0
living in low income areas	16,6	58,3	55,6	49,4	43,0

After controlling for differences in age structure, Turkish, Surinamese and Antillean/Aruban males had an approximately 25% higher risk of dying than native Dutch males, while Moroccan males had an approximately 15% lower risk of dying (Table 2.3). For females,

only among Surinamese the mortality rate ratios were significantly different (higher) than that of Dutch. Results from life table analyses confirmed the observed mortality differences (results not presented). The mortality level of most groups was influenced by socioeconomic status, while adjustment for region and degree of urbanisation did not make a meaningful difference. The mortality level of Surinamese males and females and Antillean males was related to marital status.

Age-specific rate ratios varied with age (Figure 2.1a and 2.1b). Generally, members of the minority groups had an excess mortality at young ages and a reduced mortality at older ages. The age at which the high mortality turned into a low mortality varied somewhat, but was located around about age 35. Turkish and Surinamese men above age 35 did not have a mortality advantage. Adjustment for socioeconomic inequalities reduced mortality differences to a larger extent at younger ages than at older ages (results not shown).

Table 2.3 Mortality rate ratios for ethnic minorities versus native Dutch by sex.

	Mortality rate ratio (95% confidence interval)			
	Turkish	Moroccans	Surinamese	Antilleans/ Arubans
Adjusted for age				
Male	1.21 (1.16-1.26)	0.85 (0.81-0.90)	1.24 (1.19-1.29)	1.25 (1.15-1.36)
Female	1.00 (0.94-1.07)	0.98 (0.90-1.06)	1.10 (1.06-1.15)	1.08 (0.99-1.18)
Adjusted for age and marital status				
Male	1.28 (1.22-1.34)	0.89 (0.85-0.94)	1.13 (1.09-1.17)	1.13 (1.04-1.23)
Female	1.02 (0.96-1.09)	1.00 (0.92-1.08)	1.02 (0.98-1.06)	1.00 (0.91-1.09)
Adjusted for age and region				
Male	1.21 (1.16-1.27)	0.86 (0.81-0.91)	1.26 (1.21-1.31)	1.26 (1.16-1.37)
Female	1.00 (0.94-1.07)	0.98 (0.91-1.06)	1.11 (1.07-1.16)	1.08 (0.99-1.18)
Adjusted for age and degree of urbanisation				
Male	1.16 (1.11-1.22)	0.82 (0.77-0.86)	1.19 (1.14-1.23)	1.21 (1.11-1.31)
Female	0.99 (0.92-1.05)	0.96 (0.89-1.04)	1.08 (1.04-1.13)	1.06 (0.97-1.16)
Adjusted for age and socioeconomic status				
Male	1.08 (1.03-1.13)	0.77 (0.73-0.82)	1.15 (1.11-1.20)	1.15 (1.05-1.26)
Female	0.95 (0.88-1.02)	0.94 (0.86-1.02)	1.06 (1.01-1.10)	1.03 (0.93-1.13)
Adj. for age, marital status, region, urbanisation and socioeconomic status				
Male	1.16 (1.10-1.21)	0.82 (0.77-.87)	1.07 (1.03-1.11)	1.06 (0.96-1.15)
Female	0.98 (0.91-1.05)	0.97 (0.89-1.06)	0.99 (0.95-1.03)	0.96 (0.87-1.06)

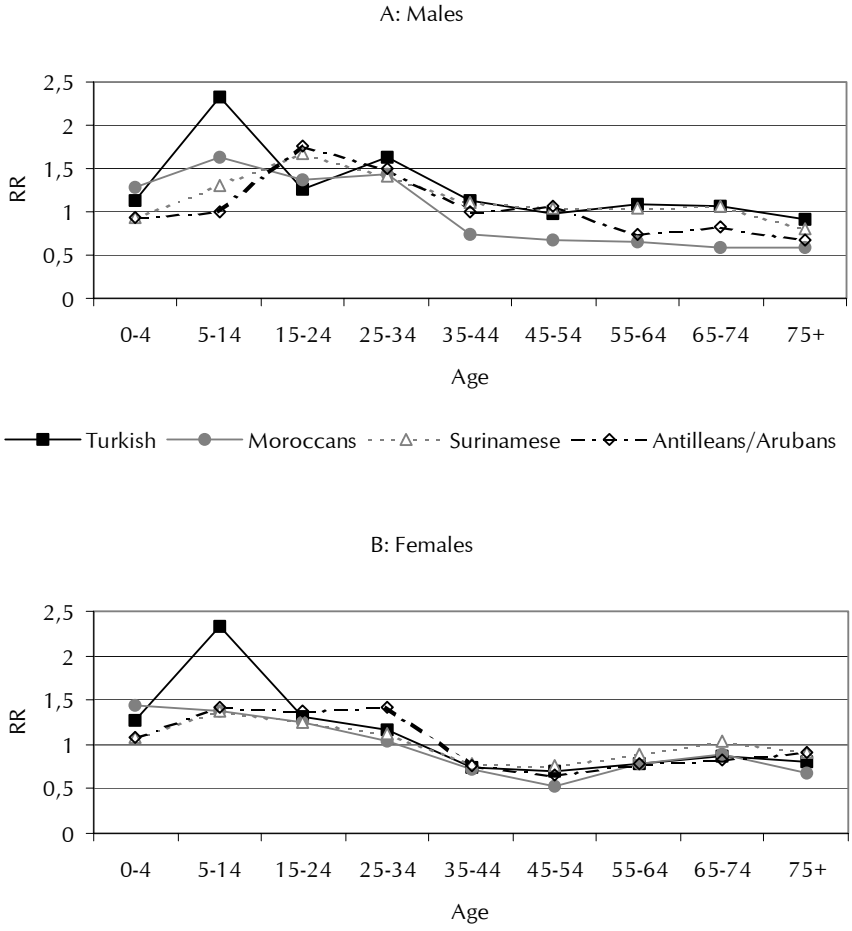

Figure 2.1 Mortality rate ratios for ethnic minority groups versus the native Dutch population by age and sex: a) Males; b) Females

After adjustment for a number of variables, ethnic differences in mortality were significant for many causes of death (Table 2.4). Most minority groups had an excess mortality from infectious diseases and a reduced mortality from neoplasms. Lung-cancer mortality was low for all groups and breast-cancer mortality was low among women. Mortality from IHD was low for Moroccan and Antillean/Aruban males and for Turkish females. Mortality from stroke was elevated for Surinamese males and females and for Turkish males. Most groups had a low probability to die from respiratory diseases. Mortality from ill-defined conditions

was high in all groups. Turkish, Surinamese and Antillean males had an elevated mortality from external causes. All minority groups, and Antillean/Aruban males in particular, had a strongly elevated mortality from homicide.

In comparison to other causes of death, marital status and socioeconomic status had, a relatively large influence on mortality from infectious diseases and external causes (results not shown)

In all groups, but among Turkish and Moroccans in particular, excess mortality from ill-defined conditions made a large contribution to the differences in all cause mortality (Figure 2.2a and 2.2b). Low mortality from neoplasms compensated for the excess mortality from other causes of death among all groups. Among Surinamese and Antillean/Aruban males, external causes and infectious diseases made a contribution to the excess mortality, as did cardiovascular disease mortality among all Surinamese. Among Moroccan men, a lower cardiovascular mortality shifted the balance from higher towards lower all-cause mortality.

2.5 Discussion

Compared to native Dutch men, mortality was higher among Turkish (RR=1.21, CI=1.16-1.26), Surinamese (1.24, 1.19-1.29) and Antillean/Aruban (1.25, 1.15-1.36) males, and lower among Moroccan males (0.85, 0.81-0.90). Among females, inequalities in mortality were small. In general, mortality differences were influenced by socioeconomic and marital status. Most minority groups had a high mortality at young ages and low mortality at older ages, a high mortality from ill-defined conditions (which is related to mortality abroad) and external causes, and a low mortality from neoplasms. Cardiovascular disease mortality was low among Moroccan males (0.51, 0.44-0.59) and high among Surinamese males (1.13, 1.05-1.21) and females (1.14, 1.06-1.23). Homicide mortality was elevated in all groups.

There are several factors that may have influenced the results of this study. Firstly, we were not able to address ethnic variations within migrant groups. Mortality differences for specific ethnic groups may have been larger and, especially for the ethnically diverse Surinamese and Antillean/Aruban population, this may have resulted in underestimated mortality differences.

Secondly, since the cause of most deaths that took place abroad is unknown, the level of mortality for specific causes of death was underestimated. We re-analysed the data and redistributed deaths that took place abroad proportionally to the known causes of death. Upon this redistribution, levels of significance altered for some causes of death, but mortality patterns remained largely the same.(65)

Table 2.4 Mortality rate ratios for specific cause of death for ethnic minorities versus native Dutch by sex

	Mortality rate ratio[a] (95% confidence interval)			
	Turkish	Moroccans	Surinamese	Antilleans/ Arubans
MALES				
Infectious d	1.25 (0.88-1.79)	1.07 (0.72-1.59)	2.21 (1.79-2.73)	2.87 (1.98-4.16)
Neoplasms	0.63 (0.57-0.71)	0.47 (0.41-0.54)	0.62 (0.56-0.68)	0.83 (0.69-1.01)
- lung c	0.68 (0.56-0.83)	0.45 (0.36-0.58)	0.38 (0.31-0.47)	0.68 (0.46-1.01)
- stomach c	1.11 (0.74-1.66)	0.90 (0.57-1.42)	1.30 (0.95-1.77)	1.80 (0.97-3.35)
Cardiovas.	0.98 (0.88-1.08)	0.51 (0.44-0.59)	1.13 (1.05-1.21)	0.83 (0.69-1.02)
- IHD	0.92 (0.79-1.06)	0.40 (0.32-0.51)	0.93 (0.83-1.03)	0.66 (0.48-0.91)
- other	0.75 (0.61-0.91)	0.42 (0.32-0.56)	0.91 (0.80-1.04)	0.50 (0.33-0.76)
- CVA	1.44 (1.14-1.82)	1.01 (0.76-1.35)	1.90 (1.66-2.17)	1.20 (0.79-1.82)
Respiratory	0.73 (0.55-0.98)	0.71 (0.52-0.97)	0.67 (0.56-0.81)	0.92 (0.61-1.38)
Ill-defined	6.30 (5.71-6.96)	3.23 (2.83-3.70)	1.98 (1.74-2.24)	1.41 (1.03-1.93)
Other d.	0.91(0.80-1.04)	0.97 (0.85-1.11)	1.15 (1.05-1.27)	0.87 (0.69-1.10)
External c	1.24 (1.07-1.42)	1.15 (0.99-1.33)	1.33 (1.19-1.48)	1.43 (1.18-1.74)
- suicide	0.85 (0.65-1.12)	0.64 (0.46-0.88)	1.13 (0.94-1.36)	1.04 (0.73-1.48)
- homicide	4.29 (3.08-5.98)	3.30 (2.28-4.77)	2.66 (1.94-3.65)	7.07 (4.99-10.03)
FEMALES				
Infectious d	1.92 (1.27-2.90)	2.42 (1.58-3.69)	1.80 (1.35-2.40)	2.58 (1.55-4.30)
Neoplasms	0.47 (0.40-0.56)	0.39 (0.31-0.48)	0.58 (0.53-0.64)	0.66 (0.54-0.80)
- lung c	0.19 (0.11-0.33)	0.07 (0.02-0.21)	0.24 (0.17-0.33)	0.30 (0.15-0.59)
- breast c	0.43 (0.31-0.61)	0.41 (0.27-0.63)	0.52 (0.42-0.65)	0.81 (0.56-1.17)
- stomach c	1.78 (1.05-3.02)	0.59 (0.19-1.85)	1.30 (0.88-1.90)	1.73 (0.82-3.63)
Cardiovas	0.87 (0.74-1.02)	0.85 (0.68-1.06)	1.14 (1.06-1.23)	0.99 (0.82-1.20)
- IHD	0.63 (0.46-0.87)	0.73 (0.49-1.08)	1.01 (0.89-1.16)	0.87 (0.62-1.23)
- other	0.78 (0.59-1.03)	0.89 (0.63-1.27)	0.96 (0.84-1.09)	0.49 (0.32-0.76)
- CVA	0.94 (0.69-1.28)	0.75 (0.47-1.19)	1.37 (1.20-1.56)	1.11 (0.79-1.56)
Respiratory	0.54 (0.35-0.82)	0.65 (0.38-1.10)	0.78 (0.65-0.93)	0.56 (0.34-0.92)
Ill-defined	5.73 (4.94-6.64)	4.84 (3.99-5.88)	1.61 (1.37-1.88)	2.02 (1.47-2.76)
Other d.	0.95 (0.81-1.11)	1.13 (0.96-1.33)	1.15 (1.05-1.26)	0.87 (0.68-1.10)
External c	0.91 (0.70-1.17)	0.98 (0.74-1.30)	0.99 (0.83-1.18)	1.00 (0.71-1.41)
- suicide	0.54 (0.32-0.93)	0.49 (0.26-0.92)	0.77 (0.59-1.02)	0.64 (0.35-1.16)
- homicide	2.09 (1.12-3.93)	3.30 (1.86-5.87)	2.70 (1.71-4.25)	2.04 (0.83-5.02)

[a] Adjusted for age, marital status, region, degree of urbanisation and socioeconomic status

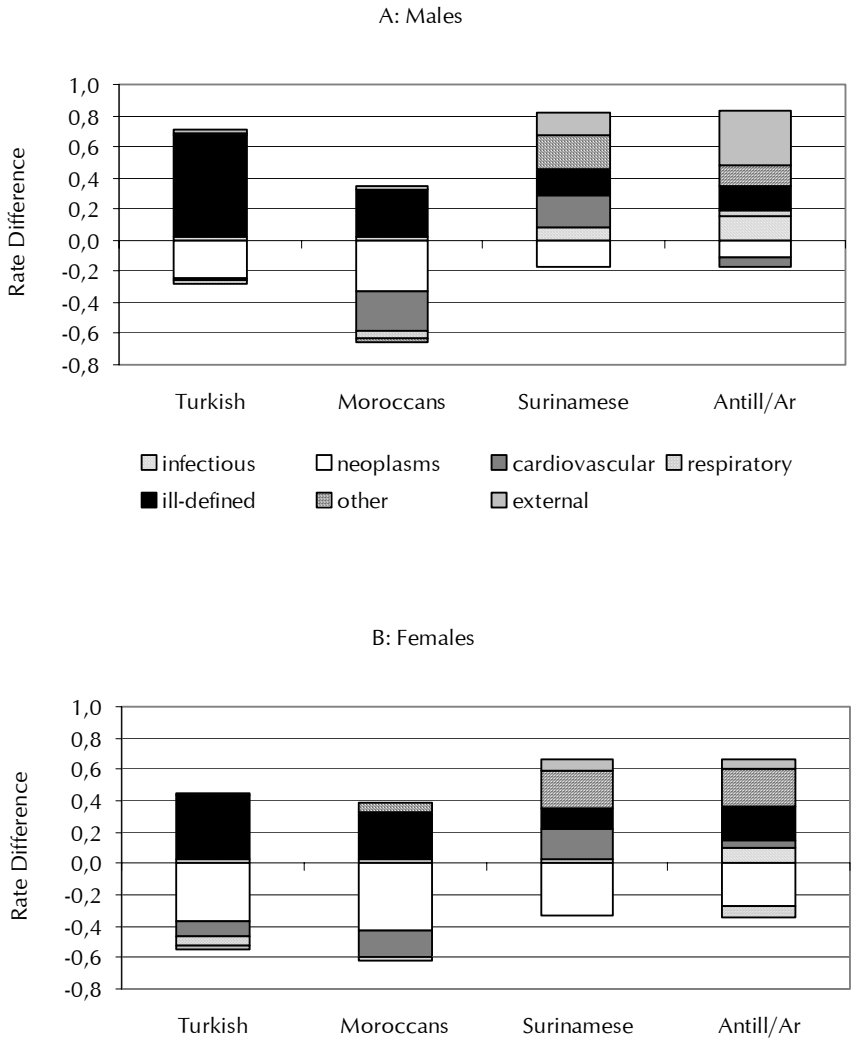

Figure 2.2 Differences between ethnic minorities and native Dutch in directly- standardised death rates for specific causes of death: a) Males; b) Females.

Thirdly, there may have been a residual effect of socioeconomic status, because we controlled for differences in socioeconomic status by using an ecological measure and because indicators of socioeconomic status do not necessarily have the same validity for

all ethnic groups.(39, 63) Further adjustment for socioeconomic status would most likely diminish differences in total mortality, but we think it is unlikely that this would eliminate the strong variations in age- and cause-specific mortality.

Fourthly, since the age limits of the labour-related migration may have been an incentive to overestimate their age, the mortality level of Turkish and Moroccan men who were young in the 1960s and the 1970s may have been underestimated.

Fifthly, unregistered re-migration could have resulted in inaccurate denominator figures.(57) Persons who re-migrate without de-registering were eventually 'administratively excluded' from the Dutch population registry. By taking into account numbers of 'administratively excluded' and estimations of mortality rates among the administratively excluded, we assessed whether unregistered remigration could have influenced our results, and observed that it is unlikely that it did so substantially (results not shown).

To identify factors that determined whether ethnic minority groups have higher or lower mortality than the native population, we compared levels of total and cause-specific mortality of comparable groups living in different countries. Three factors loomed up repeatedly.

Firstly, in many countries, mortality that took place abroad was not or (very) incompletely included in the registry, while it was included in the Dutch registry. This may, for example, for a large part explain why Turkish in Germany had a lower mortality level than Germans, while the mortality level of Turkish in the Netherlands was much less advantageous.(66) Mortality abroad was very high among Turkish in the Netherlands. Upon exclusion of all these deaths, Turkish in the Netherlands would seem to have lower mortality than Dutch (results not shown).

Secondly, a lower mortality from cancers is often found among non-western ethnic minority populations, also among groups with high overall levels of mortality.(67-73) It seems, however, that groups who had lower mortality than the native population, such as Moroccan males in the Netherlands and in France, Caribbean males in the UK, Hispanic males and females in the US, and Turkish males and females in Germany, all had low mortality from both cancer and cardiovascular diseases.(2, 13, 66, 67)

Thirdly, in some groups, specific circumstances seemed able to shift the balance from a low to a high all cause mortality. Antillean/Aruban men in the Netherlands, for example, had, like Caribbean men in the UK, low levels of mortality from both cardiovascular diseases and cancers. (2, 70) But contrary to Caribbean men in the UK, Antillean/Aruban men in the Netherlands had an excess mortality compared to the native population, which was largely due to high mortality from homicide and infectious diseases.

Two selection effects may have determined the observed mortality differences. Favourable health outcomes of migrants are often thought to be related to the selective migration of healthy individuals to the host country. Health selection effects do not affect the second generation and are reported to decrease over time.(74) If this later finding is correct, this

implies that only the mortality level of a relatively small group of persons who entered the Netherlands more recently would still be affected by the healthy migrant effect. Furthermore, it is questionable how strong health selection effects will be, because most migrants migrate at an age at which symptoms of the major causes of death are rarely present. Therefore, we think it is unlikely that the healthy migrant effect had a large influence on the mortality level of the studied groups and on groups abroad with similar migration histories.

Another explanation of favourable health outcomes that is often mentioned is the selective (r)emigration of a relatively unhealthy sub sample of migrants.(14) The population that is left in the host-country is than a relatively healthy one. Of persons who were included in the population register between 1995 and 2000, mortality abroad in the period 1995-2000 is included in our database. Selective (r)emigration of an unhealthy sample of these persons can therefore only influence our results as far it applies to registered (r)emigration, which is a relatively rare event in the Netherlands, and which therefore cannot have had a strong influence on our results. Of more importance may be the selective (r)emigration of persons who left the Netherlands prior to 1995. About 20% of the Surinamese and Moroccan population, about 30% of the Turkish population and about 40% of the Antillean/Aruban population who migrated between 1972 and 1995 have left the Netherlands before 1995(29). The health or socioeconomic status of these persons is unknown and may have been better or worse than that of those who remained in the Netherlands. If the (r)emigrants were indeed a selective group, than the persons who remained in the Netherlands are a selective group as well and this may therefore have influenced their levels of mortality.

To identify factors that determine ethnic differences in mortality we also examined factors that causally relate ethnicity with mortality. We demonstrated that socioeconomic inequalities were a sizeable cause of inequalities in mortality by country of origin. In additional analyses (results not shown) we studied socioeconomic differences in mortality within minority groups, using the same indicator of socioeconomic status as in this study. Death rates were substantially influenced by socioeconomic status in all groups. Socioeconomic inequalities in mortality were, however, relatively small among Moroccans and large among Antilleans/Arubans. These results also suggest that ethnic inequalities in mortality are underpinned by socioeconomic inequalities. Variations in the size of the socioeconomic mortality differences may have contributed to variations in the size of ethnic mortality differences.

We also showed that marital status can have a rather strong effect on ethnic differences in mortality. The mortality level of Surinamese and Antilleans/Arubans is increased due to the fact that they are often single, which includes being a lone parent, both statuses being related to an increased mortality. Whether this is due to differences in behavioural factors, or to the psychosocial consequences of being single, is unknown and needs further research.

Ethnicity is also related to mortality through lifestyle and risk factors. Turkish, Surinamese and Antillean/Aruban men in the Netherlands currently smoke more than Dutch.(75) Yet, we observed a low mortality from lung cancer among all minority groups. Since the lag time for developing lung cancer is long, this implies that older migrant males are less likely to have smoked heavily at a young age than older Dutch men, which corresponds with what is known about the smoking epidemic in less developed countries.(76) The high current prevalence of smokers than reflects a tendency to adopt behaviour was common in the host-country. Not only lung-cancer mortality, but also mortality from other cancers and cardiovascular diseases is related to smoking. Turkish and Moroccans have a Mediterranean diet and this probably had a positive influence on their mortality from cardiovascular disease.(41) The high cardiovascular mortality among Surinamese is probably partially related to the high prevalence of diabetes mellitus among the subgroup of Surinamese who originate from the Indian sub-continent.(75)

The studied minority groups obtained an important health gain from their migration to the Netherlands.(60) Most groups had however higher mortality than the native population. In part, this was related to their relatively low socioeconomic factors and/or disadvantageous marital status. Mortality from cardiovascular diseases, homicide and mortality abroad seemed of particular importance for shifting the balance from a high towards a low all cause mortality.

To reduce ethnic inequalities in mortality, inequalities by socioeconomic position and marital status should be reduced. To prevent ethnic inequalities in mortality to become more disadvantageous in the future, the further adoption of unhealthy Western lifestyles should be discouraged.

Key messages

- Compared to native Dutch males, mortality was high among Turkish, Surinamese and Antillean males, and low among Moroccan males.
- Among females, ethnic inequalities in mortality were small.
- Ethnic inequalities in mortality were partly related to the relatively low socioeconomic status of ethnic minorities and to the fact that, in some groups, being single was relatively common.
- Mortality from cardiovascular diseases, homicide and mortality abroad were of particular importance for shifting the balance from high towards low all-cause mortality.

3

Mortality Differences between native Dutch and Refugees from Asian and African Countries

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Submitted

Abstract

Objectives To analyse differences in mortality between refugees and the native Dutch population.
Design Open cohort design using data from the municipal population registers and the cause of death registers
Setting The Netherlands from 1995 through 2000
Participants All inhabitants of the Netherlands. Persons born in Afghanistan, Iran, Iraq, Vietnam, Somalia, Ghana, and Ethiopia/Nigeria/Sudan were compared to person who themselves and both parents are born in the Netherlands.
Main outcome measures Mortality rate ratios and differences in directly age-standardised mortality rates for all cause mortality, and age and cause specific mortality.
Results As compared to native Dutch, persons born in Iraq (RR: 0.63, 95% CI: 0.52-0.76), Iran (0.82, 0.71-0.96), Afghanistan (0.75, 0.61-0.93) and Vietnam (0.74, 0.60-0.91) had lower mortality, whereas persons born in Nigeria/Sudan/Ethiopia (1.66, 1.37-2.02) and Somalia (1.37, 1.17-1.61) had higher mortality. For causes of death a mixed pattern was observed, with a tendency for a low mortality from neoplasms and circulatory diseases and a high mortality from infectious diseases, ill-defined conditions and external causes.
Conclusion Asian refugees had lower mortality than native Dutch, which may be related to health or education related selection upon migration. African refugees had higher mortality higher than Dutch, which is likely to reflect a low position and a low level of integration in the Dutch society and the health situation in the countries of origin.

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3.1 Introduction

In the past century, ethnic conflicts, civil war, violation of human rights, famine and oppressive political systems have uprooted millions of people. In 2004 there were 9.7 million refugees, 1 million asylum seekers and 4.4 million internally displaced persons. Most of these people originate from Asia and Africa and have found a host country in the same continent. Nevertheless, almost 4,5 million refugees and asylum seekers today live in European countries, amongst which the Netherlands(77).

Because most countries do not have a systematic health recording system for refugees not much is known about the health situation of refugee groups living in industrialised countries(78). Mostly anecdotal evidence, stemming from agencies involved in the reception and resettlement of refugees, gives the impression that refugees broadly face health problems similar to those of other deprived and ethnic minority communities(78-80). They in addition may experience some specific health problems related to displacement, war, and sometimes torture, such as elevated levels of post-traumatic stress disorder (PTSD), unexplained somatic symptoms and high levels of communicable diseases, of which tuberculosis is the most important(78-82).

Mortality figures provide important information to describe the health situation of a population group. With respect to refugees and asylum seekers, however, such figures are scarce. In the Netherlands, male asylum seekers were reported to have a high mortality, while female asylum seekers had similar levels of overall mortality as native Dutch(28). Vietnamese refugees living in England and Wales were reported to have low overall mortality(71). Some studies report on cause specific mortality among refugee populations living in western countries. They showed low mortality from cancer in sub-Saharan African migrants living in France(83) and elevated perinatal mortality among children of refugees living in Ireland(84). The literature on mortality of internally displaced persons suggests high levels of infant/child mortality (85, 86) and no association between PTSD and mortality(87).

Thus, the evidence on mortality patterns among refugees and asylum seekers is still limited to few health problems and few refugee groups. No study includes one of the major recent refugee groups from Africa or the Near East, which form sizeable population groups in western countries at this moment. Using data from a longitudinal follow-up of all legal residents of the Netherlands in the period 1995 through 2000, we compared total, age, sex, and cause specific levels of mortality among refugees coming from Nigeria, Sudan, Ethiopia, Somalia, Iraq, Iran, Afghanistan and Vietnam to that of the native Dutch population.

3.2 Data and methods

The present study used data from the municipal population registers and the national cause of death registry of Statistics Netherlands. All inhabitants of the Netherlands with a legal

residence status are obliged to register in the population registers. Asylum seekers who have not yet obtained a residence permit are allowed to register, but not many are likely to do so. Illegal residents are not included in the registers.
All persons who, ate the time of death, were registered in the population registers, should be included in the national death registry, irrespective of whether the death occurred in the Netherlands or abroad. We linked information from the death registry to the population register, using unique personal identification numbers.

A data file was created for the observation period 1995 through 2000. An open cohort design was used in order to allow persons to enter (by birth, immigration or administrative inclusion) or to leave (by death, emigration, or administrative removal) the study during the study period. Multiple dates of entry and exit were taken into account. For each inhabitant, the number of person years was calculated, taking into account the date(s) of entry or exit. The event of interest was death.

We studied immigrants who were born in Nigeria, Sudan, Ethiopia, Somalia, Iraq, Iran, Afghanistan and Vietnam. These countries were selected because they faced a period of serious political oppression, ethnic conflict or war during the preceding decades and because, during our study period, immigrants from these countries lived substantial numbers of person years in the Netherlands. Because numbers of immigrants from Nigeria, Sudan and Ethiopia were relatively small study subjects from these countries were combined in almost all analyses.

Table 3.1 ICD-codes for included causes of death

	ICD 9 (1995)	ICD 10 (1996-2000)
Infectious diseases	001 – 139	A00 - B99
Neoplasms all	140 – 239	C00 - D48
lung cancer	162	C33 - C34
stomach cancer	151	C16
breast cancer	174 – 175	C50
Cardiovascular dis.	390 – 459	I00 - I99
IHD	410 – 414	I20 - I25
CVA	430 – 438	I60 - 69
Diseases of respiratory system	460 – 519	J00 - J99
Ill-defined conditions	780 – 799	R00 - R99
Other diseases	All remaining	All remaining
External causes	E800 - E999	V01- Y89
suicide	E950 - E959	X60 - X84
homicide	E960 - E969	X85 -Y09

The population registers provided information on sex, date of birth, marital status, and postal code of each selected individual. The 6-digit postal code was used to obtain

information on the neighbourhood of residence (region, population density and mean area income). The death registry provided information on the primary cause of death, classified on basis of the ICD-9 (1995), and ICD-10 (1996 through 2000; Table 3.1). Of most deaths occurring abroad, the underlying cause of death was not specified. In our analyses, these deaths were classified as 'symptoms and ill-defined causes'.

Differences in mortality between immigrants and the native Dutch were expressed by means of rate ratios, estimated using Poisson regression analyses (using Stata version 7). In the regression models, the number of deaths was the dependent variable, and the number of person years at risks the offset variable. Adjustments were made for 5-year age group in all analyses, and for sex where necessary. In additional analyses, adjustments were also made for marital status, region, degree of urbanisation, and average area income.

The mortality level of each ethnic group was also measured by means of directly age-standardised mortality rates. Since the refugee population living in the Netherlands is still relatively young, we used the sum of the studied refugee groups as standard population. Absolute differences in mortality rates between minority groups and native Dutch were calculated for total and cause-specific mortality. The absolute differences in cause specific mortality add up to the absolute difference in total mortality.

3.3 Results

Iraqis, Somalians and Iranians are among the largest refugee groups living in the Netherlands (Table 3.2). Other large groups include Afghans, Vietnamese and Nigerians/Sudanese/Ethiopians. Iraqis, Afghans and Somalians immigrated to the Netherlands after 1990. Nigerian/Sudanese/Ethiopian and Iranian refugees immigrated somewhat earlier. Of the Vietnamese, 47% came during the 1980s to the Netherlands and 20% came in the 1970s. Refugees are more often are unmarried, live more often in the Western part of the country and in densely populated neighbourhoods with a low average income level. Vietnamese refugees resemble the native Dutch more than the other groups.

After adjustment for 5-year age group, sex, marital status and neighbourhood characteristics, Nigerians/Sudanese/Ethiopians and Somalians had higher mortality than native Dutch, whereas Iraqis, Iranians, Afghans and Vietnamese had lower mortality (Table 3.3). Adjustment for marital status and neighbourhood characteristics hardly influenced the mortality figures. Further analysis showed rate ratios of 1.79 for Ethiopians (95% C.I. 1.40-2.27), 1.74 for Nigerians (95% C.I. 1.19-2.53) and 1.95 for Sudanese (95% C.I. 1.27-2.98, results not shown).

Table 3.2 Characteristics of refugee groups and native Dutch

	Dutch	NSE[a]	Soma-lia	Iraq	Iran	Afgha nistan	Viet-nam
Percentage of population							
Registered >1990	n.a.	71	94	95	77	97	33
Unmarried (25-59 y)	25	55	48	43	43	45	28
Living in West	31	66	50	48	56	46	45
L. in urban area	15	46	29	25	32	20	15
L. in low income area	16	44	38	37	31	27	26
Number of Person Years (* 1000)							
Total	78,186	68	118	121	105	70	59
Males	38,594	44	68	77	63	40	32
Females	39,592	24	50	44	43	30	28
0-19 year	18,293	13	43	38	28	30	7
20-39 year	23,529	46	65	61	52	28	36
40-65 year	24,932	9	10	21	23	11	15
65+ year	11,431	0	1	1	2	1	1
Number of deaths							
Total	738,864	114	149	114	176	86	93
Male	368,882	86	95	79	121	53	64
Female	369,982	28	54	35	55	33	29
0-19 year	8,664	9	17	6	6	13	1
20-39 year	14,980	68	70	40	49	19	26
40-64 year	112,109	36	47	41	64	27	33
65+ year	603,111	1	15	27	57	27	33
Infectious diseases	7,483	18	21	3	5	4	0
Neoplasms all	207,802	16	13	32	38	12	25
lung cancer	47,055	2	1	4	5	1	7
stomach cancer	9634	0	0	1	1	0	4
breast cancer[b]	19,054	0	1	8	7	1	0
Circulatory diseases	271,184	12	27	31	48	22	20
IHD	103,949	2	9	18	23	10	5
stroke	65,667	2	5	4	13	6	8
Respiratory diseases	74,299	1	4	4	9	7	10
Ill defined condit.	33,310	16	20	10	20	5	10
Other diseases	118,680	12	30	9	17	7	15
External causes	26,106	39	34	25	39	29	13

[a] Nigeria/Sudan/Ethiopia; [b] Females only

Levels of mortality generally differed little between males and females, except that among Afghans a significant mortality advantage is observed for males but not for females, and among Iranians and Vietnamese a significant mortality advantage is observed for females but not for males (Table 3.4). In general rate ratios were higher for younger age groups than for older age groups.

Refugees from Nigeria/Sudan/Ethiopia and Somalia had elevated mortality from infectious diseases (Figure 3.1, Table 3.5). All groups had a reduced mortality from neoplasms. Circulatory disease mortality was generally reduced in all groups except Somalians. Nigerians/Sudanese/Ethiopians, Somalians, Iranians and Vietnamese had high levels of mortality from ill-defined conditions, which is largely due to mortality abroad. Iraqis, Iranians and Afghans had a low mortality from 'other' causes. Nigerians/Sudanese/Ethiopians, Iranians and Afghans had an elevated mortality from external causes. Suicide mortality was only elevated among Iranians. Homicide mortality was elevated among Nigerians/Sudanese/Ethiopians, Iraqis and Iranians (Table 3.5).

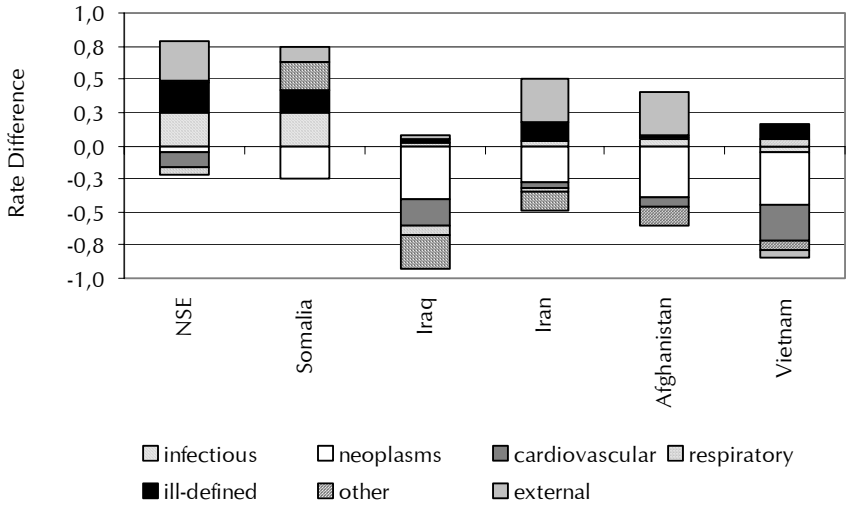

Figure 3.1. Differences between refugee groups and native Dutch in directly-standardised death rates for specific causes of death

Table 3.3 Mortality of refugee groups as compared to native Dutch: rate ratios estimated before and after adjustment for marital status and neighbourhood characteristics

Adjustment variable	Rate ratio, adjusted for five-year age group, sex and... (95 % confidence interval)					
	NSE[a]	Somalia	Iraq	Iran	Afghanistan	Vietnam
-	1.80 (1.50-2.16)	1.50 (1.28-1.77)	0.69 (0.57-0.83)	0.89 (0.77-1.03)	0.83 (0.67-1.02)	0.76 (0.62-0.93)
marital status	1.63 (1.35-1.96)	1.41 (1.20-1.66)	0.65 (0.54-0.78)	0.83 (0.72-0.97)	0.77 (0.62-0.95)	0.75 (0.61-0.92)
urbanisation	1.76 (1.46-2.12)	1.49 (1.27-1.75)	0.68 (0.57-0.82)	0.88 (0.76-1.02)	0.83 (0.67-1.02)	0.76 (0.62-0.93)
region	1.82 (1.52-2.19)	1.52 (1.29-1.78)	0.69 (0.58-0.84)	0.90 (0.78-1.04)	0.83 (0.67-1.03)	0.76 (0.62-0.93)
area income	1.71 (1.42-2.06)	1.44 (1.23-1.70)	0.66 (0.55-0.80)	0.87 (0.75-1.01)	0.84 (0.67-0.99)	0.75 (0.61-0.92)
all variables	1.57 (1.30-1.87)	1.37 (1.17-1.61)	0.63 (0.52-0.76)	0.82 (0.71-0.96)	0.75 (0.61-0.93)	0.74 (0.60-0.91)

Table 3.4 Mortality of refugee groups as compared to native Dutch: rate ratios according to sex and age group

Sex or age group	Rate ratio[b] (95 % confidence interval)					
	NSE[a]	Somalia	Iraq	Iran	Afghanistan	Vietnam
Male	1.56 (1.26-1.93)	1.40 (1.15-1.72)	0.60 (0.48-0.75)	0.86 (0.72-1.03)	0.70 (0.54-0.92)	0.82 (0.64-1.05)
Female	1.68 (1.16-2.44)	1.36 (1.04-1.77)	0.71 (0.51-0.99)	0.76 (0.59-0.99)	0.85 (0.61-1.20)	0.61 (0.42-0.87)
0-19 years	2.36 (1.22-4.55)	1.70 (1.05-2.73)	0.72 (0.32-1.60)	0.94 (0.42-2.09)	1.94 (1.13-3.35)	0.50 (0.71-3.58)
20-39 years	1.78 (1.40-2.26)	1.67 (1.32-2.11)	0.91 (0.67-1.24)	1.16 (0.88-1.53)	0.99 (0.63-1.56)	1.12 (0.76-1.65)
40-65 years	1.06 (0.76-1.46)	1.14 (0.85-1.51)	0.48 (0.35-0.64)	0.67 (0.53-0.87)	0.57 (0.39-0.83)	0.66 (0.47-0.93)
65+ years	0.26 (0.04-1.84)	0.73 (0.44-1.22)	0.54 (0.37-0.79)	0.72 (0.55-0.94)	0.59 (0.41-0.87)	0.64 (0.46-0.90)

[a] Nigeria/Sudan/Ethiopia

[b] Estimated with adjustment for 5-year age group, marital status, degree of urbanisation, region of residence and average area income. Where applicable, also with adjustment for sex

Table 3.5 Mortality of refugee groups as compared to native Dutch: rate ratios according to cause of death

Cause of death	Rate ratio[b] (95 % confidence interval)					
	NSE[a]	Somalia	Iraq	Iran	Afghanistan	Vietnam
Infectious d.	9.91 (6.21-15.82)	9.57 (6.21-14.74)	0.91 (0.29-2.84)	1.41 (0.59-3.39)	2.10 (0.79-5.60)	0.00[c]
Neoplasms	0.72 (0.45-1.19)	0.41 (0.23-0.70)	0.53 (0.37-0.74)	0.53 (0.38-0.73)	0.33 (0.19-0.59)	0.58 (0.39-0.86)
- lung c	0.44 (0.11-1.76)	0.17 (0.02-1.20)	0.28 (0.11-0.75)	0.30 (0.12-0.73)	0.13 (0.02-0.87)	0.71 (0.34-1.49)
- stomach c.	0.00[c]	0.00[c]	0.44 (0.06-3.09)	0.38 (0.05-2.67)	0.00[c]	2.36 (0.88-6.28)
- breast c.[d]	0.00[c]	0.27 (0.04-1.95)	0.51 (0.76-3.02)	0.98 (0.47-2.05)	0.27 (0.04-1.95)	0.00[c]
Circulatory d	0.89 (0.51-1.57)	1.19 (0.82-1.74)	0.68 (0.48-0.97)	0.82 (0.62-1.09)	0.70 (0.46-1.07)	0.55 (0.36-0.86)
- IHD	0.33 (0.82-1.32)	0.95 (0.49-1.83)	0.88 (0.55-1.39)	0.9 (0.60-1.36)	0.74 (0.40-1.37)	0.32 (0.13-0.76)
- stroke	0.86 (0.21-3.43)	1.13 (0.47-2.72)	0.48 (0.18-1.27)	1.12 (0.65-1.92)	0.98 (0.44-2.17)	1.09 (0.55-2.19)
Respiratory .	0.50 (0.07-3.57)	0.94 (0.35-2.50)	0.44 (0.16-1.16)	0.71 (0.37-1.37)	0.98 (0.47-2.05)	1.31 (0.71-2.44)
Ill-defined c.	3.38 (2.07-5.53)	3.13 (2.02-4.86)	1.05 (0.56-1.95)	1.80 (1.16-2.79)	0.84 (0.35-2.03)	1.65 (0.89-3.07)
Other dis.	0.77 (0.38-1.54)	0.84 (0.49-1.45)	0.25 (0.11-0.55)	0.27 (0.14-0.54)	0.19 (0.06-0.58)	0.54 (0.28-1.04)
External c.	1.93 (1.41-2.65)	1.32 (0.94-1.85)	0.88 (0.60-1.31)	1.41 (1.03-1.93)	1.96 (1.36-2.82)	0.90 (0.52-1.56)
- suicide	1.00 (0.53-1.85)	1.06 (0.59-1.92)	0.56 (0.26-1.17)	1.75 (1.16-2.64)	1.37 (0.69-2.73)	0.94 (0.42-2.09)
- homicide	5.36 (2.65-10.84)	0.64 (0.09-4.54)	4.47 (2.11-9.45)	3.68 (1.64-8.25)	2.78 (0.69-11.14)	0.00[c]

[a] Nigeria/Sudan/Ethiopia; [b] Estimated with adjustment for 5-year age group, marital status, degree of urbanisation, region of residence and average area income. Where applicable, also with adjustment for sex; [c] 95% confidence intervals could not be estimated because of zero observed deaths; [d] Females only

3.4 Discussion

As compared to the native Dutch, persons born in Iraq, Iran, Afghanistan, and Vietnam had lower mortality and persons born in Nigeria/Sudan/Ethiopia and Somalia higher mortality. Marital status and regional characteristics contributed only little to the mortality differences. The magnitude of mortality differences between refugees and the native Dutch population did not vary systematically with sex. Rate ratios were generally higher for younger than for older age groups. For causes of death a mixed pattern was observed, with a tendency for a low mortality from neoplasms and circulatory diseases and a high mortality from infectious diseases, ill-defined conditions and external causes.

There are some factors that may have influenced the results of this study and that need to be considered. First, the mortality level for specific causes of deaths was underestimated, as the cause of most deaths occurring abroad was unknown. A redistribution of cases with unknown cause of death (11% of all cases among refugees versus 5% of all cases among native Dutch) to the known causes of death would not have had a large effect on the variations in cause-specific mortality observed in his study. Second, differential mortality among refugees who emigrated from the Netherlands to another country could have influenced the results. Because there is no indication that the health situation of emigrants differs from that of persons staying in the Netherlands, we judge it unlikely that this has affected the results in a substantial manner.

There are not many studies on patterns of mortality among refugees from Asia and Africa living in Europe. A study among asylum seekers living in the Netherlands, who, in contrast to the refugees that we studied, do not have a residency permit, found, compared to Dutch, equal levels of mortality among females and elevated levels of mortality among males. The latter was related to mortality from infectious diseases and external causes(28). The differences in results between the study among asylum seekers and our study among refugees are likely to be related by the differences between the studied groups. Countries of origin differ as do their position in their country of origin and the Netherlands. Our results with respect to Vietnamese are in agreement with what was found in a study on Vietnamese refugees living in England and Wales(71). That study also observed low ischemic heart disease mortality and reduced cancer mortality. Studies done among other types of immigrant groups have also found large variations between groups, with some groups having a lower mortality than the host population and others having a higher mortality(2, 4, 11, 88). The size of the mortality differences between refugees and the native population, however, seem to be larger among refugees than among people whose migration is related to the recruitment of cheap labour or the colonial past. An elevated mortality among young people of foreign origin is also found in many other studies and is generally related to drowning, burning and other accidents(28) (2, 4, 11, 88).

Several mechanisms may have contributed to the observed mortality patterns. First, selection upon migration may have contributed to the low overall levels of mortality among Asian refugees. Selection on health may have taken place: going into exile often

requires large efforts, and those who have health problems may not undertake this. Selection with respect to socioeconomic position has probably played larger role: in times of ethnic conflicts or civil war, those with a relatively low socioeconomic status tend to flee to other regions within the country or to neighbouring countries, whereas the higher educated and/or wealthier persons move onwards to industrialised countries. Refugees from countries like Afghanistan and Iran living in western countries, are for example, known to be highly educated(89, 90).

Second, the large variations in the cause specific mortality patterns suggest that specific risk factors played a role. The low mortality was related to low cancer and circulatory disease mortality. A similar pattern was observed in Moroccan males living in the Netherlands(88, 91). Their low cancer and circulatory disease mortality is likely to be related to a series of behavioural factors such as low alcohol consumption, healthier (Mediterranean) diet and lower life-time exposure to smoking. Studies reporting health behaviour of refugees are lacking, but the low rates of lung cancer that we observed suggest that the smoking prevalence is, or has been, low in many refugee groups.

Third, differences between refugees regarding their position in Dutch society may have contributed to the variations in mortality between African and Asian refugees. Refugees from Somalia, for example, have a weak position in the Dutch labour market, while many Asian groups more often have jobs with higher skill levels and income. Levels of integration into Dutch society are reported to be lower among Africans than among Asians(90), which may affect the access to, or use of, health care and may increase the risk of mortality from external causes.

Fourth, differences in mortality levels between African refugees on the one hand and Asian refugees on the other hand may partly reflect levels of mortality (of subgroups) in the countries of origin. This effect may be relatively strong among refugees, as the majority of them have lived for only a relatively short period of time in the Netherlands, and may be especially strong for infectious disease mortality(92, 93). The high levels of infectious disease mortality and infant mortality in the African countries indicate that the general health situation in the African countries of origin is worse than in the Asian countries. High rates of HIV infection in Africa may also have contributed to the high mortality from infectious diseases among African refugees(28) (94).

Concluding, studied Asian refugees showed lower mortality than native Dutch, possibly due to health or education related selection upon migration. Studied African refugees showed higher mortality than native Dutch, which is likely to reflect a low position and a low level of integration in Dutch society and the worse health situation in the African countries of origin.

This study points at number of areas to improve the health situation of refugees. These include mortality among African refugees, mortality among young refugees, infectious disease mortality and mortality from external causes. Refugee groups might benefit from increased screening on infectious diseases and measures aimed at reducing risks of

drowning, burning and other accidents. Especially African refugee groups might benefit from structural efforts to improve their position in Dutch society.

What is already known on this subject

- Studies on immigrant mortality have shown a great diversity, with low mortality in some groups and high mortality in others.
- Studies on mortality of refugee groups living in industrialised countries are scarce and fail to provide a comprehensive picture of the mortality situation among refugees.

What this study adds

- We provide an overview of total, age-, sex- and cause-specific mortality among a number of major refugee groups living in the Netherlands.
- We showed that, as compared to native Dutch, persons born in Iraq, Iran, Afghanistan and Vietnam had a lower mortality, whereas persons born in Nigeria/Sudan/Ethiopia and Somalia had a higher mortality.
- We showed that for specific causes of death a mixed pattern was observed, with a tendency for a low mortality from neoplasms and circulatory diseases and a high mortality from infectious diseases, ill-defined conditions and external causes.
- The reduced mortality among the studied Asian refugees may have been related to health or education related selection upon migration and the elevated mortality among the studied African refugees may have been related to a low position and a low level of integration in the Dutch society and the worse health situation in the African countries of origin.

4

Mortality Differences between Native Dutch and People of Indonesian Origin

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Submitted

ABSTRACT

Background Persons of Indonesian descent form a large and well integrated, if not assimilated, group in the Dutch society. Our objective was to determine if there are nonetheless differences in cause-specific mortality between first and second generation Indonesians and the native Dutch population.

Methods We used data for the years 1995 through 2000 from the Municipal Population Registers and cause of death registry. All inhabitants of the Netherlands were included in the study, except persons from a descent other than Dutch or Indonesian. The mortality of persons with an Indonesian background was compared to that of the native Dutch population, using Poisson regression analyses and directly standardised mortality rates.

Results All cause mortality of Indonesians was similar to that of the native Dutch (RR=1.00, CI=0.98-1.02). Mortality differences were hardly affected by socioeconomic status, whereas correcting for marital status lowered the Indonesian mortality risks slightly. Indonesian men had lower mortality levels in all age groups, especially in the group of 40-64 years old (RR=0.81, CI=0.76-0.86). In contrast, Indonesian women had a somewhat elevated mortality level in most age groups, except for the group of 40-64 years old (RR=0.95, CI=0.89-1.02). Reduced mortality risks were observed in all socioeconomic groups, especially in the lowest (RR=0.94, CI=0.91-0.97) and in almost all marital status groups, notably for unmarried (RR=0.91, CI=0.86-0.97) and divorced (RR=0.88, CI=0.84-0.93) persons. Indonesians showed moderately higher mortality from cardiovascular diseases (RR=1.06, CI=1.03-1.09), diabetes (RR=1.29, CI=1.15-1.44) and ill-defined conditions (RR=1.27, CI=1.18-1.38). They showed substantially higher mortality from hepatitis (RR=5.84, CI=3.47-9.84), tuberculosis (RR=3.40, CI=2.31-5.02), liver cancer (RR=2.35, CI=1.87-2.94), Hodgkin's disease (RR=2.87, CI=1.79-4.61) and asthma (RR=2.75, CI=1.66-4.54). Indonesians had a reduced mortality from lung cancer (RR=0.68, CI=0.62-0.74), skin cancer (RR=0.33, CI=0.20-0.55), several cancers of the gastro-intestinal tract, suicide (RR=0.74, CI=0.61-0.90) and alcohol-related diseases (RR=0.25, CI=0.16-0.38). The lower mortality risks of Indonesians did not vary much according to year of settlement.

Conclusion Although overall levels of mortality are similar, cause-of-death patterns vary greatly between Indonesians and native Dutch persons. The similar levels in all cause mortality coincide with a high degree of integration of Indonesians within Dutch society. The differences in cause-of-death patterns may reflect persistent influences of country of origin and migration history.

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4.1 Introduction

Numerous studies have examined the relationship between ethnicity, migration and health status. Mortality differences between migrant groups and the native (white) population have been documented in many countries, including The United States of America, Canada, Australia and some European countries (95, 88, 2). One of the reasons for studying the health of these migrant groups is that it may identify high-risk groups that require special attention in public health interventions. In addition studies that assess how disease patterns of immigrants do, or do not, in time, converge to disease patterns of the host country can help the formulation of hypotheses on the role of the genetic factors, or factors that influence disease risk early in the life course.

Most migrant studies have focused on marginalized and disadvantaged migrant groups. For example, most studies in the Netherlands focused on the four largest migrant groups: Surinamese, Turks, Moroccans and Antilleans/Arubans, who all belong the most disadvantaged groups within Dutch society in both economic and social terms. Studies have shown large mortality differentials between these minority groups and to the native Dutch(88) (16, 96, 97). No study has focused on migrant groups who have integrated or even assimilated into the Dutch society to a higher degree. Our study focused on the largest of these groups, i.e. first and second-generation migrant from Indonesia.

Approximately 126,000 Indonesians migrated to the Netherlands between 1945 and 1949 as a result of World War II and the Indonesian War of Independence(98). A group of 13,000 Moluccans fled to the Netherlands between 1949 and 1951. They are former soldiers of the Royal Dutch Indonesian Army with their families. Nowadays there are over 400,000 Indonesian migrants in the Netherlands, counting both first and second generation(99). Indonesian migrants have a position in the Dutch society that is comparable to that of the native Dutch. They have income levels that are similar to the native Dutch, and they are equally often employed by the government or working in sectors such as education or in the health care(100).

Given this situation, we formulated two alternative hypotheses about their level and patterns of mortality. The central hypothesis was that Indonesians might exhibit similar mortality levels and patterns as the native population of the Netherlands, due to their high level of social integration. The alternative hypothesis was that, as a result of persistent influences from the country of origin and their migration history, Indonesians would show different mortality levels and patterns compared to the native Dutch.

Using data from the municipal population registers and cause of death registry of Statistics Netherlands, which contain information on all legal residents of the Netherlands, we examined whether there were differences in all cause and cause-specific mortality between first and second generation Indonesians and the native Dutch. In addition, we examined whether these Indo-Dutch differences in mortality within specific age groups, marital status groups and socioeconomic groups. Finally, we determined whether the

relative position of Indonesian migrants varied according to their generation and duration of stay in the Netherlands.

4.2 Data

We used data for the years 1995 through 2000 from the cause of death registry and the municipal population registers, which provided data on all inhabitants of the Netherlands with a legal status. All persons included in the population registry who died during the study period were included in the cause of death registry, irrespective of whether the death occurred in the Netherlands or abroad. All data were tabulated according to sex, date of birth, country of birth, country of birth of both parents, six-digit postal code and marital status. These registers were linked by means of personal identification numbers. In addition, information from geographical databases were linked to our data on the basis of six-digit postal code.

Migrant status of was determined on the basis of the country of birth of the subject and both parents. In our study, a person is considered to be a first generation migrant when the subject and his or her parents were all born in Indonesia. One is considered to be a second-generation migrant when one was born in the Netherlands, with both parents born in Indonesia. We therefore excluded persons of mixed Indo-Dutch origin.

Persons were allowed to enter the study throughout the study period (open cohort design). Of each inhabitant, the amount of person time was calculated. The event of interest was death. The causes of death were coded according to ICD-9 in 1995, and according to ICD-10 in 1996-2000. Of deaths that took place abroad, the cause was almost never established. These deaths were categorised under ill-defined conditions.

Marital status was classified as unmarried, married, widowed or divorced. As an indicator of socioeconomic status we used the mean household equivalent income of neighbourhood of residence. We ranked the total population according to income and distributed them into population deciles. Next we recoded socioeconomic status into groups that contained, respectively, 30 percent, 40 percent and 30 percent of the total number of person years, thus forming a high, middle and low socioeconomic group.

4.3 Statistical analysis

The mortality level of each group was measured by means of directly age-standardised mortality rates, using the native Dutch population as a standard. Absolute differences in mortality rates between the Indonesian migrant group and the native Dutch were calculated for all cause and cause-specific mortality.

We estimated the size of mortality rate ratios (RR), including 95 percent confidence intervals (CI), between the Indonesian migrant group and the native Dutch population by means of Poisson regression analyses (using Stata version 8.0). In all regression models, we

controlled five-year age groups and sex, and in some models we also controlled for marital status and socioeconomic status.

4.4 Results

Indonesians were more often single or divorced than the native population (Table 4.1). As compared to the native Dutch, Indonesian migrants lived more often in neighbourhoods with a low socioeconomic status and less often in neighbourhoods with a moderate socioeconomic status. In neighbourhoods with a high socioeconomic status, however, they were equally represented.

Table 4.1 Background characteristics according to ethnicity, generation and sex

	Dutch	1st generation Indonesians	2nd generation Indonesians	Total Indonesians
MALES				
Person years (*1000)	38,029	265	195	460
Number of deaths	357,357	4,326	274	4,600
Marital status, % (35-49 yrs)				
- single	18.5	21.5	31.2	26.3
- divorced	7.4	14.7	10.9	12.8
Socioeconomic status, % living in				
- low income area	25.9	31.6	32.5	32.0
- mid income area	42.3	36.1	37.5	36.7
- high income area	31.8	32.3	30.0	31.3
FEMALES				
Person years (*1000)	38,887	317	186	504
Number of deaths	348,015	5585	238	4,963
Marital status, % (35-49 yrs)				
- single	12.1	12.8	24.5	18.3
- divorced	9.5	17.5	13.7	15.7
Socioeconomic status, % living in				
- low income area	26.2	31.3	31.4	31.4
- mid income area	42.2	35.7	36.8	36.0
- high income area	31.6	33.0	31.8	32.6

First generation Indonesian men had an about 7.0 percent lower risk of dying than native Dutch men, while first generation Indonesian women had an about 6.0 percent higher risk of dying than native Dutch women (Table 4.2). The second-generation Indonesian men and women showed slightly greater mortality differentials compared to the native Dutch, with respectively 10.0 percent lower and 11.0 percent higher mortality risks. When looking at both sexes together, no mortality differentials were observed between Indonesians and native Dutch. This was true for both generations taken together (RR=1.00) and for each generation taken separately. The mortality differences between Indonesians and native Dutch were hardly influenced by socioeconomic status, whereas controlling for marital status slightly lowered the Indonesian relative mortality risks.

Table 4.2 Mortality of Indonesian migrant groups versus native Dutch: effect of adjusting for age and, in addition, for marital status and socioeconomic status

	Mortality rate ratio[a] (95% confidence interval)		
	1st generation Indonesians	2nd generation Indonesians	Total Indonesians
Adjusted for age			
Males	0.93 (0.91-0.96)	0.90 (0.80-1.02)	0.93 (0.90-0.96)
Females	1.06 (1.03-1.09)	1.11 (0.97-1.26)	1.06 (1.03-1.09)
Total	1.00 (0.98-1.02)	0.99 (0.91-1.08)	1.00 (0.98-1.02)
Adjusted for age and marital status			
Males	0.90 (0.87-0.93)	0.85 (0.76-0.96)	0.90 (0.87-0.93)
Females	1.03 (1.01-1.06)	1.06 (0.93-1.20)	1.03 (1.01-1.06)
Total	0.97 (0.95-0.99)	0.94 (0.86-1.02)	0.97 (0.95-0.99)
Adjusted for age and socioeconomic status			
Males	0.93 (0.90-0.96)	0.91 (0.81-1.03)	0.93 (0.90-0.96)
Females	1.06 (1.03-1.09)	1.11 (0.98-1.26)	1.06 (1.03-1.09)
Total	1.00 (0.98-1.02)	1.00 (0.91-1.09)	1.00 (0.98-1.02)
Adjusted for age, marital status and socioeconomic status			
Males	0.90 (0.87-0.93)	0.86 (0.77-0.97)	0.90 (0.87-0.92)
Females	1.03 (1.01-1.06)	1.06 (0.93-1.20)	1.03 (1.01-1.06)
Total	0.97 (0.95-0.99)	0.95 (0.87-1.03)	0.97 (0.95-0.99)

[a] Using the corresponding native Dutch group (respectively the male, female, total native Dutch) as reference

Indonesian men had a relatively low risk of dying in all age groups, especially the middle-aged men of 40-64 years (RR=0.81) (Table 4.3). This reduced risk was apparent in the first as well as in the second-generation Indonesian men. Indonesian women, on the other hand, have a tendency toward relatively higher mortality risks in all age groups, except for middle-aged women (RR=0.95). This trend is evident in both generations.

Table 4.3 Mortality within different age groups: Indonesian migrant groups versus native Dutch

Age (years)	Mortality rate ratio [a] (95% confidence interval)			Total # deaths in Indonesians
	1st generation Indonesians	2nd generation Indonesians	Total Indonesians	
Males				
20-39	0.84 (0.56-1.27)	0.96 (0.79-1.16)	0.94 (0.79-1.11)	128
40-64	0.80 (0.75-0.86)	0.84 (0.71-1.01)	0.81 (0.76-0.86)	1045
65+	0.93 (0.90-0.96)	0.61 (0.45-0.84)	0.92 (0.89-0.95)	3420
All ages	0.90 (0.87-0.93)	0.86 (0.77-0.97)	0.90 (0.87-0.92)	4593
Females				
20-39	1.07 (0.71-1.59)	1.18 (0.95-1.47)	1.15 (0.95-1.40)	104
40-64	0.95 (0.88-1.02)	0.99 (0.81-1.21)	0.95 (0.89-1.02)	755
65+	1.04 (1.01-1.07)	0.97 (0.75-1.26)	1.04 (1.01-1.07)	4963
All ages	1.03 (1.01-1.06)	1.06 (0.93-1.20)	1.03 (1.01-1.06)	5822
Males and Females combined				
20-39	0.95 (0.72-1.27)	1.04 (0.90-1.21)	1.02 (0.90-1.17)	232
40-64	0.86 (0.82-0.90)	0.90 (0.79-1.03)	0.86 (0.82-0.90)	1800
65+	1.00 (0.97-1.02)	0.78 (0.64-0.95)	0.99 (0.97-1.01)	8383
All ages	0.97 (0.95-0.99)	0.95 (0.87-1.03)	0.97 (0.95-0.99)	10415

[a] Adj. for age, socioeconomic status and marital status, and where applicable, for sex

Lower mortality risk of Indonesians compared to native Dutch was observed within the lowest socioeconomic group (RR=0.94). This difference was not apparent in the second generation (Table 4.4). As compared to native Dutch with the same marital status, unmarried (RR=0.91) and divorced (RR=0.88) Indonesians displayed a reduced mortality risk and rate. In the category of married and widowed persons there were no mortality differentials between Indonesians and native Dutch.

After adjustment for age, marital status and socioeconomic status, cause-specific inequalities in mortality between Indonesian migrants and native Dutch were substantial (Table 4.5). Indonesians showed slightly higher mortality from cardiovascular diseases (RR=1.06), especially cerebrovascular accidents (RR=1.21), and from diabetes (RR=1.29) and ill-defined conditions (RR=1.27). Indonesians had moderately higher mortality rates for infectious diseases (RR=1.59) and cancer of the uterus (RR=1.81). Much higher mortality among Indonesians was evident for hepatitis (RR=5.84), tuberculosis (RR=3.40), liver cancer (RR=2.35), Hodgkin's disease (RR= 2.87) and asthma (RR=2.75). For many other causes of death, Indonesians proved to have a reduced mortality compared to the native Dutch, including lung cancer (RR=0.68), colorectal cancer (RR=0.84), chronic obstructive respiratory disease (RR=0.80), suicide (RR=0.74) and motor injuries (RR=0.82). Extremely low mortality was observed among Indonesians for stomach cancer (RR=0.37), skin cancer (RR=0.33), oral cancer (RR=0.40) and alcohol-related diseases (RR=0.25).

Table 4.4 Mortality within different socioeconomic and marital status groups: Indonesian migrant groups versus native Dutch

	Mortality rate ratio [a] (95% confidence interval)			Total # deaths in Indonesians
	1st generation Indonesians	2nd generation Indonesians	Total Indonesians	
Socioeconomic status				
- High	0.99 (0.96-1.03)	0.88 (0.76-1.02)	0.98 (0.95-1.02)	3427
- Moderate	0.99 (0.95-1.02)	0.93 (0.79-1.08)	0.98 (0.95-1.02)	3563
- Low	0.94 (0.91-0.97)	1.01 (0.87-1.18)	0.94 (0.91-0.97)	3433
Marital status				
- Unmarried	0.92 (0.86-0.98)	0.89 (0.77-1.02)	0.91 (0.86-0.97)	1192
- Married	0.97 (0.94-1.00)	1.00 (0.88-1.15)	0.97 (0.95-1.01)	4059
- Widowed	1.01 (0.98-1.04)	0.90 (0.66-1.23)	1.01 (0.98-1.04)	3853
- Divorced	0.89 (0.85-0.95)	0.74 (0.58-0.94)	0.88 (0.84-0.93)	1319

[a] Adjusted for age and sex

The Indo-Dutch differences mentioned above were significant for all Indonesians together, and for the first generation migrants separately. Unlike first generation Indonesians, second generation Indonesians had an almost negligible risk of dying from tuberculosis (Table 4.5). The second generation had a lower risk of dying from hepatitis than the first generation, though still higher than the native Dutch did. The second generation also showed more similarity to native Dutch than the first generation in mortality from colorectal cancer (RR=1.00), skin cancer (RR=0.73), stomach cancer (RR=0.65), oral cancer (RR=0.52), suicide (RR=1.07) and asthma (RR=1.30). As compared to first generation Indonesians as well as native Dutch, second generation Indonesians showed higher risks of dying from lung cancer (RR=1.21), liver cancer (RR=3.17) and cancer of the uterus (RR=2.14). Second generation Indonesians were less likely to die from cardiovascular diseases (RR=0.83), such as ischemic heart disease (RR=0.87) and heart failure (RR=0.35), than first generation Indonesians and native Dutch.

Most (about 60 percent) of the Indonesian immigrants came to the Netherlands before 1959 (Table 4.6). Indonesians had a slightly lower risk of dying in every date-of-migration group. The relative mortality risks of Indonesians did not vary much with the date of migration.

Table 4.5 Rate ratios to die for specific cause of death for Indonesians versus Dutch

	Mortality rate ratio [a] (95% confidence interval)			Total # deaths in Indon.
	1st generation Indonesians	2nd generation Indonesians	Total Indonesians	
Infectious	1.56 (1.33-1.83)	1.93 (1.24-3.00)	1.59 (1.37-1.85)	177
- Tuberculosis	3.52 (2.39-5.19)	0.00 (0–)	3.40 (2.31-5.02)	27
- HIV	1.45 (0.81-2.57)	1.54 (0.80-2.99)	1.49 (0.96-2.30)	21
- Hepatitis	6.33 (3.64-11.01)	3.45 (0.84-14.27)	5.84 (3.47-9.84)	16
All cancers	0.79 (0.76-0.82)	1.07 (0.92-1.24)	0.80 (0.77-0.84)	2492
- Stomach	0.36 (0.27-0.47)	0.65 (0.24-1.73)	0.37 (0.28-0.48)	51
- Lung	0.65 (0.60-0.72)	1.21 (0.87-1.67)	0.68 (0.62-0.74)	483
- Breast	1.02 (0.91-1.14)	1.15 (0.81-1.64)	1.03 (0.92-1.15)	315
- Skin	0.26 (0.14-0.48)	0.73 (0.30-1.75)	0.33 (0.20-0.55)	15
- Oral	0.40 (0.26-0.60)	0.52 (0.13-2.07)	0.40 (0.27-0.60)	24
- Liver	2.30 (1.82-2.91)	3.17 (1.31-7.68)	2.35 (1.87-2.94)	78
- Uterus	1.75 (1.25-2.47)	2.14 (1.01-4.54)	1.81 (1.33-2.48)	41
- Colorectal	0.84 (0.74-0.94)	1.00 (0.58-1.72)	0.84 (0.75-0.95)	287
- Hodgkin's d.	2.65 (1.55-4.52)	3.96 (1.46-10.74)	2.87 (1.79-4.61)	18
Cardiovasc	1.07 (1.04-1.10)	0.83 (0.69-1.00)	1.06 (1.03-1.09)	4119
- Ischemic h	1.00 (0.95-1.05)	0.87 (0.65-1.16)	0.99 (0.94-1.04)	1490
- Heart failure	1.07 (0.97-1.17)	0.35 (0.11-1.09)	1.05 (0.96-1.16)	449
- CVA	1.22 (1.15-1.29)	1.04 (0.72-1.50)	1.21 (1.14-1.29)	1134
Diabetes M	1.31 (1.17-1.47)	0.50 (0.19-1.33)	1.29 (1.15-1.44)	321
Respiratory d	0.93 (0.87-0.99)	0.77 (0.48-1.22)	0.92 (0.87-0.98)	957
- Asthma	2.96 (1.76-4.97)	1.30 (0.18-9.33)	2.75 (1.66-4.54)	16
- COPD	0.80 (0.72-0.88)	0.63 (0.28-1.41)	0.80 (0.72-0.88)	400
- Pneumonia/I	1.04 (0.95-1.14)	0.93 (0.50-1.74)	1.04 (0.95-1.14)	480
External c.	0.90 (0.79-1.01)	0.85 (0.68-1.05)	0.88 (0.80-0.98)	354
- Suicide	0.57 (0.43-0.75)	1.07 (0.81-1.40)	0.74 (0.61-0.90)	105
- Homicide	1.32 (0.68-2.57)	1.39 (0.66-2.94)	1.36 (0.83-2.24)	16
- Alcohol	0.29 (0.19-0.45)	0.07 (0.01-0.49)	0.25 (0.16-0.38)	21
- Motor injury	0.98 (0.74-1.31)	0.54 (0.32-0.89)	0.82 (0.64-1.05)	63
Ill-defined c.	1.28 (1.18-1.38)	1.25 (0.91-1.70)	1.27 (1.18-1.38)	632

[a] Adjusted for age, sex, socioeconomic status and marital status.

Table 4.6 Mortality by year of immigration: first generation Indonesians versus native Dutch

Year of immigration	Number of Person years (*1000)	Number of deaths	Mortality rate ratio [a] (95% CI)*
- <1960	326	6,777	0.96 (0.94-0.98)
- 1960-1969	125	1,783	0.99 (0.95-1.04)
- >1969	119	895	0.92 (0.86-0.98)
Total	570	9,455	0.97 (0.95-0.99)

[a] Adjusted for age, sex, socioeconomic status and marital status. Both sexes combined.

4.5 Discussion

Although overall levels of mortality were fairly similar, cause-of-death patterns varied considerably between Indonesians and native Dutch persons. As compared to the native Dutch, the overall mortality risk was only slightly lower for Indonesian men and slightly higher for Indonesian women. Indonesians showed a significantly higher risk of mortality from several major causes of death, such as infectious and cardiovascular diseases, diabetes and ill-defined conditions. Indonesians had a reduced mortality from most neoplasms and external causes. Indonesians showed a lower mortality compared to the native Dutch in the lowest socioeconomic group, and in most marital status groups, especially among unmarried or divorced persons. Date of immigration to the Netherlands was not clearly related to their mortality risks.

The results of this study may have been influenced by some problems with the available data. First, we were not able to account for the ethnic variation within the Indonesian migrant group, which consists mainly of native Indonesians and Moluccans and Chinese. Of these three groups, the Moluccans are known to be least well integrated in Dutch society and to live in concentrated and isolated areas(101, 102). The Moluccans however form a relatively small subgroup of the total number of Indonesian migrants and it is uncertain if their mortality pattern will differ from the native Indonesians(103, 104).

Second, since the cause of most deaths that took place abroad is almost never established, the level of mortality for specific causes of death may have been underestimated. It is unlikely, however, that this would have biased the Indo-Dutch differences in cause-specific mortality, since the relative mortality risk for ill-defined conditions is only slightly elevated among Indonesians (RR=1.27, CI=1.18-1.38). Third, we controlled for socioeconomic status by using an ecological measure, which may render a residual effect of socioeconomic status at the individual level. However, further adjustment for socioeconomic status would probably not influence the results much, because Indonesians show a fairly similar income distribution(105).

In migrant studies, it is important to evaluate the role of health selection upon migration. Favourable health outcomes of migrants are sometimes related to the selective migration of healthy subgroups to the host country. This healthy migrant effect probably does not play an important role among the Indonesian migrants. They did not come to the Netherlands as labourer, and were therefore not selected on the basis of their physical abilities. After the Indonesian War of Independence (1945-1949), every Indonesian person could opt to live in the Netherlands, irrespective of health status(98). Moluccan men might however form a healthier group than native Indonesians, because they had to meet the recruitment criteria of the army. However, this selection effect is probably negligible, because the recruitment took place half a century ago.

Health selection effects are furthermore reported to fade out over time and do not affect the second generation(74). This implies that only the mortality level of a relatively small group of persons who came more recently to the Netherlands might be affected by the healthy migrant effect. However, the relative mortality risk for Indonesians who came to the Netherlands before 1959 was 0.96 (CI 0.94-0.98) versus 0.92 (CI 086-0.98) for Indonesians who arrived after 1970. We therefore conclude that it is unlikely that this selection effect had a large influence on the mortality level of Indonesians.

Selective remigration of a relatively unhealthy sub sample of migrants, leaving behind a relatively healthy migrant population in the host country(14), is unlikely to have much influence on the mortality risks of Indonesians in the Netherlands. In the Netherlands, remigration is a relatively rare event among Indonesians in the Netherlands and it can therefore not have had a strong influence on our results.

All cause mortality of Indonesians was similar to that of the native Dutch, even after stratification into age groups, marital status groups and socioeconomic status groups. This is in contrast to the widely differing mortality levels between other migrant groups in the Netherlands and the native Dutch(88). Mere coincidence is therefore not probable and the similar levels of all cause mortality most likely bear some relationship with the high degree of integration of Indonesians within Dutch society. The income levels of Indonesians are similar to that of the native Dutch; and they are equally often employed by the government, or in service sectors such as education or health care(100). On arrival in the Netherlands in the post-war era, Indonesians were initially discriminated against, but as they proved to adjust to the Dutch way of life quite smoothly, they soon became known as a success story of migrant integration (106-111). Nowadays discrimination of Indonesians is rare and may not add much to the stress load of Indonesians. The attitude of the Dutch towards foreign-born persons is strongly related to background characteristics, such as educational level and paid employment(112), and which are favourable for those born in Indonesia. In addition, the opinion of Dutch are generally more negative about 'true' foreigners than about persons originating from the former colonies, such as Surinamese(113) and probably Indonesians as well. In addition, Indonesians experience

few linguistic or cultural barriers. It is therefore unlikely that Indonesians face greater difficulties than the native Dutch in the use of health care or other services.

Indonesians have lower risks of dying from neoplasms, such as of the gastrointestinal tract, and lung cancer (Table 4.5). Health-related behaviour may have played a role. As compared to native Dutch, Indonesians have a healthier diet with less fat, and more vegetarian dishes (using tempe and tahoe), rice and fruit(114). Indonesians probably have lower prevalences of excessive tobacco and alcohol use. This is suggested by the lower mortality risks from cancers of the gastrointestinal tract, and alcohol-related deaths. Less excessive alcohol use among Indonesians could also explain their lower mortality rates from motor vehicle injuries.

Additional explanations for reduced mortality from for example alcohol-related deaths and suicide could be found in their social environment. Indonesians have a stronger social support and control system compared to the native Dutch. Religion plays a more prominent role for Indonesians than for native Dutch(115, 116). Higher levels of social and moral support might explain why the survival advantage of Indonesians compared to the native Dutch is largest within the lowest socioeconomic group, and within the group of unmarried and divorced persons.

Genetic differences might also explain part of the higher mortality from diabetes mellitus and cardiovascular disease among Indonesians(117-122). British studies described higher mortality from cardiovascular disease and diabetes for South Asian immigrants, and suggested that it may be due to higher insulin resistance and smaller diameters of coronary arteries(2, 123-127). Even if the higher mortality risk of diabetes and cardiovascular disease among Indonesians was partly due to genetic predisposition, the mortality risks for these diseases are only slightly elevated. Explanations in term of genetics are not supported by our finding that second generation Indonesian migrants have lower (instead of higher) mortality from cardiovascular disease , as compared to the native Dutch.

Poor living conditions in early life might have contributed to the higher mortality risks for some specific diseases. Infection rates for hepatitis B and tuberculosis are relatively high in Indonesia, and acquired infections may remain present for a lifetime(128, 129). For first generation Indonesians this could explain the higher mortality risks from infections and consequently for liver cancer, since hepatitis B-infection is associated with liver cancer(130-134). The second generation grew up in the Netherlands and, as expected, have lower risk of mortality from hepatitis than the first generation. The fact that they do have a higher risk of mortality from hepatitis than the native Dutch, might be due to vertical transmission between mother and child of hepatitis infection.

4.6 Conclusion

Although Indonesians have similar levels of overall mortality, cause-specific mortality patterns vary considerably between Indonesians and native Dutch persons. The similar levels in all cause mortality coincide with a high degree of integration of Indonesians within

Dutch society. The differences in cause-of-death rates and patterns may be due to persisting and often favourable influences of the country of origin on their social environment and health-related behaviours such as diet and drinking. Poorer living conditions in early life may however have contributed to excess mortality from some specific diseases. Thus, even though Indonesian migrants have achieved virtually the same chances of survival as native Dutch, their country of origin still influences the causes of death from which these persons will die.

5

Immigrant Mortality by Duration of Residence: The Role of the Healthy Migrant Effect and Acculturation

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Submitted

Abstract

Objective By examining immigrant mortality by duration of residence in the Netherlands and comparing this to levels of mortality in the native Dutch population, we aimed to contribute to the explanation of ethnic inequalities in mortality

Study design and setting For the years 1995 to 2000, we linked the national cause of death register, that contains information on deaths of legal residents, to the municipal population register, that contains information on all legal residents. We studied mortality in relation to period of immigration by means of directly standardised mortality rates and Poisson regression.

Results All cause mortality was not related to year of immigration among Turkish and Moroccan men and women, and among Surinamese women. Among Surinamese men and among Antilleans/Aruban men and women, mortality was higher in more recent immigrants. Part of their excess mortality was due to their relatively low socioeconomic status. For most specific causes of death, no consistent relation with duration of residence was observed.

Conclusion A consistent relation between duration of residence and immigrant mortality was only observed in some immigrant groups. The results suggest that the healthy migrant effect or adoption of health-related behaviours were no predominant determinants of immigrant mortality in the Netherlands.

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5.1 Introduction

The comparison of cancer, coronary heart disease and stroke of Japanese men living in Japan, Hawaii and California has shown that a change in environment and related behaviour may alter susceptibility to disease(135-139). The higher incidence of coronary heart disease in Japanese American men was accounted for by changes in the coronary risk profiles (systolic blood pressure, serum cholesterol, relative weight and age)(137) and this finding has strongly established the presumption that, with increasing duration of residence in the country of destination, migrant mortality converges towards the level that is observed in the host population.

Data needed to perform studies of immigrant mortality in relation to duration of residence in the country of destination are scarce and, hence, the assumption that immigrant mortality converges towards the national rates in the host country is only occasionally verified. Examination of the results that are available has shown that immigrant mortality in the host country does not conform to a single pattern of convergence to the national rates. Rather, patterns are complex and disease- and site-specific(66, 140-143).

Studies of immigrant mortality according to duration of residence can give insight in the relative importance of acculturation and health selection processes on migrant mortality patterns. In immigrant groups with a relatively high mortality, a decrease in mortality with increasing duration of residence suggests that acculturation has taken place. The level of mortality has than developed towards the level of mortality of the host population, which can be due to adaptation of behaviour that is common among the host population. An increase in mortality with increasing duration of residence would on the other hand suggest that health selection has taken place. Such a healthy migrant effect would lead to a health advantage among recent immigrants. This advantage becomes smaller with increasing duration of residence, resulting in a higher mortality among those with a long duration of residence.

We studied mortality from all causes, neoplasms, cardiovascular diseases and external causes for Moroccan, Turkish, Surinamese en Antillean/Aruban immigrants living in the Netherlands. We examined whether mortality in immigrants with long duration of residence in the Netherlands was more similar to that of the native Dutch population than in immigrants with shorter duration of residence.

The study of the Dutch situation has a number of attractive aspects. In the Netherlands, most types of immigration that are common within Europe are represented. Turkish and Moroccan immigrants came to the Netherlands as migrant labourers in the 1960s and for the purpose of family reunion and family formation in later years. The immigration of the Surinamese population is mainly related to the political developments within Surinam. The Dutch Antilles and Aruba are still part of the Netherlands. The immigration of Antilleans/Arubans has, over time, shifted from students to more lowly educated persons, but has, in contrast to immigration from other countries, hardly been restricted in the more recent years. An advantage of the Dutch data is that both groups

with above average mortality (Turkish, Surinamese and Antilleans/Arubans) and groups with below average mortality (Moroccans) compared to the native population reside in the Netherlands(88). Furthermore, in the Netherlands, the death registry could be linked to the population registers on personal identification number. The source of information of demographic characteristics of the study population was therefore the same for people who died as for people who did not die. The Dutch data cover all registered inhabitants and include information on mean neighbourhood income, marital status, region and degree of urbanisation. Mortality of immigrants living in the Netherlands by their year of immigration has not been described previously.

5.2 Data

We used data for the years 1995 through 2000. By means of personal identification numbers, we linked data from the cause of death registry to data of the municipal population registers (GBA). The cause of death register contained information on all deaths of legal residents, including deaths that occurred outside the Netherlands. The causes of death were coded according to the ICD-9 in 1995, and according to ICD-10 in 1996-2000. Total mortality and mortality from neoplasms (ICD-9: 140 – 239; ICD-10: C00 - D48), cardiovascular diseases (ICD-9: 390 – 459; ICD-10: I00 - I99) and external causes (ICD-9: E800 - E999; ICD-10: V01- Y89) was studied. Of deaths that took place abroad, the cause is almost never established. Mortality abroad was not systematically relation to year of immigration.

All people who legally resided in the Netherlands between 1995-2000 are included in the study. Persons were also allowed to enter the study throughout the study period (open cohort design). For each inhabitant, the amount of person time was calculated. Year of immigration was established on the basis of the latest known date of immigration into the Netherlands. If a person immigrated to the Netherlands, emigrated consecutively, and immigrated again to the Netherlands, the most recent date of immigration determined year of immigration. We classified year of immigration in such manner that there was a substantive variation in duration of residence between groups (prior to 1980, 1980-89 and 1990 or later) while maintaining sufficiently large numbers in each group. Information on year of immigration was in less than 1% of cases unknown. People who emigrated between 1995 and 2000 were censored. People who emigrated before the start of the study were not included in the study.

We used country of birth to approximate ethnicity. A person was categorised as non-native if he or she was born abroad. On the basis of age at mid-year, person years were allocated to five-year age-categories. We excluded people younger than 30, people older than 75 and second generations because they were not represented in all immigration periods. All data were tabulated according to sex, date of birth, date of immigration (if applicable), country of origin, 6-digit postal code, and marital status (unmarried, married, widowed or divorced).

On the basis of 6-digit postcodes we linked information on all neighbourhoods in the Netherlands. This included region (West, East, South and North), degree of urbanisation (address-density per square kilometre, five categories) and mean household equivalent income (classified into the 10 deciles for the total population). Although mean household equivalent income is an ecological measure, it can be used to demonstrate socioeconomic differences in mortality(64).

5.3 Statistical Analysis

By means of Poisson regression analyses we estimated mortality differences between immigrant cohorts. We estimated the mortality of persons who migrated to the Netherlands between 1980 and 1989 and persons who migrated from 1990 onwards relative to the mortality of persons who migrated to the Netherlands before 1980 (using Stata version 7). We related the number of deaths to numbers of person years as offset variable, and year of immigration-group as independent variable. All mortality rate ratios were adjusted for age (5-year age groups) and sex. Because age and duration of stay are closely related, we stratified all analyses by 15 years age group (30-44 years, 45-59 years and 60-74 years, not all results shown). Marital status, mean household equivalent income, region and degree of urbanisation were considered as possible confounders and/or intermediate variables and regression analyses were carried out with and without adjustment for differences in these variables.

In order to be able to compare levels of mortality in migrant cohorts with levels of mortality among native Dutch we calculated directly standardised mortality rates. We used the total of the studied migrant populations as a standard population. Mortality rates of the native Dutch were subtracted from mortality rates in immigrant cohorts, resulting in mortality differences between immigrants and the native Dutch population according to year of immigration.

We carried out analyses for mortality from all causes, neoplasms, cardiovascular diseases and external causes.

5.4 Results

Compared to immigrants who were long-term residents of the Netherlands, more recent immigrants lived more often in neighbourhoods with a low mean socioeconomic status, in the Western part of the country and in highly urbanised areas. They were also more often single (Table 5.1).

Table 5.1 Mortality rate ratios for migrants with short versus longer duration of residence: effect of adjustment for socioeconomic status, marital status and region/degree of urbanisation (Age: 30-74)

Country of origin	Year of immigration	% of population			RR (95 % CI) adjusted for age, sex and...				
		single	in low income area	in urban area	no other variables	socioeconomic status	marital status	region and degree of urbanisation	all variables
Turkey	<1980	1	59	46	1.00	1.00	1.00	1.00	1.00
	1980-89	2	59	46	1.05 (0.92-1.19)	1.00 (0.87-1.16)	1.04 (0.92-1.18)	1.05 (0.93-1.20)	1.00 (0.86-1.14)
	>1989	7	60	52	0.92 (0.78-1.07)	0.90 (0.76-1.06)	0.87 (0.74-1.02)	0.91 (0.78-1.07)	0.84 (0.71-1.00)
Morocco	<1980	2	54	49	1.00	1.00	1.00	1.00	1.00
	1980-89	1	57	54	0.99 (0.84-1.16)	0.95 (0.80-1.13)	0.98 (0.83-1.15)	0.99 (0.84-1.16)	0.94 (0.79-1.12)
	>1989	7	64	63	1.07 (0.87-1.30)	1.02 (0.82-1.27)	0.97 (0.80-1.19)	1.07 (0.88-1.31)	0.91 (0.73-1.14)
Surinam	<1980	28	47	58	1.00	1.00	1.00	1.00	1.00
	1980-89	23	55	62	1.04 (0.95-1.14)	0.97 (0.88-1.07)	1.03 (0.94-1.13)	1.02 (0.93-1.12)	0.98 (0.89-1.08)
	>1989	33	61	69	1.12 (1.02-1.24)	1.05 (0.95-1.17)	1.10 (1.00-1.21)	1.11 (1.00-1.22)	1.05 (0.94-1.16)
Antilles	<1980	17	46	58	1.00	1.00	1.00	1.00	1.00
Aruba	1980-89	14	56	64	1.18 (0.97-1.44)	1.08 (0.86-1.34)	1.16 (0.95-1.42)	1.16 (0.95-1.42)	1.08 (0.87-1.35)
	>1989	19	69	70	1.41 (1.17-1.72)	1.31 (1.06-1.63)	1.37 (1.12-1.66)	1.36 (1.12-1.66)	1.30 (1.05-1.62)
Netherlands	n.a.	8	15	14	n.a.	n.a.	n.a.	n.a.	n.a.

Table 5.2 Mortality rate ratios for migrants with short versus longer duration of residence: distinction by age

Country of origin	Year of immi-gration	30-44				45-59				60-74				30-74			
		PY[a]	D[b]	RR	(95% CI)	PY[a]	D[b]	RR	(95% CI)	PY[a]	D[b]	RR	(95% CI)	PY[a]	D[b]	RR	(95% CI)
Turkey	<1980	154	166	1.00		129	674	1.00		39	657	1.00		323	1497	1.00	
	1980-89	150	155	1.05	(0.84-1.31)	29	111	1.12	(0.90-1.38)	6	76	0.97	(0.75-1.24)	185	342	1.05	(0.92-1.19)
	>1989	77	72	0.88	(0.66-1.16)	15	52	0.93	(0.70-1.24)	4	66	0.95	(0.73-1.23)	96	190	0.92	(0.78-1.07)
Morocco	<1980	80	80	1.00		101	340	1.00		31	386	1.00		212	806	1.00	
	1980-89	115	94	0.90	(0.66-1.21)	37	92	1.00	(0.77-1.30)	7	69	1.01	(0.75-1.36)	159	255	0.99	(0.84-1.16)
	>1989	86	65	0.83	(0.59-1.16)	12	37	1.18	(0.83-1.68)	2	37	1.32	(0.92-1.89)	100	139	1.07	(0.87-1.30)
Surinam	<1980	249	425	1.00		157	785	1.00		49	966	1.00		455	2176	1.00	
	1980-89	116	141	0.78	(0.64-0.94)	34	179	1.13	(0.96-1.33)	12	272	1.13	(0.98-1.29)	162	592	1.04	(0.95-1.14)
	>1989	87	119	0.85	(0.70-1.04)	25	159	1.25	(1.05-1.48)	10	231	1.19	(1.03-1.38)	122	509	1.12	(1.02-1.24)
Antilles/ Aruba	<1980	23	25	1.00		25	118	1.00		5	63	1.00		54	206	1.00	
	1980-89	53	74	1.51	(0.95-2.39)	14	56	0.96	(0.70-1.33)	4	70	1.38	(0.98-1.94)	71	200	1.18	(0.97-1.44)
	>1989	41	79	2.03	(1.28-3.20)	13	77	1.33	(1.00-1.78)	4	65	1.29	(0.91-1.83)	58	221	1.41	(1.17-1.72)

[a] Number of Person Years *1000

[b] Number of deaths

Table 5.3 Mortality rate ratios for migrants with shorter versus longer duration of residence: distinction by sex (Age: 30-74)

Country of origin	Year of immigration	Men				Women			
		PY[a]	D[b]	RR	(95% CI)	PY[a]	D[b]	RR	(95% CI)
Turkey	<1980	190	1176	1.00		133	321	1.00	
	1980-89	90	203	1.17	(0.99-1.39)	95	139	0.91	(0.74-1.11)
	>1989	60	120	0.88	(0.73-1.08)	36	70	1.00	(0.77-1.30)
Morocco	<1980	147	670	1.00		65	136	1.00	
	1980-89	71	114	1.07	(0.86-1.34)	88	141	0.88	(0.69-1.11)
	>1989	64	87	1.09	(0.84-1.41)	36	52	0.98	(0.71-1.36)
Surinam	<1980	213	1307	1.00		242	869	1.00	
	1980-89	70	332	1.04	(0.93-1.18)	93	260	1.03	(0.89-1.18)
	>1989	61	340	1.22	(1.08-1.38)	62	169	0.97	(0.82-1.14)
Antilles/ Aruba	<1980	26	131	1.00		27	75	1.00	
	1980-89	32	92	1.00	(0.76-1.32)	38	108	1.40	(1.03-1.89)
	>1989	29	135	1.52	(1.19-1.95)	30	86	1.27	(0.93-1.74)

[a] Number of Person Years *1000

[b] Number of Deaths

All cause mortality of Turkish and Moroccans did not systematically vary according to year of immigration into the Netherlands (Table 5.1). But after adjustment for differences in socioeconomic status, marital status, region and degree of urbanisation, Turkish who arrived in the Netherlands in the 1990s had a lower mortality than those who migrated before 1980. In Surinamese and Antilleans/Arubans, all cause mortality was significantly higher among those who immigrated in the 1990s than among those who immigrated before the 1980's. This excess mortality decreased upon adjustment for differences in socioeconomic status. Upon adjustment for all variables, the excess mortality among recently immigrated Antillean/Aruban remained still significant.

The relation between mortality and year of immigration varied somewhat between different age groups (Table 5.2). The excess mortality among more recently arrived Surinamese was not observed in those aged 30-44, while the excess mortality among recently arrived Antilleans/Arubans was more pronounced in those aged 30-44 than in those older that were older than 44.

The relation between all cause mortality and year of immigration also varied somewhat between men and women (Table 5.3). The elevated mortality among Surinamese and Antilleans/Arubans who immigrated in the 1990s was only observed

among men and not among women. Among Surinamese (and Turkish and Moroccan) women all cause mortality did not vary much by year of immigration, whereas among Antillean/Aruban women all cause mortality was significantly higher among those who immigrated in the 1980s.

Mortality from neoplasms was elevated in Turkish who immigrated in the 1980s (especially in males, results not shown) but was not clearly related to duration of residence in the other immigrant groups (Table 5.4). Cardiovascular mortality was in general not clearly related to duration of residence in the Netherlands, but was reduced in Turkish immigrants who arrived relatively recently and was elevated in Surinamese women who arrived in the 1980s (results not shown). Mortality from external causes was elevated in Turkish who immigrated in the 1980s and among Antilleans/Arubans who immigrated to the Netherlands in the 1990s, but did not vary by year of immigration among Moroccans and Surinamese.

Table 5.4 Mortality rate ratios for migrants with shorter versus longer duration of residence: distinction by cause of death (Age: 30-74)

Country of origin	Year of immigration	Neoplasms		Cardiovascular diseases		External causes	
		D[a]	RR (95% CI)	D[a]	RR (95% CI)	D[a]	RR (95% CI)
Turkey	<1980	341	1.00	401	1.00	62	1.00
	1980-89	94	1.35 (1.05-1.73)	76	1.07 (0.82-1.39)	53	1.66 (1.11-2.50)
	>1989	43	1.00 (0.72-1.39)	33	0.66 (0.46-0.95)	26	1.33 (0.82-2.16)
Morocco	<1980	209	1.00	191	1.00	54	1.00
	1980-89	60	0.86 (0.62-1.19)	52	0.99 (0.70-1.40)	25	0.63 (0.38-1.06)
	>1989	34	1.00 (0.68-1.50)	24	1.11 (0.71-1.75)	22	0.71 (0.41-1.23)
Surinam	<1980	463	1.00	739	1.00	196	1.00
	1980-89	100	0.83 (0.66-1.03)	205	1.12 (0.96-1.31)	51	0.77(0.56-1.05)
	>1989	87	0.92 (0.73-1.16)	137	0.94 (0.78-1.12)	43	0.79 (0.56-1.11)
Antilles/ Aruba	<1980	80	1.00	54	1.00	19	1.00
	1980-89	45	0.77 (0.53-1.11)	51	1.24 (0.84-1.84)	26	1.07 (0.57-1.98)
	>1989	56	1.00 (0.71-1.42)	41	1.06 (0.70-1.60)	41	1.97 (1.11-3.48)

[a] Number of deaths

Figures 5.1a to 5.1d represent differences in all and cause-specific mortality rates between native Dutch and immigrant cohorts. They can be used to determine whether mortality of immigrants with longer duration of residence is more similar to that of the native Dutch population than mortality of immigrants with shorter duration of residence. This was indeed

observed among Surinamese and Antilleans/Arubans; levels of mortality among those with longer duration of residence were closer to that of the native Dutch population than among those with shorter duration of residence. This was not found among Turkish and Moroccans. In these groups, no systematic relation between duration of residence and mortality was observed. Mortality from neoplasms was lower in all ethnic minorities than in the native Dutch, but was not closer to that of native Dutch among migrants with longer duration of residence. Likewise, mortality from cardiovascular diseases and external causes was also not more similar to that of Dutch among those with a long duration of residence.

5.5 Discussion

All cause mortality was not related to year of immigration among Turkish and Moroccan men and women, and among Surinamese women. Among Surinamese men and in Antilleans/Aruban men and women, mortality was higher in more recent immigrants. Part of their excess mortality was due to their relatively low socioeconomic status. For most specific causes of death, no consistent relation with duration of residence was observed.

Limitations

Elsewhere(88) we discussed the influence of factors as the inability to address ethnic variations within migrant groups, the unknown cause of most deaths that take place abroad and the use of an ecological measure of socioeconomic status. Here we discuss factors that specifically apply to the relation between year of immigration and mortality. First, this was a cross-sectional study comparing persons that emigrated in different time periods and that were still living in the Netherlands between 1995 and 2000. Because emigration cohorts differ on more aspects than duration of residence, this brings about problems of confounding. We have addressed this problem by limiting our study population to persons aged 30-74 years, by stratifying our results by age and by studying the effect of adjustment for a number of factors (mean neighbourhood socioeconomic status, marital status, degree of urbanisation and region). Despite these measures, residual confounding is likely to remain present. This problem limited our possibilities to explain our results in terms of convergence over time. Second, the size of the population groups was too small to perform more detailed cause of death specific analyses and our analyses may therefore have been unable to detect relations between year of immigration and single causes of death. Third, due to a lack of reliable information on cause-specific mortality in the countries of origin, we were unable to evaluate whether the level of mortality of migrants diverged from levels of mortality in the country of origin.

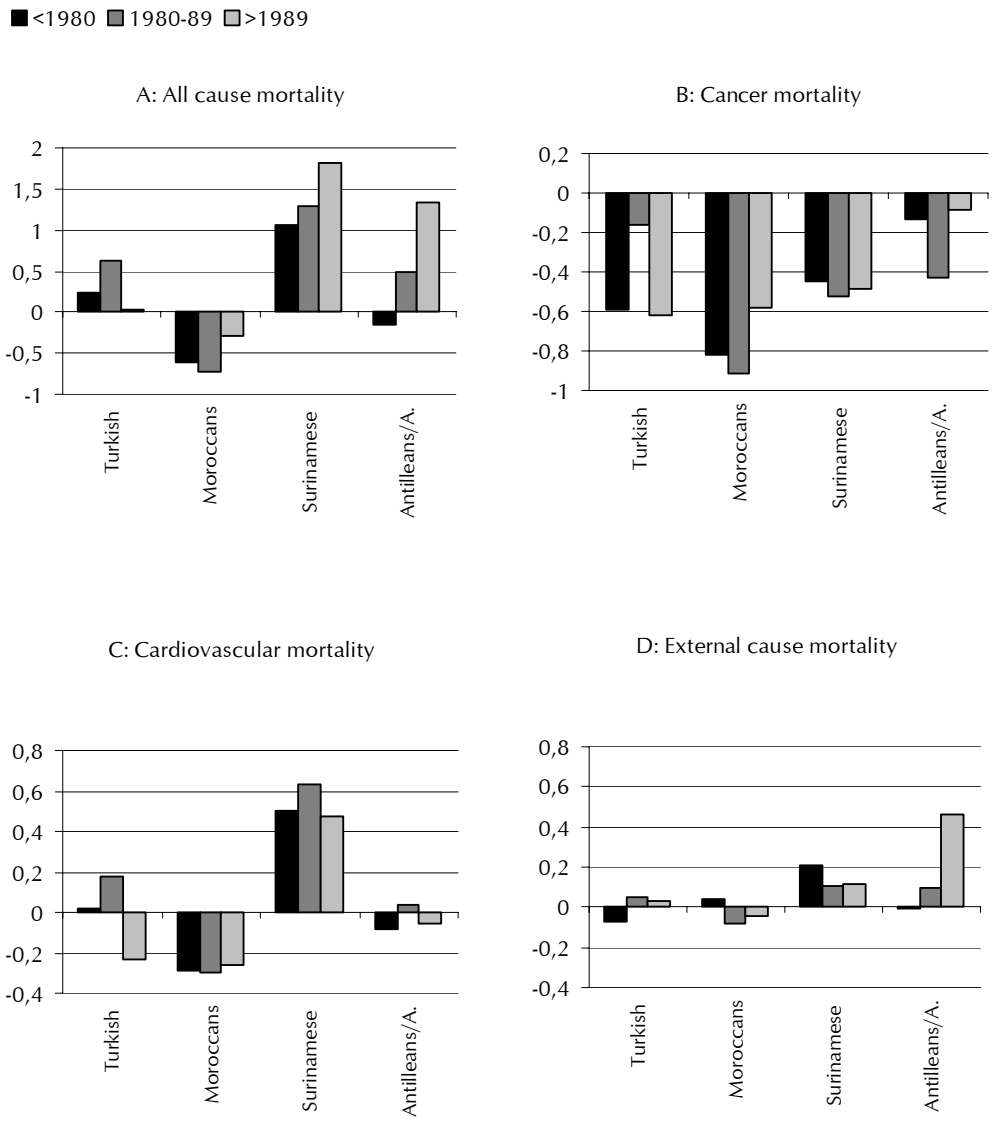

Figure 5.1 Difference in mortality between native Dutch and immigrants by year of immigration: men and women combined, age 30-74

Comparison to other studies

Studies that report on the relation between immigrant mortality and year of immigration/duration of residence show a mixed picture. In some studies a convergence towards the national rates is observed. Cancer mortality for example, is usually relatively low in ethnic minority populations, and is often reported to converge towards the national levels of cancer mortality with increasing duration of residence(140, 141, 143-146). Other studies only report that mortality increased or decreased with increasing duration of residence, but do not compare these trends with levels of mortality in the population in the host country(141) (142). In other studies, no clear relation between immigrant mortality and duration of residence is found(66) (140). The observation that cancer mortality converges towards the national rates was not confirmed in the present study, but the main conclusion of this study, that a relation between duration of residence and immigrant mortality is only observed in some ethnic groups, is not contradictory to what is found in other studies.

Explanation of results

We hypothesised that mortality of immigrants with long duration of residence in the Netherlands was more similar to that of the native Dutch population than that of immigrants who arrived more recently. This was expected on the basis of the assumption that changes in environment and related behaviour play an important role in the development of chronic disease and that behaviour changes as a consequence of a change in environment. With increasing duration of residence, immigrants may adapt their behaviour increasingly more to that of the host country. Our hypothesis was not consistently supported by our results.

An explanation may be that, with increasing duration of residence in the Netherlands, immigrants did not adopt health-related behaviours that are common among the Dutch population. Berry posed that culture change, resulting from continuous firsthand contact between two cultures, can take four distinct forms (separation, marginalisation, assimilation and integration). Only two of these (assimilation and integration) would lead to adoption of behaviour that is common in the host country(147). Our results suggest that Turkish and Moroccans in the Netherlands have not adopted various aspects of health-related behaviour of the native Dutch, while Surinamese and Antilleans/Arubans did. Unfortunately, no information on health-related behaviour by year of immigration is available for ethnic minorities living in the Netherlands and thus, we were unable to verify this suggestion.

It is known, however, that Turkish and Moroccans are, in a social-cultural sense (attitudes about religion and social roles, informal contact with native Dutch, language use), less well integrated into Dutch society than Surinamese and Antilleans/Arubans are and that Surinamese and Antilleans/Arubans who immigrated before 1980 are better integrated than those who arrived later(148). If this social-cultural integration is regarded as a proxy of attitudes and behaviours that are more directly related to health, this suggests

that Turkish and Moroccans who already live for a long time in the Netherlands have to a lesser extent adopted behaviours that are common in the Netherlands than Surinamese and Antilleans/Arubans with long duration of residence in the Netherlands did.

From the onset on, the socioeconomic position of Turkish and Moroccans in the Netherlands has been lower than that of Surinamese and Antilleans/Arubans. Surinamese and Antilleans/Arubans with a longer duration of residence in the Netherlands have a relatively high socioeconomic status. This is not so much due to improvement of their socioeconomic position during their stay in the Netherlands, but rather to the socioeconomic status they had before leaving their own country(148). Recently immigrated people from Surinam and the Dutch Antilles and Aruba have a relatively low socioeconomic position and an elevated mortality. Cause of death specific analyses showed that, among Antillean/Aruban men, this elevated mortality among the latter immigrants is partly due to a higher mortality of external causes, and more specifically, to a very high homicide mortality (results not shown). Antillean/Aruban men in the Netherlands also have high detention rates and criminal justice records. It seems that many problems are concentrated among the more recently arrived Antilleans/Arubans.

A low mortality of ethnic minority populations is sometimes attributed to the selective emigration of a relatively healthy sub-sample of the population of the country of origin ('the healthy migrant effect'). Because health selection effects are reported to wean out over time(74), analyses by duration of residence enable us to examine to what extent health selection influences levels of immigrant mortality. The healthy migrant effect would be supported by an increasing mortality with increasing duration of residence in the country of destination. This study showed, however, stable or decreasing mortality with increasing duration of residence. Although levels of mortality of the more recently immigrated may have been higher without health selection effects, the results of this study suggest that the healthy migrant effect is not of major importance for the explanation of patterns of mortality among migrant populations.

Immigrant mortality may also be influenced by the selective remigration of relatively (un)healthy or (un)successful immigrants. If the strength of the selection effect varied between cohorts or if emigration did not occur to the same extent in all cohorts, this may have influenced the results. About 20% of the Surinamese and Moroccan population, about 30% of the Turkish population and about 40% of the Antillean/Aruban population who immigrated between 1972 and 1995 have left the Netherlands again prior to 1995(29). The health or socioeconomic status of people who remigrated prior to 1995 is unknown and may have been better or worse than that of people who remained in the Netherlands. In qualitative research among Turkish people remigrating to Germany it was found that some had returned to Turkey because of poor health, but also, that in case of severe disease, the better health facilities and the social security system in Germany would be reasons to remain in Germany. Remigration of Turkish to Germany was rarely based on purely economic or health-related motives, value-oriented and emotional themes almost

always played a role(149). This makes it is difficult to make assumptions on the direction in which remigration has been selective and on the effects it may have had on the results.

Because the Antilles and Aruba are still part of the Netherlands, immigration of Antilleans and Arubans is not restricted by immigration policy. The elevated mortality among more recently immigrated Antilleans/Arubans might therefore partly be attributed to immigration because of medical reasons. Because immigration policy is stricter in the other studied groups, selective immigration of people with ill health is less likely to occur in the other groups.

Policy implications

This study has shown that immigrant mortality does vary by year of immigration but not in a uniform way. This study has nonetheless shown that in some cases, it might be worth the effort to differentiate public health interventions between immigration cohorts. Interventions aimed at lowering the excess mortality among Antillean/Aruban men should, for example, be directed to Antillean/Aruban men who arrived relatively recently to the Netherlands. Specific attention should be directed to lowering the homicide mortality in this group.

Conclusions

A consistent relation between duration of residence and immigrant mortality was only observed in some immigrant groups. Variations in mortality by year of immigration were in part related to variations in socioeconomic status between immigrant cohorts. The results suggest that adaptation of health-related behaviours of the host population and the healthy migrant effect were no predominant determinants of immigrant mortality in the Netherlands.

6

Ethnic Inequalities in Avoidable Mortality: Role of the Healthcare System

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Submitted

Abstract

Background The role of the healthcare system in mortality rates variations for ethnic minorities as compared to the native population can be explored by examining ethnic differences in 'avoidable' mortality.

Objective This study investigates the association between the level of mortality from 'avoidable' causes and ethnic origin in the Netherlands and to identify social factors that contribute to this association.

Data Data were obtained from cause of death and population registries in the period 1995-2000.

Methods We compared mortality rates for selected 'avoidable' conditions for Turkish, Moroccan, Surinamese and Antillean/Aruban groups to native Dutch.

Results We found slightly elevated risk in total 'avoidable' mortality for ethnic minorities (RR=1.13). Higher risks of death for ethnic minorities were observed from almost all infectious diseases (most RR > 3.00) and several chronic conditions including asthma, diabetes, cholecystitis/lithiasis and cerebrovascular disorders (most RR > 1.70). Ethnic minority women experienced a higher risk of death from maternity-related conditions (RR=3.37). Surinamese and Antillean/Aruban population had a higher risk of death (RR=1.65 and 1.31 respectively), while Turkish and Moroccans experienced a lower risk of death (RR=0.93 and 0.77 respectively) from 'avoidable' conditions compared to native Dutch. Control for demographic and socioeconomic factors explained a substantial part of ethnic differences in 'avoidable' mortality. Recent immigrants had higher risks of death from infectious diseases (RR=1.62), but lower risk from suicides (RR=0.68) compared to those who resided longer than 15 years in the Netherlands.

Conclusion Compared to the native Dutch population, total 'avoidable' mortality was slightly elevated for the ethnic minority groups combined. Risks of death varied greatly by cause of death and ethnic origin. We could not find compelling evidence that the general characteristics of the healthcare system drive ethnic inequalities in mortality outcomes. Nevertheless, the substantial differences in mortality suggest opportunities for improvement within specific areas of the healthcare system targeted to disadvantaged groups.

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6. 1 Introduction

One of the factors described in the literature that influences mortality rates in developed countries is ethnic origin(150). For some ethnic minority groups a higher mortality is observed, while others benefit from lower mortality rates compared to native population(151, 152). Factors like socioeconomic status, the healthy migrant effect, and lifestyle risk factors were shown to partly explain the differences in levels of mortality among ethnic minority groups and the native population(153, 154). However, they do not explain the full variation in mortality outcomes.

Some researchers suggested that the healthcare system might influence mortality outcomes for ethnic minorities. Unequal access opportunities and sub optimal quality of services were suggested in some studies to have contributed to ethnic disparities in mortality(47, 48, 155). Learning more about these factors will enable health authorities to adjust the healthcare system in ways that would reduce ethnic inequalities in health.

The contribution of the healthcare system to ethnic differences in mortality could be explored by investigating 'avoidable' mortality levels(156-159). A cause of death is considered avoidable if effective measures exist (by applying appropriate treatment procedures on time) to prolong the life of the patient(159). Previous researches showed that mortality from 'avoidable' causes has significantly declined in the past decades in many countries(160-163) most likely due to the increased effectiveness of the healthcare services. However, the ethnic gap continues to remain(164-166). An overview covering a broad range of conditions would allow pinpointing important potential problems in the delivery of health services to ethnic minorities.

In the Netherlands, where total mortality was found to be higher for most minority groups compared to the native Dutch population(16, 88) differences in avoidable mortality between ethnic groups have not been documented. Thus, this study is the first to investigate the association between avoidable mortality and ethnic origin of the population in the Netherlands. We also analyse the role of socioeconomic and demographic factors in this association and the influence of the duration of residence in the Netherlands on the risk of death from 'avoidable' conditions. Based on the results we will reflect on the extent to which ethnic inequalities in mortality in the Netherlands could be attributed to the specific problems in the Dutch healthcare system.

6.2 Data

The population studied comprised all inhabitants who legally resided in the Netherlands in the period 1995-2000. Data on death and population for the period 1995-2000 were obtained from the cause of death register and the Municipal Population Register that includes all inhabitants of the Netherlands with a legal status. The data included information on sex, age, ethnicity, marital status, socioeconomic status (estimated using

mean household equivalent income of the neighbourhoods(64), region of residence, and urbanisation degree.

Country of birth of the person and both parents was used to measure ethnicity, according to the definition used by Statistics Netherlands. If at least one parent was born abroad, the person was considered to be of non-Dutch origin. In mixed ethnic families, the country of birth of the mother prevailed(29). We compared death rates of the four largest ethnic minority groups residing in the Netherlands (Turkish, Moroccan, Surinamese and Antillean/Aruban) to native Dutch.

Selection of 'avoidable' conditions

Our selection of conditions considered avoidable was based on the original list of Rutstein et al further enlarged by Tobias and Jackson(165). We concentrated on the role of the curative medical services, i.e. secondary and tertiary levels of care. Therefore, we excluded conditions, outcome of which depend in more than 80% on primary prevention, and for which curative medical care is able to play only a very limited role to avoid death. The contribution of primary, secondary and tertiary levels of care for each disease was previously estimated by Tobias and Jackson(165). As a result, all types of injuries, smoking and alcohol-related conditions, and skin cancer were excluded from the analysis.

All causes of death were coded according to International Classification of the Diseases (ICD), ninth revision for the year 1995 and ICD 10th revision for the period 1996-2000. Although there is some variability in the codes between ICD revisions, the changes were not judged large enough to affect comparability over time.

All conditions were grouped into 5 subcategories depending on the type of medical service required: conditions with infectious origin, suicides, malignant neoplasms, other acute and chronic diseases, and conditions related to maternity and neonatal period (Table 2). Following Tobias and Jackson(165), the age limit 0-74 was chosen for the analysis.

6.3 Analysis

Mortality levels in each population group were estimated using age-standardised mortality rates. The direct method was used with the four-studied minority groups combined as a standard population.

The size of the difference in avoidable mortality rates between ethnic minorities and Dutch population was calculated using Poisson regression (in Stata software, version 7). All mortality rate ratios were adjusted for age and sex when both sexes were investigated together. Additional adjustment for marital status, urbanisation level, and socioeconomic status was performed separately.

To estimate the role of the duration of residence, an additional regression analysis was performed determining the risk of mortality for recent immigrants as compared to those that arrived to the Netherlands more than 15 years ago.

6.4 Results

The native Dutch population contributed the most person time and the largest amount of avoidable' deaths for the analysis (Table 6.1). Turkish, Moroccans and Surinamese groups provided about equal person times and Antilleans/Arubans about 3 times less of person times. All ethnic minority groups were more likely to live in urbanised areas and to belong to a lower socioeconomic group. Turkish and Moroccans were more often married than native Dutch.

Table 6.1 Background characteristics by ethnicity and sex

	Dutch	Turks	Moroccans	Surinamese	Antilleans/ Arubans
Person Years (*1000)					
Male	36831	904	780	810	264
Female	36315	810	666	866	266
Total number of deaths					
Male	178131	1967	1293	2388	520
Female	108602	837	585	3013	355
Total number of avoidable deaths					
Male	62605	560	381	984	183
Female	45687	272	211	698	145
Percentage of the population that is single (aged 25-44 years)					
Male	41.9	12.4	26.6	48.8	67.7
Female	29.8	6.5	8.9	39.3	56.9
Percentage of the population that arrived before 1980					
Male	-	63.3	59.1	69.9	45.6
Female	-	60.2	55.1	67.8	43.5
Percentage of the population that is living in urban areas					
Male	32.8	74.8	77.3	80.0	66.8
Female	34.0	74.1	77.0	80.3	69
Percentage of the population that is living in low income areas					
Male	16.3	58.7	56.1	50.8	43.8
Female	16.3	58.2	55.6	49.4	43.0

Table 6.2 Rate ratios from avoidable causes for ethnic minorities versus native Dutch

Cause (ICD10 code)	No of death[a]		Mortality rate ratio[b] (95% CI)	
	M	F	Male	Female
Total mortality	6168	3316	1.18 (1.15-1.21)	1.12 (1.08-1.16)
Total avoidable mortality	2108	1326	1.15 (1.10-1.20)	1.10 (1.04-1.16)
Dis. of infectious origin	243	103	2.06 (1.81-2.35)	1.86 (1.53-2.27)
Pneumonia/flu (J10-8)	77	42	1.25 (0.99-1.57)	1.13 (0.83-1.54)
HIV/AIDS (B20-4)	80	8	3.03 (2.39-3.85)	2.20 (1.05-4.64)
Liver cancer (C22.0-1, C22.9)	46	26	2.33 (1.72-3.14)	2.49 (1.67-3.71)
Hepatitis A-E (B15-9)	23	8	8.54 (5.28-13.8)	7.82 (3.50-17.49)
Tuberculosis (A15-9, B9)0	13	12	5.10 (2.80-9.28)	12.98 (6.85-24.61)
Chr. rheum heart d (I 00-9).	4	7	3.28 (1.17-9.19)	5.71 (2.59-12.60)
Suicide (X60-84, Y87)	280	105	1.04 (0.92-1.17)	0.89 (0.73-1.09)
Malignant diseases	151	286	0.63 (0.54-0.74)	0.56 (0.50-0.63)
Breast cancer (C50)	0	172	-	0.52 (0.45-0.60)
Colorectal cancer (C18-21)	89	42	0.57 (0.46-0.70)	0.40 (0.29-0.54)
Leukemia (C91-5)	54	31	0.82 (0.63-1.08)	0.75 (0.52-1.07)
Cancer cervix uteri (C53)	NA	35	NA	1.29 (0.92-1.81)
Hodgkin Disease (C81)	4	6	0.52 (0.19-1.41)	1.26 (0.55-2.89)
C. testis prostate (C62, N40)	4	NA	0.39 (0.15-1.06)	NA
Acute & chronic conditions	1258	665	1.22 (1.15-1.29)	1.67 (1.55-1.81)
Appen/hernia (K35-8, 40-6, 56)	10	10	0.85 (0.45-1.60)	1.39 (0.73-2.64)
Cholectit/lithiasis (K80-3, 91.5)	15	3	3.04 (1.79-5.17)	0.80 (0.26-2.53)
Peptic ulcer (K25-8)	9	5	1.05 (0.54-2.03)	1.02 (0.42-2.48)
Ischemic heart d. (I20-2, I24-5)	646	253	0.89 (0.82-0.96)	1.21 (1.06-1.37)
Hypert/cereb (I10-5, 61-6, 67.4)	281	187	1.64 (1.45-1.85)	1.71 (1.48-1.98)
Diabetes (E10-4)	254	184	3.10 (2.73-3.53)	3.99 (3.43-4.65)
Epilepsy (G40-1)	32	15	1.51 (1.05-2.18)	1.15 (0.68-1.96)
Asthma (J45-6)	11	8	2.72 (1.43-5.19)	1.76 (0.85-3.64)
Rel. to maternity/neonatal per	176	167	1.00 (0.86-1.17)	1.28 (1.09-1.51)
All Maternal deaths (O00-99)	NA	19	NA	3.37 (2.02-5.62)
Cong an.(P10-5, 20-1, 50-1, 95)	75	59	0.98 (0.77-1.25)	1.23 (0.93-1.61)
O[c] (P08, 22, 25-6, 28, 52-94, 96)	34	29	0.38 (0.25-0.60)	0.97 (0.66-1.43)
Neural tube defects (Q00-7)	25	35	1.12 (0.74-1.69)	1.55 (1.08-2.22)
T/as[d] (Q10-23.3, 23.8-28, 35-84)	22	17	0.90 (0.58-1.40)	0.41 (0.20-0.84)
SIDS (R95)	20	8	1.74 (1.07-2.82)	1.31 (0.62-2.75)

[a] For all ethnic minorities combined; [b] Adj for age; [c] Other neonatal deaths; [d] Birth trauma and asphyxia

Table 6.3 Mortality rate ratios from groups of conditions for ethnic minorities compared to native Dutch population. Male and female combined

	Mortality rate ratio [a] (95% CI) adjusted for	
	age and sex	all factors [b]
Total mortality	1.16 (1.13-1.18)	0.98 (0.96-1.00)
Total avoidable mortality	1.13 (1.09-1.17)	0.97 (0.94-1.01)
Diseases of infectious origin	2.00 (1.79-2.23)	1.50 (1.32-1.70)
Suicides	0.99 (0.90-1.10)	0.83 (0.74-0.93)
Malignant diseases	0.58 (0.53-0.64)	0.55 (0.50-0.61)
Acute and Chronic conditions	1.36 (1.29-1.42)	1.17 (1.11-1.23)
Asthma	2.20 (1.36-3.56)	1.66 (0.99-2.76)
Hypertension/cerebrovascular	1.67 (1.53-1.84)	1.46 (1.32-1.60)
Diabetes	3.45 (3.13-3.81)	2.65 (2.38-2.94)
Maternity/neonatal period rel. cond..	1.12 (1.00-1.26)	1.05 (0.92-1.20)

[a] Ethnic minorities compared to the native Dutch population, adjusted for age

[b] Adjusted for age, sex, marital status, urbanisation level, and average area income

We found total avoidable mortality for all studied ethnic minorities combined to be slightly elevated compared to the native Dutch population (RR=1.15 for men and 1.10 for women, Table 6.2). The overall risk of mortality from infectious diseases was about two times higher for ethnic minorities compared to Dutch population. The excess risk for tuberculosis (RR=5.10 for men and 12.98 for women) and hepatitis (RR about 8.00) was the highest, although, in absolute terms liver cancer and HIV were the two top causes of deaths.

Compared to the native Dutch population, ethnic minorities experienced a lower risk of death from the majority of malignant conditions (Table 6.2). Exceptions are cervical cancer and Hodgkin's disease among women. The Mortality rate ratio of death for all 'avoidable' malignant conditions combined was around 0.60 for both men and women.

Compared to the native Dutch population, the mortality excess for acute and chronic conditions combined ranged between 22% for men and 67% for women (Table 6.2). Cholecysitis/cholelithiasis had a three times higher risk among ethnic minority men compared to native Dutch. For appendicitis, hernia, and ulcer the risks of death did not differ substantially from the Dutch population. Among chronic conditions, ethnic minorities experienced an elevated risk of death from asthma (RR about 2.00), diabetes (RR above 3.00), and hypertensive and cerebrovascular disorders (RR above 1.60).

Table 6.4 Mortality rate ratios from groups of conditions for different ethnic minority groups compared to the native Dutch population

	Mortality rate ratio [a] (95% Confidence interval)			
	Turks	Moroccans	Surinamese	Antillean/Arubans
Males and females combined				
Total	1.15 (1.11-1.20)	0.90 (0.86-0.94)	1.33 (1.29-1.37)	1.27 (1.18-1.35)
Avoidable	0.93 (0.86-0.99)	0.77 (0.71-0.84)	1.50 (1.43-1.57)	1.23 (1.13-1.40)
Avoi. adj[b]	0.86 (0.81-0.93)	0.72 (0.66-0.78)	1.19 (1.13-1.25)	1.00 (0.90-1.11)
Male				
Total	1.22 (1.16-1.27)	0.86 (0.81-0.90)	1.40 (1.34-1.45)	1.35 (1.24-1.47)
Avoidable	0.99 (0.91-1.07)	0.72 (0.65-0.80)	1.64 (1.54-1.75)	1.36 (1.18-1.57)
Infectious	1.28 (0.95-1.71)	1.48 (1.12-1.98)	2.89 (2.40-3.47)	3.56 (2.51-5.05)
Suicides	0.77 (0.60-0.98)	0.61 (0.46-0.83)	1.58 (1.33-1.88)	1.38 (0.99-1.93)
Malignant	0.58 (0.40-0.78)	0.42 (0.29-0.60)	0.81 (0.64-1.04)	0.88 (0.53-1.46)
Acute/chr	1.08 (0.97-1.20)	0.68 (0.59-0.78)	1.79 (1.65-1.93)	1.25 (1.02-1.55)
- Asthma	0.77 (0.11-5.57)	1.77 (0.43-7.25)	3.20 (1.16-8.79)	11.23 (4.05-31.14)
- Hypert/c	1.25 (0.97-1.60)	0.80 (0.58-1.10)	2.61 (2.23-3.05)	1.68 (1.07-2.64)
- Diabetes	1.72 (1.27-2.32)	1.96 (1.47-2.62)	5.29 (4.48-6.25)	3.25 (2.04-5.17)
Neonatal	1.14 (0.90-1.44)	1.01 (0.78-1.31)	0.78 (0.54-1.11)	1.01 (0.60-1.72)
Female				
Total	1.04 (0.97-1.11)	1.00 (0.92-1.08)	1.23 (1.17-1.29)	1.16 (1.05-1.29)
Avoidable	0.83 (0.73-0.93)	0.89 (0.78-1.02)	1.34 (1.24-1.44)	1.15 (0.98-1.36)
Infectious	1.45 (0.95-2.22)	1.97 (1.27-3.04)	1.97 (1.49-2.61)	2.12 (1.23-3.67)
Suicides	0.59 (0.38-0.92)	0.56 (0.33-0.95)	1.29 (1.00-1.67)	0.98 (0.55-1.73)
Malignant	0.46 (0.36-0.59)	0.44 (0.33-0.60)	0.61 (0.51-0.72)	0.84 (0.62-1.12)
Acute/chr	1.09 (0.90-1.32)	1.09 (0.86-1.39)	2.18 (1.98-2.40)	1.46 (1.14-1.88)
- Asthma	0.77 (0.11-5.56)	0.99 (0.14-7.13)	3.35 (1.46-7.65)	- [c]
- Hypert/c	0.99 (0.67-1.46)	1.08 (0.68-1.72)	2.26 (1.90-2.71)	1.60 (1.02-2.52)
- Diabetes	2.17 (1.46-3.22)	2.29 (1.42-3.70)	5.54 (4.62-6.64)	3.63 (2.28-5.78)
Neona/M	1.31 (1.01-1.70)	1.52 (1.19-1.96)	0.89 (0.61-1.30)	1.32 (0.78-2.23)

[a] adjusted for age

[b] adjusted for age, sex, marital status, degree of urbanisation, and average area income

[c] no cases

Table 6.5 Mortality rate ratios from groups of conditions for recent immigrants compared to immigrants residing in the Netherlands 15 years or longer

	Mortality rate ratio (95% confidence interval)		
	Male	Female	Male & Female
Total mortality	1.08 (1.02-1.15)	0.94 (0.87-1.01)	1.02 (0.98-1.07)
Total avoidable mortality	1.13 (1.02-1.25)	0.88 (0.78-0.98)	1.01 (0.94-1.09)
Conditions of infectious o.	1.64 (1.24-2.18)	1.42 (0.96-2.11)	1.62 (1.29-2.03)
Suicides	0.72 (0.57-0.93)	0.59 (0.39-0.87)	0.68 (0.55-0.84)
Malignant diseases	1.09 (0.74-1.60)	0.90 (0.71-1.15)	0.92 (0.75-1.13)
Acute and chronic conditions	1.19 (1.04-1.36)	0.84 (0.72-0.98)	1.04 (0.94-1.15)
- Asthma	0.50 (0.12-2.05)	0.37 (0.07-1.92)	0.46 (0.16-1.34)
- Hypertension/cerebrov. d	1.49 (1.14-1.93)	0.67 (0.49-0.91)	1.04 (0.85-1.28)
Diabetes	1.29 (0.96-1.72)	1.05 (0.78-1.41)	1.17 (0.95-1.44)
Neonatal/Maternity related.	1.36 (0.56-3.30)	1.0 (0.52-1.93)	1.12 (0.65-1.91)

The overall risk of death from conditions related to maternity and neonatal period was 28% higher for ethnic minority women compared to the native Dutch women (Table 6.2). Ethnic minority women experienced an especially high mortality risk from maternity related conditions (RR=3.37). Sudden infant death syndrome (RR=1.74 for boys and 1.31 for girls) and neural tube defects (RR=1.12 for boys and 1.55 for girls) showed elevated risks, while birth trauma and asphyxia showed lower risk for ethnic minorities compared to the native Dutch children.

Social factors contributed largely to the explanation of the excess mortality risks for ethnic minorities (Table 6.3). Adjustment for these factors explained about 50% of the total excess risk and for some causes of death fully explained the difference. This effect is primarily attributed to socioeconomic factors and less to geographic characteristics. Mortality rate ratios for some diseases, however, remained elevated after adjustments, especially for conditions of infectious origin (RR=1.50), hypertension and cerebrovascular diseases (RR=1.46), and diabetes (RR=2.65).

Not all ethnic groups carried equal burden of 'avoidable' mortality risk. As shown in Fig 6.1 and Table 6.4, the Antillean/Aruban and Surinamese ethnic groups were in a far more disadvantaged position with 23 to 50% increased risk of total avoidable mortality, while the Moroccan and Turkish population had 7 to 23% less risk compared to the Dutch population. Adjustment for socioeconomic and geographic factors explained a large portion of the total avoidable mortality difference, although some excess risk remained in the Surinamese population (RR=1.19). The lower Mortality rate ratio of death for the Turkish and Moroccan population decreased even more. This pattern is observed for almost all disease categories. Surinamese and Antillean/Aruban people had increased risk of death from infectious diseases (RR about 3.00 for men and about 2.00 for women), acute and chronic conditions (RR about 1.50 for men and about 2.00 for women) and

suicide (RR about 1.40). Diabetes was substantially elevated among all four minority groups, but especially among Surinamese and Antilleans/Arubans. Excess mortality from asthma and cerebrovascular disorders was found only among the Surinamese and Antillean/Aruban populations. Mortality risk from maternal and child conditions, on the other hand, was higher only in Turkish and Moroccan groups.

We observed a difference in risks for recent immigrants compared to those that arrived more than 15 years ago (Table 6.5). Recent immigrants had higher risk of death from infectious diseases and hypertension and cerebrovascular disorders (men only) while 'older' immigrants more often died from suicides. Altogether, recent male immigrants experienced a somewhat increased risk of death from avoidable conditions, while recent female immigrants had a lower risk.

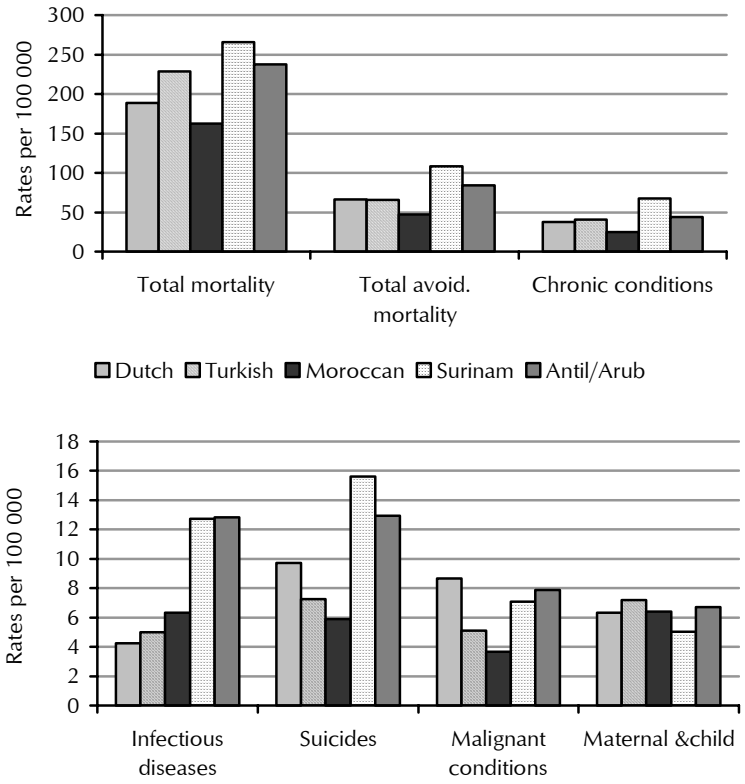

Figure 6.1 Age standardised group specific mortality rates for different ethnic groups

6.5 Discussion

We found total avoidable mortality to be slightly elevated for all ethnic minority groups combined compared to the native Dutch population. Cause specific examination showed a higher risk of death for ethnic minorities from infectious and several chronic conditions and low risk of death from malignant conditions. Ethnicity specific investigation showed that the Surinamese and Antillean groups had higher risks of death and Turkish and Moroccan groups had lower risks of death from 'avoidable' conditions compared to the native Dutch population. Control for demographic and socioeconomic factors explained a substantial part of ethnic differences in 'avoidable' mortality. Recent immigrants had higher risks of death from infectious diseases, but lower risk from suicides compared to those who resided longer than 15 years in the Netherlands.

Some potential limitations of the data should be considered. First, the power of the study was too limited to allow examination of all causes of death for each ethnic group separately. Second, there is a possibility of an insufficient adjustment for socioeconomic status since an ecological measure of socioeconomic status based on income equivalent matched on postcode was used. It is likely that further adjustment for socioeconomic status would provide additional explanation of the higher mortality for some causes in ethnic groups(39). Third, the definition of ethnicity is based on available information on country of birth of the subject and both parents, but does not take into account ethnic identity, culture, language or ancestry. In addition, third generation migrants could not be distinguished. This is unlikely to affect Turkish and Moroccan groups, since their migration occurred relatively recently, but might have produced an incomplete view for Surinamese and Antilleans.

Additional care should be taken when interpreting the role of the healthcare system. Mortality levels are influenced by a series of factors and activities of which health care is only a part. One of the largest effects on ethnic variation in mortality may be produced by variation in incidence of the selected diseases(39). Additional adjustment for the incidence could have modified the presented results. Furthermore, some of avoidable death could be the late consequence of inadequate care in the earlier stages of the disease before arrival to the Netherlands. Finally, two selection effects, 'the healthy migrant effect' and 'the unhealthy remigration effect', may have influenced the observed results. Recent studies, however, showed that they fail to explain differences in mortality between ethnic groups in Europe(26, 88, 167). Despite the problems with the validity and interpretation of the results, our overview could help identify some potential shortcomings in the healthcare system and justify further investigations in particular areas.

Potential shortcomings in the healthcare system

We observed striking differences in cause-specific and ethnicity-specific risks of avoidable mortality that require closer attention. Several factors might contribute to the higher risk of mortality from conditions of infectious origin among ethnic minorities in the Netherlands.

From a social perspective, these might be substandard housing, overcrowding and poor sanitation that migrants often experience(168). From a healthcare perspective, these are more likely to be ineffective screening programs (less than 50% follow up screening for tuberculosis, no screening for other infectious diseases(169)) and limited access to healthcare services in the first years after migration. Although generally access in the Netherlands was found to be quite adequate(16, 170, 171), access in the first years after migration could be hampered due to financial barriers, unclear legal status and limited entitlements to healthcare, and low knowledge on the use of healthcare services. The elevated risk of death from infectious diseases among recent immigrants (compared to 'older' immigrants) also supports this suggestion.

The observed increased risks of death from diabetes, hypertension and cerebrovascular disorders could be partly explained by genetic and behavioural factors, such as increased low birth weight prevalence(172) and nutritional differences with higher intake of fat and carbohydrates(173, 174). However, some features of the present healthcare system may play an additional role by functioning less adequately for ethnic minority groups and, thus, increasing ethnic differences in mortality outcomes. These include: (a) lower rate of referrals to the specialists(175) (b) somewhat less frequent use of primary healthcare facilities and poorer secondary prevention, especially among Surinamese(175); (c) difference in the relative importance of risk factors for prediction of outcomes(176), which is not taken into account in current clinical guidelines(177); (d) less efficient communication between providers and ethnic minority patients due to cultural differences in attitudes towards health and healthcare(178), and illiteracy or inadequate command of local language(19, 179).

Elevated maternal mortality for ethnic minorities is another point of concern. It may be related to fertility patterns (e.g. substantially higher parity), but also be related to medical services, such as reported substandard care(180), late prenatal control, higher frequency of unassisted births (181), and lower use of maternity home care(171). Underreporting of maternal(182) and child(183) mortality (the last found to be associated with ethnicity) might have hindered assessment of the full extent of the ethnic gap.

General considerations

Decreased risk of death from acute and chronic conditions, especially among Moroccan men (RR=0.68), might be related to a relatively late uptake of smoking, relatively healthier traditional diet(184-186), and better access to modern medical services that ethnic minority groups experience in the Netherlands (as compared to their countries of origin). Lower mortality, however, does not imply better overall health of ethnic minorities(15, 16, 26). Given current changes in diet and smoking(187), a higher mortality may be expected in the future.

The results of our study indicate a large difference in mortality between the Turkish and Moroccan population on one hand and Surinamese and Antillean/Aruban on the other hand. The difference is striking taking into account the on average better integration into

the local Dutch society, higher local language proficiency, and more advanced education level of Surinamese and Antilleans compared to Turkish and Moroccans(15). Differences in healthcare utilisation or quality of care between Surinamese/Antillean and Turkish/Moroccan groups are minimal(15, 175, 188, 189) and, therefore, unlikely to play a major role. This suggests that genetic, environmental, and behavioural factors play a more important role in predicting mortality outcomes of migrant groups in the Netherlands.

Adjustment for demographic and socioeconomic factors explained a substantial part of ethnic differences in avoidable mortality, sometimes completely abolishing the excess risk. A more comprehensive socioeconomic measure could have explained excess mortality even more substantially(39). This indicates that socioeconomic factors are more important in explaining ethnic differences in mortality in the Netherlands than the quality of medical services. Similar conclusions were reached earlier by other researchers(190, 191). For a few causes of death, however, the situation is more complex, and adjustment for social factors only somewhat attenuated the considerably higher risks.

Even though we found ethnicity to be associated with higher mortality from 'avoidable' conditions, elevated risks are confined only to specific diseases and/or separate ethnic groups. In addition, they are largely explained by socioeconomic and demographic factors. Thus, we could not find compelling evidence that general characteristics of the healthcare system drive ethnic inequalities in mortality outcomes. The current healthcare system in the Netherlands ensures equal financial access to healthcare services, with relatively small differences between socioeconomic groups in health care utilisation, after adjustment for differences in prevalence of health problems(190, 191). These findings are supported by other studies from Sweden (192), Canada(193) and UK(48, 194) where no gross inequalities in access to and utilization of the healthcare system for ethnic minorities were observed either.

Nevertheless, the substantial differences in cause-specific mortality between some ethnic minorities and the native Dutch population present a challenge for the healthcare system and suggest many opportunities for improvement within specific areas, particularly if targeted to Surinamese and Antillean/Aruban groups. More in depth research is needed to determine more precisely the causes for the observed differences in mortality outcomes and to develop appropriate policies to address them.

7

Trends in Socioeconomic Inequalities in Mortality in Six Western European Countries

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Abstract

Objectives During the past decades a widening of the relative gap in death rates between upper and lower socioeconomic groups has been reported for several European countries. Although differential mortality decline for cardiovascular diseases has been suggested as an important contributory factor, it is not known what its quantitative contribution was, and to what extent other causes of death have contributed to the widening gap in total mortality.

Methods We collected data on mortality by educational level and occupational class among men and women from national longitudinal studies in Finland, Sweden, Norway, Denmark, England/Wales, and Italy (Turin), and analysed age-standardised death rates in two recent time periods (1981–1985 and 1991–1995), both total mortality and by cause of death. For simplicity, we report on inequalities in mortality between two broad socioeconomic groups (high and low educational level, non-manual and manual occupations).

Results Relative inequalities in total mortality have increased in all six countries, but absolute differences in total mortality were fairly stable, with the exception of Finland where an increase occurred. In most countries, mortality from cardiovascular diseases declined proportionally faster in the upper socioeconomic groups. The exception is Italy (Turin) where the reverse occurred. In all countries with the exception of Italy (Turin), changes in cardiovascular disease mortality contributed about half of the widening relative gap for total mortality. Other causes also made important contributions to the widening gap in total mortality. For these causes, widening inequalities were sometimes due to increasing mortality rates in the lower socioeconomic groups. We found rising rates of mortality from lung cancer, breast cancer, respiratory disease, gastrointestinal disease, and injuries among men and/or women in lower socioeconomic groups in several countries.

Conclusions Reducing socioeconomic inequalities in mortality in Western Europe critically depends upon speeding up mortality declines from cardiovascular diseases in lower socioeconomic groups, and countering mortality increases from several other causes of death in lower socioeconomic groups.

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7.1 Introduction

In all countries with available data, mortality has been shown to be higher among those in less-advantaged socioeconomic positions, regardless of whether socioeconomic position is indicated by educational level, occupational class, or income level. Several studies have shown that these mortality differences widened in many countries during the 1970s and the 1980s(195-203). Until now changes into the 1990s have been documented for a few countries only. For example, studies from Finland, England & Wales, and Sweden observed a widening of relative inequalities in mortality by occupational class(195-203).

The explanation of widening inequalities in mortality is only partly known. One factor that has certainly contributed to widening inequalities in total mortality, at least in some countries, is faster mortality decline from cardiovascular diseases, particularly ischemic heart disease, in the higher socioeconomic groups(204). Because countries differ in the cause-of-death composition of the mortality excess in lower socioeconomic groups(205), it is unknown, however, to what extent this is a generalised phenomenon. Also, the contribution of other causes of death has been studied less extensively(205).

The purpose of this paper is to analyse recent trends in socioeconomic inequalities in mortality in a range of European countries. The analysis focused on the extent to which widening inequalities in mortality were driven by faster mortality decline from cardiovascular diseases in higher socioeconomic groups, and what the contribution of other causes of death was.

7.2 Data

For each country, numbers of deaths by 5-year age group, sex, and socioeconomic indicators were obtained for two periods: about 1981–1985 and 1991–1995. These data were obtained from a longitudinal mortality follow-up of population censuses that were carried out around 1981 and around 1991, respectively. People enumerated in the census were followed for 5 years. The Nordic studies cover entire national populations. The data for England & Wales apply to a 1 per cent sample of the population.12 The Italian study is restricted to the city of Turin(206). Table 7.1 gives the total number of person-years at risk and deaths observed in each study.

Data on educational level of both men and women were available for Finland, Denmark, Norway, and Italy (Turin). Most analyses concern men and women in the age group 30–74 years. Age was measured at the start of each subperiod. In Denmark, people 60 years had to be excluded because the educational level was not known for most men and women 60 years in 1980.

Table 7.1 Number of person-years (PY) at risk (in 000's) and deaths observed in each country

Country	Period	Education				Occupation	
		Men		Women		Men	
		PY	Deaths	PY	Deaths	PY	Deaths
Finland	1981-85	5584	82086	6325	52256	4491	31598
	1986-90	5904	79845	6633	50175	4882	31885
	1991-95	6438	75597	6906	44990	5144	29082
Sweden	1981-85					7199	26653
	1986-90					5827[c]	24461[c]
	1991-95					8045	27182
Norway	1981-85	4709	64945	4927	37270	3278	16338
	1985-90	4837	63542	5038	37471	3355	15285
	1991-95	5076	56160	5228	34027	3699	12133
Denmark	1981-85	4043[a]	23021[a]	4049[a]	14682[a]	4360	21276
	1986-90	4248[a]	23155[a]	4250[a]	15086[a]	4457	19820
	1991-95	3492[a]	23145[a]	4549[a]	15263[a]	4589	18379
England/	1981-85					458	2372
Wales	1986-90					381[c]	2070[c]
	1991-95					497	1941
Italy/	1982-86	1322	15958	1511	10700	1041	5361
Turin	1987-91	1089[b]	14128[b]	1259b	8922[b]	805[c]	4464[c]
	1992-96	1206	12727	1363	7941	886	3785

[a] Age group 30-59 years
[b] Age group 35-74 years
[c] Age group 35-59 years

In each study, men and women were classified according to their completed educational level into three levels: up to lower secondary, upper secondary, and post-secondary education. In the analysis we report on differences in mortality between 'up to lower secondary' and 'post-secondary'. In every country, the proportion of the population in the

highest educational level is higher among men than among women, and increases over time for both men and women.

Data on occupational class of men were available for Finland, Sweden, Norway, Denmark, England & Wales, and Italy (Turin). Age was measured at the start of each subperiod. Data are analysed for men in the age group 30–59 years. Men >60 years had to be excluded because of lack of detailed occupational information on retired men in most studies. Women had to be excluded from analysis because it was impossible for many countries to assign women to occupational classes (on the basis of their own occupation or their partner's occupation) in a way that was both valid and comparable over time.

Four broad occupational classes were distinguished: non-manual workers, manual workers, farmers and farm labourers, and self-employed men. The Erikson-Goldthorpe-Portocarero (EGP) scheme was used as a reference(207). We report here on differences in mortality between 'non-manual' and 'manual workers' outside the agricultural sector (all self-employed excluded). In all countries, the non-manual and manual classes are the largest two classes, and the share of the manual class decreases over time, while the share of the non-manual class increases.

The occupational class of all men was determined on the basis of the occupation that they had at the time of the population census. For some men, however, information was lacking on their current occupation. This especially applies to men who were economically inactive at the time of the census. In these cases, their occupational class was, as far as possible, determined on the basis of information on a previously held occupation. This information could be obtained in some countries (especially Finland and England & Wales) by linkage to a previous population census.

Despite these efforts, the proportion of men with unknown class was considerable in some countries, and ranged between 1% in Finland and 10% in one of the two time-periods in Sweden and Denmark. The mortality levels of these men are relatively high, due to the fact that most of the men with unknown occupational class are economically inactive men, such as retired or work-disabled men. Unfortunately, their exclusion from analysis is likely to lead to an underestimation of the magnitude of mortality differences between occupational classes, because these men not only have high mortality rates but in addition most of them originate from lower occupational classes(208). However, an adjustment procedure to correct for this underestimation was used which has been shown to provide less-biased estimates of mortality differences between occupational classes(208). Table 7.2 provides the International Classification of Disease codes for the causes of death distinguished in the analysis reported in this paper(209).

Table 7.2 ICD-codes for included cause of death

Disease	ICD 8	ICD 9	ICD 10
Neoplasms	140-239	140-239	C00-D48
Lung cancer	162	162	C33, C34
Breast cancer	174	174, 175	C50
Cardiovascular d.	390-458	390-459	I00-I99
Cerebrovascular disease	430-438	430-438	G45, G46, I60-I69
Ischemic heart disease	410-414	410-414	I20-I25
Gastro-intestinal diseases	520-577	520-579	K00-K93
Injuries/external causes	E800-E999	E800-E999	V01-Y89
Respiratory disease	460-519	460-519	J00-J99

ICD8: Sweden (1980-86), Norway (80-90), Denmark (81-85) and (91-93)
ICD9: Finland, Italy, Sweden (1987-95), Norway (86-95), and England
ICD10: Denmark (94-95)

The mortality level per socioeconomic group was measured by means of directly standardised mortality rates. Standardisation on the basis of 5-year age groups was done by means of the direct method using the European standard population of 1987. By means of this standardisation procedure, differences in age structure between socioeconomic groups, between men and women, between countries, and between periods were controlled for. In order to determine the contribution of changes in cardiovascular mortality to changing inequalities in total mortality we compared the observed rate ratios (RR) for total mortality in 1981–1985 and 1991–1995 with an RR for total mortality in 1991–1995 as it would have been, if neither the proportion of all deaths due to cardiovascular disease, nor the RR of dying from cardiovascular diseases had changed between 1981–1985 and 1991–1995. This 'expected' RR for 1991–1995 was calculated on the basis of (1) the 1981–1985 proportions of total mortality due to four main groups of causes of death (cardiovascular diseases, neoplasms, other diseases, injuries), (2) the 1981–1985 RR of dying from cardiovascular diseases, and (3) the 1991–1995 RR of dying from neoplasms, and other diseases and injuries.

7.3 Results

As Figure 7.1 shows, relative inequalities in mortality have tended to increase between 1981–1985 and 1991–1995 in all countries represented in this study, both with occupational class (men only) and with educational level (men and women) as a socioeconomic indicator. Non-overlapping 95% CI of the 1981–1985 and 1991–1995 RR are found in Finland, Sweden, Norway, and Denmark (men by educational level only), and steep increases on top of already large inequalities are seen for mortality by occupational class among men in Finland.

The widening relative gap is mostly due to faster proportional mortality declines in higher socioeconomic groups (Table 7.3). Mortality declined in all countries and all socioeconomic groups, the only exceptions being low educated Danish men among whom mortality slightly increased, and low educated Norwegian and Danish women among whom mortality has remained stable. In all cases, relative (percentage) mortality decline has been faster in the upper socioeconomic groups. The extent of absolute mortality decline, however, has mostly been similar in the upper and lower socioeconomic groups, due to which absolute inequalities in mortality have been more or less stable.

Faster proportional mortality declines in higher socioeconomic groups are also seen for cardiovascular diseases (Table 7.4). Mortality from cardiovascular diseases declined in all countries and all socioeconomic groups. Although absolute mortality decline was mostly faster in lower socioeconomic groups, relative (percentage) mortality decline was usually faster in the upper socioeconomic groups. The main exception is Italy (Turin) where proportional mortality decline was similar across socioeconomic groups.

Table 7.5 shows the contribution of changes in cardiovascular disease mortality to the widening gap in total mortality. Cardiovascular disease mortality made a substantial contribution to the widening gap in total mortality in all countries except Italy (Turin). For example, in Finland for educational differences among men the 'expected' RR for 1991–1995 calculated on the basis of 1981–1985 cardiovascular disease mortality data (constant proportion of total mortality, constant RR) is 1.70, showing that changes in cardiovascular disease mortality contribute more than half of the widening gap in total mortality (1.70 being less than halfway between the RR for total mortality in 1981–1985 (1.61) and 1991–1995 (1.82). In general, changes in cardiovascular disease mortality explain about half of the widening of the relative gap in total mortality, with the exception of Italy (Turin) where the contribution is nil.

Clearly, other causes of death must have also contributed to the widening gap in total mortality. In an analysis of changes in mortality from the other three large cause-of-death groups (neoplasms, other diseases, injuries, results not shown) we found that RR by occupational class among men between the first half of the 1980s and first half of the 1990s increased for neoplasms in Sweden, England & Wales, and Italy (Turin), for all other diseases in Finland and Sweden, and for injuries in Finland and Italy (Turin) (results not shown). In several cases, these widening inequalities for other causes of death were due to increasing rates of mortality in lower socioeconomic groups. We found rising rates of mortality from lung cancer, breast cancer, respiratory disease, gastrointestinal disease, and injuries among men and/or women in lower socioeconomic groups in several countries.

Figure 7.1a: Occupational class: men

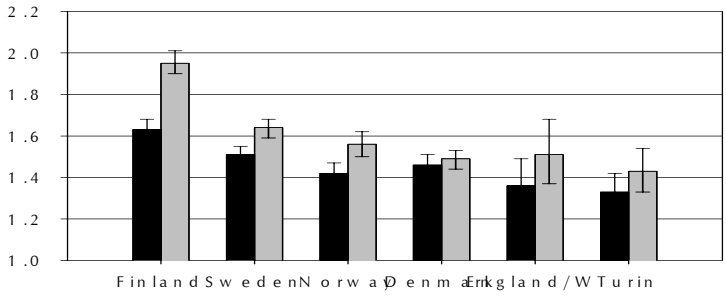

Figure 7.1b: Educational level, men

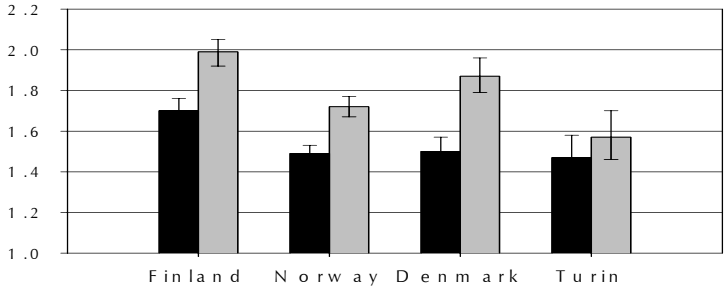

Figure 7.1c: Educational level: women

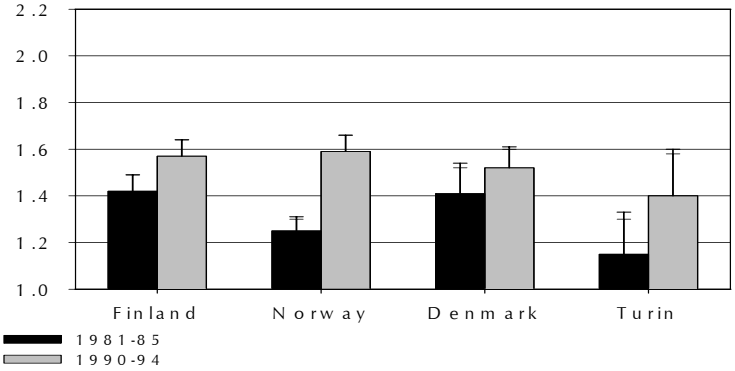

Figure 7.1 Rate ratios for total mortality by educational level and occupational class, 1981–1985 and 1991–1995: a) Occupational class, men; b) Educational level, men; c) Educational level, women.

Table 7.3 Changes in total death rates (per 1000 person-years) by educational level (30-74 years) and occupational class (30-59 years)

Country	Sex	Socioeconomic group	Age standardised death rate			Change '93-'83	
			81-85	86-90	91-95	Abs.	Rel. (%)
Finland	M	High educ.	9.0	7.6	6.9	-2.1	-23
		Low educ.	14.4	13.8	12.5	-1.9	-13
	W	High educ.	4.0	3.8	3.4	-0.6	-15
		Low educ.	5.7	5.6	5.3	-0.4	- 7
	M	Non-manual	4.7	4.0	3.6	-1.1	-23
		Manual	7.4	7.2	6.9	-0.6	-8
Sweden	M	Non-manual	3.4	3.0[c]	2.5	-0.9	-26
		Manual	5.1	4.7[c]	4.1	-1.0	-20
Norway	M	High educ.	7.5	7.2	6.1	-1.3	-17
		Low educ.	10.8	11.6	10.5	-0.3	- 3
	W	High educ.	3.6	3.5	3.2	-0.4	-11
		Low educ.	5.2	5.3	5.1	-0.0	- 0
	M	Non-manual	3.7	3.5	2.8	-0.9	-24
		Manual	5.2	5.1	4.3	-0.9	-17
Denmark	M	High educ.[a]	3.5	3.4	2.8	-0.7	-20
		Low educ.[a]	5.1	5.4	5.3	-0.2	- 4
	W	High educ.[a]	2.4	2.2	2.2	-0.2	- 8
		Low educ.[a]	3.3	3.4	3.3	0.0	0
	M	Non-manual	4.3	4.4	3.9	-0.4	-9
		Manual	6.2	6.2	5.7	-0.4	-6
England/	M	Non-manual	3.9	3.3[c]	3.0	-0.9	-23
Wales		Manual	5.3	4.9[c]	4.6	-0.7	-13
Italy/	M	High educ.	7.9	6.8[b]	6.3	-1.6	-20
Turin		Low educ.	11.6	10.4[b]	10.0	-1.6	-14
	W	High educ.	4.5	3.8[b]	3.0	-1.4	-31
		Low educ.	5.4	4.6[b]	4.4	-1.0	-19
	M	Non-manual	4.0	3.7[c]	3.0	-1.0	-25
		Manual	5.3	4.7[c]	4.3	-1.0	-19

[a]Age group 30-59 years; [b]Age group 35-74 years; [c]Age group 35-59 years

Table 7.4 Changes in cardiovascular disease death rates (per 100000 person-years) by educational level and occupational class

Country	Sex	Socioeconomic group	Age standardised death rate			Change '93-'83	
			81-85	86-90	91-95	Abs.	Rel. (%)
Finland	M	High educ.	480	372	315	-165	-34
		Low educ.	761	650	569	-193	-25
	W	High educ.	155	129	102	-52	-34
		Low educ.	280	260	208	-72	-26
	M	Non-manual	238	166	131	-106	-45
		Manual	344	294	246	-98	-28
Sweden	M	Non-manual	146	137[c]	84	-61	-42
		Manual	213	208[c]	143	-70	-33
Norway	M	High educ.	367	331	247	-121	-33
		Low educ.	530	552	460	-70	-13
	W	High educ.	115	100	82	-32	-28
		Low educ.	213	205	177	-36	-17
	M	Non-manual	164	142	91	-73	-45
		Manual	220	206	149	-71	-32
Denmark	M	High educ.[a]	116	93	73	-43	-37
		Low educ.[a]	188	175	141	-47	-25
	W	High educ.[a]	28	23	21	-7	-24
		Low educ.[a]	65	65	55	-10	-16
	M	Non-manual	165	140	110	-55	-33
		Manual	223	204	160	-63	-28
England/	M	Non-manual	179	172[c]	116	-63	-35
Wales		Manual	264	266[c]	196	-68	-26
Italy/	M	High educ.	324	333[b]	235	-89	-27
Turin		Low educ.	436	384[b]	306	-130	-30
	W	High educ.	106	112[b]	68	-38	-36
		Low educ.	194	185[b]	132	-62	-32
	M	Non-manual	136	124[c]	90	-46	-34
		Manual	166	150[c]	105	-61	-37

[a]Age group 30-59 years; [b]Age group 35-74 years; [c]Age group 35-59 years

Table 7.5 Contribution of cardiovascular diseases to the widening relative gap in total death rates

Country	Sex	Socioeconomic variable	Rate Ratio for total mortality			
			1981-85 (observed)	1991-95 (observed)	1991-95 (cod-shares 1981-85)	1991-95 (cod-shares 1981-85, RR CVD 1981-85)
Finland	M	Education	1.61	1.82	1.81	1.70
	W	Education	1.41	1.55	1.60	1.51
	M	Occupation	1.59	1.92	1.88	1.66
Sweden	M	Occupation	1.48	1.63	1.62	1.52
Norway	M	Education	1.45	1.71	1.74	1.54
	W	Education	1.44	1.61	1.65	1.55
	M	Occupation	1.41	1.53	1.55	1.42
Denmark	M	Education	1.48	1.86	1.88	1.77
	W	Education	1.39	1.52	1.50	1.47
	M	Occupation	1.42	1.46	1.47	1.43
England/W	M	Occupation	1.36	1.52	1.53	1.43
Italy/	M	Education	1.47	1.59	1.57	1.59
Turin	W	Education	1.21	1.44	1.46	1.44
	M	Occupation	1.34	1.45	1.43	1.45

Table 7.4 illustrates the changes occurring in mortality from these causes among women with high and low educational levels. For lung cancer, rates of mortality have increased among women in all four countries represented in this Table, with stronger increases among women with low levels of education in Finland, Norway, and Denmark. Women with low levels of education sometimes also have rising rates of mortality from breast cancer (Finland), gastrointestinal diseases (Finland, Denmark), respiratory diseases (Norway, Denmark), and injuries (Finland). Italy (Turin) is again the exception, with mostly decreasing rates of mortality among women with low levels of education.

Table 7.6 Changes in death rates (per 100 000 person years) for selected causes, women by educational level

Country	Sex	Socio-economic variable	Change 1993-1983 (absolute)				
			Lung cancer	Breast cancer	Gastro-intestinal dis.	Respir.. dis.	Injuries
Finland	W	High educ.	+1	-10	+1	-0	+1
		Low educ.	+3[a]	+4[a]	+8[a]	+2	+13
Norway	W	High educ.	+3	+5	-2	+0	-4
		Low educ.	+16[a]	+1	+0	+9[a]	-0
Denmark	W	High educ.	+3	+0	-3	+2	-16[a]
		Low educ.	+7	-1	+6	+4	-8[a]
Italy/	W	High educ.	+7	-26	-15	-4	-8
Turin		Low educ.	+2	-4	-7	-8	-10[a]

[a] 95% CI does not include 0

7.4 Discussion

Short summary of findings

This study shows that mortality inequalities by educational level and occupational class tended to increase between the first half of the 1980s and first half of the 1990s in all countries participating in this study, but mainly in a relative sense. This was generally due to faster proportional mortality declines in higher socioeconomic groups, and these in turn were partly due to faster proportional mortality declines for cardiovascular diseases, except in Italy (Turin). Although changes in mortality from cardiovascular diseases are an important driving factor behind the widening gap in total mortality, other causes of death also made important contributions. For these causes, widening inequalities were sometimes due to increasing mortality rates in the lower socioeconomic groups. We found rising rates of mortality from lung cancer, breast cancer, respiratory disease, gastrointestinal disease, and injuries among men and/or women in lower socioeconomic groups in several countries.

Data problems

Comparisons between countries may be hampered by differences in data collection and in data classification. This paper, however, did not intend to quantitatively compare countries:

the focus is on changes over time for which we found rather consistent results in the countries represented in this study.

The classification of the population into the broad educational and occupational groups distinguished in our study has not changed between the 1980s and 1990s. What has changed, however, is the proportion of the population in the lower socioeconomic groups: this has generally become smaller, and it is possible that in 1991–1995 the lower educational and occupational groups represent a more 'extreme' group than in 1981–1985, in terms of (relative) socioeconomic position and associated material, behavioural, and psychosocial characteristics. In an additional analysis we have looked at changes between the 1980s and 1990s in inequalities in mortality measured with the Relative Index of Inequality, which adjusts for changes in population share of socioeconomic groups(210). In this analysis we found similar results to those reported in this paper on the basis of the simpler RR: relative inequalities in mortality have widened in all countries participating in this study(211).

Our analysis is based on a robust distinction between a few broad socioeconomic groups. This may have obscured differences within these broad groups, and the question arises whether similar trends would have been observed had a finer distinction been made. This point could be evaluated with more detailed data on mortality by occupational class from England & Wales. Changes over time in the manual/non-manual RR, as reported in this paper, could be compared with trends in the ratio of mortality of social class IV/V (semi- and unskilled workers) to social class I/II (professional and managerial workers). In the first case, the RR increased from 1.36 to 1.51, whereas in the second case the RR increased from 1.61 to 1.80, reflecting a similar change in relative excess mortality in the lower socioeconomic groups.

The educational and occupational data do not cover the same age range: educational mortality data in most countries are available until (at least) the age of 74, but for occupational class men 60 years had to be excluded from the analyses (see Data and Methods). In order to cover as large a part as possible of deaths as they relate to socioeconomic factors, we decided not to harmonise the age ranges of the analyses. However, this implies that a direct comparison between the results for education and occupation may be subject to bias. In order to see what the effect of age range restriction is, we did an additional analysis in which we restricted the data on mortality by educational level to the age group 30–59 years. As expected, in this younger age range absolute inequalities in mortality are smaller, but relative inequalities larger than in the original analyses. The pattern of changes over time, however, is largely identical. While absolute differences in total mortality by educational level were fairly stable, relative inequalities have increased in the age group 30–59 as they did in the age group 30–74 years, mainly due to faster mortality declines in the higher educational groups. Also, changes in cardiovascular disease mortality contribute importantly to the widening gap in total mortality (results not shown).

Comparison with previous studies

Widening inequalities in mortality in the period covered by this study have been reported before for Finland, Sweden, and England & Wales(195-198). What this study adds are two other Nordic countries, Norway and Denmark, and a Mediterranean country (Italy, Turin).

While declines in mortality by occupational class among men in Norway appear to be quite similar to those in Sweden, Denmark presents a slightly different picture, with less favourable mortality trends in manual and non-manual groups. Both in Norway and Denmark, mortality trends among women are generally less favourable than among men, with stagnating mortality among low educated women. Among Danish men with low education total mortality has slightly increased. This shows that the favourable impression given by the Swedish trends in mortality by occupational class among men cannot be generalised to other Scandinavian countries, and perhaps not even to Swedish women.

Although Turin cannot be seen to be representative of Italy as a whole, let alone other southern European countries for which longitudinal mortality data are generally lacking, it does present an interesting contrast to the other countries represented in this study. In this southern European city relative inequalities in mortality show a slight tendency to increase as they do in England & Wales and the Nordic countries, but this is not due to faster declines in mortality from cardiovascular diseases in the upper socioeconomic groups. On the contrary: if anything, cardiovascular disease declines faster in lower socioeconomic groups in Turin. Again, this shows the lack of generalizability of this type of finding from one part of Europe to the other.

While the international (English language) literature on trends in inequalities in mortality is dominated by reports from England & Wales, the latter are put into perspective by the results of our overview. The widening of the gap in total mortality in England & Wales has not been stronger than elsewhere, and appears to be an expression of developments that are shared with other northern European countries.

Implications

Faster proportional declines of mortality from cardiovascular diseases in the upper socioeconomic groups may be due to faster (proportional) changes in various 'proximate' determinants of cardiovascular disease, such as health-related behaviours (smoking, diet, exercise, ...) or health care interventions (hypertension detection and treatment, thrombolytic therapy, ...)(197, 212). The similarity between the developments in England & Wales and the Nordic countries on the one hand, and the dissimilarity with the developments in Italy (Turin) on the other hand, suggest that changes in health-related behaviours are an important part of the explanation. It has been shown before that there are important differences between northern and southern Europe in the social patterning of behaviours like smoking and diet(213, 214). For example, over the past decades smoking prevalence has declined faster in upper than in lower socioeconomic groups in northern Europe, resulting in strong socioeconomic gradients in smoking. In some parts of

southern Europe smoking is still more prevalent in upper socioeconomic groups, particularly among women(214).

Some of the cause-specific rises in mortality observed in lower socioeconomic groups also suggest an important role of health-related behaviours. Rising rates of mortality from lung cancer and respiratory disease probably point to the (delayed) effects of rising smoking prevalences in lower socioeconomic groups. Rising rates of breast cancer mortality among low educated women, as observed in Finland, may be due to changes in reproductive behaviour(215). The common determinant of rising rates of mortality from gastrointestinal diseases (which include liver cirrhosis as an important component) and injuries may be an increase in excessive alcohol consumption(216).

While these behavioural risk factors may be implicated as 'proximate' determinants, this social patterning of behaviour in turn is likely to be due to underlying structural factors like material disadvantage, unfavourable psychosocial conditions, or lack of access to behaviour change support(217, 218). Changing these behaviour patterns will therefore require much more than health education. Innovative approaches that combine individual behaviour change support with environmental interventions to remove barriers for healthy behaviour need to be developed.

In conclusion, reducing socioeconomic inequalities in mortality in Western Europe critically depends upon speeding up mortality declines from cardiovascular diseases in lower socioeconomic groups, and countering mortality increases from several other causes of death (lung cancer, breast cancer, respiratory diseases, gastrointestinal diseases, injuries) in lower socioeconomic groups.

8

Socioeconomic Inequalities in Mortality: Analyses on the Basis of Data at the Neighbourhood Level

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TSG. 2002;80(3):158-65.

Abstract

Background In many European countries data on socioeconomic differences in mortality rates are the core of a national monitoring system of socioeconomic differences in health. In the Netherlands however, no data on socioeconomic differences in mortality are available at the individual level.

Objectives The aim of this study is to evaluate if, and how, socioeconomic differences in mortality can be monitored by making use of data from Statistics Netherlands at the level of neighbourhoods.

Data The cause of death register 1995 is matched at the neighbourhood level with the borough and neighbourhood register as well as with data from the Regional Income study 1994.

Methods Neighbourhoods are ranked by their score on indicators of income and then divided into quintiles. The size of mortality differences is quantified by means of Poisson regression analysis.

Results The mortality level in areas with the lowest income is 13% higher than in areas with the highest income. The size of mortality differences is to a small extent biased by confounding variables. The size of mortality differences depends on the selected indicators of income. Household equivalent income is an indicator that is not very sensitive for confounding and that is easily interpretable. Comparatively large income related differences in mortality are observed in semi-urban areas and in the South.

Conclusions Based on these results, recommendations are developed for the use of neighbourhood level data for monitoring socioeconomic differences in mortality in the Netherlands.

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8.1 Introduction

In many European countries, data on socioeconomic differences in mortality rates are the core of a national monitoring system of socioeconomic differences in health. These data have made it possible to describe socioeconomic differences in mortality in Europe in detail(208, 219). They have also shown that mortality differences increased in most European countries in the decades between the seventies and the nineties(220).

Unfortunately, as socioeconomic characteristics of deceased are not recorded in the Dutch mortality registers, national data on socioeconomic differences in mortality are lacking. No census has been held in the Netherlands since 1971, ruling out the possibility of linking the death register to socioeconomic information obtained from census data. In 1995, Statistics Netherlands explored the possibilities of linking cause of death statistics to fiscal data(221). This approach was dogged by numerous problems. Aligning data from the municipal population registers with the fiscal data held by the taxation authorities proved to be difficult. Moreover, the fiscal data solely provided information about the income in the year prior to death. This is not always a reliable indication of a person's socioeconomic status during their lifetime. Regretfully, there are no indications that it will be routinely possible to link data on socioeconomic status to the register of deaths in the near future.

There is some information available on socioeconomic differences in mortality in the Netherlands. This information is derived from regional studies, such as those carried out in the Eindhoven (GLOBE) and Zutphen regions. These studies found that individuals with a low socioeconomic status had a higher mortality risk than individuals with a high socioeconomic status(222-224). In addition, studies were carried out in Amsterdam, Rotterdam and The Hague. But whereas in the Eindhoven and Zutphen studies socioeconomic status was measured at the levels of individuals, in these other studies socioeconomic status was measured at the level of neighbourhoods. It was found that the risk of death was higher among the populations of poorer neighbourhoods than among those residing in well-to-do neighbourhoods(225-227). Studies conducted abroad also found that socioeconomic mortality differences between small geographical units exist(228, 229).

The aim of the present study was to evaluate whether socioeconomic differences in mortality in the Netherlands as a whole can be monitored using data obtained at the level of neighbourhoods. The first step was to investigate whether practically speaking, it is possible to monitor socioeconomic mortality differences using neighbourhood level data. Next, the aspects to be considered when monitoring socioeconomic mortality differences at the level of the neighbourhood were examined, during which the following questions arose: 1) is the relationship between income and mortality at neighbourhood level sensitive for confounding? 2) do the mortality differences change in magnitude depending on the choice of specific indicator of socioeconomic status? 3) do geographic variables such as region and degree of urbanisation modify the relationship between socioeconomic status and mortality? The background for these three questions is discussed in more detail below.

Confounding variables

The relationship between socioeconomic status and mortality was evaluated prior to and after adjusting for variables that could confound the relationship between neighbourhood socioeconomic status and mortality. The effect of the following variables was investigated: percentage of institutionalised population, percentage of families, region, degree of urbanisation and percentage of ethnic minorities. These area characteristics are correlated with socioeconomic indicators and can act as confounding variables for the relationship between neighbourhood socioeconomic status and mortality because these variables a) can independently affect neighbourhood mortality rates and b) can exert influence on the socioeconomic composition of areas. This study seeks to determine the variables to be adjusted for in monitoring socioeconomic differences in mortality at the level of the neighbourhood.

Indicators of socioeconomic status

Income is the sole indicator of the socioeconomic status of neighbourhoods about which detailed information is available throughout the Netherlands. In this study, a comparison is made of various available income indicators and their association with mortality. In the first instance, preference could be given to household equivalent income, a measure calculated on the basis of the net household income adjusted for the composition and size of the household. This yields a 'purchasing power income', which is in general the preferred measure in the (inter) national literature(230) (64, 210). However, alternative income indicators are available. These differ in a) the extent to which the emphasis is placed on subgroups, such as the presence of relatively poor or wealthy inhabitants, b) whether households or individuals form the unit of observation and c) whether they solely comprise the full-time working population, or also include other inhabitants. In the present study, six income indicators, all differing from one another in the above respects, are compared with respect to their association with mortality.

Effect modifiers

The final aspect to be evaluated is whether the relationship between income and mortality is consistent throughout the Netherlands, or whether this varies according to a) degree of urbanisation and b) region. Geographic variation in the strength of the association between income and mortality may indicate a need to monitor this relationship more closely in specific areas. In addition, in this way insight is gained into the generalizability of results obtained in studies carried out in specific cities or regions.

8.2 Methods and data

We made use of three databases that are routinely generated by Statistics Netherlands:

The cause of death register 1995

This register contains records on all inhabitants of the Netherlands who died in 1995 (N=135.675). The neighbourhood in which the deceased resided up to the time of death was determined on the basis of the complete postal code (four digits and two letters). The cause of death register was aggregated at the neighbourhood level, resulting in a file containing the number of deceased per neighbourhood, sex and cause of death (coded according to the ICD 9).

The boroughs and neighbourhoods register 1995

This database contains descriptive information about all the neighbourhoods in the Netherlands in 1995. It includes information about the number of inhabitants by age and sex, about the percentage of ethnic minorities (first and second generation migrants from Turkey, Morocco, Surinam and the Netherlands Antilles and Aruba, source: population registers GBA 1995), degree of urbanisation (based on area address density, source: population registers GBA 1995) and a number of income indicators (source: regional income study 1994).

The regional income study 1994

This database offers detailed information about the income level and income distribution in neighbourhoods. The regional income study is based on the fiscal administration of income, and contains information about the taxed and untaxed income of the population. Moreover, this database contains information about the number of households per category of household (one-person, two or more persons cohabiting with or without children), number of households according to the socioeconomic status of the head of the household (active/inactive) and number of households according to age of the head of the household. Six indicators of income were selected from this database.

These three databases were linked by matching the data according to neighbourhood code. This yielded a file of 137,675 deceased in 10,693 neighbourhoods. However, a few neighbourhoods, such as those with a population of less than 100, had to be excluded from the analyses. These neighbourhoods had many variables containing missing values or did not occur in the Boroughs and neighbourhoods register or in the Regional Income Study. The final file comprised 8830 neighbourhoods with a total of 135,092 deceased. See Bos et al(231) for a more detailed description of the linking procedure.

Neighbourhoods are ranked by their score on indicators of income and then divided into quintiles, such that each quintile contains approximately 20% of the total number of inhabitants of the Netherlands (see Table 8.1). This was done for each separate indicator of income.

The size of the mortality differences by income was quantified in two ways: by mortality rate ratios (RRs) and by the more advanced indices of inequality (Relative Index of Inequality; RII). Mortality rate ratios, or risk ratios, express the mortality in an income

quintile as a ratio of the mortality in another income quintile. The quintile with the highest income was used as reference group to calculate the mortality rate ratios. Mortality rate ratios and their 95% confidence intervals were estimated by means of Poisson regression analysis. A series of four terms was included in the regression model, which represent the contrast between the lower and highest quintiles.

Table 8.1 Characteristics of neighbourhoods classified into quintiles by their average income

Quintile	Range of the av. household equivalent income (indexed)	No. of neighbour-hoods	No. of deaths	No of PY (* 1000)	Gross mortality rate (per 100,000 PY)
1 (high)	> 109.95	2275	26,263	3,060.36	858.16
2	102.49 – 109.95	1719	23,202	3,080.32	753.23
3	96.87 – 102.49	1577	26,626	3,047.61	873.67
4	89.59 – 96. 87	1653	29,279	3,044.23	961.78
5 (low)	< 89.59	1452	28,664	3,027.43	946.81
Total	100	8676	134,034	15,259.96	878.33

Relative indices of inequality consider all quintiles together and show that mortality systematically changes with the income level of the quintiles. To calculate RIIs, the quintiles were assigned scores according to their relative income position, which scores were equated with the proportion of the population having a higher-ranking position. For example, if the highest income quintile contained 20% of the population, the relative position of that quintile would be between 0.0 and 0.2, with an average of 0.1. The ranking so obtained was subsequently related to mortality using Poisson regression analysis. The exponent of the regression coefficient expresses the RII. This represents the mortality level of those at the bottom of the income hierarchy as a ratio of those at the top, estimated on the basis of the systematic association between mortality and income in all quintiles.

The expected number of deaths was used as the offset variable in the Poisson regression for both the RR and RII. The expected number of deaths per neighbourhood was calculated on the basis of the age and sex distribution of the persons 'at risk'.

To investigate the effect of confounding variables on the relation between income and mortality, regression analyses were performed with and without adjustment for confounding variables. The results of the analyses without confounders were compared to the results of the analysis where adjustments were carried out for the percentage of the institutionalised population, family composition, percentage of ethnic minorities, region and degree of urbanisation. Geographic variation was examined by stratification according to degree of urbanisation and region.

8.3 Results

The first column in Table 8.2 demonstrates the relationship between mortality and income, measured in terms of household equivalent income, at the neighbourhood level. As the average neighbourhood income level declines, mortality rates rise with regularity. After controlling for age and sex only, the mortality rate in the lowest-income neighbourhoods is 15% higher than that in the most affluent neighbourhoods. This mortality difference decreases after further adjustment for the percentage of institutionalised inhabitants, the percentage of ethnic minorities and neighbourhood composition by type of household. By contrast, the geographic variables were not important confounders.

In Table 8.3, six different indicators of income are compared. This analysis included controls for age, sex, percentage of the institutionalised population, percentage of ethnic minorities, region and degree of urbanisation. The difference in size of the mortality difference between several of these indicators is the same as those seen for the indicator household equivalent income. Considerably larger differences are found in measures that only take inhabitants with 52 weeks of income as the unit of observation.

In the bottom row of Table 8.3, the same six indicators are compared. This time, the analysis only controlled for age and sex. We found that the income indicators differ in the extent to which they are sensitive to confounding. The 'percentage of inhabitants with a low income' proved to be especially sensitive to confounding, while the indicator 'household equivalent income' was relatively insensitive to this.

Table 8.4 shows the relationship between income and mortality in the four parts of the country and per degree of urbanisation. Income-related mortality differences are relatively small in rural districts, but are large in semi-urban areas. The urban areas occupy the middle field. A comparison of the different parts of the country reveals that the biggest differences by far are seen in the southern region of Zealand, Brabant and Limburg.

The bottom row of Table 8.4 also illustrates the relationship between income and mortality stratified according to degree of urbanisation and region, after controlling for age and sex only. These results suggest that the largest differences in mortality occur in urban areas. After adjusting for confounding variables, the mortality differences in urban areas appeared to shrink, while the size of the mortality differences in semi-urban and rural areas, by contrast, were found to increase. Further analysis (no results presented) demonstrated that controlling for the percentage of ethnic minorities and family composition in urban areas caused the differences in mortality in urban areas to decrease, while controlling for 'percentage of institutionalised inhabitants' increased the association between socioeconomic status and mortality. Family composition was also found to explain part of the health differences in semi-urban areas, while this variable proved to mask the health differences in rural districts.

Confounders did not affect the size of socioeconomic mortality differences in the North, East or South. In the West, however, factors such as the foregoing were found to be

related to socioeconomic mortality differences. The observed size of mortality differences there was reduced by controlling for confounding variables.

An analysis not presented here explored whether income-related mortality differences among neighbourhoods could be demonstrated for all age groups. This analysis found that differences in mortality, in men and women, were the largest in middle age and that these decreased with age. From age 85 and up, no relation is found between mortality and income at the neighbourhood level(231)

8.4 Discussion

This article describes the results of a study aimed at evaluating whether, and how, socioeconomic differences in mortality could be monitored using neighbourhood level data. In the course of the study, it became evident to us that monitoring socioeconomic differences in mortality in the Netherlands using neighbourhood level data, was, indeed, feasible. For a detailed discussion on how the practical execution could be improved in a number of respects, please refer to Bos et al. (231).

Socioeconomic mortality differences exist at the neighbourhood level throughout the Netherlands. Inhabitants of poor neighbourhoods have a higher risk of death than do those of wealthy areas. Further, the goal of this study was to evaluate whether 1) the relationship, at neighbourhood level, between income and mortality was sensitive to confounding variables, 2) the size of the mortality differences varied according to the income indicator selected and 3) the relationship between income and mortality was modified by geographical variables.

Table 8.2 Mortality rate ratio in neighbourhoods ranked according to their household equivalent income: the effect of confounders

Income Quintile	RR (95 % confidence interval) adjusted for age, sex and...						
	No other variables	% institutionalised	Family composition	% Ethnic minorities	Region	Degree of urbanisation	All 5 confounders
1 (high)	1.00	1,00	1,00	1,00	1,00	1.00	1.00
2	1.03 (1.02-1.05)	1.07 (1.05-1.09)	1.05 (1.03-1.07)	1.03 (1.02-1.05)	1.03 (1.01-1.04)	1.04 (1.02-1.06)	1.06 (1.04-1.08)
3	1.09 (1.07-1.11)	1.12 (1.10-1.14)	1.10 (1.08-1.12)	1.09 (1.07-1.11)	1.08 (1.06-1.10)	1.10 (1.08-1.11)	1.10 (1.08-1.12)
4	1.09 (1.07-1.11)	1.10 (1.09-1.12)	1.08 (1.06-1.09)	1.08 (1.07-1.10)	1.09 (1.07-1.10)	1.09 (1.08-1.11)	1.10 (1.08-1.12)
5 (low)	1.15 (1.13-1.17)	1.14 (1.12-1.16)	1.11 (1.09-1.13)	1.12 (1.10-1.15)	1.15 (1.13-1.17)	1.15 (1.13-1.17)	1.13 (1.11-1.16)
RII	1.18 (1.16-1.20)	1.15 (1.13-1.18)	1.12 (1.10-1.14)	1.15 (1.13-1.18)	1.18 (1.16-1.21)	1.18 (1.16-1.20)	1.16 (1.13-1.19)

Table 8.3 Mortality rate ratio in neighbourhoods ranked according to their income: comparison of six income indicators

Income Quintile	RR [a] (95 % confidence interval)					
	Average household equivalent income	Average disposable income of households	Average disposable income of inhabitants with 52 weeks income	Average disposable income per inhabitant	% inhabitants with 52 weeks income in the lowest 40% of nat. income distribution	% inhabitants with 52 weeks income in the top 20% of national income distribution
1 (high)	1.00	1.00	1.00	1.00	1.00	1.00
2	1.06 (1.04-1.08)	1.03 (1.01-1.05)	1.06 (1.04-1.08)	1.08 (1.07-1.10)	1.04 (1.01-1.06)	1.05 (1.03-1.07)
3	1.10 (1.08-1.12)	1.09 (1.07-1.11)	1.13 (1.11-1.15)	1.09 (1.07-1.11)	1.11 (1.09-1.13)	1.13 (1.11-1.15)
4	1.10 (1.08-1.12)	1.06 (1.04-1.09)	1.16 (1.14-1.18)	1.12 (1.09-1.14)	1.13 (1.10-1.15)	1.13 (1.11-1.16)
5 (low)	1.13 (1.11-1.16)	1.09 (1.06-1.11)	1.21 (1.18-1.23)	1.14 (1.12-1.17)	1.19 (1.17-1.22)	1.18 (1.14-1.17)
RII [a]	1.16 (1.13-1.19)	1.11 (1.08-1.14)	1.26 (1.23-1.29)	1.16 (1.14-1.19)	1.24 (1.21-1.27)	1.23 (1.20-1.26)
RII [b]	1.18 (1.16-1.20)	1.19 (1.17-1.21)	1.36 (1.33-1.38)	1.10 (1.08-1.12)	1.49 (1.46-1.52)	1.29 (1.27-1.32)

[a] Adjusted for age, sex, percentage institutionalised population, family composition, percentage ethnic minorities, region and degree of urbanisation.

[b] Adjusted for age and sex.

Table 8.4 Mortality rate ratio in neighbourhoods ranked according to their household equivalent income: neighbourhoods stratified by degree of urbanisation and region

	RR (95 % confidence interval)							
	All	Degree of urbanisation			Region			
		Urban	Semi-urban	Rural	North	East	West	South
# Inh.[c]	15,327	6,004	6,069	3,254	1,594	3,142	7,206	3.386
1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1,00
2	1.06 (1.04-1.08)	1.05 (1.02-1.08)	1.08 (1.05-1.11)	1.08 (1.04-1.12)	1.08 (0.99-1.17)	1.08 (1.03-1.12)	1.06 (1.04-1.09)	1,06 (1,02-1,11)
3	1.10 (1.08-1.12)	1.07 (1.04-1.10)	1.15 (1.12-1.18)	1.08 (1.04-1.13)	1.15 (1.07-1.25)	1.06 (1.02-1.11)	1.06 (1.04-1.09)	1,18 (1,13-1,24)
4	1.10 (1.08-1.12)	1.09 (1.06-1.12)	1.17 (1.14-1.21)	1.06 (1.02-1.11)	1.14 (1.06-1.22)	1.09 (1.05-1.14)	1.05 (1.03-1.08)	1,21 (1,15-1,26)
5	1.13 (1.11-1.16)	1.13 (1.09-1.17)	1.22 (1.18-1.27)	1.10 (1.05-1.16)	1.19 (1.11-1.28)	1.10 (1.05-1.16)	1.08 (1.04-1.11)	1,29 (1,22-1,36)
RII[a]	1.16 (1.13-1.19)	1.16 (1.11-1.21)	1.27 (1.22-1.32)	1.08 (1.03-1.14)	1.16 (1.09-1.24)	1.10 (1.04-1.15)	1.10 (1.06-1.15)	1,32 (1,26-1,39)
RII[b]	1.18 (1.16-1.20)	1.24 (1.21-1.28)	1.18 (1.15-1.22)	1.01 (0.97-1.06)	1.16 (1.10-1.23)	1.08 (1.04-1.13)	1.18 (1.15-1.21)	1,31 (1,25-1,36)

[a] Adjusted for age, sex, percentage institutionalised population, family composition, percentage ethnic minorities, region and degree of urbanisation.

[b] Adjusted for age and sex.

[c] Number of Inhabitants *1000

Confounding variables

Mortality differences at neighbourhood level were virtually unable to be explained by the various possible confounding variables. Controlling for degree of urbanisation or region had no effect whatsoever on the size of the mortality differences. Controlling for percentage of the institutionalised population, percentage of ethnic minorities and family composition somewhat reduced the differences in mortality. Whether or not this study adequately controlled for confounding variables is discussed in the below.

The results could be biased by a flawed measurement of the confounding variables. The adjusted variables were classified into a mere four, or respectively, five categories. Residual confounding may occur due to the spread within the categories. Another possible shortcoming could be the fact that the variable 'percentage of ethnic minorities' was restricted to ethnic minorities from the four target groups (Turks, Moroccans, Surinamese and Antilleans), leading to underreporting of ethnic minorities in general. Furthermore, controlling for 'percentage of families', as an ecological variant of the variable civil status, may well be sub optimal. Families, as defined in the Regional Income Study, also include single parents, while this group is known to have an elevated mortality risk(232).

However, we are confident that the controls applied in this study will have largely eliminated the influence of these confounding variables. The sub optimal operationalization of a variable, or an underestimated percentage of ethnic minorities may, perhaps, temper the effect of these controls somewhat. Yet in the light of the fact that a) controls were applied for a relatively wide range of variables, b) controlling for the majority of these variables affected the relationship between income and mortality to only a very minor extent and c) that income and mortality were found to be associated whichever income indicator was selected, it is unlikely that the relation between income and mortality is more heavily influenced by confounders, than was observed by us in this study.

Factors for which our analysis could not control could also bias the results. Environmental factors, such as crime or traffic safety could also potentially confound the results. We expect the confounding effect of these environmental factors in general to be minimal, as the number of persons dying as a result of poor traffic safety or high crime rates *in their own neighbourhood* is relatively small. Moreover, the relevant question then becomes whether such specific factors function as intermediating factors in the effect of socioeconomic status on mortality at neighbourhood level.

Indicators of socioeconomic status

The results show that the observed size of mortality differences at neighbourhood level vary according to the indicator of income selected. The excess mortality in neighbourhoods with a low socioeconomic status is highest when using the income indicator 'average disposable income of inhabitants with 52 weeks income'. If indicators are selected that take either the household, or all inhabitants, as the unit of observation, the mortality differences are relatively small. An attempt to find an explanation for the variation in mortality differences according to indicator of income is made below.

Understanding this variation could possibly help in understanding which aspect of income is important in explaining these differences in mortality.

We examined whether the variation in mortality differences could be ascribed to a variation in the size of income differences. We hypothesized that income disparities are greater when measured on the basis of variables across the income of the working population (persons with 52 weeks income) than using variables across household income. This proved not to be the case. The disparities in income at neighbourhood level showed little variation among the income indicators.

Another explanation for the variation in the size of the mortality differences is that the income measures for inhabitants with 52 weeks income closely approximate the earned income and hence a person's position in the labour market. This measure does not adjust for household size and solely includes persons with an income. Obviously, measures that adjust for household size provide a better indication of the disposable income, but the income of the working population may well offer a better indication of other aspects of socioeconomic status. Earned income is more strongly associated with, among other things, occupation, the status of this occupation and level of education.

It should moreover be noted that, in particular, measures regarding the income of the working population are sensitive to confounding. Residual confounding may well serve to explain part of the relatively sizeable differences in mortality that are seen when selecting different income indicators.

In conclusion, we attribute the variation seen across the income indicators in the size of the socioeconomic differences in mortality on the one hand, to the fact that the indicators emphasize different components of socioeconomic status, and on the other hand to the fact that the correlation between the indicators and confounding variables is not, in all cases, the same. The household equivalent income is an income indicator that is relatively insensitive to confounding. As it also happens to be easily interpretable, we prefer to monitor the differences in mortality on the basis of this indicator, despite the fact that did not yield the biggest differences in mortality.

Effect modifiers

It emerged from the analyses that controlled for all confounding variables, that the biggest socioeconomic differences in mortality occurred in semi-urban areas and the smallest in rural districts. This is a surprising result, given the assumption that socioeconomic mortality differences would be higher in urban areas than in semi-urban and rural districts.

This variation by degree of urbanisation may partly be due to the age structure of neighbourhoods. Individuals over the age of 65 tend to live more often in urban, rather than rural areas. Individuals under age 65 are more likely to live in rural areas, and just as likely to live in semi-urban areas. As among the elderly, socioeconomic mortality differences are relatively small, the overrepresentation of persons over the age of 65 in urban areas may have contributed to the lower-than-expected mortality differences in urban areas.

The variation of socioeconomic mortality differences according to degree of urbanisation for people older than 65 was comparable to the variation we observed summed over all ages. However, the differences in mortality for persons under age 65 were the same in urban and in semi-urban areas (results not presented). This cannot be attributed to the age structure of these areas. After all, persons under the age of 65 are relatively less likely to reside in urban areas. The relatively large mortality differences among the younger population of urban areas may possibly be explained by confounding factors, such as the geographical distribution of special subpopulations such as ethnic minorities and one-person households. In themselves, these groups tend to have a higher mortality risk(233, 234). The concentration of these groups in urban areas might also influence the mortality risks of other neighbourhood residents (235, 236).

Socioeconomic differences in mortality were found to be larger in the southern part of the country than in the rest of the Netherlands. This study offers no explanation of the reason for the larger mortality differences seen in the south. Perhaps the differences in health-related behaviour between rich and poor are greater than in the rest of the country. Furthermore, it may not be entirely coincidental that the socioeconomic differences in mortality observed in the more southern regions, and particularly in the northern part of France, are extremely large by European standards(205). These very considerable differences are attributed mainly to the extremely high level of alcohol consumption by the social lower classes(205). It may be advisable to investigate whether the same phenomenon, albeit less pronounced, is at work in the southern part of the Netherlands.

The fact that mortality difference sizes vary from region to region is an indication that possibilities exist to reduce the size of these differences. The results suggest that interventions aimed at the reduction of socioeconomic mortality differences should in particular be directed at the specific situation in the southern part of the country.

Comparison with recent studies

In this study, after adjusting for confounders the mortality level in low-income neighbourhoods is 13% higher than in affluent neighbourhoods. Larger mortality differences appeared to emerge in previous studies using neighbourhood level data(225-227), but because these studies differed on various (methodological) points from the present study, comparing the size of the mortality differences found is no straightforward task. Previous studies referred solely to the population under 65, made use of other socioeconomic status indicators and controlled for other confounders. Moreover, earlier research was conducted in specific cities, while our study clearly shows that regional differences occur in socioeconomic differences in mortality.

In the present study, we chose to compare neighbourhoods and not smaller geographical units such as six character alphanumeric postal code areas. This prompts the question of whether bigger differences would have been found at a lower aggregation level. In two recently conducted studies(235, 237), the size of the differences at neighbourhood level

were compared to the size of the differences at postal code level. In the city of Amsterdam, an analysis was carried out relating to the size of socioeconomic differences in health. This study found that the size of the health inequalities did not depend on aggregation level(235). An analysis of the size of socioeconomic mortality differences in the Netherlands as a whole is also available. The differences measured at postal code level deviated only very slightly from those measured at the neighbourhood level, although the mortality difference seemed slightly stronger for men at postal code level than at neighbourhood level(237).

8.5 Conclusion

The objective of this study was to evaluate whether socioeconomic differences in mortality could be monitored by making use of data at the level of neighbourhoods. We observed that neighbourhood level data can be applied to identify socioeconomic mortality differences. This opens the way for monitoring mortality differences at the level of small geographical units, enabling the developments in these differences to be tracked over time.

An important advantage of the data used is their availability for the Netherlands as a whole, allowing these to be broken down geographically, as well. Analyses that have been stratified by degree of urbanisation and national region have proven to be very informative. The variation in the size of mortality differences on the basis of these two variables indicates the importance of using data that cover the entire country of the Netherlands.

Using ecological data for monitoring has the additional advantage of being available for both sexes and all ages. Mortality differences can now be measured in groups such as women, the elderly and children, where, traditionally, monitoring for socioeconomic differences in mortality has been difficult, such that the results for men are comparable to those for women, and moreover, the results can be compared across all ages.

A final benefit is the fact that the confidence levels are relatively small in an analysis on an ecological level. This offers numerous possibilities for detailed analyses, among other things of modest causes of death. In analysing these data, we found cause of death specific patterns, such as minor differences for some types of cancer and large differences in respiratory disorders, that correspond closely with patterns observed in other European countries(231).

We concluded that socioeconomic differences in mortality can be monitored by making use of neighbourhood level data. Data at the level of the neighbourhood offer new possibilities for research into socioeconomic health differences in groups and health problems that have hitherto received only scant attention. Whether or not this approach can also be applied to other registration systems would therefore seem well worth investigating.

Key points

- Data at the neighbourhood level make it possible to monitor socioeconomic mortality differences in the Netherlands.
- Neighbourhood level socioeconomic mortality differences are relatively large in semi-urban areas and in the southern part of the country. This variation by degree of urbanisation and by country region means that, when monitoring mortality differences, use must be made of data that cover the whole of the Netherlands.
- Confounders have a slight effect on the magnitude of the mortality differences, but this is dependent on the income indicator selected.
- An advantage of neighbourhood-level data is that its use makes it possible to assess socioeconomic mortality differences for traditionally hard-to-reach groups and for minor causes of death. A disadvantage is the relatively small size of the mortality differences at the neighbourhood level.

9

Socioeconomic Inequalities in Mortality measured at the Neighbourhood Level: Comparison with Estimates based on Individual Level Data

Bos V, Kunst AE, Mackenbach JP.
In: Sociaal-economische gezondheidsverschillen: Van verklaren naar verkleinen. Den Haag: ZonMW, 2001:8-20.

Abstract

Objectives This study analyses whether data at the neighbourhood level can be used to proxy the magnitude of income-related mortality differences on the individual level. To this end, we compared the magnitude of socioeconomic mortality differences, measured on the basis of neighbourhood level data to those measured on the basis of individual level data. The factors complicating this comparison are discussed, after which the extent to which these complications can be resolved is assessed.

Data The neighbourhood level data were obtained from the cause of death statistics for 1995, the boroughs and neighbourhoods register 1995 and the Regional Income Study 1994. Individual level data were provided by the GLOBE study.

Conclusions The findings of this study suggest that 1) socioeconomic mortality differences between neighbourhoods are smaller than socioeconomic mortality differences between individuals, 2) applying a variant to Beral's method can considerably reduce the discrepancy between the magnitude of socioeconomic differences in mortality measured on the basis of neighbourhood data and those measured on the basis of individual level data, 3) despite application of this method, achieving accurate proxy measurements of individual socioeconomic mortality differences based on neighbourhood level data remains a challenge.

Implications The fact that neighbourhood level inequalities in mortality are relatively small does not imply that neighbourhood data are wholly unable to provide a clear idea of the pattern of mortality differences by e.g. age, sex and cause of death, or of changes in the size of mortality differences over time.

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9.1 Introduction

In many countries, data on socioeconomic differences in mortality rates are the core of a national monitoring system of socioeconomic inequalities in health. In the Netherlands, we unfortunately have no national data on socioeconomic differences in mortality, as socioeconomic characteristics of the deceased are not recorded in the mortality register. Since 1995, however, it has been possible to link data from the cause of death register kept by the Central Bureau of Statistics to socioeconomic characteristics of a neighbourhood on the basis of postal code geocoding. This study aims to assess whether these neighbourhood level data can be used to monitor socioeconomic mortality differences in the Netherlands.

The use of aggregate-level data offers numerous advantages. In general, the number of observations is very considerable, which means that the statistical power is high. This also makes it possible to study cause-specific mortality. Aggregated data often cover the entire population, including the elderly, the young and women – groups often absent in individual level studies. Another advantage of aggregated data is the fact that such data tends to become available relatively quickly. This makes it possible to measure recent developments, as well.

In many other European countries, socioeconomic mortality differences are monitored on the basis of individual level data. In order to compare the magnitude of the mortality differences in the Netherlands with that of other countries, estimates should first be obtained of the socioeconomic mortality differences occurring at the level of the individual. Moreover, socioeconomic mortality differences are in all likelihood mainly caused by the influence of socioeconomic status at the individual level. The influence of the average socioeconomic status of the neighbourhood on mortality is less pronounced(238, 239). Thus, preference should be given to measuring socioeconomic mortality differences at the individual level.

This study assesses whether data at the neighbourhood level can be used to proxy the magnitude of income-related mortality differences on the individual level. To this end, we compared the magnitude of socioeconomic mortality differences, measured on the basis of neighbourhood level data, to that of the differences measured on the basis of individual level data. The factors complicating this comparison are subsequently discussed, after which the extent to which these complications can be resolved is evaluated. The exact research questions are: 1) do the differences in mortality at the neighbourhood level correspond in magnitude with the differences in mortality occurring at the level of the individual? 2) to what may differences in magnitude be attributed? 3) can discrepancies be reduced by taking complicating factors into account? On the basis of these analyses, we proposed to assess the degree to which neighbourhood level data may be applied to estimate the size of mortality differences at the individual-level.

There are a number of reasons why socioeconomic mortality differences at the aggregated level cannot directly be compared with socioeconomic mortality differences at

the individual level. One important reason is that the range in socioeconomic status seen at the aggregated level will be smaller than the range in socioeconomic status at the individual level. On analysing national data on the distribution of households by household income and by the income of the neighbourhoods in which these households were located, we found an income range at the individual level that was nearly four times that found at the level of the neighbourhood (see Table 9.1)(64). As the range in income at the neighbourhood level is much smaller than the range in income at the level of the individual, this implies a high degree of heterogeneity in income within neighbourhoods. This difference in range strongly suggests that the size of socioeconomic differences between neighbourhoods is smaller than the size of socioeconomic differences between individuals.

Table 9.1 Households classified into quintiles by household equivalent income and by average household equivalent income of neighbourhoods

Households classified by average household equivalent income of neighbourhoods (ecological data)	Households classified by household equivalent income (individual level data)					% correct per neighbour-hood quintile
	142 and more	112-142	89-112	67-89	67 and less	
109.95 and more	**406100**	257290	195730	143680	112920	36.4
102.49-10.9.95	270800	**258930**	240510	211510	153870	22.8
96.87-102.49	220030	245830	**248860**	245820	196410	21.5
89.59-96.87	179760	234010	257530	**280000**	267520	22.9
89.59 and less	113460	193250	244020	301980	**434680**	33.8
% correct per household quintile	34.1	21.8	21.0	23.7	37.3	27.5

Other reasons why socioeconomic mortality differences at the neighbourhood level cannot be directly compared with socioeconomic differences at the individual level come under the heading of what is called the 'ecological fallacy'. This refers to the fact that associations on the ecological level may differ greatly from associations on the individual level(240, 241). There is therefore some risk in drawing conclusions on the basis of a relation measured on the ecological level. The ecological fallacy is related to a number of aspects that are briefly discussed below.

Aggregated effects

In various multi-level studies(242, 243) it has been shown that the socioeconomic status of small geographical units have an effect on the health of individuals. Hence, the correlation between socioeconomic characteristics and mortality at the level of the neighbourhood is not only affected by individual level effects, but also by contextual level effects. If

contextual effects are indeed present, mortality differences at the neighbourhood level will be greater than is expected based on the effects at the level of the individual alone.

Selection

Socioeconomic inequalities in health arise, not only due to the causal effect of socioeconomic status on health, but also as a result of health selection, i.e. a person's health affects his or her socioeconomic status. At the level of the neighbourhood, health selection implies that there are people living in neighbourhoods with a lower socioeconomic status as a result of the fact that they suffer from impaired health. It may well be the case that the strength of the effect of health selection is not the same at individual level as at the aggregated level. If the importance of health selection, as a health determinant, is not the same at the individual and the aggregate level, this will complicate the estimation of mortality differences at the individual level based on aggregated data.

Multicollinearity

The mutual correlation between explanatory variables (multicollinearity) is often stronger on the aggregated than on the individual level. Because of this higher correlation, aggregated studies run the risk of bias due to confounding variables. These variables can result in a different background risk for neighbourhoods, which means that the risk of health problems will differ systematically between neighbourhoods with a high, and those with a low socioeconomic status(240). A higher multicollinearity increases the chance that neighbourhoods, rather than individuals, will differ in background risk. If this is indeed the case, it will make it even more difficult to compare results from a study on the aggregated level to the results of a study on the individual level.

The above factors may complicate comparisons between socioeconomic mortality differences on the basis of data at the neighbourhood level, and socioeconomic mortality differences based on individual level data.

In this study, a method was used which made it possible to adjust for the smaller range in socioeconomic status at the neighbourhood level. This method is based on a method developed by Beral that enables a mortality rate ratio to be estimated in situations where morbidity is correlated with an average exposure to a risk factor(244). Assuming a (log)linear relation between morbidity and exposure, the disease frequency is estimated in a population with full exposure and a population without any exposure. Subsequently, the mortality rate ratio is estimated for exposure versus no exposure. By applying a variant of Beral's method, we proposed to adjust for the smaller range in income at the aggregated data level.

9.2 Data

Use was made for the purpose of this study of three databases that are routinely generated by Statistics Netherlands.

The cause of death register 1995
This register contains records on all the inhabitants of the Netherlands who died in 1995 (N=135.675). Sex, age, latest address and the primary and secondary cause of death (coded according to the ICD 9) are entered for each death. The neighbourhood in which the deceased resided up to the time of death was determined on the basis of the complete postal code (four digits and two letters). The cause of death register was aggregated at the neighbourhood level, resulting in a file with a number of deaths per neighbourhood, sex and cause of death.

The database key figures on boroughs and neighbourhoods 1995
This database contains descriptive information about all the neighbourhoods existing in the Netherlands in 1995. It includes information about the degree of urbanisation (source: population registers GBA 1995), the number of inhabitants by age, by sex, number of families with and without children, the percentage of ethnic minorities (source: population registers GBA 1995), various income indicators (source: regional income study 1994), and the number of companies per sector (source: general register of companies).

The regional income study 1994
This database offers detailed information about the income level and income distribution in neighbourhoods. The regional income study is based on the fiscal administration of income, and contains information about the taxed and untaxed income of the population (rent rebate, student allowance, child benefits, source: Ministry of Housing, Spatial Planning and Environment). Moreover, this database contains information about the number of households per category of household (single-parent, persons cohabiting with or without children), number of households according to the socioeconomic status of the head of the household (active/inactive) and number of households according to age of the head of the household.

These three databases were linked by matching the data according to neighbourhood code. Neighbourhoods not included in both the database of key figures on boroughs and neighbourhoods and that of the Regional Income Study were excluded from the analysis. Also, neighbourhoods with a population of less than 100 persons were excluded, as they had missing values for most variables from the database of key figures on boroughs and neighbourhoods and that of the Regional Income Study. This ultimately yielded a file of 137,675 deaths in 8830 neighbourhoods. See Bos et al(64, 231) for a more detailed description of the linking procedure.

The above files contain national data on the entire Dutch population. At the individual level, however, the only data available related to the Eindhoven area and referred to the age group of 15-74 years. In order to maximize the comparability between the data at the neighbourhood, and data at the individual level, only neighbourhoods situated in the Eindhoven area were selected at the neighbourhood level from the original file. Furthermore, the analysis was restricted to inhabitants and deaths between the ages of 15 and 74.

Individual level research data were obtained from the GLOBE study (in Dutch, an acronym for Gezondheid en Levensomstandigheden Bevolking Eindhoven e.o.). In this prospective cohort study, individuals between the ages of 15 and 74 were followed over a period of time. A mail questionnaire was conducted in 1991 among 27,000 non-institutionalised inhabitants of Eindhoven and a number of surrounding municipalities. The municipal population register provided data about total mortality among respondents in the follow-up period, until mid-1997. Information about income level and confounders are derived from an oral survey held among part of the respondents. For more detailed information about this study, please refer to Schrijvers et al(245).

9.3 Methods

For the purpose of the neighbourhood level analysis, neighbourhoods in the Eindhoven region were ranked by the average household equivalent income of the neighbourhoods and then divided into quartiles, such that each quartile contained approximately 25% of the total number of inhabitants. In the individual level analysis, respondents from the GLOBE study were ranked according to their household equivalent income and then divided into quartiles, such that each quartile contained approximately 25% of the number of respondents.

The magnitude of the differences in mortality by income was quantified by mortality rate ratios. The quartile with the highest income was used as reference group. In the analysis at the neighbourhood level, RRs expressed how much higher/lower the chance of death is for a person in a less affluent neighbourhood, compared to an individual residing in a wealthy neighbourhood. In individual level analysis, RRs expressed how much higher/lower the chance of death is for a person with a lower income, compared to an individual with an income in the highest quartile.

RRs and their 95% confidence intervals were estimated by means of Poisson regression analysis, using the expected number of deaths as offset variable. The expected number of deaths was calculated based on the distribution of persons at risk by age and sex.

The regression model included a series of three terms showing the contrast between a lower and the highest quartile (Table 9.2 and 9.3). A regression analysis was also conducted which took household equivalent income as a continuous variable. The

regression coefficient thus obtained represents the mortality increase seen in the event of a decrease of NLG 1000 in household equivalent income (Table 9.4).

In order to compare the mortality rate ratios obtained at the neighbourhood level (RRn) with those obtained at the individual level (RRi), this study adjusted for the smaller range in income at the neighbourhood level. Beral developed a method to estimate a mortality rate ratio from ecological data in which a health measure is correlated with an average exposure to a risk factor(244). Assuming that this measure has a (log)linear relation to exposure, the disease frequency is estimated in a population with full exposure and a population without any exposure. Subsequently, the mortality rate ratio is estimated for exposure versus no exposure.

However, if income is the risk factor, it is impossible to adhere to full exposure versus no exposure. A variant of Beral's method was therefore devised, which involved extrapolating the range in income at the neighbourhood level (I_b) to the income range seen at the individual level (I_i). The mortality rate ratio of death in neighbourhoods with the lowest extrapolated income was calculated against the risk of death in neighbourhoods with the highest extrapolated income. In calculating this mortality rate ratio, use was made of the beta observed at the neighbourhood level. The mortality rate ratio thus obtained was maximally comparable to a mortality rate ratio determined on the basis of individual level data. The equation for this maximally comparable mortality rate ratio is:

$$\text{Exp}^{\text{Beta}_b * (\text{Ihigh}_i - I_j)}$$

where Beta_b is the regression coefficient derived from a Poisson regression of neighbourhood data. Ihigh_i is the reference income at the individual level, which in this study is equated to the median income of 25% of the GLOBE study participants with the highest income. I_j is the median income in the quartile for which the mortality rate ratio is being calculated. Our concern is mainly with the mortality rate ratio for the lowest income group versus the highest income group. I_j is in that case the median income of the 25% of participants in the GLOBE study with the lowest income.

9.4 Results

In Table 9.2, the association between income and mortality has been estimated using neighbourhood level data. In Table 9.3, the association between income and mortality has been estimated using individual level data. Comparison of the two tables reveals that bigger mortality differences are common at the individual level. It should be noted that the confidence intervals are sizeable, especially in the GLOBE study, which considerably complicates making any precise estimates about the size of the differences.

Table 9.2 Mortality rate ratio by average equivalent household income of neighbourhoods

Income quartile	Average household equivalent income (NLG)	Mortality rate ratio[a] (95% CI)
1 (high)	34,400 or more	1.00
2	31,900 – 34,400	1.11 (.96-1.28)
3	29,200-31,900	1.27 (1.10-1.46)
4 (low)	Less than 29,200	1.27 (1.06-1.51)

[a] adjusted for age, sex, degree of urbanisation, family composition, percentage of ethnic minorities and institutionalised population

In figure 9.1, the mortality rate ratios from Tables 9.2 and 9.3 have been set off against the absolute level of household equivalent income. The income quartiles that have been distinguished at the individual level, naturally demonstrate a far greater range than the quartiles differentiated at the neighbourhood level. Both data sources show a similar effect of income level on mortality rate ratios. The main point of difference is that according to the neighbourhood level there is no difference between the lowest and the next-to-lowest quartile.

Table 9.3 Mortality rate ratio by equivalent household income from the GLOBE data

Income quartile	Household equivalent income (NLG)	Mortality rate ratio[a] (95% CI)
1	42,940 or more	1.00
2	29,000 – 42,940	1.60 (.94-2.70)
3	20,370 – 29,000	1.79 (1.05-3.03)
4	Less than 20,370	2.33 (1.40-3.86)

[a] adjusted for age, sex, degree of urbanisation and marital status.

Based on the data presented in figure 9.1, the correlation between mortality and income level was quantified using regression analysis. The regression coefficients (betas) are shown in the third row of Table 9.4. We applied Beral's method on the basis of these betas. The mortality rate ratio of 1.64 (below right) is an 'ecological' estimate of the magnitude of mortality differences at the individual level. This estimate was made by multiplying the beta estimated at neighbourhood level (0.0144) with the difference in income observed at the individual level (52,0-17,5). This estimate of 1.64 is smaller than the 2.20 that was estimated solely on the basis of individual data.

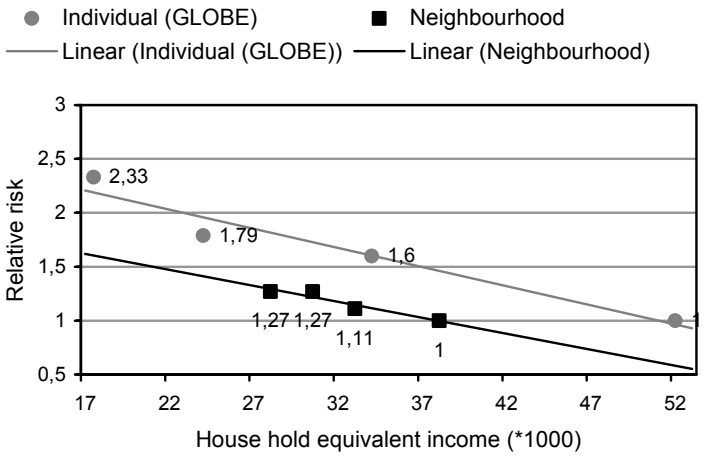

Figure 9.1 Association between mortality rate ratio of death and household equivalent income, observed using data at the individual (GLOBE) and neighbourhood level respectively.

Table 9.4 Estimation of a mortality rate ratio that is maximally comparable to a mortality rate ratio at the individual level on the basis of neighbourhood level data (beta) and individual level data (income limits).

	Individual data	Aggregated data	Combination aggregated and individual data
IHigh: median household equivalent income of the highest quintile (NLG 1000)	52.0	38.0	52.0
Ilow: median household equivalent income of the lowest quintile (NLG 1000)	17.5	28.2	17.5
Beta with 95% c.i.: increase in mortality at a decrease of NLG 1000	0.0229 0.011-0.035)	0.0144 (0.003-0.026)	0.0144 (0.003-0.026)
Mortality rate ratio with 95% CI: $\exp^{\text{Beta * (Ihigh-Ilow)}}$	2.20 (1.46-3.35)	1.15 (1.03-1.29)	1.64 (1.11-2.45)

9.5 Discussion

In this article, we assessed whether the size of income-related mortality differences could be determined at the individual level using neighbourhood level data. The income-related mortality differences were five times those found at the neighbourhood level. However, a direct comparison between the two does not yield an accurate picture, as the range in individual incomes is far greater than the income range found in neighbourhoods. In this article, we therefore applied a variant of Beral's method to adjust for the smaller range in neighbourhood level income. After this adjustment, the mortality differences at the individual level were much closer to the mortality differences based on extrapolated neighbourhood data. However, not all the differences were eliminated with this adjustment. Even after adjustment, the individual level mortality differences were about twice those of the mortality differences approximated with the help of neighbourhood data. A number of possible reasons for this are discussed in the below.

We start with discussing three reasons that are specific to the data files used in this study.

Coincidental fluctuation

In the first place, it should be noted that the differences might well be attributable to coincidental fluctuation. The difference between the mortality rate ratio at the individual level and the maximum comparable mortality rate ratio based on neighbourhood level data is by far not always statistically significant. We nonetheless deem it important to assess what other possible reasons there may be for the relatively small mortality differences at the neighbourhood level and have therefore looked at five possible reasons for these in the below.

Income measurement flaws

The size of the mortality differences estimated using Beral's method is dependent on the size of the income differences observed at the individual level. An inaccurate measurement of the range in income could have possibly biased the results. In this study, data on household equivalent income was obtained by asking respondents about their income, while on the neighbourhood level, income was obtained on the basis of data from the tax department. As a result, the income reported on the individual level is probably less accurate than the income data obtained at the neighbourhood level. Income components which respondents in the GLOBE study, failed to take into account, whether deliberately or otherwise (such as income from capital), are probably not distributed equally over the population. An empirical evaluation of the extent to which the less accurate reporting of data could have affected mortality differences is impossible. We would expect, however, that if income components failed to be reported by respondents in the GLOBE study, the differences in income would decline, rather than grow. In our opinion, the magnitude of mortality differences at the individual level have, in all likelihood, been somewhat

underestimated. A flaw in the income measurement process can therefore not explain why mortality differences based on neighbourhood data are smaller than mortality differences measured on the basis of individual level data.

Difference in populations

On the individual level, only subjects who could a) answer the questions on the questionnaire in writing, b) who were willing to answer the questions and c) who spoke Dutch, took part. As the neighbourhood level survey was not based on questionnaires, no such selection mechanisms were involved. Everyone in the relevant age group residing in the Eindhoven region was included in this study. Those who did not participate in the GLOBE study may very well have been people in poorer health and with a lower income. As a result, the health inequalities may have been underestimated in the GLOBE study. If that is the case, it fails to explain why mortality differences on the basis of neighbourhood level data should be smaller than those that emerged from the individual level data provided by the GLOBE study.

The reasons mentioned above are specific to this study. There are, in addition, three more general reasons that are inherent to the problem of the ecological fallacy.

Aggregated effects

In this study, socioeconomic status was measured on an aggregated level: the average household equivalent income of a neighbourhood. Were the average socioeconomic status of a neighbourhood to be an important determinant of health, very sizeable differences in mortality should have been observed at the neighbourhood level in this study. The fact that relatively small mortality differences turned up at the neighbourhood level indicates that the effect of the average socioeconomic status of a neighbourhood on health is relatively weak. The difference between income and mortality at the level of the neighbourhood would therefore appear to be weaker than the association between income and mortality on the individual level. This corresponds with the findings of most socioeconomic studies, that the socioeconomic status of a neighbourhood has a far weaker effect on mortality than does socioeconomic status at the individual level(238) (239).

Selection

On an individual level, mortality differences may also arise because people have a lower socioeconomic status because of poor health. Health selection may also play a role at the neighbourhood level if people are more likely to live in poorer neighbourhoods because of poor health, or if people are more likely to live in affluent neighbourhoods due to good health. However, we know of no publications that use health selection to explain socioeconomic differences in mortality between neighbourhoods, nor of any on the

magnitude of selection effects seen at the neighbourhood level compared to the individual level.

As a rule, health-related migration might be expected to strengthen the association between death and socioeconomic status at the neighbourhood level. Locating institutions such as nursing homes and homes for the elderly in neighbourhoods with a low socioeconomic status may be one of the mechanisms by which this association is reinforced. In another study, we found a weak inverse relation between the presence of institutions and the average household equivalent income of neighbourhoods (results not shown here). The effects of health selection at the level of the neighbourhood encompass far more than those related to the above institutions. Other selection effects can play a role. All in all, selection effects would appear to be complex and it is not immediately clear whether health-related migration always leads to bigger mortality differences. In our opinion, the size of selection effects at the neighbourhood level is not likely to be the same as the size of the selection effects found at the individual level, and we therefore by no means rule out the possibility that this contributed to the difference in the size of the mortality differences found at the neighbourhood level compared to those found at the individual level.

Multicollinearity

An increased correlation between variables on the aggregated level can influence health inequalities at the neighbourhood level. We investigated whether the correlation between variables is stronger at the neighbourhood level than at the individual level and whether there were, indeed, indications of an intensified relationship at the neighbourhood level. We found, for example, that the correlation between the variables marital status, family composition, degree of urbanisation and income were stronger at the neighbourhood level than at the individual level (results not shown here). This higher correlation complicates the estimation of the magnitude of socioeconomic differences at the neighbourhood level, because of the chance of a strong degree of confounding occurring, which happens when neighbourhoods with a low socioeconomic status have a different background risk than neighbourhoods with a higher socioeconomic status. This difference in background risk also occurs between individuals, but is probably in that case smaller as the correlation between relevant variables is, as a rule, also smaller. Both in the neighbourhood level analysis and in the individual level analysis, differences in background were controlled for as far as possible. However, residual confounding cannot be ruled out, with the risk of this being higher at the neighbourhood level than on the individual level. Confounders can both explain and mask socioeconomic health inequalities. We cannot exclude confounders as a cause of the relatively small health differences at the neighbourhood level or the relatively large differences in health seen at the individual level.

9.6 Conclusions

In this study, we assessed whether the size of income-related mortality differences at the individual level could be proxied using neighbourhood level data. Before drawing any conclusions, however, it should be noted that a limitation of this study was that it was solely possible to compare the results at the neighbourhood level with the results of one study conducted on the individual level, and that the coincidence fluctuations in this study were considerable.

The findings of this study suggest that 1) socioeconomic mortality differences are smaller between neighbourhoods than between individuals, 2) the discrepancy between the magnitude of the socioeconomic mortality differences at the neighbourhood level and at the level of the individual may be made smaller by applying a variant of the Beral method, 3) despite application of this method, the use of neighbourhood level data on socioeconomic mortality differences as a proxy for individual level data would not appear to yield a truly accurate measurement of these differences.

The fact that health differences are relatively small at the neighbourhood level does not imply that it is impossible to gain insight, on the basis of neighbourhood level data, into the pattern of mortality differences by e.g. age, sex and cause of death, or of changes in the size of these mortality differences over time. Elsewhere, we have presented an analysis using neighbourhood level data to describe how the magnitude of mortality differences varies by age, sex and cause of death. The patterns observed in this analysis correspond strongly with the patterns that might be expected on the basis of findings in studies performed abroad(64). Despite their inherent limitations, neighbourhood level data can yield an important contribution to efforts to chart and monitor socioeconomic mortality differences in the Netherlands.

10

Socioeconomic Inequalities in Mortality within Ethnic Groups

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Abstract

Study objective To analyse socioeconomic inequalities in mortality in Dutch, Turkish, Moroccans, Surinamese and Antillean/Aruban men and women living in the Netherlands and to assess the contribution of specific causes of death to these inequalities.
Design Open cohort design using data from the Municipal Population Registers and cause of death registry.
Setting The Netherlands from 1995 through 2000.
Participants All inhabitants of the Netherlands.
Main outcome measures We calculated directly standardised mortality rates by mean neighbourhood income and estimated relative mortality ratios comparing the two lowest socioeconomic groups with the two highest socioeconomic groups for all and cause-specific mortality by country of origin and sex.
Main results Socioeconomic differences in total mortality were relatively large in Dutch, (RR=1.49, CI=1.46-1.52), Surinamese (1.32, 1.19-1.46) and Antillean/Aruban men (1.56, 1.29-1.89) and in Dutch (1.39, 135-1.42) and Surinamese women (1.27, 1.11-1.46). They were relatively small among Turkish (1.10, 0.99-1.23) and Moroccan men (1.10, 0.97-1.26) and among Turkish (1.13, 0.97-1.33), Moroccan (1.12, 0.93-1.35) and Antillean/Aruban women (1.03, 0.80-1.33). The mortality differences among the Dutch were partly attributable to inequalities in mortality from cardiovascular diseases, whereas among Antillean/Aruban men external causes strongly contributed to the mortality differences. The small differences among Turkish and Moroccan men were due to a lack of inequalities for cardiovascular diseases and small inequalities for the other causes.
Conclusions The impact of socioeconomic status on mortality differed between ethnic groups living in the Netherlands. Maintaining small socioeconomic inequalities in mortality among Turkish and Moroccans men and women and among Antillean/Aruban women could prevent future increases in overall mortality in these groups.

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10.1 Introduction

Within many countries, substantial inequalities in mortality between ethnic groups exist(2, 3, 88). The extent to which socioeconomic inequalities underlie ethnic inequalities in mortality remains contested, but many argue that ethnic inequalities in mortality are predominantly determined by socioeconomic inequalities(38, 40). If the strength of the relation between socioeconomic status and mortality would vary between ethnic groups, this would have consequences for the extent to which socioeconomic inequalities can underlie ethnic differences in mortality. Therefore, in order to better understand the relationship between ethnicity, socioeconomic status and mortality, it is important to assess whether socioeconomic factors affect mortality in a similar way in all ethnic groups. However, up to now, little research has been done on the size of socioeconomic inequalities in mortality within ethnic minority groups. Most of the existing evidence originates from the UK and USA and suggests that the association between socioeconomic position and mortality may not be equally strong in all ethnic groups(2, 3, 246-249).

The size of socioeconomic inequalities in mortality varies between countries, age groups, sexes, periods and rural/urban areas,(250-253) and this suggests that it may also vary between ethnic groups. Variations in the size of the gradient between ethnic groups could be related to artefacts, but it may also be related to real phenomena, such as health selection effects being more pronounced in some socioeconomic strata than in others or to ethnic variations in the relationship between specific risk factors (such as smoking and diet) and socioeconomic status.

The situation in the Netherlands resembles that in many other continental-European countries, in the sense that many important types of immigration that are common within Europe are represented. Turks and Moroccans initially came as labour migrants to the Netherlands, while the migration of Surinamese and Antilleans/Arubans is related to the colonial past. We estimated the size of socioeconomic inequalities in mortality within these minority groups by making use of information on mean neighbourhood income. We aimed to identify factors that explain possible variations between groups in the size of socioeconomic inequalities in mortality by evaluating the contribution of specific causes of death to these inequalities.

10.2 Data

We used data for the years 1995 through 2000 from the cause of death register and the municipal population registers (GBA), which provided data on all inhabitants of the Netherlands with a legal status. These registers were linked on personal identification number. Persons were allowed to enter the study (through birth or immigration) throughout the study period (open cohort design). Of each inhabitant, the amount of person time was calculated. The event of interest was death. Deaths of persons that are included in the population registry should be included in the cause of death registry,

irrespective of whether the death occurred in the Netherlands or abroad. Only deaths of persons that officially de-registered from the population registry, for example because they (r)emigrated, are not included in the cause of death registry. The causes of death were coded according to ICD 9 in 1995, and according to ICD 10 in 1996-2000. Although deaths that took place abroad are included in the cause of death registry, the *cause* of death was almost never established. Usually, these deaths were categorised under ill-defined conditions. Among Turkish and Moroccans, 80% of deaths within this category took place abroad, among Surinamese and Antilleans/Arubans 50%, and among Dutch 13%.

All data were tabulated according to sex, date of birth, country of origin, 6-digit post code and marital status (unmarried, married, widowed or divorced). As a proxy of ethnicity we used the country of birth of subject and both parents. We applied the standard definition of foreigners of Statistics Netherlands and considered a person to be Non-Dutch if at least one parent was born abroad.[62] In case of mixed origin, the country of birth of the mother prevailed. Because the age structure varied strongly between ethnic groups and because socioeconomic differences in mortality varied strongly with age, all analyses were restricted to the population aged 0-59 years. Five year age-bands were applied, using age at mid-year. Information on socio-demographic characteristics of people who remained alive and of people who died both came from the population register.

On the basis of 6-digit postal code we linked information on all neighbourhoods in the Netherlands that we obtained from the regional income register (RIO) and the register on areas and neighbourhoods (WBR). Neighbourhoods contained on average about 1500 persons. This information included region (West, East, South and North), degree of urbanisation (address-density per square kilometre within neighbourhoods classified into five groups) and mean household equivalent income (classified into the 10 deciles of the total population). Mean household equivalent income of neighbourhoods was used as indicator of socioeconomic status. Although it is an ecological measure, it is able to demonstrate socioeconomic differences in mortality in the Netherlands and it is relatively robust for confounding(63, 64). In order to have sufficient numbers of deaths for each ethnic group in each socioeconomic class, we recoded socioeconomic status into four groups that contained, respectively, 50%, 30%, 10% and 10% of the total number of person years (see Table 10.1).

10.3 Statistical analyses

The mortality level of each socioeconomic group was measured by means of directly standardised mortality rates using the total of the studied migrant populations as a standard. Absolute differences in mortality rates between the two highest and the two lowest socioeconomic groups were calculated for total and cause-specific mortality.

We estimated the size of relative mortality differences between the two lowest and the two highest socioeconomic groups by means of Poisson regression analyses (using

Stata version 7). We related the number of deaths to numbers of person years as offset variable, and to income group as independent variable. All mortality rate ratios were adjusted for age (5-year age groups) and for all mortality rate ratios 95% confidence intervals were estimated. In order to test whether the size of socioeconomic inequalities in mortality did significantly differ between ethnic minority groups and Dutch, an interaction term between socioeconomic status and ethnicity was added to the regression analyses. Regression analyses were carried out with and without adjustment for differences in marital status, region and degree of urbanisation.

10.4 Results

Dutch lived more often in high-income neighbourhoods than Surinamese and Antilleans/Arubans (Table 10.1), whereas the latter lived more often in high-income neighbourhoods than Turkish and Moroccans.

Table 10.1 Population by ethnicity, socioeconomic status and sex

	% of population according to socioeconomic status[a]				Total number of PY (*1000)
	1 (high)	2	3	4 (low)	
Male					
Dutch	54	30	9	7	32128
Turkish	14	27	17	42	875
Moroccan	19	25	16	41	751
Surinamese	26	23	13	38	779
Antillean/Aruban	31	25	16	28	259
Female					
Dutch	54	30	9	7	30973
Turkish	14	28	17	41	790
Moroccan	19	26	16	40	654
Surinamese	26	24	13	36	823
Antillean/Aruban	31	26	16	27	257
Total	51	30	10	9	68289

[a] As a measure of socioeconomic status mean household equivalent income of neighbourhoods was used.

Directly standardised mortality rates varied between socioeconomic groups in most ethnic groups (Figure 10.1a en 10.1b) but the size of differences varied between groups. Socioeconomic mortality differences were relatively large in Dutch (RR=1.49, CI=1.46-1.52), Surinamese (1.32, 1.19-1.46) and Antillean/Aruban men (1.56, 1.29-1.89) and in Dutch (1.39, 135-1.42) and Surinamese women (1.27, 1.11-1.46) (Table 10.3). They were relatively small in Turkish (1.10, 0.99-1.23) and Moroccan (1.10, 0.97-1.20) men and in

Turkish (1.13, 0.97-1.33), Moroccan (1.12, 0.93-1.35) and Antillean (1.03, 0.80-1.33) women. The variation in the size of socioeconomic differences in mortality between ethnic groups was significant in men (0.95, 0.92-0.97) and women (0.94, 0.91-0.98) (results not shown). Only mortality differences in Antillean/Aruban men and Surinamese women were not significantly different from those in Dutch (results not shown).

Table 10.2 Percentage of the population according to background characteristics and ethnicity

	Marital status: % single (aged 30-49)	Region: % living in West	Degree of urbanisation: % living in highly urbanised areas
Male			
Dutch	25,5	30,5	17,6
Turkish	6,7	35,4	21,1
Moroccan	13,2	39,9	21,4
Surinamese	36,5	42,5	22,9
Antillean/Aruban	53,1	38,7	21,4
Female			
Dutch	16,8	30,3	17,3
Turkish	3,3	36,4	21,1
Moroccan	3,9	40,8	20,6
Surinamese	30,8	44,0	22,5
Antillean/Aruban	44,5	40,5	21,0

Comparison of Mortality rate ratios of death before and after adjustment for marital status, region and degree of urbanisation showed the extent to which socioeconomic differences in mortality were explained by these variables (Table 10.3). The inequalities among the Dutch, the Surinamese and among Antillean/Aruban men were partly explained by marital status. Region barely influenced the size of inequalities. Degree of urbanisation did have some effect, especially on mortality differences among Antillean/Aruban men. After adjustment for these variables, there still was a significant variation between ethnic groups in the size of socioeconomic inequalities in mortality (men: 0.95, 0.92-0.97; women: 0.94, 0.91-0.98 – results not shown).

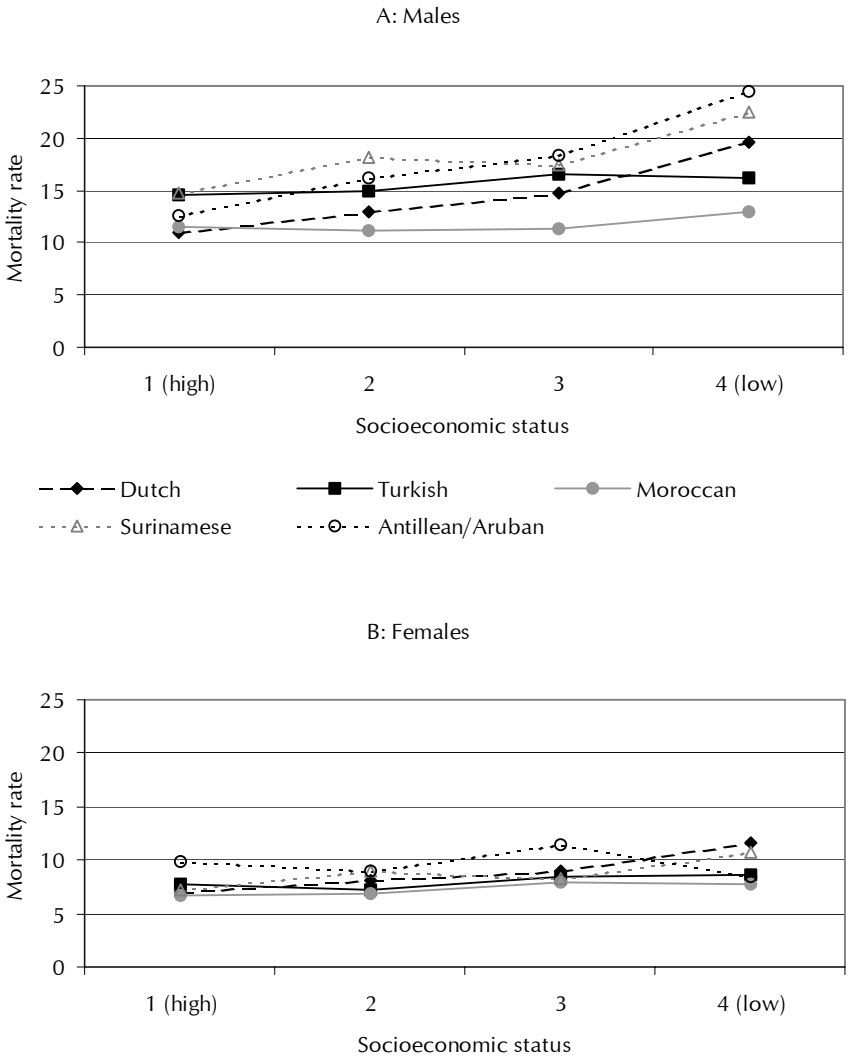


Figure 10.1 Directly standardised mortality rates for all cause mortality by ethnicity and SES: a) Males; b) Females

Table 10.3 Relative mortality risks for all cause mortality: the two lowest versus the two highest socioeconomic groups after adjustment for age and, respectively, marital status, region and degree of urbanisation

	RR (95% CI) two lowest versus two highest SES groups adjusted for age and				
	No other	Marital status	Region	Urbanisation	All
Male					
Dutch	1.49 (1.46-1.52)	1.33 (1.30-1.35)	1.52 (1.49-1.55)	1.42 (1.39-1.45)	1.31 (1.28-1.34)
Turkish	1.10 (0.99-1.23)	1.10 (0.99-1.23)	1.10 (0.98-1.22)	1.08 (0.96-1.22)	1.09 (0.97-1.24)
Moroccan	1.10 (0.97-1.26)	1.10 (0.96-1.25)	1.10 (0.97-1.26)	1.08 (0.93-1.25)	1.07 (0.93-1.24)
Surinamese	1.32 (1.19-1.46)	1.23 (1.11-1.36)	1.31 (1.19-1.46)	1.26 (1.12-1.41)	1.17 (1.04-1.31)
Antillean/Aruban	1.56 (1.29-1.89)	1.46 (1.20-1.77)	1.54 (1.26-1.87)	1.41 (1.14-1.75)	1.32 (1.06-1.65)
Female					
Dutch	1.39 (1.35-1.42)	1.29 (1.26-1.32)	1.42 (1.38-1.46)	1.32 (1.29-1.36)	1.27 (1.24-1.31)
Turkish	1.13 (0.97-1.33)	1.14 (0.97-1.33)	1.15 (0.97-1.35)	1.15 (0.96-1.37)	1.14 (0.95-1.37)
Moroccan	1.12 (0.93-1.35)	1.13 (0.94-1.35)	1.11 (0.92-1.33)	1.12 (0.91-1.37)	1.17 (0.94-1.44)
Surinamese	1.27 (1.11-1.46)	1.22 (1.07-1.40)	1.29 (1.13-1.49)	1.22 (1.05-1.43)	1.14 (0.97-1.33)
Antillean/Aruban	1.03 (0.80-1.33)	1.02 (0.78-1.32)	1.01 (0.78-1.31)	1.04 (0.78-1.38)	0.97 (0.72-1.30)

Table 10.4 Directly standardised mortality rates and relative mortality risks for specific causes of death by socioeconomic status and ethnicity for males

Cause of death	Cause as % of total	rate 1 (high)	2	3	4 (low)	RR (1+2 vs 3+4) (95% C.I.)
Dutch						
Infectious dis.	1.8	0.20	0.25	0.28	0.63	2.03 (1.77-2.33)
Neoplasms	32.2	3.11	3.50	3.85	4.62	1.32 (1.27-1.36)
Cardiovasc. dis.	25.6	2.22	2.81	3.39	4.32	1.57 (1.51-1.64)
Other diseases	24.6	3.13	3.59	4.19	6.09	1.62 (1.56-1.69)
External causes	15.9	2.22	2.73	3.02	3.94	1.47 (1.40-1.54)
Turkish						
Infectious dis.	2.6	0.15	0.25	0.61	0.46	2.39 (1.09-5.27)
Neoplasms	17.4	2.91	2.32	3.00	2.82	1.11 (0.85-1.44)
Cardiovasc. dis.	18.0	3.00	3.22	2.54	2.86	0.92 (0.71-1.18)
Other diseases	43.3	5.66	6.30	6.84	6.86	1.11 (0.94-1.31)
External causes	18.7	2.27	2.52	3.34	3.13	1.33 (1.03-1.73)
Moroccan						
Infectious dis.	3.1	0.20	0.10	0.73	0.50	3.57 (1.36-9.39)
Neoplasms	17.0	1.73	1.97	1.63	2.24	1.10 (0.80-1.52)
Cardiovasc. dis.	13.6	1.92	1.57	1.76	1.51	0.94 (0.66-1.34)
Other diseases	42.5	4.37	4.22	4.21	5.34	1.15 (0.94-1.42)
External causes	23.8	2.99	2.63	2.75	3.16	1.10 (0.83-1.44)
Surinamese						
Infectious dis.	5.3	0.67	0.73	1.22	1.11	1.66 (1.05-2.63)
Neoplasms	15.0	2.01	2.57	2.37	3.47	1.43 (1.09-1.86)
Cardiovasc. dis.	24.3	3.82	4.31	4.56	4.50	1.16 (0.94-1.42)
Other diseases	32.8	4.62	5.59	5.47	7.96	1.52 (1.27-1.82)
External causes	22.6	3.15	4.17	3.37	5.19	1.29 (1.04-1.60)
Antillean/Aruban						
Infectious dis.	7.5	0.69	1.10	1.24	1.64	1.81 (0.87-3.76)
Neoplasms	17.9	2.09	4.15	2.89	4.46	1.28 (0.80-2.03)
Cardiovasc. dis.	15.9	2.32	2.71	2.82	3.47	1.22 (0.75-1.99)
Other diseases	25.4	3.76	3.04	4.19	6.90	1.60 (1.08-2.37)
External causes	33.3	2.39	2.43	6.44	7.38	2.13 (1.49-3.03)

Table 10.5 Directly standardised mortality rates and relative mortality risks for specific causes of death by socioeconomic status and ethnicity for females

Cause of death	Cause as % of total	Rate 1 (high)	2	3	4 (low)	RR (1+2 vs 3+4) (95% C.I.)
Dutch						
Infectious dis.	1.3	0.12	0.14	0.18	0.30	1.84 (1.50-2.25)
Neoplasms	49.5	3.02	3.31	3.59	4.17	1.23 (1.19-1.28)
Cardiovasc. dis.	15.6	0.88	1.18	1.35	1.85	1.67 (1.56-1.78)
Other diseases	24.2	2.17	2.49	2.67	3.62	1.45 (1.38-1.52)
External causes	9.3	0.83	1.00	1.17	1.65	1.55 (1.43-1.67)
Turkish						
Infectious dis.	3.4	0.28	0.16	0.23	0.32	1.41 (0.57-3.50)
Neoplasms	18.9	0.96	1.62	1.56	1.82	1.23 (0.84-1.79)
Cardiovasc. dis.	13.2	1.04	0.91	1.26	1.11	1.15 (0.74-1.80)
Other diseases	53.0	3.61	3.29	4.27	4.55	1.32 (1.05-1.66)
External causes	11.5	1.13	1.02	0.93	0.74	0.77 (0.49-1.23)
Moroccan						
Infectious dis.	4.0	0.07	0.42	0.18	0.30	0.97 (0.38-2.47)
Neoplasms	18.2	1.39	1.31	2.02	1.54	1.20 (0.77-1.87)
Cardiovasc. dis.	9.1	1.02	0.38	0.63	0.90	1.25 (0.67-2.35)
Other diseases	55.1	2.53	3.79	3.64	3.93	1.12 (0.87-1.44)
External causes	13.6	0.86	0.60	1.29	1.12	1.64 (0.96-2.80)
Surinamese						
Infectious dis.	3.2	0.20	0.45	0.10	0.32	0.67 (0.30-1.47)
Neoplasms	24.2	2.41	1.74	1.59	2.02	0.93 (0.71-1.24)
Cardiovasc. dis.	21.1	1.21	2.14	1.49	1.94	1.13 (0.84-1.52)
Other diseases	36.2	2.65	2.97	3.54	4.40	1.58 (1.26-2.00)
External causes	15.3	0.54	1.65	1.29	2.07	1.87 (1.30-2.70)
Antillean/Aruban						
Infectious dis.	5.3	0.14	0.90	0.50	0.42	0.92 (0.29-2.91)
Neoplasms	27.2	2.73	1.81	4.53	1.35	1.09 (0.66-1.80)
Cardiovasc. dis.	16.7	1.86	1.30	1.19	1.32	0.81 (0.42-1.56)
Other diseases	35.5	2.83	3.66	3.79	3.78	1.21 (0.78-1.87)
External causes	15.4	1.69	0.84	0.86	1.62	1.03 (0.53-2.00)

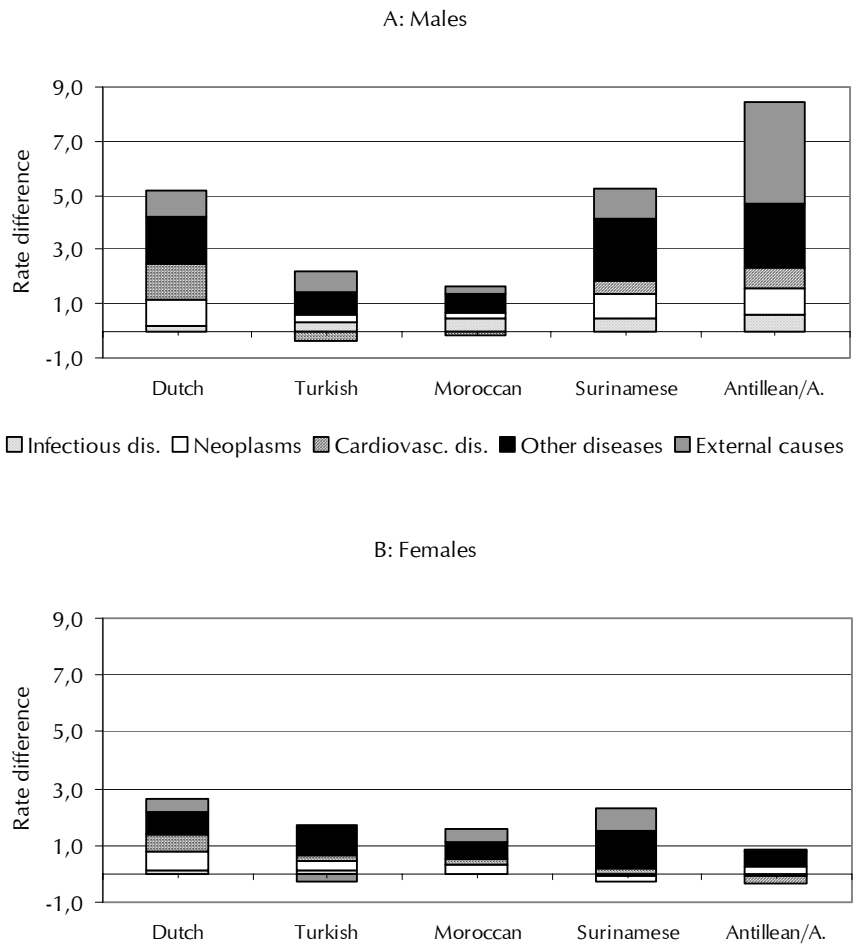


Figure 10.2 Absolute differences in mortality rates between the two highest and the two lowest socioeconomic groups for specific causes of death: a) Males, b) Females

The size of socioeconomic differences in mortality varied between ethnic groups for specific causes of death as well. (Table 10.4 and 10.5). In males, mortality differences varied significantly between ethnic groups for cardiovascular diseases (RR=0.87, 95% CI= 0.82-0.92) and other causes of death (0.95, 0.91-0.99 – results not shown). In females the variations were significant for infectious (0.77, 0.63-0.92) and cardiovascular diseases (0.85, 0.78-0.92 – results not shown). More specifically, socioeconomic inequalities in mortality from infectious diseases were relatively small in Surinamese women (0.67, 0.30-

1.47) and mortality differences from cardiovascular diseases were small in Turkish (0.92, 0.71-1.18), Moroccan (0.94, 0.66-1.34) and Surinamese (1.16, 0.94-1.42) men and in Surinamese (1.13, 0.84-1.52) and Antillean/Aruban (0.81, 0.42-1.56) women. Mortality differences from other causes were small in Turkish (1.11, 0.94-1.31) and Moroccan (1.15, 0.94-1.42) men and mortality differences from external causes were small in Moroccan (1.10, 0.83-1.44) men and Turkish (0.77, 0.49-1.23) women and were large in Antillean/Aruban (2.13, 1.49-3.03) men.

The socioeconomic differences in total mortality among the Dutch were to a relatively large degree attributable to inequalities in mortality for cardiovascular diseases, while among Antillean/Aruban men, inequalities in mortality from external causes made a large contribution to the differences in total mortality (Figure 10.2a and 10.2b). The small socioeconomic differences in total mortality among Turkish and Moroccan men were due to slightly inverse inequalities for cardiovascular diseases and small inequalities for most of the other observed causes.

10.5 Discussion

Socioeconomic differences in total mortality were relatively large among the Dutch, the Surinamese and among Antillean/Aruban men. They were small among the Turkish, the Moroccans and among Antillean/Aruban women. Among the Dutch, the mortality differences were partly attributable to inequalities in mortality from cardiovascular diseases, whereas among Antillean men external causes strongly contributed to the mortality differences. The small differences among Turkish and Moroccan men were due to a lack of inequalities for cardiovascular diseases and small inequalities for the other observed causes.

This is the first study to report on socioeconomic differences in mortality within ethnic groups in the Netherlands. A study that used data from the 1970s from the UK showed no mortality inequalities according to occupational class in minority groups, but later studies all showed socioeconomic inequalities in mortality within most ethnic groups(39, 247). In the UK, the size of the inequalities seems to vary, with strong gradients for Irish immigrants, small gradients for people born in the Indian subcontinent and no gradients for Caribbeans(254). In the USA, the magnitude of mortality differences was similar in Blacks as in Whites(247, 248). A study done in New Zealand showed markedly larger social class mortality differences within Maori than Non-Maori(12). The available evidence thus suggests the association between social position and mortality is not always equally strong in all ethnic groups, which is in accordance with our results.

There are three limitations that may have affected the results of this study. First, it may be that we would have obtained different results if we had used a different indicator of socioeconomic position. Unfortunately, because no other measures of socioeconomic position were available, we were unable to examine the extent to which inequalities in

mortality within ethnic minority groups depended upon the socioeconomic measure that we used.

Second, systematic differences in income within broad income groups may have influenced the results. Dutch within the highest income category had, for example, a relatively high income. This, however, did not explain the relatively large socioeconomic inequality in mortality among Dutch because, upon exclusion of the Dutch population with the highest incomes (40% of the total Dutch population), the mortality differences among Dutch remained relatively large (RRmen: 1.36, RRwomen: 1.28). It is also unlikely that heterogeneity of income within the lowest income group explained the small socioeconomic inequalities in mortality among Turks and Moroccans because, among them, mean neighbourhood income was hardly related to mortality.

Third, the validity of the used indicator of socioeconomic status, a measure at the ecological level, may not be equally good for all ethnic groups. Perhaps, in some groups, the place of residence is determined by the mean socioeconomic status of a neighbourhood, whereas in others it is predominantly determined by the ethnic composition of a neighbourhood. In order to evaluate this, we compared the population distribution according to our measure at the neighbourhood-level with a population distribution according to a measure at the individual level (household income). For Antilleans, the two measures yielded the same population distributions. For Turks, Moroccans and Surinamese, however, a somewhat larger proportion (5 to 15%) of the population belonged to the lowest income quintile according to the measure at the ecological level than according to the measure at the individual level. The place of residence of Turks, Moroccans and Surinamese may be more strongly determined by other factors than neighbourhood income, hence, neighbourhood income may for them be a less valid indicator of socioeconomic status. As the discrepancy between the population distributions was fairly small, we think this aspect of differential validity had only limited influence on the mortality differences among Turks, Moroccans and Surinamese.

Variations in the steepness of the socioeconomic mortality gradient could also be due to selection effects being more pronounced in some socioeconomic strata than in others. If the selective migration of healthy people to the Netherlands ('healthy migrant effect') was relatively strong among the currently poor migrants, or, if the selective remigration of a relatively unhealthy subsample of migrants ('salmon bias') occurred more often among the poor, this could result in relatively small socioeconomic inequalities in mortality.

Because the Netherlands received the a large part of its non-western migrants more than 25 years ago and health selection effects are reported to wear out over time(74), the healthy migrant effect can only have affected a small proportion of the migrant population. Selective remigration of relatively unhealthy people can only have affected a small proportion of the population, because, in the Netherlands, unregistered re-migrants remain in the cohort and registered remigration is a very rare event, especially among Surinamese

and Antilleans. We therefore think it is unlikely that a differential influence of selection effects substantially influenced the size of socioeconomic inequalities in mortality.

Socioeconomic inequalities in mortality can also be associated with levels of social support(255). A strong social network can both attenuate and enhance the socioeconomic inequalities within some ethnic groups. Amongst Turks and Moroccans, family ties are generally very close. Our results on the influence of marital status suggest that this has to some extent buffered against the adverse effects of a low socioeconomic status. Among Turks in the Netherlands, the group cohesion is very strong(256) and this too may have contributed to the relatively small mortality differences among them. The small socioeconomic inequalities amongst Moroccans are somewhat less likely to be attributable to the protective effect of a social network, because within this group there is considerable disunity and suspicion(256). Among Antilleans/Arubans there is a disintegration of the own network,(256) which is probably related to the economic recession in the Dutch Antilles and Aruba. A marginalized minority is now involved in the trafficking of drugs and other crimes(257) which has resulted in a large number of casualties from homicide among Antillean/Aruban men(88). This occurs more often among those with a lower socioeconomic status, and hence strongly contributes to the large socioeconomic differences in mortality within this group.

Variations in the steepness of socioeconomic differences in mortality may also be attributable to variations in the relationship between behavioural risk factors and socioeconomic status. In southern European countries smoking and an unhealthy diet was for a long time more common among those in higher socioeconomic strata than among those in lower strata(214). Within Europe, this has resulted in a north-south gradient, with larger socioeconomic inequalities in cardiovascular mortality in the north than in the south and even some inverse inequalities for ischemic heart disease in some parts of southern Europe(258, 259). Among Turkish and Moroccan men living in the Netherlands, we observed slightly inverse inequalities in mortality from cardiovascular diseases. There are no studies that report on socioeconomic differences in mortality in Morocco and there is only one study on Turkey. It found that family income was not predictive of overall mortality, but was predictive of future CHD events, with an excess mortality in the lowest income groups(260). Yet, we think that the pattern among Turkish and Moroccan men living in the Netherlands may be an extension of the north-south gradient that is observed within Europe. For the Netherlands, many studies report on differences in health-related behaviours between ethnic groups(75), but in none of them was information on socioeconomic gradients included. Based on what is known about the relation between socioeconomic status and risk factors in countries that are less advanced in the epidemiological transition, we expect that the observed inverse gradient in mortality from cardiovascular diseases is related to less smoking, to a less sedentary way of life, and/or to a more traditional food pattern with more Mediterranean products among Turkish and Moroccan men with a lower socioeconomic status.

Because minority groups within the Netherlands resemble groups in other countries in many ways, we expect that these results may to some extent apply to other countries with similar minority groups. This study has shown that the size of socioeconomic inequalities in mortality varies between ethnic groups. Studies that aim to assess the effect of socioeconomic status on ethnic differences in mortality should take into account these variations by, for example, studying the interaction between socioeconomic status and ethnicity in the regression model. Information about such interactions adds to our understanding of ethnic differences in mortality. Compared to native Dutch men, Moroccan men have, for example, a low level of overall mortality(88), which is partly related to the weak association between socioeconomic status and mortality within this group. Antillean men, on the contrary, have high overall mortality(88), which is partly related to the high mortality within the lowest socioeconomic group. This knowledge can also serve the development of policies aimed at the prevention or reduction of ethnic inequalities in mortality. Maintaining small socioeconomic inequalities in mortality among Turkish and Moroccan men and women and Antillean/Aruban women can prevent future increases in overall mortality in these groups, while the reduction of excess mortality among Surinamese men and women and Antillean/Aruban men with a low socioeconomic status can strongly reduce overall levels of excess mortality in these groups.

Policy Implications

- Maintaining small socioeconomic inequalities in mortality among Turkish and Moroccans men and women and Antillean/Aruban women can prevent future increases in overall mortality in these groups, while the reduction of excess mortality among Surinamese men and women and Antillean/Aruban men with a low socioeconomic status can strongly reduce overall levels of excess mortality among them.
- Specific attention should be directed towards the prevention of an increase in socioeconomic differences in cardiovascular disease mortality among Turkish, Moroccan and Surinamese men and among Surinamese and Antillean/Aruban women.

Key Points

- The size of socioeconomic inequalities in mortality varied between ethnic groups.
- Socioeconomic differences in total mortality were large among Dutch and Surinamese men and women and among Antillean/Aruban men. They were small among Turkish and Moroccan men and women and among Antillean/Aruban women.

- Among the Dutch, the large mortality differences were partly attributable to large inequalities in mortality from cardiovascular diseases, whereas among Antillean/Aruban men differential mortality from external causes strongly contributed to the inequalities.
- The small mortality differences among Turkish and Moroccan men were due to a lack of inequalities for cardiovascular diseases and small inequalities for the other observed causes.
- These variations in socioeconomic mortality inequalities may in part be attributable to ethnic variations with respect to social support and with respect to social gradients in behavioural risk factors.

11

General Discussion

In this chapter, we evaluate the data and methods that we used (paragraph 11.1), we provide an overview of our results (paragraph 11.2), we discuss the role of socioeconomic status and other factors in explaining the observed ethnic inequalities in mortality (paragraph 11.3) and consider implications for policy and research (paragraph 11.4).

11.1 Evaluation of data and methods

Specific methodological limitations of the studies that are included in this thesis have been discussed in the chapter 2 through 10. Here we discuss two more general issues: firstly the strengths and weaknesses of the data that we used, and secondly, the validity of mean neighbourhood income as a proxy of socioeconomic status in studies on ethnic inequalities in mortality.

Strengths and weaknesses of the data that are used

Internationally, studies on ethnic inequalities in mortality have been hampered by a number of data-problems(54, 57). In this thesis, we made use of routinely collected data from Statistics Netherlands. These data are relatively sound. They have four advantages that we discuss below.

The first advantage is that, in the Netherlands, the demographic data on the population at risk and on the population that died come from the same source. Instead of a census, the Netherlands has a system consisting of a cause of death register and a municipal population register. The municipal population register contains information on the country of birth of a person and both parents. People that are included in both registers can be linked by a personal identification number. There are therefore no problems with the consistency of the recording of country of birth and/or on death certificates and in the census, as is the case in some other countries(57, 83, 146, 261, 262).

The second advantage is that legal residents of the Netherlands that die outside the Netherlands are generally included in the cause of death register. Dutch embassies and consulates abroad or family of the deceased report the event of death to the municipality where the deceased resided. According to Statistics Netherlands it is unlikely that many deaths are missed[a]. The assessment of numbers of death was therefore relatively good. This in contrast with most other European countries, where people that die abroad are generally not included in the mortality statistics.

A third advantage of the Dutch data is that the assessment of the population at risk was, in comparison to other countries, relatively adequate. Within the population register,

[a] If a death would be missed, this person is registered as 'administratively lost'. The numbers of administratively lost give an impression of the numbers of deaths that are missed.

events that result in not being at risk any more are registered. Besides death such events are emigration and 'administrative loss'. Administrative loss occurs when a person disappears, for example because the person moved abroad without resigning from the register(263-265). In order to become lost all communication with the person has to be stopped. Statistics Netherlands claims that municipalities and/or the Dutch government notice this within a few months (see evaluation below). The problem of falsely counting people as being at risk is thereby minimised.

Information about the numbers of people that are administratively lost enabled us to evaluate the possible effects of a) missing deaths that occurred abroad and b) an overestimation of person time(88). We made extreme assumptions on mortality rates of the administratively excluded and on the time it took before being classified as administratively lost. We observed that either of these phenomena or a combination of these phenomena could not explain mortality differences between Dutch and Turkish, Moroccans, Surinamese and Antilleans/Arubans.

A fourth advantage of used data is that they are national data that cover all legal inhabitants of the Netherlands. We therefore had no problems generalising the results to the country as a whole and had relatively large power.

The Dutch data also have some disadvantages. Firstly, even in this national study that contained data for six consecutive years, confidence intervals were large in the more detailed analyses. Secondly, ethnic variations within country of origin groups could not be identified and variations in mortality rates within groups may therefore have averaged out. Thirdly, due to unknown cause of death among deaths that occurred abroad, the mortality level for specific causes of death was underestimated in our analyses. That this problem did not severely influence our results was showed by an analysis in which we redistributed deaths that took place abroad proportionally to the known causes of death. Upon this redistribution, mortality patterns remained largely the same(65).

Validity of mean neighbourhood income as a proxy of socioeconomic status in studies on ethnic inequalities in mortality

In this thesis we approximated socioeconomic status at the individual level by making use of mean neighbourhood income. We evaluated this indicator in chapters 8 and 9(63, 64). We observed that socioeconomic mortality differences between neighbourhoods were smaller than socioeconomic mortality differences between individuals but that neighbourhood level data can be used to describe socioeconomic inequalities in mortality. Based on these evaluations, we used mean neighbourhood income to adjust for socioeconomic differences in analyses relating ethnicity to mortality (chapters 2-6). We observed that average area income explained part of the excess mortality in Turkish, Surinamese and Antillean/Aruban males, but not, or to a much smaller extent in the studied African refugee groups (88, 92, 266, 267). Because socioeconomic inequalities in mortality at the individual level are generally larger than socioeconomic inequalities in mortality at the neighbourhood level, we consider it likely that adjustment for

socioeconomic status at individual level would have reduced the excess mortality to a larger extent(63). We thus conclude that, in general, the effect of adjustment for socioeconomic status is likely to be underestimated. Adjustment for mean neighbourhood income did, nevertheless, provide a good impression of the direction in which adjustment for individual level socioeconomic status would have influence the results.

Reasons why socioeconomic inequalities in mortality at the neighbourhood level are smaller than those at the individual level are discussed in chapter 9 and will not be repeated here. There are however a few reasons that are specific for the application of mean neighbourhood income in studies on ethnic inequalities in mortality. These issues are addressed below.

Firstly, a high correlation between mean neighbourhood income and ethnicity (collinearity) may make it difficult to separate the effects of these variables statistically. Fortunately, there was enough variability in socioeconomic status within ethnic groups, i.e. there were also ethnic minorities living in high-income neighbourhoods. We were therefore able to the separate effects of socioeconomic status and ethnicity(97).

Secondly, systematic differences in income within broad income groups may have influenced the results. Within income quintiles, the incomes of Dutch may have been systematically higher than that of ethnic minority populations. Evaluations performed in chapter 10 showed however that it is unlikely that this explained the results. We could however not evaluate the possible effect of ethnic minorities living systematically in the worse parts of neighbourhoods and Dutch living systematically in the better parts.

Thirdly, it may be the case that ethnic groups differ in the extent to which the mean socioeconomic status of neighbourhoods determines their place of residency. Perhaps, place of residency is in some groups more strongly determined by other characteristics of neighbourhoods, such as the ethnic composition of a neighbourhood. For these groups, the difference between the own income and the mean neighbourhood income may be comparatively large and mean neighbourhood income would than be a comparatively weak indicator of socioeconomic status. We were able to perform some evaluations on this (see chapter 10) and observed that this may, but only to a small extent, have influenced the size of socioeconomic inequalities in mortality in Turkish, Moroccans and Surinamese(97).

The above-discussed issues were all related to the use of a variable at the ecological level. One may however also question the sole use of income as an indicator of socioeconomic status. Especially where analyses concerned people from Iraq, Iran, Afghanistan and Vietnam there may be a discrepancy between the income and education. These groups are likely to be relatively highly educated in their countries of origin. These people may have encountered problems with getting their degrees accredited in the Netherlands and therefore also with obtaining well-paid jobs. This discrepancy between income and education may also have applied to groups who arrived relatively recently and who may not yet master the Dutch language. Perhaps it applies, to a certain extent, even to all ethnic

minority groups, who because of racial discrimination, may have problems finding well-paying jobs, despite a high education.

11.2 Overview of size and pattern of ethnic inequalities in mortality in the Netherlands

In chapter 1 (Table 1.1) we summarise the results of an international review on ethnic inequalities in cause specific mortality(4). Here we summarise our own results of cause-, sex-, and age-specific analyses in a similar manner as we did for the international results in chapter 1 (see Table 11.1). All mortality rate ratios summarised here were adjusted for age, marital status, socioeconomic status, region, degree of urbanisation and, where appropriate, for sex.

Ethnic inequalities in total mortality

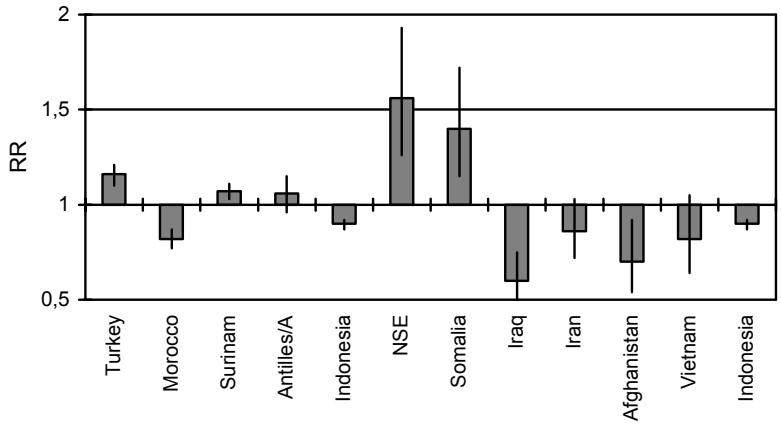
Results on total mortality that are presented in chapters 2, 3 and 4 of this thesis, are summarised in Table 11.1. Analyses for total mortality were done separately for males and females (resulting in 22 groups).

Because life expectancies in the countries of origin are generally lower than that of the Netherlands(60) (see Figure 1.1), and because the studied groups generally had a relatively low socioeconomic position, we expected to observe a relatively high mortality among ethnic minority groups living in the Netherlands. We observed, however, that only 7 of the 22 studied groups had significantly higher mortality than native Dutch. Mortality was only slightly elevated among Turkish and Surinamese males and among Indonesian females. Mortality was substantially elevated among Nigerian/ Sudanese/Ethiopian and Somalian males and females (see Figure 11.1). In 7 of the 22 groups total mortality was significantly lower that among native Dutch. These groups were Moroccan, Iraqi, Afghan, and Indonesian males and Iraqi, Iranian and Vietnamese females. In 8 of the 22 groups mortality differences did not reach statistical significance. These groups were Antillean/Aruban, Iranian and Vietnamese males and Turkish, Moroccan, Surinamese, Antillean/Aruban and Afghan females.

Sex specific patterns

For all countries, analyses for total mortality were done separately for males and females (resulting in two times 11 groups). When comparing ethnic inequalities in mortality among males with those among females (Figure 11.1) we see that the direction of the inequalities was generally the same. When males had an elevated mortality, females of the same ethnic group usually had an elevated mortality too. Among Turkish, Moroccans, Surinamese, Antilleans/Arubans and Indonesians, mortality differences were larger among males than among females. Among Asian and African refugees, there was not a clear difference in the size of mortality differences between males and females.

A: Males



B: Females

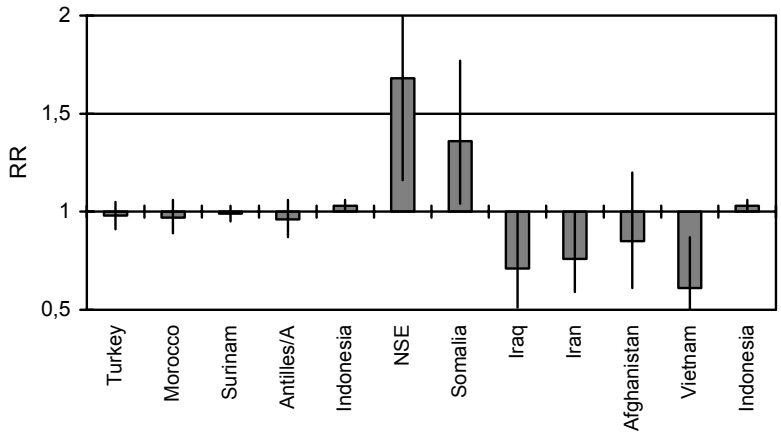


Figure 11.1 Mortality rate ratios for ethnic minority groups versus native Dutch:

Age specific patterns

Age specific analyses were done separately for males and females from Turkey, Morocco, Surinam, the Dutch Antilles/Aruba and Indonesia. For all other countries men and women were combined. This resulted in 16 groups.

Mortality differences varied often substantially by age (see Table 11.1). Compared to native Dutch, many minority groups had a higher mortality at young ages (< 40 years) and lower mortality at older ages (see also Figure 2.1, Table 3.4 and Table 4.3). The excess mortality at young ages and the reduced mortality at older ages often compensated each other and resulted in small overall inequalities in mortality. On the other hand is the excess mortality at younger ages often also observed in groups who had low overall levels of mortality (such as Moroccan and Afghan men) and is the mortality advantage at older ages often also observed in groups with elevated overall levels of mortality (such as Surinamese men).

Cause of death specific patterns

Results on cause specific mortality that are presented in chapters 2, 3 and 4 of this thesis are summarised in Table 11.1. Due to small numbers, males and females from Nigeria/Sudan/ Ethiopia, Somalia, Iraq, Iran, Afghanistan, Vietnam and Indonesia were combined in cause specific analyses. Males and females from Turkey, Morocco, Surinam and the Dutch Antilles/Aruba were studied separately (resulting in 15 groups).

For many specific causes of death, substantial ethnic inequalities in mortality were observed. This was even the case in minority groups where overall levels of mortality were similar to those of native Dutch. The studied ethnic minority groups had a tendency for a high mortality from infectious diseases, ill-defined conditions (which was related to mortality abroad) and external causes (including homicide) and for a low mortality from cancer (including lungcancer) and respiratory diseases. The picture for cardiovascular mortality was diverse. There seems to be a tendency for a reduced mortality from ischemic heart disease and an elevated mortality from stroke, but in many cases, mortality differences did not reach statistical significance (see Tables 2.4, 3.5 and 4.5 for the mortality rate ratio's). Among Turkish, Moroccans, Surinamese and Antilleans/Arubans, the cause specific pattern differed between males and females. Ethnic inequalities in cancer mortality were for example larger among females than among males (see Table 2.4).

The age and cause specific death patterns are not independent of each other. In Figure 11.2 we present differences in directly- standardised death rates between ethnic minorities and native Dutch for broad classes of causes of death for males and females younger than 35 versus males and females aged 35 and older. The excess mortality at young ages is partly attributable to a high mortality from external causes. The mortality advantage at older ages is partly attributable to a low mortality from cancer and cardiovascular diseases. Mortality from symptoms, signs and ill-defined condition, which is strongly related to mortality abroad, plays an important role in both age groups.

Table 11.1 Number of ethnic minority groups living in the Netherlands with better, similar or worse mortality than native Dutch, results according to sex, age and cause of death

	Better	Similar/not significant	Worse	Unknown
Total mortality	7	8	7	0
Males	4	3	4	0
Females	3	5	3	0
< 20 years	0	7	7	2
20-39 years	0	9	6	1
40-64 years	9	5	1	1
>64 years	7	8	1	0
Infectious d.	0	5	9	1
Cancer	13	2	0	0
- Lung cancer	11	4	0	0
- Breast cancer	3	6	0	2
- Stomach cancer	1	10	1	3
Cardiovascular d.	4	8	3	0
- IHD	3	12	0	0
- CVA	0	9	4	2
Respiratory d.	7	6	0	2
Ill-defined conditions	0	2	13	0
External diseases	1	8	6	0
- Suicide	4	10	1	0
- Homicide	0	3	10	2

General picture

Despite the observation that the magnitude and the direction of ethnic inequalities in mortality is highly variable, we observed the following trends: a) many ethnic minority groups have a high mortality from infectious diseases, external causes, homicide and death abroad; b) many minority groups have a low mortality from cancer, lung cancer and respiratory diseases; c) in young people with a foreign origin an excess mortality is often observed, while in older people with a foreign origin a mortality advantage is often observed; d) the excess mortality in young people is partly related to a high mortality from external causes, while the reduced mortality in older ages is partly related to a reduced cancer mortality.

If we compare the picture that emerges from our own results (Table 11.1) with the picture that emerges from the review performed by McKay et al(4) (Table 1.1), we see that our results for total and for cancer mortality are more advantageous than those obtained in

other countries, while our results for cardiovascular mortality are similar to international results. This is quite striking especially if we take into account that in the review of McKay et al, in contrast to in our study, also immigrants originating from Western countries of origin are included. The levels of mortality in the countries of origin of these Western groups are in some cases lower than levels of mortality in the host countries.

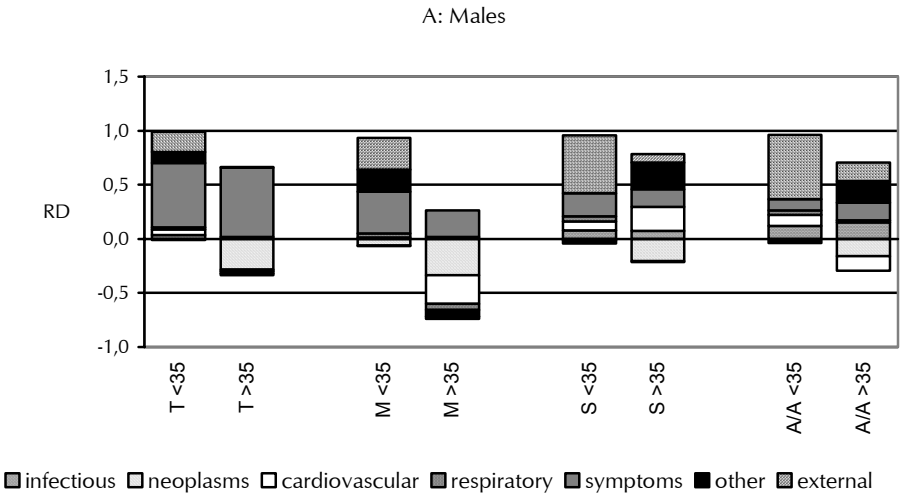


Figure 11.2 Differences between ethnic minorities and native Dutch in directly-standardised death rates for specific causes of death: Persons aged 0-34 versus Persons aged >34. T: Turkish, M: Moroccan, S: Surinamese and A/A: Antillean/Aruban.

11.3 The role of socioeconomic status and other factors in explaining ethnic inequalities in mortality

In chapter 1 we hypothesized that migrant mortality is in-between the level of the country of origin and the level of the host country. The size of ethnic inequalities in mortality that we observed in the Netherlands was however more advantageous than could be expected on the basis of such a simple explanatory model. This made clear that the health of migrants cannot be explained by the simple accumulation of exposure to risk factors that are related to the country of origin and the host-country.

In chapter 1 we listed a number of factors that are thought to contribute to ethnic inequalities in mortality. Here, we discuss the role of the socioeconomic status, lifestyle factors, the health care system and genetics and of selection effects. Limited availability of data made that we had to refrain from studying the contribution of discrimination and early life exposure.

The role of socioeconomic status

A low socioeconomic status has shown to be related to a high mortality(250, 251, 259, 268). Socioeconomic inequalities in mortality are a persistent problem. We observed that such inequalities still existed in all studied European countries and even had a tendency to widen over time (chapter 7).

Socioeconomic status is often mentioned as one of the most important explanations of ethnic inequalities in mortality(38, 40). The extent to which socioeconomic inequalities underlie ethnic inequalities in mortality however still remains contested. This is (at least partially) due to an insufficiency of data needed to study the relation between ethnicity, socioeconomic status and mortality.

In the Netherlands, we also experience these data problems. We cannot link data on socioeconomic status at the individual level to data on mortality. This makes it impossible to study socioeconomic inequalities in mortality or to examine the relationship between ethnicity, socioeconomic status and mortality, at least at a national basis and at the levels of individuals. It is however possible to link neighbourhood level data on socioeconomic status to mortality. We therefore examined whether socioeconomic inequalities in mortality can be studied by making use of data at the neighbourhood level. We observed that socioeconomic inequalities in mortality between neighbourhoods are smaller than between individuals, but that neighbourhood level data can be used to describe socioeconomic inequalities in mortality (chapters 8 and 9). Based on this evaluation of neighbourhood level data on socioeconomic status, we used these data in analyses relating ethnicity, socioeconomic status and mortality.

Ethnic minority groups have in general a lower socioeconomic position than the ethnic majority(29, 40, 88). Socioeconomic status may therefore contribute to excess mortality among ethnic minority groups(12, 38, 39, 247, 248, 269). We studied this relationship by

adjusting for average area income in analyses relating ethnicity to mortality. We observed that average area income explained part of the excess mortality in Turkish, Surinamese and Antillean/Aruban males, but not, or to a much smaller extent, among the studied African refugee groups(88, 266, 267). Substantial age and cause specific inequalities in mortality between native Dutch and ethnic minority groups persisted after adjusted for mean neighbourhood income and often increased upon adjustment for socioeconomic status in groups with lower levels of mortality than native Dutch. Based on these observations, we conclude that it is unlikely that socioeconomic status could explain all ethnic inequalities in mortality.

The limited effect of adjustment for socioeconomic status may, in part, be due to limitations of the indicator than we used (see paragraph 11.1 for a discussion of these limitations). In some groups, such as Indonesians, relatively small income inequalities may also explain why adjustment for socioeconomic status had little effect(105, 266). In other groups, this may be due a relatively weak relationship between socioeconomic status and mortality. We discuss this further below.

In chapter 10 we studied socioeconomic inequalities in mortality within ethnic groups. We observed that socioeconomic inequalities in mortality were relatively large in Dutch, Surinamese and Antillean/Aruban men and in Dutch and Surinamese women. They were relatively small among Turkish and Moroccan men and among Turkish, Moroccan and Antillean/Aruban women.

These differences in the size of socioeconomic inequalities in mortality between ethnic groups may be attributable to variations in the relationship between behavioural risk factors and socioeconomic status(76). In southern European countries smoking and an unhealthy diet were for a long time more common among those in higher socioeconomic strata than among those in lower socioeconomic strata. Within Europe, this has resulted in a north-south gradient, with larger socioeconomic inequalities in cardiovascular mortality in the north than in the south and even some inverse inequalities in mortality from ischemic heart disease in some southern parts of Europe.

We observed similar inverse socioeconomic inequalities in mortality from cardiovascular disease among Turkish and Moroccan men living in the Netherlands. Those in high-income neighbourhoods had slightly higher mortality from cardiovascular diseases than those in low-income neighbourhoods. We expect this to be related to less smoking, to a less sedentary way of life and/or to a more traditional food pattern with more Mediterranean products among Turkish and Moroccan men with a lower socioeconomic position. Turkish and Moroccans with a higher socioeconomic position may have adopted more of the Western lifestyle, which is characterised by higher prevalences of smoking and a higher intake of saturated fats.

Our hypothesis that levels of mortality would be higher among ethnic minority groups than among native Dutch was partly based on the fact that ethnic minority groups have a relatively low socioeconomic status and that a low socioeconomic status is related

to an elevated mortality. We observed however that socioeconomic inequalities in mortality were small among Turkish and Moroccans. In this case, an elevated mortality on the basis of a low socioeconomic status can than not be expected anymore. The weak relationship between socioeconomic status and mortality also partly explains why adjustment for socioeconomic status does not have a large effect in all groups[b].

The role of lifestyle factors

Lifestyle factors, such as smoking, excessive alcohol use, obesity and physical exercise are strongly associated with mortality and may therefore contribute to ethnic inequalities in mortality(270). The relation between ethnicity and lifestyle factors is however not uniform. In some cases minority populations are reported to have healthier behaviour than the native population, while in others they are reported to have unhealthier behaviour(43, 271). Due to shortage of data, studies of migrant mortality hardly ever include information on the prevalence of health related behaviours of the study population. Causes of death specific results are therefore often used to make inferences about the extent to which health behaviours have contributed to the ethnic inequalities in mortality. This is informative because mortality from specific causes is related to specific behaviours. Lung cancer mortality for example, is largely explained by smoking behaviour.

The strong variations in the cause specific death patterns that we observed in all ethnic groups suggests that differences in health related behaviour were likely to have contributed to the mortality patterns. The low cancer mortality that we observed among almost all studied groups is likely to be related to differences in smoking behaviour and dietary habits (43, 271). Turkish, Moroccans, Surinamese and Indonesians are reported to have a relatively healthy (Mediterranean) diet with lower unsaturated fat intake and a higher fruit and vegetables consumption. This is likely to have contributed to low (gastro-intestinal) cancer(43, 114, 271). Differences in smoking behaviour and food intake will also have contributed to ethnic inequalities in cardiovascular disease mortality(43, 176, 187, 271).

It is not always easy to link information about the prevalence of lifestyle factors to the cause specific mortality patterns. Turkish males for example, are reported to smoke more than Dutch do. Yet, we observed a reduced lung cancer mortality in this group (mortality rate ratio: 0.68; confidence interval: 0.56-0.83). In chapter 2 we hypothesised that older Turkish males are less likely to have smoked heavily at a young age than older

b In analyses in which the effect of socioeconomic status is estimated by adjustment, the beta-coefficient for socioeconomic status is dominated by the strength of the relationship between socioeconomic status and mortality in the largest group. In cases where the strength of the relation between socioeconomic status and mortality varies between the groups that are being compared, the effect of socioeconomic status should in fact be assessed through stratification. This is especially true in cases where the group of interest in much smaller than the reference group, as is often the case when studying ethnic inequalities in mortality.

Dutch men do. This suggestion corresponds with what is known about the smoking epidemic in less developed countries(76). The cumulative life time exposure among migrants would than be smaller than among Dutch, and this, together with lag times between employment of the behaviour and the development of disease, could explain the low lung cancer mortality among Turkish males. The current high prevalence of smokers among Turkish males than reflects a tendency to adopt behaviour was common in the host-country. An increase in lung- and other- cancer mortality may therefore be expected in these groups

Diabetes mellitus is also related to lifestyle factors(176, 272, 273). It is also a cause of death in itself and an important risk factor for cardiovascular and various other diseases. The high prevalence of physical inactivity and obesity that is observed among the largest ethnic minority groups in the Netherlands may have contributed to their significantly elevated mortality from diabetes (Mortality rate ratios: Turkish: 1.72; Moroccans: 1.96; Surinamese: 5.29; Antilleans/Arubans: 3.25; Indonesians: 1.29)(43, 75, 271).

Low alcohol consumption, likely to occur among the studied Islamic groups and Indonesians, has probably also contributed to the mortality patterns. This may have reduced numbers of death from alcoholic liver cirrhosis, alcoholic hepatitis, motor vehicle injuries, stroke and coronary heart diseases(15, 270, 274).

In order to study the effect of adoption of the health-related behaviours of the host country (sometimes called 'acculturation') we examined immigrant mortality according to duration of residence (see chapter 5)(275). For most specific causes of death, we did not observe a consistent relation with duration of residence. An explanation may be that immigrants did not yet adopt health-related behaviours that are common among the Dutch population. The cause of death patterns that we observed among Indonesians for example suggests that Indonesians maintained their dietary habits. Another and more likely explanation may be that the lag time between changing behaviour and observing the health consequences of these changes is to long to expect clear differences in mortality already(141).

We conclude that lifestyle factors are likely to have contributed to the observed cause specific death patterns and thereby to overall levels of mortality. The death patterns did not (yet) seem to be influenced by adoptions of behaviours that are common in the Dutch population. Data on hospital admissions among younger minorities may however give a clue about what may be expected in the future. The high admission rates in relation to lung cancer found among young Turkish males are in this respect worrisome(276).

The role of the health care system

Through unequal access to the healthcare system or sub optimal quality of services to ethnic minority populations, the health care system may also have contributed to the observed ethnic inequalities in mortality(47, 48, 155). In chapter 6 we examined its role. We did this by studying ethnic inequalities in avoidable mortality. A cause of death was considered avoidable if effective measures exist (by applying modern treatment

procedures on time) to prolong the life of the patient(156-158). Large differences in avoidable mortality may indicate that the heath care system is not equally effective for all ethnic groups.

Compared to the native Dutch population, we found total avoidable mortality to be slightly elevated for all ethnic minority groups combined(92). Cause specific examination showed higher risks of death for ethnic minorities from infectious and several chronic conditions and low risks of death from malignant conditions.

Group specific examination showed that Surinamese and Antilleans/Arubans had higher risks of death and that Turkish and Moroccans had lower risks of death from 'avoidable' conditions compared to the native Dutch population. This difference is striking taking into account that Surinamese and Antilleans/Arubans are on average better integrated into the Dutch society and have higher language proficiency and a more advanced educational level than Turkish and Moroccans. Differences in healthcare utilisation or quality of care between Surinamese/Antillean and Turkish/Moroccan groups are minimal are and, therefore, unlikely to play a major role(15, 175, 188, 189).

Also, control for demographic and socioeconomic factors explained a substantial part of ethnic differences in avoidable mortality, sometimes completely abolishing the excess risk. This indicates that socioeconomic factors are more important in explaining ethnic differences in mortality in the Netherlands than the quality of medical services(190).

We concluded that there is no clear overall evidence that the healthcare system contributed to inequalities for ethnic minorities in the Netherlands. The observed differences for some specific causes of death and for some specific ethnic groups present nevertheless a challenge for the healthcare system.

The role of genetics

Studies of migrants have often been regarded as a natural experiment that enable the study of the relative contribution of lifestyle factors and genetics(135, 136, 142). If mortality patterns of migrants would not change as a consequence of migration, this has been regarded as evidence indicating that genetic factors are the key determinant of mortality, while the gradual acquirement of the mortality rates of the host country would suggest that environmental or lifestyle factors are the key determinant of mortality. The increasing evidence that has shown that people with a genetic susceptibility for a certain disease only develop the disease if it is triggered by exposure to certain risk factors has made this argumentation more complex(49, 50, 277, 278).

The high prevalence of diabetes mellitus and cardiovascular disease that is observed in South Asians living around the world is often related to genetic susceptibility(49, 50, 272, 273, 279-281). Among Surinamese – who are partly of Indian descent - and Indonesians living in the Netherlands, we too observe a high mortality from diabetes and cardiovascular disease. Among Indonesians, the mortality risks for these diseases were only slightly elevated. For second generation Indonesian migrants we found lower (instead of higher) mortality risks(266). This later finding suggests that, among

Indonesians, the elevated diabetes mortality cannot be explained by genetically susceptibility. In Surinamese, the mortality risks were more strongly elevated, particularly for diabetes mellitus (mortality rate ratio > 5.0). This increased risk was not restricted to the first generation. Cardiovascular mortality among Surinamese (and other ethnic groups) did also not systematically vary with duration of residence in the Netherlands(275). Considering also the international evidence on elevated risks of diabetes mellitus among South Asians, we think it is likely that genetics plays a role in explaining the high mortality from diabetes among Surinamese. For other causes of death and other ethnic groups, evidence about the role of genetics is lacking at this moment.

The role of selection effects

There are two selection effects that are important when considering ethnic inequalities in mortality. These are the 'healthy migrant effect' and selective return migration. In case of the 'healthy migrant effect' a selective group of relatively healthy people are thought to migrate from the country of origin to the country of destination. The relatively good health of immigrants may then be due to them being a selective group. Likewise, either relatively healthy or relatively unhealthy people may remigrate from the host country to the country of origin, leaving a selective group of people in the host country. In case of unhealthy people remigrating, this has been called the 'salmon bias'.

Health selection effects do not affect the second generation and are reported to decrease over time(74). This implies that only the mortality level of immigrants who entered the Netherlands recently are affected by the healthy migrant effect. The healthy migrant is than unlikely to have played an important role among Turkish, Moroccan, Surinamese, Antillean/Aruban and Indonesian migrants who, one the whole, immigrated to the Netherlands some decades ago. It may have had a stronger effect on Asian and African refugees living in the Netherlands. They immigrated more recently and are largely first generation(33, 90).

Because health selection effects are reported to wean out over time(74), the healthy migrant effect would be supported by an increasing mortality with increasing duration of residence in the country of destination. For Turkish, Moroccans, Surinamese, Antillean/Arubans and Indonesians we studied this relationship. We observed stable or decreasing mortality with increasing duration of residence. Although levels of mortality of the more recently immigrated may have been higher without health selection effects, suggested these results that the healthy migrant effect was not of major importance for the explanation of patterns of mortality among these groups. In the various refugee groups, variations in duration of residence were to small to study variations in mortality according to duration of residence.

Among refugees, and particularly among those from the studied Asian countries, education related selection upon migration may have played a stronger role than health related selection. It is known that, in times of ethnic conflicts or civil war, those with a low socioeconomic status generally flee to other regions within the country or to neighbouring

countries and that only the highly educated and/or richer people move onwards to industrialised countries(89, 90).

For Turkish, Moroccans, Surinamese, Antilleans/Arubans and Indonesians, the selective return migration of a relatively (un)healthy sub sample of migrants is possibly of more importance than the healthy migrant effect. A considerable part (20-40%) of the original immigrants from these countries left the Netherlands before the start of this study(29). There is no evidence that indicates whether the health or socioeconomic status of these persons is better or worse than that of those who remained in the Netherlands(149). If the (r)emigrants were a selective group, than the persons who remained in the Netherlands are a selective group as well and this may therefore have influenced their levels of mortality. We cannot exclude the possibility that the low levels of mortality among older immigrants is related to the selective emigration of those with a relatively bad health or low socioeconomic status.

Return migration is less likely to have influenced mortality levels of political refugee groups for whom return migration is not an option. These groups may however, to some extent, have migrated to other western countries.

Discussion

The levels of mortality that we observed among ethnic minority groups living in the Netherlands were lower than we expected on the basis of levels of mortality in the countries of origin. Migration to the Netherlands thus seems to be associated with health gains. Ethnic minorities do benefit from the better health care system and from the better individual living conditions and healthier environment.

In addition to these health gains, migration can also expected to be associated with health losses. In the Netherlands, mortality from cardiovascular diseases and cancers is, as a consequence of the epidemiological transition, relatively high. It can be expected that people of non-western origin living in the Netherlands gradually replace their more traditional food pattern with one that is more common in the Netherlands and that is generally characterised with a higher consumption of alcohol and tobacco and a higher intake of unsaturated fats. Males and people with a higher socioeconomic status may be the first to adopt these unhealthy behaviours. We have found indications that in some groups these transitions already take place.

It will however take some more time before these changed habits translate into an increased mortality from cancer and coronary heart disease. The advantageous and disadvantageous health effects of migration thus seem to become apparent at different moments. If it would be the case that the health gains of migration to the Netherlands manifest themselves sooner than the health losses, our observations for the period 1995-2000 might be done in a period in which the health gains are still larger than the health losses. The relatively low mortality that was observed in this thesis may than partly be explained by a difference in timing between the health benefits and the health risks of migration(282).

11.4 Implications for policy and research

Implications for policy

In this thesis we have provided an overview of the size and patterns of ethnic inequalities in mortality in the Netherlands. We observed that a) migrants have lower levels of mortality than the population that remained in the country of origin, b) many ethnic minority groups had similar or more favourable total mortality rates than native Dutch, and c) the healthcare system did not seem to cause ethnic differences in avoidable mortality. One may wonder whether these observations justify the conclusion that future monitoring of ethnic inequalities in mortality is not necessary and that investment in the reduction of ethnic inequalities in mortality has low priority. We want to make a few objections against this optimistic interpretation.

There are two reasons why inequalities in mortality may increase in the future. Firstly, as discussed above, the reported observations might be done in a period in which the health gains of migration are still larger than the health losses. If ethnic minorities continue to adapt to the western life style, the mortality levels of ethnic minorities in the Netherlands will increase. The higher mortality from infectious diseases, and external causes will than not be counterbalanced any more with a low cancer mortality(282).

Secondly, mortality figures are dominated by old-age mortality. Elderly migrants living in the Netherlands generally have a lower mortality than Dutch while younger migrants have a higher mortality. Because our studies are cross-sectional, we do not know whether the younger generations will take with them into older age their elevated mortality risks (cohort-pattern) or whether those that are young now will outgrow their increased mortality risk (age-pattern). Considering the comparatively high prevalence of smoking and obesity among young migrants, we consider it rather unlikely that the young migrants will not take with them into older age their elevated levels of mortality. The mortality figures for ethnic minority populations at large may therefore increase steeply.

At this moment 10% of the Dutch population of non-Western origin. This percentage is expected to be doubled by 2050. Considering the possibly worrisome developments we conclude that levels of mortality among ethnic minorities should be monitored closely.

The possibilities for monitoring would be increased if the municipal population and cause of death registers would undergo some adaptations. Efforts should be undertaken in order to enable a) the identification of the third generation, b) the identification of different ethnic groups originating from the same country (through inclusion of country of family origin and/or ethnicity), c) the possibility to link information about socioeconomic status at the individual level to information about mortality, d) the investigation of other outcome measures than mortality such as hospital admission, incidence of diseases, quality of life etc.

We will now discuss if investments in the reduction of ethnic inequalities in mortality are required at this moment. We want to point out a few possibilities for prevention.

Firstly, in some groups all cause mortality was considerably higher among ethnic minority groups than in the native Dutch populations. These groups include Somalian males (mortality rate ratio: 1,54) and females (RR: 1,47), Nigerians/Sudanese/Ethiopians males (RR: 1,82) and females (1,84), Turkish males (RR: 1,21), Surinamese males (RR: 1,24) and females (RR: 1.10) and Antillean/Aruban males (RR 1,25)[a]. These differences in *all cause* mortality are too large to be disregarded.

Secondly, even were overall levels of mortality were fairly similar, *cause-of-death* specific patterns varied considerably between ethnic minority groups and native Dutch. These differences present a challenge for prevention and the healthcare system and suggest many opportunities for improvement. Specific areas that deserve attention include mortality from infectious diseases, stroke, diabetes mellitus and asthma, external causes amongst which homicide, and mortality abroad.

Thirdly, even were overall levels of mortality were fairly similar, *age* specific patterns varied considerably between ethnic minority groups and native Dutch. We observed that older migrants often have a low mortality compared to the host population, while younger migrants often have a high mortality compared to the native population. Young people of foreign origin deserve therefore particular attention. Among them mortality levels are up to 2,5 times higher than among Dutch.

Fourthly, a low mortality does not imply that morbidity is low as well. Studies on ethnic inequalities in *morbidity* have shown that ethnic minorities have a higher self-reported morbidity than the native population(16, 54, 283) (284). This discrepancy between outcomes for mortality and morbidity has been called the mortality-morbidity paradox(10) (284). The explanation for such a paradox may be found in the observation that migrants have more often a non-fatal disease than native Dutch. Here may be possibilities to enhance their quality of life.

Fifthly, and perhaps most importantly, in this thesis we have outlined that, despite the relatively favourable mortality rates that we observed, there is no reason for optimism. Levels of mortality among ethnic minority groups can be expected to rise in the near future. Only by making ethnic minority populations aware that adopting a western lifestyle is not a healthy idea, and by supported them in maintaining healthy elements of their more traditional lifestyles, such a negative trend can be prevented.

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[a] The figures that are presented here are mortality rate ratio's before adjustment for socioeconomic status and other factors. If policy makers want to assess the size of inequalities in mortality they should look at inequalities in mortality before adjustment for these factors, because these figures reflect the burden of mortality that is experienced by these groups.

One may wonder whether interventions aimed at the reduction of socioeconomic inequalities in mortality can be expected to lead to a reduction of ethnic inequalities in mortality at the same time. Generally, a reduction of socioeconomic inequalities in mortality could lead to a reduction of ethnic inequalities in mortality, but only if the intervention reaches the ethnic minority groups and if it is effective within these groups. In order to obtain this result, the intervention should be tailored to the needs and characteristics of the specific ethnic minority group. Because socioeconomic inequalities only explained part of the observed ethnic inequalities in mortality, ethnic inequalities in mortality are likely to exist even after the hypothetical situation that all socioeconomic inequalities in mortality would be eliminated.

Implications for research

We want to outline a few directions for future research that we consider important. Firstly, because negative developments in the future might be expected we regard it important to gain further insight into factors that shed further light on current patterns and future developments of ethnic inequalities in health. This includes research on ethnic inequalities in lifestyle factors in which distinctions are made by age, degree of acculturation, duration of residence and socioeconomic status.

Secondly, research on predictors of mortality and morbidity among the second generation should be undertaken. A longitudinal research design could illuminate important determinants but has as a drawback that groups need to be followed for a long period of time. Alternatively, a design allowing for intergenerational comparison would enable to study the effects of being born and raised in the Netherlands.

Thirdly, because the size of the effect of socioeconomic status is most likely underestimated in analyses in which mean neighbourhood income is used, new possibilities for linkage between data-files at Statistics Netherlands that improve the availability of data on socioeconomic status deserve to be pursued. This could shed further light on the interrelation between ethnicity, socioeconomic status and mortality.

Fourthly, the evaluation of the extent to which the healthy migrant effect influences the mortality figures is based on the presumption that selection effects wean out over time. The evidence on this is however rather thin. It should therefore be reiterated.

Fifthly, mortality figures of older immigrants may be influenced by selective emigration. Research on the health and socioeconomic status of emigrants now living in the countries of origin would help to interpret the extent to which the low mortality among older immigrants is influenced by this selective emigration.

Sixthly, in order to take into account quality of life, other outcome measures than mortality need to be investigated. Relatively objective figures such data on hospital admission or incidence of diseases would be informative, but more subjective data such as those obtained from health interview surveys would too.

Seventhly, more information is needed about the effectiveness of strategies aimed at the reduction of health problems among ethnic minority groups. This thesis has shown

that groups/diseases for which such intervention research is particularly needed include Surinamese, Nigerian/Sudanese/Ethiopian and Somalian males and females, Turkish and Antillean/Aruban males, young ethnic minorities, infectious diseases, stroke, diabetes mellitus, asthma, external causes amongst which homicide, mortality abroad, and the uptake of health damaging behaviours.

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Summary

Introduction

This thesis contains studies about ethnic inequalities in the Netherlands and the role of socioeconomic status. Chapter 1 describes why this research was conducted. Ten percent of the population that lives in the Netherlands is of non-western origin. These are persons of which at least one parent is born abroad. Life expectancies in the countries where these migrant groups originate from are substantially lower than in the Netherlands and their socioeconomic positions in the Netherlands are generally lower than that of native Dutch. This raised the expectation that levels of mortality in ethnic minority groups were higher than among native Dutch. When we started conducting the studies presented in this thesis, no clear picture existed of the size and patterns of ethnic inequalities in mortality in the Netherlands. From 1995 onwards, the availability of data in the Netherlands improved. On the basis of country of birth of the subject and both parents, it became possible to identify people of foreign origin in the municipal population registers. Making use of personal identification numbers we could link these registers to the cause of death registers. This enabled us to conduct the presented studies. In these studies, the following two research questions were central:

1) What is the size and pattern of ethnic inequalities in mortality in the Netherlands?

2) What role of socioeconomic status and other factors play in explaining ethnic inequalities in mortality in the Netherlands?

Size and pattern of ethnic inequalities in the Netherlands

Chapter 2 describes age and cause specific inequalities in mortality between native Dutch and people of Turkish, Moroccan, Surinamese and Antillean/Aruban descent. These are the four largest ethnic minority groups (of non-western origin) living in the Netherlands. We observed that compared to native Dutch men, mortality was higher among Turkish, Surinamese, and Antillean/Aruban males, and lower among Moroccan males. In these groups, inequalities in mortality were small among females. Most minority groups had an excess mortality at young ages and reduced mortality at older ages, an excess mortality from ill defined conditions (which is related to mortality abroad) and external causes, and a reduced mortality from neoplasms. Cardiovascular disease mortality was low among Moroccan males and high among Surinamese males and females.

Chapter 3 describes mortality differences between refugees from a number of Asian and African countries residing in the Netherlands and the native Dutch population. These groups migrated relatively recently to the Netherlands. We observed that, as compared to native Dutch, persons born in Afghanistan, Iran, Iraq and Vietnam had lower mortality, whereas persons born in the African Nigeria/Sudan/Ethiopia and Somalia had

higher mortality. The size of mortality differences between refugees and the native Dutch population did not systematically vary with sex. Rate ratios seemed higher for younger age groups than for older age groups. For causes of death a mixed pattern was observed, with a tendency for a low mortality from neoplasm's and circulatory diseases and a high mortality from infectious diseases, ill-defined conditions and external causes.

Chapter 4 describes mortality differences between native Dutch and people of Indonesian descent. This is a large and well integrated, if not assimilated, group. Our objective was to determine if there are nonetheless differences in cause-specific mortality between first and second generation Indonesians and the native Dutch population. We observed that all cause mortality of Indonesians was similar to that of the native Dutch. Indonesian men had lower mortality levels in all age groups. In contrast, Indonesian women had a somewhat elevated mortality level in most age groups. Indonesians showed moderately higher mortality from cardiovascular diseases, diabetes and ill-defined conditions. They showed substantially higher mortality from hepatitis, tuberculosis, liver cancer, Hodgkin's disease and asthma. Indonesians had a reduced mortality from lung cancer, skin cancer, several cancers of the gastro-intestinal tract, suicide and alcohol-related diseases. The lower mortality risks of Indonesians did not vary much according to year of settlement.

Role of socioeconomic status

Chapter 7 examines the extent to which socioeconomic inequalities in mortality are still a relevant problem in a range of European countries. We made use data on mortality by educational level and occupational class among men and women from national longitudinal studies in Finland, Sweden, Norway, Denmark, England/Wales, and Italy (Turin). We observed that socioeconomic inequalities in mortality are still substantial in the studied countries.

In the Netherlands, there are no data available that can be used to monitor socioeconomic inequalities in mortality at the individual level. We therefore examined in chapters 8 and 9 whether socioeconomic inequalities in mortality within the Netherlands can be studied by making use of data at the neighbourhood level. We observed that the mortality level in areas with the lowest income was 13% higher than in areas with the highest income.

In chapter 9 we compared the size of income-related inequalities in mortality at the neighbourhood level with the size of income-related mortality differences on the individual level. The findings of this study suggested that socioeconomic mortality differences between neighbourhoods are smaller than socioeconomic mortality differences between individuals. Despite this limitation, neighbourhood data can provide an idea of the pattern of mortality differences by age, sex and cause of death, or of changes in the size of mortality differences over time.

Based on these evaluations of our indicator of socioeconomic status, we adjusted for mean neighbourhood income in analyses relating ethnicity to mortality (chapter 2, 3

and 4). We observed that average area income explained part of the excess mortality in Turkish, Surinamese and Antillean/Aruban males, but not, or to a much smaller extent, among the studied African refugee groups. Substantial age and cause specific inequalities in mortality between native Dutch and ethnic minority groups persisted after adjusted for mean neighbourhood income and often increased upon adjustment for socioeconomic status in groups with lower levels of mortality than native Dutch. Based on these observations, we conclude that it is unlikely that socioeconomic status could explain all ethnic inequalities in mortality.

Because the strength of the relation between socioeconomic status and mortality between influences the extent to which socioeconomic inequalities can determine ethnic differences in mortality, we examined, in chapter 10, whether the relationship between mortality and mean neighbourhood income varied between ethnic groups. We observed that socioeconomic differences in total mortality were relatively large in Dutch, Surinamese and Antillean/Aruban men and in Dutch and Surinamese women. They were relatively small among Turkish and Moroccan men and among Turkish, Moroccan and Antillean/Aruban women. The mortality differences among the Dutch were partly attributable to inequalities in mortality from cardiovascular diseases, whereas among Antillean/Aruban men external causes strongly contributed to the mortality differences. The small differences among Turkish and Moroccan men were due to a lack of inequalities for cardiovascular diseases and small inequalities for the other causes. We concluded that the impact of socioeconomic status on mortality did indeed differ between ethnic groups living in the Netherlands.

The limited effect of adjustment for socioeconomic status may, in part be due to limitations of the indicator of socioeconomic status that we used. In chapter 11 (paragraph 11.1) we discussed these limitations.

The role of lifestyle factors

Ethnic differences in cause specific mortality can provide some information on the role of life style factors. We examined ethnic differences in cause specific mortality in chapters 2-6 and summarised the results of the cause specific analyses in chapter 11. We observed that ethnic minority groups have in general a relatively low mortality from neoplasms, lung cancer and respiratory diseases and a high mortality abroad and from infectious diseases, external causes and homicide.

In order to study the effect of adoption of the health-related behaviours of the host country (sometimes called 'acculturation') we examined immigrant mortality according to duration of residence in chapter 5. We compared mortality among Turkish, Moroccans, Surinamese and Antilleans/Arubans with long duration of residence to those with shorter duration of residence. We observed that all cause mortality was not related to year of immigration among Turkish and Moroccan men and women, and among Surinamese women. Among Surinamese men and among Antilleans/Aruban men and women, mortality was higher in more recent immigrants. Part of their excess mortality was due to

their relatively low socioeconomic status. For most specific causes of death, no consistent relation with duration of residence was observed.

We conclude that lifestyle factors are likely to have contributed to the observed cause specific death patterns and thereby to overall levels of mortality. The death patterns did not (yet) seem to be influenced by adoptions of behaviours that are common in the Dutch population.

Role of the health care system

In chapter 6 we studied the possible role the health care system on ethnic inequalities in mortality. We studied this by looking at ethnic differences in avoidable mortality. We hypothesised that levels of avoidable mortality were higher among ethnic minorities than in native Dutch. We found slightly elevated risk in the total 'avoidable' mortality for ethnic minorities. Cause-specific examination showed higher risks of death for ethnic minorities from almost all infectious and several chronic conditions including asthma, diabetes, cholecystitis/lithiasis and cerebrovascular disorders. Ethnic minority women experienced a higher risk of death from maternity-related conditions. Ethnicity specific investigation showed that the Surinamese and Antillean/Aruban population had a higher risk of death, while Turkish and Moroccans experienced a lower risk of death from 'avoidable' conditions compared to the native Dutch population. Adjustment for demographic and socioeconomic factors explained a substantial part of ethnic differences in 'avoidable' mortality. We found no compelling evidences in the general health system inequalities between ethnic groups. Nevertheless, there are opportunities for improvement within specific sectors of the health system for disadvantaged groups.

The role of selection effects

Because health selection effects are reported to wean out over time, the healthy migrant effect would be supported by an increasing mortality with increasing duration of residence in the country of destination. We studied this in chapter 4 for Indonesians and in chapter 5 for Turkish, Moroccans, Surinamese and Antillean/Arubans. We observed stable or decreasing mortality with increasing duration of residence. Although levels of mortality of the more recently immigrated may have been higher without health selection effects, these results suggested that the healthy migrant effect was not of major importance for the explanation of patterns of mortality among these groups. In the various refugee groups, variations in duration of residence were to small to study variations in mortality according to duration of residence. In chapter 3 we suggest that the reduced mortality among refugees from the studied Asian countries is more likely to be related to education related selection.

In chapters 2, 4 and 11 we discuss that, for Turkish, Moroccans, Surinamese, Antilleans/Arubans and Indonesians, the selective return migration of a relatively (un)healthy sub sample of migrants is possibly of more importance than the healthy migrant effect. A considerable part of the original immigrants from these countries left the

Netherlands before the start of this study. If the (r)emigrants were a selective group, than the persons who remained in the Netherlands are a selective group as well and this may therefore have influenced their levels of mortality. We cannot exclude the possibility that the low levels of mortality among older immigrants is related to the selective emigration of those with a relatively bad health or low socioeconomic status.

The role of genetics

Studies on ethnic inequalities in cause specific mortality (chapters 2-4) and on ethnic inequalities in mortality in relation to duration of residence (chapter 5) can shed light on the role of genetics. We observed a high mortality from diabetes and cardiovascular disease among Surinamese – who are partly of Indian descent - and Indonesians living in the Netherlands. In chapter 11 we conclude that it is likely that genetics played a role in the elevated risks of diabetes mellitus among Surinamese but not among Indonesians and that for other causes of death evidence is lacking at this moment.

General discussion

In chapter 11 we discuss strengths and weaknesses of the data that are used. We conclude that the Dutch data are relatively sound because a) the system consisting of a cause of death register and a municipal population register is better than one consisting of censuses, b) legal residents of the Netherlands that die outside the Netherlands are generally included in the cause of death register, c) the establishment of the population at risk was relatively adequate, and d) they cover all legal inhabitants of the Netherlands. We discuss the validity of mean neighbourhood income as a proxy of socioeconomic status in studies on ethnic inequalities in mortality. We conclude that adjustment for mean neighbourhood income provided a good impression of the direction in which adjustment for individual level socioeconomic status would have influence the results but that the size of the effect of socioeconomic status is most likely underestimated.

We summarise our results of cause, sex and age and specific analyses. We conclude that the general picture that emerges from both our results is that it depends on country of origin, cause of death, age and sex whether mortality among ethnic minorities is higher, similar or lower mortality than in the host population. Despite these variations, we distil a few trends. Ethnic minorities have in general more favourable levels of mortality than could be expected on the basis of the life expectancies in the countries of origin and on the basis of their socioeconomic position in the Netherlands. These mortality rates are the result of each other compensating phenomena: a) higher mortality among young migrants than among native Dutch people and lower mortality among elderly migrants than among elderly native Dutch people and b) a relatively low mortality from cancer and respiratory diseases and a relatively high mortality from infectious diseases and external causes.

Some of the findings may be explained by a difference in timing between the health benefits and the health risks of migration. Migrant health could be benefiting from the

favourable socioeconomic, public health and health-care conditions in the Netherlands, but not yet be affected by the higher risks of cancer and cardiovascular disease associated with prosperity.

We consider implications for policy. We discuss whether our observations justify the conclusion that future monitoring of ethnic inequalities in mortality is not necessary and that investment in the reduction of ethnic inequalities in mortality has low priority. We argue that this conclusion is not justified. Lastly, we outline a few directions for future research that we consider important.

Samenvatting

Introductie

Hoofdstuk 1 beschrijft de aanleiding van het in dit proefschrift beschreven onderzoek. Van de Nederlandse bevolking is tien procent van niet-westerse origine. Dit zijn personen van wie tenminste 1 ouder in een niet-westers land is geboren. In de landen ven herkomst is de levensverwachting veelal aanzienlijk lager dan in Nederland. Omdat allochtonen bovendien gemiddeld genomen een lagere sociaal-economische status hebben dan autochtone Nederlanders, wekt dit de verwachting dat sterfte onder allochtonen hoger zou kunnen zijn dan onder Nederlanders. Toen wij met dit onderzoek begonnen bestond er nog geen duidelijk beeld van de omvang van etnische verschillen in Nederland. Vanaf 1995 nam de kwaliteit van de beschikbare data toe. Op basis van land van geboorte van persoon en beide ouders, werd het mogelijk mensen met een buitenlandse origine te identificeren in de gemeentelijke basisadministratie. Gebruik makende van persoonlijke identificatienummers konden we deze registers koppelen aan de doodsoorzakenregistratie. Dit stelde ons in staat de hier beschreven studies uit te voeren. Hierbij stonden twee onderzoeksvragen centraal. Deze luidden:

1) Wat is de omvang en het patroon van etnische verschillen in sterfte in Nederland?

2) Wat is de rol van sociaal-economische status en andere factoren bij de verklaring van etnische verschillen in sterfte in Nederland?

Omvang en patroon van etnische verschillen in sterfte

Sterfteverschillen tussen autochtone Nederlanders en mensen van Turkse, Marokkaanse, Surinaamse en Antilliaanse/Arubaanse[a] worden beschreven in hoofdstuk 2. In vergelijking tot Nederlandse mannen, was de sterfte hoger was in Turkse, Surinaamse en Antilliaanse/Arubaanse mannen en lager onder Marokkaanse mannen. Sterfteverschillen onder vrouwen waren klein. De jongere groepen hadden een hogere mortaliteit dan autochtone Nederlanders en de oudere een lagere. Een analyse van doodsoorzaken liet een hoge sterfte aan ongevallen en geweld en aan slecht omschreven ziektebeelden zien. Dit laatste wordt verklaard door sterfte in het buitenland, waardoor de doodsoorzaak in de Nederlandse registratie ontbreekt. De sterfte aan kanker bleek laag te zijn. Cardiovasculaire sterfte was laag onder Marokkaanse mannen en hoog onder Surinaamse mannen en vrouwen.

Sterfteverschillen tussen autochtone Nederlanders en in Nederland woonachtige vluchtelingen uit een aantal Aziatische en Afrikaanse landen worden beschreven in

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a Deze groepen zijn samengevoegd in de analyses.

hoofdstuk 3. We vonden dat, in vergelijking tot Nederlanders, personen geboren in Irak, Iran, Afghanistan en Vietnam een lagere sterfte hadden, terwijl personen geboren in Nigeria/Soedan/Ethiopië[a] en Somalië een verhoogde sterfte hadden. De omvang van deze sterfteverschillen tussen vluchtelingen en Nederlanders varieerde niet systematisch tussen mannen en vrouwen. Rate ratio's leken hoger op jongere leeftijd dan op oudere leeftijd. Voor doodsoorzaken werd een gevarieerd patroon gevonden met een tendens voor lage sterfte aan kanker en cardiovasculaire ziekten en een hoge sterfte aan infectieziekten, slecht omschreven ziektebeelden (als gevolg van sterfte in het buitenland) en ongevallen en geweld.

Sterfteverschillen tussen Nederlanders en eerste en tweede generatie Indonesiërs worden beschreven in hoofdstuk 4. Dit is een grote en goed geïntegreerde, zo niet geassimileerde, groep. Indonesische mannen hadden een iets verlaagde sterfte in alle leeftijdsgroepen, terwijl Indonesische vrouwen in de meeste leeftijdsgroepen een iets verhoogde sterfte hadden. Indonesiërs hadden een verhoogde sterfte aan cardiovasculaire doodsoorzaken, diabetes en slecht omschreven ziektebeelden. Ze hadden een sterk verhoogde sterfte aan hepatitis, tuberculose, leverkanker, ziekte van Hodgkin en astma. Sterfte aan longkanker, huidkanker, kankers van het spijsverteringskanaal, suïcide en alcoholgerelateerde doodsoorzaken was daarentegen verlaagd. De sterfte van Indonesiërs varieerde niet duidelijk met verblijfsduur.

De rol van sociaal-economische status

De mate waarin sociaal-economische verschillen in sterfte nog steeds een relevant probleem vormen in een aantal Europese landen wordt onderzocht in hoofdstuk 7. Hiervoor hebben we gebruik gemaakt van data over sterfte naar opleiding en beroep onder mannen en vrouwen. Deze informatie was afkomstig van nationale longitudinale studies in Finland, Zweden, Denemarken, Engeland/Wales en Italië (regio Turijn). Sociaal-economische verschillen in sterfte bleken nog steeds een aanzienlijk probleem vormen in deze landen en bleken niet te zijn afgenomen in de periode 1981-1995.

In Nederland zijn er geen landelijke gegevens beschikbaar waarmee sociaal-economische verschillen in sterfte op individueel niveau gemeten kunnen worden. Hierom hebben we in hoofdstuk 8 onderzocht of sociaal-economische verschillen in sterfte binnen Nederland gemeten kunnen worden door gebruik te maken van data op buurtniveau. Met data van het Centraal Bureau van de Statistiek konden we aantonen dat sterfte in buurten met het laagste inkomen 13% hoger is dan sterfte in buurten met het hoogste inkomen.

In hoofdstuk 9 vergelijken we de omvang van inkomensgerelateerde sterfteverschillen op het buurtniveau met de omvang van inkomensgerelateerde sterfteverschillen op individueel niveau. De resultaten lieten zien dat sociaal-economische verschillen in sterfte tussen buurten kleiner zijn dan sociaal-economische verschillen in sterfte tussen individuen. Informatie over gemiddeld buurtinkomen kan echter wel degelijk een beeld geven van de omvang van sociaal-economische sterfteverschillen naar leeftijd, geslacht en doodsoorzaak.

In hoofdstuk 2, 3 en 4 hebben we gecorrigeerd voor gemiddeld buurtinkomen in analyses die etniciteit aan sterfte relateren. Gemiddeld buurtinkomen bleek een deel van de sterfteverschillen tussen Nederlandse en Turkse, Surinaamse en Antilliaanse/Arubaanse mannen en tussen Nederlandse en Surinaamse vrouwen te verklaren, maar niet, of in veel mindere mate, tussen Nederlanders en de bestudeerde Afrikaanse vluchtelingen. In alle groepen bestonden er ook na correctie voor gemiddeld buurtinkomen grote verschillen in leeftijd- en doodsoorzaakspecifieke sterfte. Op grond hiervan concluderen we dat het onwaarschijnlijk is dat sociaal-economische status alle etnische verschillen in sterfte kan verklaren.

De mate waarin etnische verschillen in sterfte verklaard kunnen worden door sociaal-economische status hangt mede af van de sterkte van de relatie tussen sociaal-economische status en sterfte. Hierom hebben we in hoofdstuk 10 onderzocht of de relatie tussen sterfte en gemiddeld buurtinkomen varieert tussen etnische groepen. Dit bleek inderdaad het geval. Sociaal-economische verschillen in totale sterfte waren relatief groot onder Nederlandse, Surinaamse en Antilliaanse/Arubaanse mannen en Nederlandse en Surinaamse vrouwen. Ze waren relatief klein onder Turkse en Marokkaanse mannen en Antilliaanse/Arubaanse vrouwen. De sociaal-economische sterfteverschillen onder Nederlanders zijn deels toe te schrijven aan ongelijkheid in sterfte aan cardiovasculaire doodsoorzaken. De sociaal-economische sterfteverschillen onder Antilliaanse/Arubaanse mannen worden in belangrijke mate veroorzaakt door ongevallen en geweld. De kleine sociaal-economische sterfteverschillen onder Turkse en Marokkaanse mannen zijn te wijten aan het ontbreken van sociaal-economische verschillen in cardiovasculaire sterfte en aan kleine sociaal-economische verschillen in sterfte voor andere doodsoorzaken.

Het beperkte effect van controle voor sociaal-economische status kan deels te wijten zijn aan de beperkingen van de gebruikte indicator. In paragraaf 11.1 worden deze beperkingen besproken.

De rol van leefstijlfactoren

Etnische verschillen in doodsoorzaakspecifieke sterfte kunnen informatie geven over de rol van levensstijlfactoren. Etnische verschillen in doodsoorzaakspecifieke sterfte worden beschreven in de hoofdstukken 2 t/m 6 en zijn samengevat in hoofdstuk 11. De bestudeerde groepen blijken in het algemeen een verlaagde sterfte hebben aan kanker (waaronder longkanker) en respiratoire aandoeningen en een verhoogde sterfte in het buitenland en aan infectieziekten en ongevallen en geweld.

Om de effecten van aanpassing aan gezondheidsgerelateerde gedragingen van het gastland (soms acculturatie genoemd) te onderzoeken hebben we in hoofdstuk 5 sterfte onder immigranten onderzocht in relatie tot hun verblijfsduur in Nederland. Onder Turkse en Marokkaanse mannen en vrouwen en onder Surinaamse vrouwen blijkt totale sterfte niet aan verblijfsduur gerelateerd te zijn. Onder Surinaamse mannen en onder Antilliaanse/Arubaanse mannen en vrouwen was de sterfte hoger onder recente immigranten dan onder degenen die al langer in Nederland woonden. Deel van dit

overschot in sterfte was gerelateerd aan de relatief lage sociaal-economische status van de meer recent geïmmigreerde. Voor de meeste specifieke doodsoorzaken is geen consistente relatie gevonden met verblijfsduur.

De sterke variatie in doodsoorzaakspecifieke sterftepatronen vormen een indicatie dat leefstijlfactoren bijdragen aan de gevonden etnische verschillen in sterfte. Het ontbreken van een duidelijke relatie met verblijfsduur geeft aan dat de sterfte (nog) niet beïnvloed wordt door de overname van gezondheidsgerelateerd gedrag dat gebruikelijk is onder de Nederlandse populatie.

De rol van het gezondheidszorgsysteem

In hoofdstuk 6 hebben we de mogelijke invloed van het gezondheidszorgsysteem op etnische verschillen in sterfte onderzocht. We hebben dit gedaan door te kijken naar etnische verschillen in vermijdbare sterfte. Sterfte wordt als vermijdbaar gezien als er een effectieve maatregel bestaat om het leven van de patient te verlengen. Totale vermijdbare sterfte onder allochtonen bleek iets hoger te zijn dan onder autochtonen. Doodsoorzaakspecifiek onderzoek toonde echter aan dat dit verhoogde sterfte niveau beperkt bleef tot enkele doodsoorzaken. En het bleek ook niet gevonden te worden voor alle etnische groepen. In vergelijking tot de Nederlandse populatie, haaden Surinamers en Antillianen/Arubanen een verhoogde, maar Turken en Marokkanen een verlaagde sterfte aan vermijdbare doodsoorzake. Een deel van de etnische verschillen in vermijdbare sterfte bleek verklaard te kunnen worden door demografische en sociaal-economische factoren. Deze resultaten wijzen maken het onwaarschijnlijk dat etnische verschillen in sterfte verklaard zouden kunnen worden door verschillen in ontvangen gezondheidszorg. Desondanks zijn er aanknopingspunten voor verbetering van de zorg in specifieke sectoren en voor specifieke groepen.

De rol van selectie-effecten

In vrijwel alle hoofdstukken hebben we aandacht besteed aan de mogelijke rol van selectie-effecten. Van selectie-effecten wordt gezegd dat ze afnemen met het verstrijken van de tijd. De hypothese dat de relatief lage sterfte van sommige migranten verklaard kan worden door de selectie immigratie van gezonde mensen ('healthy migrant effect') zou hierom ondersteund worden door een afnemende sterfte bij een afnemende verblijfsduur in het land van bestemming. Wij hebben dit in hoofdstuk 4 onderzocht voor Indonesiërs en in hoofdstuk 5 voor Turken, Marokkanen, Surinamers, en Antillianen/Arubanen. Sterfteniveau's van immigranten bleken niet sterk samen te hangen met verblijfsduur in Nederland. In enkele gevallen was de sterfte iets verlaagd onder immigranten met een langere verblijfsduur. Hoewel sterfteniveaus van meer recente immigranten hoger zouden kunnen zijn geweest zonder selectie-effecten, suggereren de resultaten dat de selectieve immigratie van gezonde mensen niet een belangrijke verklaring vormt van het sterfteniveau van immigranten.

In de verschillende vluchtelingengroepen was de variatie in verblijfsduur te kort om de relatie tussen sterfte en verblijfsduur te kunnen onderzoeken. Gezien het relatief hoge opleidingniveau van sommige vluchtelingen groepen suggereren we in hoofdstuk 3 dat de verminderde sterfte onder vluchtelingen uit Aziatische landen samen kan hangen met aan opleiding gerelateerde selectie.

In de hoofdstukken 2, 4 en 11 bespreken we dat voor Turken, Marokkanen, Surinamers en Antillianen/Arubanen en Indonesiërs de selectieve remigratie van een relatief (on)gezonde groep migranten mogelijk van meer belang is voor de verklaring van etnische verschillen in sterfte dan de selectieve immigratie van gezonde mensen. Een niet onaanzienlijk deel van de immigranten uit deze landen hebben Nederland weer verlaten voor de aanvang van deze studie. Als deze remigranten een selectieve groep vormden, dan zijn de mensen die in Nederland zijn gebleven ook een selectieve groep. Dit vormt een mogelijke verklaring voor de relatief lage sterfte oudere immigranten.

Rol van genetische verschillen

Studies naar etnische verschillen in doodsoorzaakspecifieke sterfte (hoofdstukken 2, 3, 4 en 6) en over etnische verschillen in sterfte naar verblijfsduur (hoofdstuk 5) kunnen ook licht werpen op de rol van genetische verschillen. We hebben een hoge sterfte aan diabetes en cardiovasculaire sterfte gevonden onder Surinamers – die deels van Indiase origine zijn – en onder Indonesiërs woonachtig in Nederland. In hoofdstuk 11 concluderen we dat het waarschijnlijk is dat genetische factoren een rol hebben gespeeld in het verhoogde risico van diabetes mellitus onder Surinamers, maar niet onder Indonesiërs en dat voor andere doodsoorzaken het bewijs op het moment ontbreekt.

Algemene discussie

In hoofdstuk 11 worden sterke en zwakke kanten van de gebruikte data besproken. We concluderen dat de Nederlandse data relatief robuust zijn omdat a) ze een systeem bevatten bestaande uit een doodsoorzaken en populatie registratie, hetgeen beter is dan data op basis van een census, b) legale inwoners van Nederland die in het buitenland overlijden in het algemeen geïncludeerd zijn in de sterfte registratie, c) de vaststelling van de populatie at risk relatief goed was, en d) alle legale inwoners van Nederland in de studie zijn opgenomen. We bespreken de validiteit van het gemiddelde buurtinkomen als een proxy van sociaal-economische status in studies naar etnische verschillen in sterfte. We concluderen dat correctie voor buurtinkomen een goede impressie geeft van de richting waarin correctie voor sociaal-economische status op individueel niveau de resultaten zou hebben beïnvloed maar dat de omvang van het effect waarschijnlijk is onderschat.

We vatten de resultaten van onze doodsoorzaak, sekse- en leeftijdspecifieke analyses samen. Ondanks dat het afhangt van het land van origine, de doodsoorzaak, de leeftijd en het geslacht of sterfte onder etnische minderheden hoger, gelijk of lager is dan onder de populatie van het gastland, kunnen we een paar trends destilleren. Allochtonen hebben in het algemeen een lagere sterfte dan verwacht op basis van de sterfteniveaus in

de landen van origine en op basis van hun sociaal-economische status in Nederland. Deze over het algemeen gunstige mortaliteit is het resultaat van elkaar compenserende fenomenen. Zo hebben jongere allochtonen in het algemeen een hogere mortaliteit dan autochtone Nederlanders en de oudere een lagere en hebben allochtonen vaak een relatief lage sterfte aan kanker en respiratoire aandoeningen en een relatief hoge sterfte aan infectieziekten en ongevallen en geweld.

Sommige bevindingen kunnen worden verklaard doordat de voordelen voor de gezondheid van migranten (sociaal-economische voordelen en voordelen voortkomend uit effectieve preventie en gezondheidszorg) zich mogelijk eerder voordoen dan de nadelen, zoals het hogere risico op doodsoorzaken die gepaard gaan met welvaart.

Tot slot beargumenteren we waarom het toekomstig monitoren van etnische verschillen in gezondheid nodig is, geven we aanknopingspunten voor preventie en bespreken mogelijkheden voor toekomstig onderzoek.

List of Tables and Figures

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Curriculum Vitae

Vivian Bos werd op 26 oktober 1973 geboren te Nagele (Noordoost Polder). In 1993 behaalde zij het atheneum diploma aan het Krimpenerwaard College te Krimpen aan den IJssel. Na enkele maanden gereisd te hebben begon zij in 1994 met de studie culturele antropologie/sociologie der niet-westerse samenlevingen aan de Universiteit Leiden. In 1995 begon zij bovendien aan de studie psychologie, eveneens aan de Universiteit Leiden. In het kader van deze studies volbracht zij stages bij niet-gouvernementele organisaties in Calcutta en Mexico-stad en volgde ze vakken medische antropologie en psychologie aan de Universiteit van Amsterdam en de University College London. In 1998 behaalde zij doctoraal examens van de studies sociologie der niet-westerse samenlevingen en psychologie (beide met genoegen). Hierna werkte zij enige maanden als toegevoegd onderzoeker bij de vakgroep sociale psychologie aan de Universiteit Leiden. Van 1999 tot 2004 was zij aangesteld bij het instituut Maatschappelijke Gezondheidszorg (iMGZ), Erasmus Medisch Centrum Rotterdam. Hier verrichtte zij het onderzoek beschreven in dit proefschrift (promotor Prof.dr. J.P. Mackenbach). Tevens was zij betrokken bij diverse andere studies op het gebied van etnische en sociaal-economische verschillen in gezondheid en sterfte. Van 2000 tot 2003 volgde zij de Master of Science opleiding Epidemiologie bij de Netherlands Institute of Health Sciences, waarvan zij in 2003 het diploma behaalde. Vanaf oktober 2004 werkt zij bij het Nationaal Instituut voor Gezondheidsbevordering en Ziektepreventie (NIGZ) te Woerden.

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