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Incidence of first acute myocardial infarction over time specific for age, sex, and country of birth

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ABSTRACT

Objectives: To study the age- and sex-specific incidence rates of first acute myocardial infarction (AMI) among first-generation ethnic minority groups (henceforth, migrant groups) and the Dutch majority population in the Netherlands during two time periods (2000-2004 and 2005-2010).
Methods: Through linkage of Dutch nationwide registers, first AMI events in the Dutch majority population and the major migrant groups living in the Netherlands were identified from 2000-2004 and 2005-2010. Absolute incidence rates were calculated within each age-sex-period-country of birth group.
Results: Regardless of ethnic background, AMI incidence rates were higher in men than in women and increased with age. Incidence significantly declined over time among the Dutch majority population (men: -26.8%, women: -26.7%), and among most migrant groups under study. It was only in Moroccan migrants that AMI incidence significantly increased over time (men: 25.2%, women: 41.7%). Trends differed between age categories, but did not show a consistent pattern. The higher AMI incidence in Surinamese men and women and Turkish and Indonesian men compared with the Dutch majority population persisted over time, but decreased with age and became absent after 70 years of age. Moroccans had a significantly lower incidence compared with the Dutch majority population during 2000-2004, which disappeared during 2005-2010.
Conclusion: Primary preventive strategies should focus on Surinamese men and women and Turkish and Indonesian men below 70 years of age. Future research is necessary to unravel the factors that provoke the increasing AMI incidence over time among Moroccans.

KEYWORDS

Acute myocardial infarction, age, ethnicity, sex, time trends

INTRODUCTION

Cardiovascular disease (CVD) is one of the main contributors to morbidity and mortality worldwide. In the Netherlands it is the number one cause of death in women and the number two in men, immediately after cancer. Ischaemic heart disease (IHD), and in particular acute myocardial infarction (AMI), is responsible for the majority of CVD deaths.[1] Information on age- and sex-specific incidence rates of AMI is vital in developing and maintaining preventive strategies. The latest detailed estimates of absolute AMI incidence in the Netherlands stratified by age and sex date back to 2000, and were restricted to the general Dutch population.[2] As a decline in AMI incidence has taken place in the Netherlands over the past decade, there is a need for updated AMI incidence estimates.[3]
Since 10% of the Dutch population was born abroad, and ethnic variations in AMI incidence have been reported, it is important to present results specific for country of birth.[4-7] Internationally, only a few studies have described absolute age- and sex-specific incidence rates in minority and migrant groups.[8-11] Results of these studies suggest that ethnic differences in AMI incidence are particularly present in the young, and that AMI incidence is higher in men than in women irrespective of age and country of birth. In the Netherlands, such estimates are unavailable yet. It is well known that AMI incidence has been declining over time in Western countries.[3,12] However, time trends among ethnic minority and migrant groups have not been

widely investigated, and age- and sex-specific time trends are even more limited.[11,13-16] The one study reporting such extensively stratified data showed a larger decline in AMI incidence among White Americans than among African Americans, especially in men and elderly women.[11] This information is important to monitor whether preventive strategies have gained effect, and in which groups this occurred. Furthermore, it may target specific groups that need extra attention in future preventive strategies. Therefore this study presents the absolute incidence rate of age- and sex-specific first AMI events (hospitalisations and out-of-hospital deaths) during two time periods (2000-2004 and 2005-2010) within the Dutch majority population and within migrant groups living in the Netherlands.

METHODS

Data sources and enrolment

New cases of first AMI events in the Dutch population were identified during two time periods: 2000-2004 (period one) and 2005-2010 (period two). This enabled us to investigate trend patterns in AMI incidence during the past decade, while keeping numbers high enough for analysis. First AMI events included hospitalised first AMI patients and out-of-hospital deaths from first AMI. Data on AMI hospitalisations were derived from the Dutch National Hospital Discharge Register (HDR). Data on out-of-hospital deaths from AMI were derived from the National Cause of Death Register (CDR). Demographic data (date of birth, country of birth, country of birth of parents, sex) were derived from the Dutch Population Register (PR), which contains information on all officially registered persons living in the Netherlands. The registers have been described in detail previously.[17] The overall quality of Dutch nationwide registers proved to be adequate.[18,19]

As the nominator, all persons with a first AMI event during period one and period two were included. A first AMI comprised all first hospitalisations with AMI as principal or secondary diagnosis (ICD-9 code 410) and all out-of-hospital deaths with AMI as primary or secondary cause (ICD-10 code I21). Persons who suffered a previous hospitalisation with AMI as the principal or secondary diagnosis from 1995 onwards were excluded. As denominator, person-years at risk were calculated based on all unique persons in the PR during the years 2000-2010 (if a person was unique in only a part of these years, person-years at risk were based on these years). A person was ascribed PR unique when there was a unique combination of the variables date of birth, sex, and four digits of postal code in the year of interest. In case of non-uniqueness a person could not be validly tracked down in the HDR and had to be excluded.

Ethnic background

Only first-generation ethnic minority groups were included (henceforth, migrant groups). Migrant groups were constructed based on the country of birth of the resident and his/her parents, according to the definition of Statistics Netherlands.[20] A person is considered a migrant if he/she was born abroad and at least one of the parents were born abroad. Persons in which both parents were born in the Netherlands were indicated as the Dutch majority population. For this study, individuals born in Suriname, Morocco, Turkey, Netherlands Antilles, and Indonesia were included (the five major migrant groups living in the Netherlands).

Data analysis

AMI incidence rates in period one and two with 95% confidence intervals (95% CI) were computed by age (30-39, 40-49, 50-59, 60-69, 70-79, 80-89 and ≥90) and sex within the Dutch majority population and within the migrant groups under study. The incidence rates were expressed as number of events per 100,000 person-years at risk. Subsequently, age-standardised incidence rates were calculated using the age distribution of the European population in ten-year age bands. The percent change in AMI incidence rate over the two time periods was calculated within each age-sex-country of birth group. To study the differences between migrant groups and the Dutch majority population, relative risks (RR) were calculated within each age-sex-period group (reference=Dutch majority population). We used SPSS software, version 14.0 (SPSS Inc, Chicago, Illinois, USA) to calculate the number of events and person-years at risk. Incidence rates with 95% CIs were calculated with the online program openepi.com.[21] Age-standardised incidence rates with 95% CIs were calculated with STATA 11.0 (Stata Corp. 2009. *STATA Statistical Software: Release 11*. College Station, TX: StataCorp LP). Relative risks and percent changes were calculated using Microsoft Excel 2010. All analyses were performed in accordance with privacy legislation of the Netherlands.

RESULTS

During 2000-2004, the mean number of first AMI events was 25,070 per year; from 2005-2010 this number decreased to 18,507 per year. Among migrants, the Antilleans were the smallest and the Surinamese the largest group *(results not shown)*. Men had the highest AMI incidence rate within all countries for birth groups, age strata, and time periods (*table 1 and 2*). Incidence increased with age in all groups and time periods under study.

Trends in AMI incidence among migrants and the Dutch majority population

There was a decline in AMI incidence over time among the Dutch majority population, among Surinamese and

Table 1. *Incidence rate of acute myocardial infarction per 100,000 person-years at risk in every age-sex group in the Dutch majority population and in the major migrant groups living in the Netherlands between 2000 and 2004*

	Majority population	Surinamese		Moroccan		Turkish		Antillean		Indonesian	
	IR	IR	RR	IR	RR	IR	RR	IR	RR	IR	RR
Men											
<30	1.4 (1.1-1.6)	-	-	-	-	-	-	-	-	-	-
30-39	31 (30-33)	81 (63-103)	2.6*	31 (21-46)	1.0	61 (48-76)	2.0*	29 (13-55)	0.9	-	-
40-49	141 (137-145)	318 (281-357)	2.3*	78 (51-113)	0.6*	283 (244-326)	2.0*	172 (127-228)	1.2	229 (187-278)	1.6*
50-59	334 (328-340)	573 (511-641)	1.7*	179 (126-247)	0.5*	571 (499-651)	1.7*	322 (243-417)	1.0	383 (342-429)	1.1*
60-69	581 (572-590)	698 (600-807)	1.2*	473 (366-602)	0.8	726 (641-819)	1.2*	624 (444-854)	1.1	642 (582-706)	1.1*
70-79	993 (979-1007)	782 (618-976)	0.8*	392 (223-643)	0.4*	681 (474-950)	0.7*	946 (526-1577)	1.0	996 (906-1093)	1.0
80-89	1500 (1472-1528)	1609 (1175-2155)	1.1	-	-	-	-	-	-	1372 (1201-1561)	0.9
≥90	1971 (1878-2067)	-	-	-	-	-	-	-	-	2424 (1748-3280)	1.2
All ages	248 (246-250)	293 (275-312)	1.2*	71 (61-82)	0.3*	220 (205-236)	0.9*	123 (106-143)	0.5*	574 (546-604)	2.3*
Age stand[a]	*205 (203-206)*	*270 (247-292)*	*1.3**	*111 (92-131)*	*0.5**	*228 (208-248)*	*1.1**	*196 (158-234)*	*1.0*	*235 (220-250)*	*1.1**
Women											
<30	0.5 (0.4-0.7)	-	-	-	-	-	-	-	-	-	-
30-39	10 (9-11)	16 (9.3-25)	1.6	-	-	12 (6.2-20)	1.2	-	-	-	-
40-49	43 (41-45)	53 (41-69)	1.2	-	-	48 (33-70)	1.1	-	-	44 (28-66)	1.0
50-59	81 (78-84)	154 (124-188)	1.9*	-	-	106 (78-142)	1.3	82 (48-130)	1.0	86 (68-109)	1.1
60-69	211 (206-217)	304 (247-372)	1.4*	225 (134-358)	1.1	213 (158-281)	1.0	302 (200-539)	1.4	236 (201-275)	1.1
70-79	500 (491-509)	590 (479-719)	1.2	-	-	420 (267-630)	0.8	304 (148-558)	0.6	523 (468-583)	1.0
80-89	986 (969-1002)	978 (744-1263)	1.0	-	-	785 (318-1633)	0.8	1059 (538-1888)	1.1	952 (850-1063)	1.0
≥90	1423 (1380-1467)	1060 (539-1890)	0.7	-	-	1579 (402-4297)	1.1	-	-	1335 (1076-1639)	0.9
All ages	147 (145-148)	106 (96-117)	0.7*	17 (12-23)	0.1*	48 (41-56)	0.3*	51 (40-63)	0.3*	297 (279-317)	2.0*
Age stand[a]	*86 (85-87)*	*108 (96-120)*	*1.3**	*48 (30-65)*	*0.6**	*86 (64-109)*	*1.0*	*71 (53-88)*	*0.8*	*88 (81-94)*	*1.0*

IR=Incidence rate per 100,000 person-years at risk; RR=relative risk of AMI incidence compared to the Dutch majority population; [a]Standardised to the age-distribution of the European population in ten year age-bands; *Significant difference compared with the Dutch majority population.

Indonesian men and women, and among Turkish and Antillean men (*figure* 1). Among Moroccans incidence increased over time, whereas it remained stable among Turkish and Antillean women. After age stratification, the direction of time trends was often similar between age categories, with some variation in magnitude (*figure 2*). An exception was in Moroccan men, where age-stratified results showed decreased, increased, as well as stable AMI incidence rates over time.

Difference in AMI incidence between migrants and the Dutch majority population

Surinamese men and women, as well as Turkish and Indonesian men, had a statistically significantly higher AMI incidence compared with their Dutch counterparts, which remained stable over time (*table 1 and 2*). After age stratification, the higher incidence decreased with age and only remained in those younger than 70 years of age. Moroccans had a statistically significantly lower AMI incidence compared with their Dutch counterparts during period one, whereas there was no difference observed during period two. Among Moroccan men this was mainly due to the fact that the lower incidence in 50-80 year olds disappeared over time. Among Antillean men and women, and Turkish and Indonesian women, there was no difference in incidence with the Dutch majority population. After age stratification, however, AMI incidence was higher in some age groups among Turkish and Indonesian women, but in period two only (*table 2*).

Table 2. *Incidence rate of acute myocardial infarction per 100,000 person-years at risk in every age-sex group in the Dutch majority population and in the major migrant groups living in the Netherlands between 2005 and 2010*

	Majority population	Surinamese		Moroccan		Turkish		Antillean		Indonesian	
	IR	IR	RR	IR	RR	IR	RR	IR	RR	IR	RR
Men											
<30	0.9 (0.8-1.1)	-	-	-	-	-	-	-	-	-	-
30-39	28 (27-30)	91 (72-114)	3.3*	16 (9.6-25)	0.6*	47 (37-60)	1.7*	39 (22-65)	1.4	-	-
40-49	116 (113-119)	238 (209-268)	2.1*	79 (60-102)	0.7*	220 (195-247)	1.9*	95 (66-132)	0.8	179 (128-243)	1.5*
50-59	266 (261-270)	458 (415-506)	1.7*	250 (194-317)	0.9	403 (350-462)	1.5*	261 (205-329)	1.0	361 (323-403)	1.4*
60-69	408 (401-414)	565 (497-640)	1.4*	443 (358-542)	1.1	501 (439-569)	1.2*	464 (357-593)	1.1	498 (450-551)	1.2*
70-79	665 (654-675)	571 (464-696)	0.9	760 (593-961)	1.1	524 (424-640)	0.8*	530 (314-843)	0.8	711 (643-784)	1.1
80-89	1106 (1086-1127)	1013 (742-1352)	0.9	906 (491-1540)	0.8	-	-	-	-	1180 (1051-1321)	1.1
≥90	1561 (1491-1632)	2227 (1171-3870)	1.4	-	-	-	-	-	-	1565 (1147-2088)	1.0
All ages	199 (197-200)	287 (270-304)	1.4*	101 (90-113)	0.5*	196 (183-209)	1.0	119 (103-136)	0.6*	517 (491-544)	2.6*
Age stand[a]	*150 (148-151)*	*211 (197-225)*	*1.4**	*139 (122-155)*	*0.9*	*170 (156-183)*	*1.1**	*132 (110-154)*	*0.9*	*180 (168-192)*	*1.2**
Women											
<30	0.6 (0.5-0.7)	-	-	-	-	-	-	-	-	-	-
30-39	9.1 (8.2-10)	-	-	-	-	10 (5.5-16)	1.1	-	-	-	-
40-49	37 (36-39)	47 (36-59)	1.3	19 (10-34)	0.5*	38 (28-51)	1.0	-	-	37 (20-62)	1.0
50-59	72 (69-75)	116 (97-139)	1.6*	46 (25-79)	0.6	112 (86-144)	1.6*	48 (28-78)	0.7	76 (60-95)	1.1
60-69	145 (141-149)	236 (196-282)	1.6*	221 (143-326)	1.5	216 (173-266)	1.5*	111 (67-174)	0.8	175 (147-207)	1.2*
70-79	350 (343-357)	398 (324-483)	1.1	423 (269-635)	1.2	275 (194-378)	0.8	260 (148-425)	0.7	400 (355-448)	1.1*
80-89	732 (720-745)	555 (417-723)	0.8*	-	-	691 (384-1152)	0.9	989 (563-1621)	1.4	732 (656-815)	1.0
≥90	1140 (1107-1173)	-	-	-	-	-	-	-	--	1002 (813-1223)	0.9
All ages	117 (116-118)	96 (88-105)	0.8*	26 (21-32)	0.2*	58 (51-66)	0.5*	41 (33-52)	0.4*	256 (240-273)	2.2*
Age stand[a]	*63 (63-64)*	*74 (67-81)*	*1.2**	*68 (49-87)*	*1.1*	*70 (59-81)*	*1.1*	*60 (44-75)*	*1.0*	*67 (61-72)*	*1.1*

IR=Incidence rate per 100,000 person-years at risk; RR=relative risk of AMI incidence compared to the Dutch majority population; [a]Standardised to the age-distribution of the European population in ten year age-bands; *Significant difference compared with the Dutch majority population.

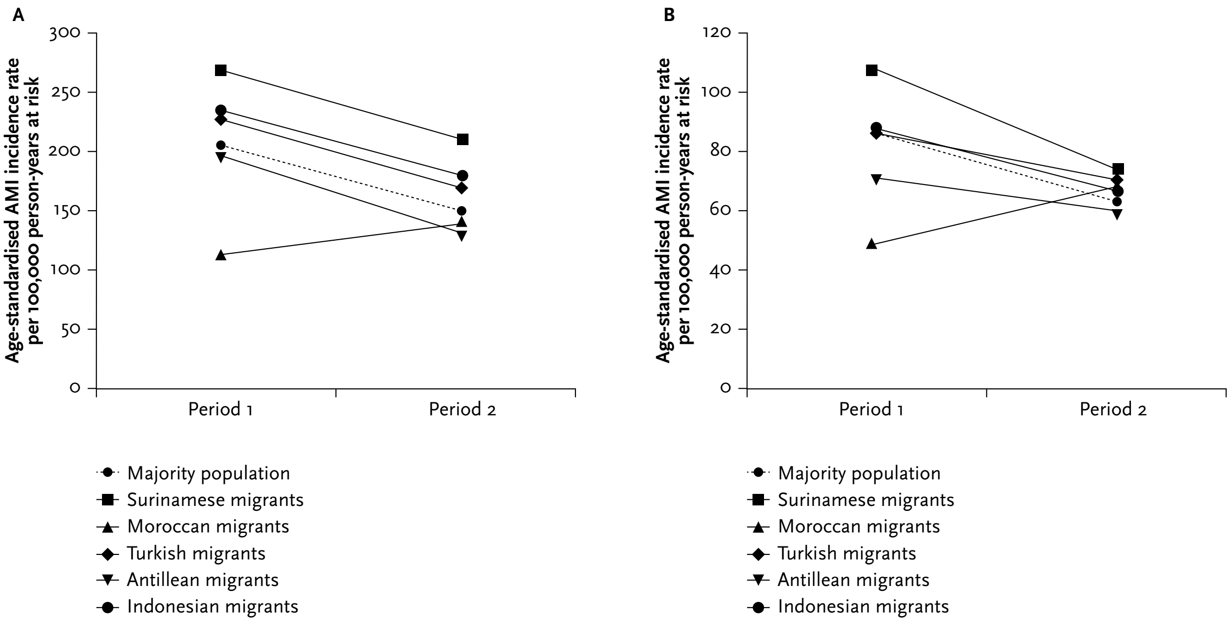
DISCUSSION

In every group under study AMI incidence increased with age and was higher in men than in women. All migrant groups, except Moroccans, showed a decreased or stable AMI incidence over time. The extent varied between age categories, depending on the country of birth. Among migrant groups with a higher incidence compared with the Dutch majority population, the difference diminished with increasing age, and disappeared in those older than 70 years of age. Among migrant groups with a similar or lower incidence compared with the Dutch majority population, there was no clear pattern over age categories. Among most age-sex-migrant groups, the difference with the Dutch majority population remained similar over time.

Key findings

There are some important findings that need to be addressed. Firstly, in migrant groups with a higher overall AMI incidence compared with the Dutch majority population (Surinamese men and women, Turkish and Indonesian men), the difference declined with increasing age. After the age of 70 years, a difference was no longer observed. This is in accordance with international literature studying aboriginal vs. non-aboriginal subjects in an Australian population, South Asian vs. White subjects in a Canadian population, and African-American vs. Caucasian American subjects in a US population.[8,10,22] Explanations for this phenomenon may include selective survival, which prevents those in the higher risk groups from reaching old age. Subsequently, elderly migrant

Figure 1. *Age-standardised AMI incidence rate in the Dutch majority population and migrants groups during period one and period two. A) Men; B) Women. Period one: 2000-2004, period two: 2005-2010*



groups are healthier compared with their younger counterparts, resulting in diminishing ethnic inequalities in AMI incidence among the elderly.[23] Literature also indicates that cardiovascular risk factors present themselves at an earlier age in migrants than in the majority population, which could lead to a shift in AMI incidence towards the young. For example, Surinamese women already had a hypertension prevalence of 35% at age 35, whereas their ethnic Dutch counterparts did not reach this level before the age of 45.[24] Similarly, another study showed that the prevalence of diabetes in the Dutch majority population started to increase from 55-64 years of age, while in Turkish and Moroccan migrants the same prevalence was already reached 10-20 years earlier.[25]

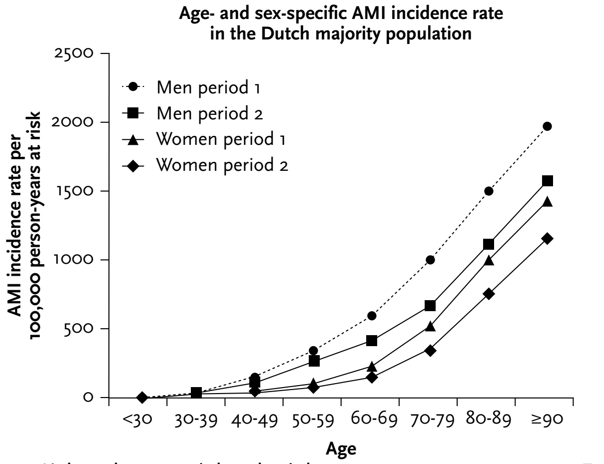
Secondly, Moroccans had a lower overall AMI incidence compared with the Dutch majority population in period one, whereas this difference disappeared in period two. In men this was caused by increasing incidence rates over time, especially in the 50-60 and the 70-80 year olds. In women, number of events was too small to distinguish time trends across age groups. One explanation for the increased AMI incidence among Moroccans is the very low initial AMI incidence rate, which may hinder the trend of further decline. Moreover, improvements in primary preventive efforts over the past years may have had less effect in Moroccans due to cultural and language barriers.[26-28] In addition, most improvements in the Netherlands were accomplished in the fields of cardiovascular drug use, smoking cessation and lowering total cholesterol, but not in reducing the major risk factors Moroccans have to deal with (obesity and diabetes).[29] Finally, previous literature indicates that migrants with an initially lower risk converge towards the risk of the majority population over time, provoked by the loss of healthy lifestyle factors and adoption of adverse lifestyle factors in the host country.[15,30] This was reflected in our study, since the AMI risk difference between Moroccans and the Dutch majority population narrowed from 0.5-0.9 in men, and from 0.6-1.1 in women between the two time periods (*figure 1*). The underlying factors of this adverse trend in AMI incidence among Moroccans need further attention in future research.

Thirdly, Turkish and Indonesian women had a similar overall age-standardised AMI incidence rate compared with the Dutch majority population. However, after age stratification, there was a significantly higher incidence observed in 50- to 70-year-old Turkish women and 60- to 80-year-old Indonesian women in period two. This was not observed in period one. The higher incidence in Turkish women was provoked by the absent decline in AMI incidence over time, especially in the 50- to 70-year-olds (*figure 2*). It is unclear why specifically these Turkish women show an adverse picture. Among Indonesian women between 60 and 80 years the significant difference with the Dutch majority population was only small and less relevant.

Considerations

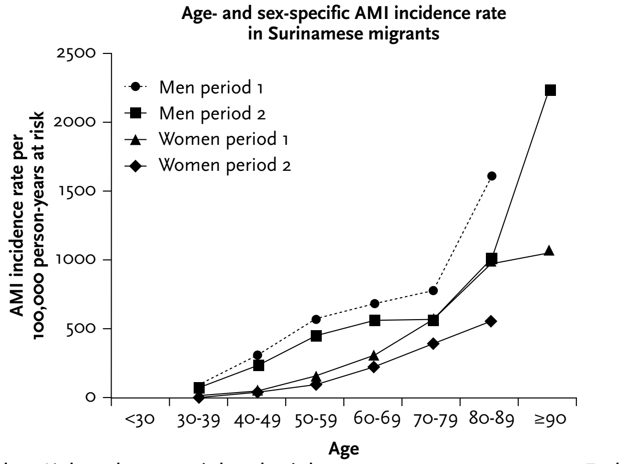
Literature concerning absolute incidence rates of coronary heart disease by age, sex, and country of origin is scarce,

Figure 2. *Age- and sex-specific incidence rates during period one and period two by country of birth. Period one: 2000-2004; Period two: 2005-2010*



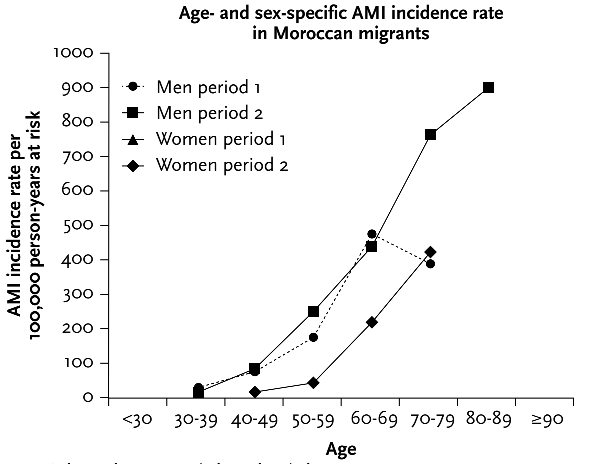
% change between period 1 and period 2	<30	30-39	40-49	50-59	60-69	70-79	80-89	≥90	Total
Men	-35.7*	-9.7*	-17.7*	-20.3*	-29.8*	-33.0*	-26.3*	-20.8*	-26.8*
Women	20.0	-9.0*	-14.0*	-11.0*	-31.3*	-30.0*	-25.8*	-19.9*	-26.7*

*Significant difference between period 1 and period 2



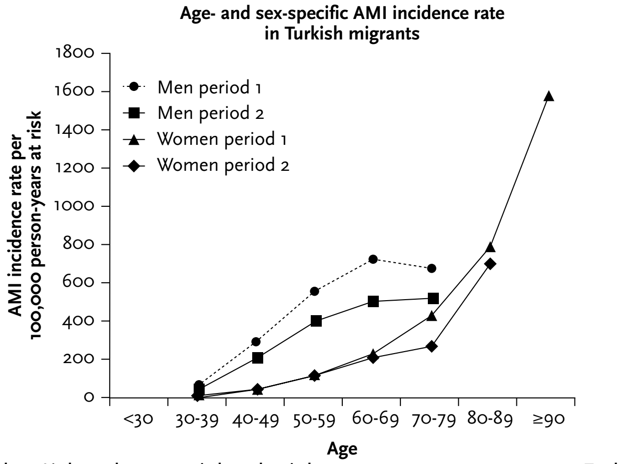
% change between period 1 and period 2	<30	30-39	40-49	50-59	60-69	70-79	80-89	≥90	Total
Men		12.2	-25.0*	-20.1*	-19.1*	-27.0*	-37.0*		-21.9*
Women			-12.0	-24.5*	-22.5*	-32.5*	-43.2*		-31.5*

*Significant difference between period 1 and period 2



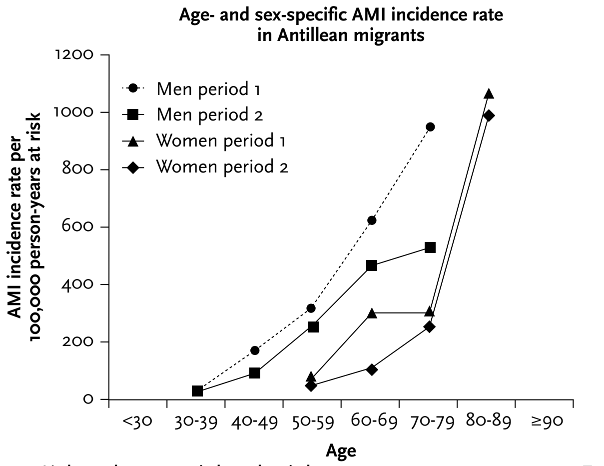
% change between period 1 and period 2	<30	30-39	40-49	50-59	60-69	70-79	80-89	≥90	Total
Men		-48.8*	1.9	39.8*	-6.3	93.7			+25.2*
Women					-2.0				+41.7*

*Significant difference between period 1 and period 2



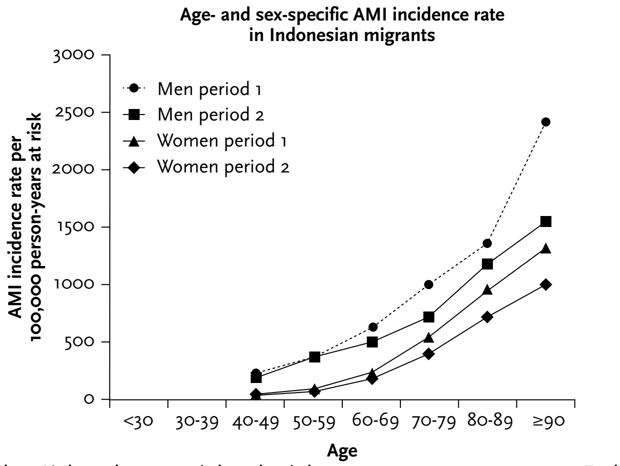
% change between period 1 and period 2	<30	30-39	40-49	50-59	60-69	70-79	80-89	≥90	Total
Men		-22.4	-22.1*	-29.4*	-31.0*	-23.1			-34.1*
Women		-13.1	-21.6	5.3	1.5	-34.4	-12.0		-18.6

*Significant difference between period 1 and period 2



% change between period 1 and period 2	<30	30-39	40-49	50-59	60-69	70-79	80-89	≥90	Total
Men		35.7	-44.8*	-18.8	-25.7	-44.0			-32.7*
Women				-41.2*	-63.3	-14.5	-6.6		-15.5

*Significant difference between period 1 and period 2



% change between period 1 and period 2	<30	30-39	40-49	50-59	60-69	70-79	80-89	≥90	Total
Men			-21.8	-5.9	-22.4*	-28.6*	-14.0*	-35.4*	-23.4*
Women			-15.9	-12.0	-25.8*	-23.6*	-23.1*	-25.0*	-23.9*

*Significant difference between period 1 and period 2

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and in most cases reported results for one time period only.[8-10,22] Our study, stratifying by age, sex, country of origin, and time period, expands existing evidence. The nationwide registers yielded a large study population which made it possible to stratify by a wide range of determinants. The inclusion of primary as well as secondary diagnosis and causes of death decreased the chance of missed AMI events. The availability of hospital data from 1995 onwards provided a medical history varying from 5-9 years in the first period and from 10-15 years in the second period. This long medical history dramatically diminished the risk of misclassifying recurrent AMI events as first AMI events. Previous literature reported a five-year risk of recurrent AMI of 2.5% in both men and women, and a 12-year risk of 1.5% in men and 1.0% in women.[31] Because of the shorter medical history in period one compared with period two, incidence rates could have been slightly overestimated during period one. However, this overestimation will be minimal since the risk of a recurrent AMI only differed by 1% between a five- and a 12-year medical history.

Inevitably our study has some limitations. Firstly, incidence rates may have been underestimated because of misclassification of AMI events. However, validity of AMI registration in the HDR proved to be high with a positive predictive value of 97% and a sensitivity of 84%.[19] This means that 97% of all AMI cases in the HDR were correctly coded and that 84% of all AMI events in the Netherlands were registered in the HDR. Furthermore, the validity of AMI death in the cause of death register proved to be one of the highest of all causes, with a maximal misclassification of 10%.[18] By additionally including the secondary diagnosis and causes of death, misclassification was further limited. Secondly, persons who were not PR unique with respect to the combination of the variables date of birth, sex, and four digits of the postal code were excluded. The migrant groups under study have a higher risk on non-uniqueness, mainly due to the absence of the exact date of birth. Therefore, person-years at risk is underestimated, but since non-uniqueness was not related to AMI incidence it did not influence the absolute incidence rates.[32,33] Thirdly, a small number of the subjects could not be traced back completely between 1995-2000/2010 because they were not PR unique during the entire study period, or because they immigrated to the Netherlands during the study period. This could have led to a slight overestimation of first AMI events. Migrants are more likely to have migrated to the Netherlands during the study period, but since the majority of those who migrated after 1995 were too young to have suffered an AMI, differential overestimation of first AMI events is unlikely. Fourthly, from 2005 onwards, hospitals are no longer obliged to register in the HDR, which has led to about 10% missing AMI events between 2005 and 2010.[34] Subsequently, absolute incidence rates in the second period have been underestimated and declines over time may have been overestimated by maximally 10%. However, this percentage is not high enough to have influenced our final conclusions concerning trends in AMI incidence over time. The risks relative to the Dutch majority population also remain unaffected, since missing AMI events were evenly distributed within the entire Netherlands.

CONCLUSION

Regardless of ethnic background, AMI incidence increased with age and was higher among men than among women. Overall, all migrant groups, except Moroccans, showed a stable or declining AMI incidence over time. With respect to primary preventive strategies, health care professionals should focus on Surinamese men and women and Turkish and Indonesian men below 70 years of age, because of their high AMI incidence relative to the Dutch majority population. Future research should elucidate the factors that provoke the increasing AMI incidence over time among Moroccans.

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REFERENCES

1. Vaartjes I, van Dis I, Visseren F, Bots M. Hart- en vaatziekten in Nederland. Hart- en vaatziekten in Nederland 2010. Cijfers over leefstijl- en risicofactoren, ziekte en sterfte. Nederlandse Hartstichting; 2010.
2. Koek HL, de Bruin A, Gast A, et al. Incidence of first acute myocardial infarction in the Netherlands. Neth J Med. 2007;65:434-41.
3. Koopman C, Bots ML, van Oeffelen AA, et al. Population trends and inequalities in incidence and short-term outcome of acute myocardial infarction between 1998 and 2007. Int J Cardiol. 2012 Nov 17.
4. Gadd M, Johansson SE, Sundquist J, Wandell P. Morbidity in cardiovascular diseases in immigrants in Sweden. J Intern Med. 2003;254:236-43.
5. Hedlund E, Lange A, Hammar N. Acute myocardial infarction incidence in immigrants to Sweden. Country of birth, time since immigration, and time trends over 20 years. Eur J Epidemiol. 2007;22:493-503.
6. Sundquist K, Li X. Coronary heart disease risks in first- and second-generation immigrants in Sweden: a follow-up study. J Intern Med. 2006;259:418-27.
7. van Oeffelen AA, Vaartjes I, Stronks K, Bots ML, Agyemang C. Incidence of acute myocardial infarction in first and second generation minority groups: Does the second generation converge towards the majority population? Int J Cardiol. 2013;pii:S0167-5273(13)01596.
8. Bradshaw PJ, Alfonso HS, Finn J, Owen J, Thompson PL. A comparison of coronary heart disease event rates among urban Australian Aboriginal people and a matched non-Aboriginal population. J Epidemiol Community Health. 2011;65:315-9.
9. Fischbacher CM, Bhopal R, Povey C, et al. Record linked retrospective cohort study of 4.6 million people exploring ethnic variations in disease: myocardial infarction in South Asians. BMC Public Health. 2007;7:142.

10. Nijjar AP, Wang H, Quan H, Khan NA. Ethnic and sex differences in the incidence of hospitalized acute myocardial infarction: British Columbia, Canada 1995-2002. BMC Cardiovasc Disord. 2010;10:38.

11. Wang H, Steffen LM, Jacobs DR, et al. Trends in cardiovascular risk factor levels in the Minnesota Heart Survey (1980-2002) as compared with the National Health and Nutrition Examination Survey (1976-2002): A partial explanation for Minnesota's low cardiovascular disease mortality? Am J Epidemiol. 2011;173:526-38.

12. Levi F, Chatenoud L, Bertuccio P, Lucchini F, Negri E, La Vecchia C. Mortality from cardiovascular and cerebrovascular diseases in Europe and other areas of the world: an update. Eur J Cardiovasc Prev Rehabil. 2009;16:333-50.

13. Cooper R, Cutler J, Svigne-Nickens, et al. Trends and disparities in coronary heart disease, stroke, and other cardiovascular diseases in the United States: findings of the national conference on cardiovascular disease prevention. Circulation. 2000;102:3137-47.

14. Gadd M, Johansson SE, Sundquist J, Wandell P. The trend of cardiovascular disease in immigrants in Sweden. Eur J Epidemiol. 2005;20:755-60.

15. Harding S, Rosato M, Teyhan A. Trends for coronary heart disease and stroke mortality among migrants in England and Wales, 1979-2003: slow declines notable for some groups. Heart. 2008;94:463-70.

16. van Oeffelen A, Agyemang C, Koopman C, Stronks K, Bots M, Vaartjes I. Downward trends in acute myocardial infarction incidence: how do migrants fare with the majority population? Results from a nationwide study. Eur J Prev Cardiol. 2013; Aug 8. [Epub ahead of print]

17. Agyemang C, Vaartjes I, Bots ML, et al. Risk of death after first admission for cardiovascular diseases by country of birth in The Netherlands: a nationwide record-linked retrospective cohort study. Heart. 2009;95:747-53.

18. Harteloh P, de Bruin K, Kardaun J. The reliability of cause-of-death coding in The Netherlands. Eur J Epidemiol. 2010;25:531-8.

19. Merry AH, Boer JM, Schouten LJ, et al. Validity of coronary heart diseases and heart failure based on hospital discharge and mortality data in the Netherlands using the cardiovascular registry Maastricht cohort study. Eur J Epidemiol. 2009;24:237-47.

20. Stronks K, Kulu-Glasgow I, Agyemang C. The utility of 'country of birth' for the classification of ethnic groups in health research: the Dutch experience. Ethn Health. 2009;14:255-69.

21. Dean AG, Sullivan KM, Soe MM. OpenEpi: Open Source Epidemiologic Statistics for Public Health, Version. www.OpenEpi.com, updated 2013/04/06, accessed 2013/06/26. [computer program]. 2013.

22. Wang OJ, Wang Y, Chen J, Krumholz HM. Recent trends in hospitalization for acute myocardial infarction. Am J Cardiol. 2012;109:1589-93.

23. Markides KS, Machalek R. Selective survival, aging and society. Arch Gerontol Geriatr. 1984;3:207-22.

24. Agyemang C, Bindraban N, Mairuhu G, Montfrans G, Koopmans R, Stronks K. Prevalence, awareness, treatment, and control of hypertension among Black Surinamese, South Asian Surinamese and White Dutch in Amsterdam, The Netherlands: the SUNSET study. J Hypertens. 2005;23:1971-7.

25. Ujcic-Voortman JK, Schram MT, Jacobs-van der Bruggen MA, Verhoeff AP, Baan CA. Diabetes prevalence and risk factors among ethnic minorities. Eur J Public Health. 2009;19:511-5.

26. Harmsen JA, Bernsen RM, Bruijnzeels MA, Meeuwesen L. Patients' evaluation of quality of care in general practice: what are the cultural and linguistic barriers? Patient Educ Couns. 2008;72:155-62.

27. te Riele S. Marokkanen hebben minder moeite met Nederlands dan Turken [in Dutch]. Centraal Bureau voor Statistiek 2008 Available from: URL: cbs.nl/nl-NL/menu/themas/onderwijs/publicaties/artikelen/archief/2008/2008-2570-wm.htm

28. Uiters E, van Dijk L, Deville W, Foets M, Spreeuwenberg P, Groenewegen PP. Ethnic minorities and prescription medication; concordance between self-reports and medical records. BMC Health Serv Res. 2006;6:115-21.

29. van Dis I, Poos M, Engelfriet P, Deckers J. Neemt het aantal mensen met een coronaire hartziekte toe of af? In: Volksgezondheid Toekomst Verkenning, Nationaal Kompas Volksgezondheid. Bilthoven: RIVM. 10 A.D. Dec 7.

30. Kunst A, Stronks K, Agyemang C. Non-communicable diseases. In: Rechel B, Mladovsky P, Devillé W, Rijks B, Petrova-Benedict R, McKee M, editors. Migration and health in the European Union. 1 ed. Open University Press; 2012. p. 116.

31. Osler M, Rostgaard K, Sorensen TI, Madsen M. The effect of recurrent events on register-based estimates of level and trends in incidence of acute myocardial infarction. J Clin Epidemiol. 1999;52:595-600.

32. De Bruin A, de Bruin E, Gast A, Kardaun J, van Sijl M, Verweij G. Koppeling van LMR- en GBA-gegevens: methode, resultaten en kwaliteitsonderzoek. Voorburg/Heerlen: Centraal Bureau voor de Statistiek; 2003.

33. De Bruin A, Kardaun J, Gast A, de Bruin E, van Sijl M, Verweij G. Record linkage of hospital discharge register with population register: experiences at Statistics Netherlands. Statistical Journal of the United Nations Economic Commission for Europe. 2013;21:23-32.

34. Centraal Bureau voor de Statistiek. Documentatierapport Landelijke Medische Registratie (LMR) 2009V1. Den Haag, The Netherlands: Centraal Bureau voor de Statistiek, 2011.