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Prevention of cardiovascular diseases: focus on modifiable cardiovascular risk

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ABSTRACT

Background
Several current guidelines suggest that patients should be treated if the 10-years absolute risk of developing a CVD exceeds 20%, without taking into consideration which part of this risk can be reduced by influencing modifiable risk factors such as blood pressure and lipids.

Methods
We used data collected within the framework of an RCT in 3 primary health care centres located in deprived neighbourhoods. The 10-year absolute risk and the modifiable part of risk were calculated using the Framingham risk equation. Within the patients with a modifiable risk reduction of 5% or more (i.e. an NNT ≤ 20), we compared the characteristics and risk factors of patients with an absolute risk ≥ 20% and those with an absolute risk <20%.

Results
293 patients aged 30-70 years at risk of developing CVD were included. 66% was female and 36% from Dutch origin. Of all individuals, 33% had an absolute risk ≥ 20% and 61% had a modifiable risk ≥ 5%. Of those at 20% or greater absolute risk, a vast majority (98%) had a modifiable risk ≥ 5%. Among those with an absolute risk <20%, 43% had a modifiable risk ≥ 5%. The latter group constitutes 29% of all individuals and was relatively young and often female.

Conclusions
Targeting preventive strategies at a10-years absolute risk ≥ 20% leads to exclusion of a large group of relatively young, predominantly female individuals. In total, about one quarter had an absolute risk <20%, but had a modifiable risk ≥ 5% and should therefore benefit from intervention.

INTRODUCTION

Cardiovascular disease (CVD) is a major cause of disability and mortality in developed countries. Interventions targeted at modifiable risk factors, such as hypercholesterolemia, hypertension, and smoking, can delay or even prevent the occurrence of CVD. [1][2][3] Furthermore, multiple risk factor interventions in high risk groups are more beneficial than single risk factor interventions. [4]
The most widely used method for assessment of CVD risk is based on equations derived from the Framingham Heart study, which are based on multiple risk factors. [5][6] Whether individuals are identified as "high risk" and thus should be subject to prevention activities, depend on absolute risk threshold values, which vary between different guidelines. [7][8][9] These risk thresholds are not only based on the population prevalence of cardiovascular risk factors and CVD but also on the availability of health care resources. [10] Similar to several Western guidelines, the Dutch guidelines for Hypertension and Hypercholesterolemia recommend treatment in case of an absolute risk of CVD equal or greater than 20%. [11][12] However, these national and international absolute risk thresholds depend largely on non-modifiable risk factors age, gender and diabetes mellitus. They do not take into consideration which part of the cardiovascular risk is due to modifiable risk factors to identify individuals for prevention activities. We considered whether focus on this modifiable part of the absolute risk is more appropriate for identifying individuals at risk of developing CVD than the currently applied absolute risk thresholds. First, CVD risk reduction is larger when larger reductions of the modifiable risk factors blood pressure, cholesterol and smoking, are achieved, indicating larger absolute risk reductions and lower numbers needed to treat (NNT). Different trials on cholesterol lowering and antihypertensive interventions reported number needed to treat of approximately 20 [13][14][15][16] i.e. 20 individuals are needed to treat to prevent one cardiovascular event. This NNT corresponds to an absolute risk reduction of 5%. Second, the use of absolute risk thresholds in some patient groups such as women, young people and ethnic minorities may result in under treatment because of a lower 10-year absolute risk than 20% compared to men, older people and White/ Western people respectively despite large achievable absolute risk reductions. [17] [18] This problem is more likely in deprived neighbourhoods, because people living in these areas are at greater risk of developing CVD than the general population. [19]

We conducted a study in a heterogeneous patient population at high risk of developing CVD, which consisted of both males and females from different ethnic groups living in deprived neighbourhoods without a history of CVD. Aim of this study is to determine whether the use of a 20% absolute risk threshold as recommended in current guidelines leads to exclusion of individuals with a substantial modifiable risk (≥ 5%).

METHODS

We used data, collected within the framework of a randomised controlled trial to assess the effectiveness of a structured collaboration within the general practice to reduce cardiovascular risk. Briefly, the trial consisted of an intervention group that received intensified preventive care and a control group that received usual GP care. Both groups were invited to the general practice for the assessment of the cardiovascular risk profile every three months. We performed the study in three Dutch health care centres representing 5 general practices situated in the deprived neighbourhoods of Rotterdam and The Hague. Area deprivation in the Netherlands is defined according to an index, based on income, number of people dependant on social benefits and level of urbanisation. [20] In this paper the baseline data of the trial were analysed.

Patient selection and data collection

To identify all potential high-risk patients, the next steps were followed:
1) A search in the electronic medical GP records, using all available medical data (including consultations, laboratory results, letters from specialists and prescriptions). All patients aged 30-70 years, with one or more registered risk factor (hypertension, diabetes mellitus, hypercholesterolemia, history of CVD, family history of CVD, smoking, measurements of blood pressure ≥160/90 or total cholesterol ≥ 6,2 within the last two years) were selected.
2) Selected patients from step (1) were actively invited to participate. They were informed about the study during a home visit, and asked to give their informed consent. A structured questionnaire was used to measure background characteristics, cardiovascular risk factors, family history of CVD and history of CVD. In addition, patients underwent a limited physical examination consisting of blood pressure, weight and height measurements by a trained research assistant. Blood pressure was measured during the home visit in sitting position using a validated electronic sphygmomanometer. Two measurements were taken with at least a 10 minutes interval. The mean of these readings was used for the analyses.
Blood samples were taken at the laboratory to measure fasting glucose, HbAc1 and the lipid-profile.
Of 536 patients who signed informed consent for the trial, 430 had a completed cardiovascular risk profile. Of these, the Framingham risk formula could not be applied to 173 patients because of prior CVD history and were thus excluded from analysis. Finally, data of 293 participants were available for analysis.

Determination of cardiovascular risk and modifiable risk

Using the Framingham equation, we calculated for each patient the 10-year risk of developing a CVD event. [5] [17] The formula used includes the following independent variables: age (in years), gender (male/female), systolic blood pressure (in mmHg), total cholesterol/HDL cholesterol, smoking (yes/no), and diabetes mellitus (yes/no). Diabetes mellitus was considered present if a patient was registered as diabetic according to GP records, used diabetes medication currently or the patient's fasting glucose was ≥ 7 mmol/l. We considered a 10-year cardiovascular risk threshold of 20% and 40%, as recommended in several international guidelines. [8][9] [11]

The modifiable part of the absolute risk was determined in two ways (see appendix):
1. A "potential" modifiable risk, which is the maximal reduction in the absolute risk by eliminating modifiable risk factors and is composed of the separate absolute risk reductions for systolic blood pressure (reduction of systolic blood pressure >120 to 120 mm Hg), total/HDL-cholesterol (reduction of total/HDL-cholesterol > 4 to 4) and smoking cessation (if patients smoke). The non-modifiable risk consists of the absolute risk for CVD based on age, gender, diabetes and fixed values on modifiable risk factors (total/ HDL-cholesterol = 4, systolic blood pressure = 120 mm Hg and non-smoking).
2. A "realistic" modifiable risk, which is the expected reduction in absolute risk according to trials on hypertension, [22] hypercholesterolemia [21] and smoking. The non-modifiable risk is based on age, gender, diabetes and respectively the following values for cholesterol, systolic blood pressure and smoking: a 20% decrease in total cholesterol and 5% increase in HDL cholesterol; [21] a 12 mm Hg decrease in systolic blood pressure; [22] and smoking cessation. The modifiable risk is composed of the separate risk reductions for systolic blood pressure (if systolic blood pressure >120 mm Hg), total/HDL-cholesterol (if total/HDL-cholesterol > 4) and smoking (if patients smoke).

Data analyses

We used cross tabulations to determine the numbers and proportions of individuals identified according to the absolute risk thresholds, the modifiable part of absolute risk or both

identification criteria. To assess differences in patient characteristics, we distinguished two groups; those with an absolute risk ≥ 20% and a modifiable part of risk ≥ 5%, and those with an absolute risk < 20% but with a modifiable part of risk ≥ 5%. Mean values of age and proportion of females, non Dutch, current smokers, obese, total-cholesterol:HDL-cholesterol > 4, systolic blood pressure ≥ 140, presence of diabetes mellitus, family history of CVD were compared between the groups using independent t-test and Chi-square tests respectively. The analysis was carried out using SPSS software, version 12.0.

RESULTS

The general characteristics and cardiovascular risk factors of the 293 participants are given in table 1.

Table 1: General characteristics and cardiovascular risk profile of the study population (values are means (sd) unless stated otherwise)

	total (n= 293)
Ethnicity (n (%))	
Dutch	106 (36)
Turkish	97 (33)
Surinamese	36 (12)
Moroccan	18 (6)
Other	36 (12)
Diabetic * (n (%))	106 (36)
Current smoker † (n (%))	95 (32)
Ex-smoker † (n (%))	76 (26)
Family history of CVD † (n (%))	106 (36)
With ≥ 2 CVD risk factors (n(%))	220 (75)
With ≥ 3 CVD risk factors (n(%))	140 (48)
Age (years)	51.8 (9.3)
Systolic BP (mmHg)	143.0 (23.8)
Diastolic BP (mmHg)	87.9 (12.5)
HbAc1 (%)	6.5 (1.4)
Fasting glucose (mmol/l)	6.6 (2.4)
Serum total cholesterol (mmol/l)	5.6 (1.0)
Serum HDL-cholesterol (mmol/l)	1.4 (0.4)
Total/HDL-cholesterol	4.4 (1.4)
Serum LDL-cholesterol (mmol/l) .	3.4 (1.0)
Triglycerides (mmol/l)	1.9 (1.3)
Body mass index (kg/m²)	30.9 (5.6)
10-years CVD absolute risk (%)	17.2 (12.6)

*: Based on diabetes medication use, or medical GP records information or fasting glucose ≥ 7 mmol/l
†: Based on patients self reports

Two third of the patients was female (66%) and a majority had a non- Dutch background (36% was Dutch, 33% Turkish, 12% Surinamese, 6% Moroccan, 12% “others” mainly Antilleans, Pakistani/Indians, and ex-Yugoslavs). The study population was young (51.8 years (sd 9.3)) but had multiple risk factors. 32 % of patients were current smokers and 36% reported having a family history of cardiovascular diseases. A large group of all patients (75%) had 2 or more cardiovascular risk factors and about half of patients (48%) had 3 or more risk factors.

Table 2: Numbers and proportions of patients (as % of all patients) according to different absolute risk thresholds and modifiable part of the absolute risk

	Modifiable part of absolute risk				
	"potential" reduction†		"realistic" reduction‡		
10-years absolute risk*	< 5%	≥ 5%`	< 5%	≥ 5%	Total
< 20%	111 (38%)	84 (29%)	148 (51%)	47 (16%)	195(67%)
≥ 20%	2 (1%)	96 (33%)	12 (4%)	86 (29%)	98 (33%)
< 40%	113 (39%)	162 (55%)	159 (54%)	116 (40%)	275 (94%)
≥ 40%	0 (0%)	18 (6%)	1 (0%)	17 (6%)	18 (6%))
Total	113 (39%)	180 (61%)	160 (55%)	133 (45%)	293 (100%)

*: 10-years cardiovascular risk based on the Framingham risk equation (based on age, gender, diabetes mellitus, systolic blood pressure, total cholesterol/HDL cholesterol and smoking)

†: potential reduction: the maximum reduction in 10-years absolute risk by eliminating modifiable risk factors (reduction of systolic blood pressure >120 to 120 mmHg, total cholesterol/HDL-cholesterol > 4 to 4 and smoking cessation if patient smokes)

‡: realistic reduction: the expected reduction in 10-years absolute risk by lowering the modifiable risk factors according to results from trials (systolic blood pressure ↓ by 12 mmHg, total cholesterol ↓by 20% and HDL ↑ by 5% and smoking cessation).

Table 2 shows that using a 10-year absolute risk threshold ≥ 20% lead to the identification of 33% of individuals. On the basis of the 5% modifiable risk threshold, 61% of individuals were identified with a potential reduction ≥ 5% and 45% with a realistic reduction ≥ 5%.
A large majority of individuals at 20% or greater absolute risk had a modifiable part of risk ≥5%; that is 98% with a potential modifiable risk of 5% or more and 88% with a realistic modifiable risk of 5% or more. These proportions correspond respectively to 33% and 29% of all individuals. Only 1-4% had an absolute risk ≥ 20% and a modifiable risk < 5% (table 2).

Among those patients at < 20% absolute risk, a considerable group had a modifiable part of risk ≥ 5% which could justify prevention activities: 43% with a potential modifiable part ≥ 5% and 24% with a realistic modifiable part ≥ 5%. As a proportion of all patients, these figures were 29% and 16% respectively (table 2).

Using a higher absolute risk threshold, for example ≥ 40% as recommended by some guidelines, [9] resulted in the identification of a very small proportion of individuals (6%). Of those patients not identified, a large group had a modifiable part of risk ≥ 5% (55% of all individuals had a potential modifiable part ≥ 5%, and 40% had a realistic modifiable part ≥ 5%).

To illustrate the differences between using the absolute risk threshold and the potential or realistic modifiable part of risk, some examples are given in box 1:

Box 1:
Absolute risk <20% and potential and realistic modifiable risk ≥ 5%
A middle-aged female patient (age 49,5 years), non-diabetic, her systolic blood pressure is 191.00 mmHg and total cholesterol/HDL =4.42. The calculated absolute risk is lower than the 20% absolute risk threshold (16.54%). However the potential modifiable risk is 11.29% and the realistic modifiable risk is 5.00%

A young male diabetic patient, (age 39 years), smokes cigarettes, his systolic blood pressure = 120 mmHg and total cholesterol/HDL cholesterol = 7.17. The absolute risk is 13.85% while the potential modifiable risk is 7.80%; the realistic reduction is 5.98%

Absolute risk ≥ 20% and potential and realistic modifiable risk <5%
A male patient aged 67 years; the systolic blood pressure = 130 mmHg, total cholesterol/HDL cholesterol = 4.00, do not smoke and without diabetes; the absolute risk is 21.5%; the potential modifiable risk is 3.15% and the realistic modifiable risk is 3.31%.

In table 3 we compare the characteristics of patients with an absolute risk < 20% and a modifiable part ≥ 5% (group 1), and those with an absolute risk ≥ 20% and a modifiable part ≥ 5% (group 2). The patients at a lower risk than 20%, but with a modifiable risk ≥ 5% (group 1) were predominantly female and young. A slightly higher proportion in this group was from a non-Dutch origin but this difference was not significant. Although the proportions of individuals with modifiable risk factors were smaller in group 1 than group 2, more than half of them suffered from hypertension and hypercholesterolemia and more than one quarter had diabetes mellitus. No differences in obesity between both groups were notified.

Table 3: Characteristics of patients with a 10-years absolute risk* < 20% and a modifiable risk ≥ 5% (group 1), and those with a 10-years absolute risk ≥ 20% and a modifiable part ≥ 5% (group 2) (values are numbers (%), unless stated otherwise)

	"potential" reduction† ≥ 5%			"realistic " reduction‡ ≥ 5%		
	10-y risk< 20% (group 1) (n = 84)	10-y risk ≥ 20 % (group 2) (n = 96)	p-values group 1 & 2	10-y risk< 20% (group 1) (n = 47)	10-y risk ≥ 20 % (group 2) (n = 86)	p-values group 1& 2
Mean age (sd))	49.9 (6.3)	59.1 (6.7)	p < 0.0001	49.9 (7.0)	58.4 (6.7)	p < 0.0001
Age categories						
< 50 years	44 (52)	9 (9)	p < 0.0001	25 (53)	9 (11)	p < 0.0001
50 +	40 (48)	87 (91)		22 (47)	77 (90)	
Gender (female)	52 (62)	33 (34)	p < 0.0001	25 (53)	29 (34)	p = 0.023
Non-Dutch	54 (64)	57 (59)	p = 0.301	25 (53)	49 (57)	p = 0.405
Smoking §	37 (44)	45 (47)	p = 0.409	29 (62)	45 (52)	p = 0.196
Hypercholesterolemia**	53 (63)	75 (78)	p = 0.020	39 (83)	76 (88)	p = 0.269
Hypertension**	50 (60)	81 (84)	p < 0.0001	22 (47)	70 (81)	p < 0.0001
Diabetes mellitus**	25 (30)	41 (43)	p = 0.050	13 (28)	35 (41)	p = 0.095
Obesity **	41 (51)	50 (53)	p = 0.459	22 (50)	46 (55)	p = 0.372
Family history of CVD*	31 (37)	27 (28)	p = 0.136	15 (32)	25 (29)	p = 0.440

*: 10-years cardiovascular risk based on the Framingham risk equation (based on age, gender, diabetes mellitus, systolic blood pressure, total cholesterol/HDL cholesterol and smoking)

†: potential reduction: the maximum reduction in 10-years absolute risk by eliminating modifiable risk factors (reduction of systolic blood pressure >120 to 120 mmHg, total cholesterol/HDL-cholesterol > 4 to 4 and smoking cessation if patient smokes)

‡: realistic reduction: the expected reduction in 10-years absolute risk by lowering the modifiable risk factors according to results from trials (systolic blood pressure ↓ by 12 mmHg, total cholesterol ↓by 20% and HDL ↑ by 5% and smoking cessation).

§: Smoking and family history of CVD: based on patients self reports
**: Hypercholesterolemia defined as total cholesterol/HDLcholesterol > 4; hypertension as systolic blood pressure ≥ 140 mmHg, obesity as body mass index ≥ 30 kg/m²

DISCUSSION

Our results demonstrate that using an absolute risk threshold of 20% or higher leads to the exclusion of individuals with large potential reduction in absolute risk mainly in women and young patients in which preventive activities are more cost-effective on the long term. A more appropriate criterion for identifying high risk individuals is using the proportion of absolute risk contributed by the major modifiable risk factors namely systolic blood pressure, the cholesterol: HDL-cholesterol ratio and smoking. We considered a modifiable part of 5% or higher of the absolute risk as appropriate because it discriminates between those individuals where lowering the modifiable risk factors to target levels is possible and those where this is not the case. This risk reduction corresponds also to the number needed to treat to prevent one cardiovascular event by means of intervention activities.

The application of the proposed modifiable part of the absolute risk, instead of using a CVD risk threshold ≥ 20% in general practices is for several reasons advantageous.
First, it is more likely to identify those young patients who should be considered for treatment because of high levels of risk factors to prevent cardiovascular diseases on the long term. Similarly focusing on the modifiable risk will reduces over treatment in older people at low modifiable risk. [18]
Second, the absolute risk of CVD is lower in women than in men. Using the same absolute risk thresholds for men as women resulted in excluding a large number of female individuals from prevention activities, despite their unfavourable modifiable risk factors while focusing on the modifiable part of the risk could allow more women to be involved in prevention and treatment of CVD than the absolute risk. Although not all risk factor intervention trials included women, it is clear that the relative benefits on cardiovascular morbidity and mortality are similar for both sexes. The major risk factors have a substantial impact on the absolute risk in women and for, for example the US population as a whole, as many women as men die of coronary heart diseases. [23] Therefore prevention based on cardiovascular risk factors in women should not be delayed.
Third, people living in deprived neighbourhoods have a greater risk of developing cardiovascular diseases than the general population due to their unfavourable (modifiable) risk factors. [19] Therefore, focussing on modifiable risk is a reasonable approach, mainly because of the heterogeneity within such a population in terms of ethnicity (i.e. a large proportion of non-Dutch people) and age distribution (mainly young people from ethnic minorities and elderly Dutch). The ethnic origins of the population must be taken into consideration because the Framingham risk score is derived from a population consisted of a large majority of whites of European origin and both under estimation as overestimation of the absolute risk in other ethnic groups were reported. [17] [24][25][26]. About two third of our study population was from a non-European origin, mainly Turkish, Surinamese or Moroccan. We found no significant ethnic differences in the proportions of identified individuals according to the used risk thresholds, but this may be because of small numbers of the different ethnic minority groups. Compared to other international guidelines, [8][9] the current Dutch guidelines mentioned no information about the underestimation of the CVD risk in ethnic minority groups. [27] So the focus on the modifiable part of risk instead of the absolute risk in a heterogeneous population living in deprived neighbourhoods could be an alternative.

Several limitations of the present study should be mentioned. The proposed modifiable part of the CVD risk is based on blood pressure measurements taken at one occasion while national guidelines recommend that blood pressure should be considered after repeated measurements. Our measuring procedure may have led to overestimation of the modifiable part of the risk and consequently of the CVD risk. On the other hand, we belief that misclassification is limited because the CVD risk assessment depends on many risk factors and because the risk formula initially was based on single measurements.

For determination of the modifiable risk, we considered that smokers could quite smoking and we included individuals who's blood pressure was higher than 120 mmHg and cholesterol/HDL> 4. Although smoking cessation may be successful among a limited number of individuals, according to a large Danish Study, [28] smoking reduction has no impact on CVD risk while smoking cessation clearly reduces the risk. The above mentioned blood pressure levels are relatively low to justify intervention according to guidelines. However evidence has shown that each 10 mmHg lower systolic blood pressure decreases the risk of stroke in one third of subjects and that this association is continuous down to levels of at least 115/75 mmHg. [29]
We considered in this paper a modifiable risk ≥ 5%. Of course, using pharmacological treatment could further reduce blood pressure (systolic blood pressure < 120 mmHg) or lipids (total cholesterol/HDL <4) resulting in higher levels of the realistic or potential modifiable risk. Consequently fewer individuals could be identified for intervention activities (lower NNT). Nevertheless we think that further reductions of modifiable risk factors is not realistic and that drugs related adverse effects are more likely to exceed the benefits. [30]

A major strength of this study is stating the importance of reducing modifiable risk factors for all patients, despite a lower threshold of absolute cardiovascular risk. Whether the potential or realistic modifiable risk should be taken into account in daily practice depends on the levels of the modifiable risk factors and the patient's likelihood to comply with prevention strategies. In daily practice, clinicians should discuss the modifiable risk for CVD with patients because it is a more comprehensive approach for the prevention of CVD instead of just individual risk factors and it is easier to communicate with patients. Additionally clinicians should be aware that using risk charts based on absolute risk thresholds as recommended by guidelines are inadequate for the identification of high risk individuals to initiate intervention. Therefore, adaptation of current guidelines regarding prevention of cardiovascular diseases is needed.

We conclude that targeting preventive strategies to those with an absolute 10-years risk ≥ 20% would result in exclusion of a large group of relative young, predominantly female individuals. Nevertheless this group constitutes as much as one quarter of all patients and may benefit from preventive strategies to prevent cardiovascular diseases on the long term because their potential reduction in absolute risk of CVD exceeds 5%. Moreover, using the modifiable part of risk will reduce over treatment in older individuals with an elevated absolute risk but at low modifiable risk.

Competing interest:

“ I confirm that none of the authors has a financial or other relationship that might lead to competing interests”

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APPENDIX

Calculations of absolute risk, modifiable and non-modifiable risk

$\mu = 18.8144 - (1.2146 * gender) - (1.8443 * (LN(age))) + (0.3668 * LN(age) * gender) - (1.4032 * LN(SBP)) - (0.3899 * smoking) - (0.5390 * LN(cholhdl)) - 0.13036 * diabetes - (0.1697 * gender * diabetes)$

$\sigma = 0.6536 + (\mu * (-0.2402))$

$\epsilon = \exp(\sigma)$

$\Gamma = (LN(10) - \mu) / \epsilon$

AR (Absolute risk) = $100 * (1 - EXP((- EXP(\Gamma))))$.

Potential reduction

NMR_p (non-modifiable risk):
AR (if systolic blood pressure = 120 mmHg& smoking = 0 & cholhdl = 4)

1. Separate risk for SBP: AR with SBP value and (cholhdl = 4 & smoking = 0) – NMR_p
2. Separate risk for cholesterol: AR with cholhdl value and SBP = 120 & smoking = 0) –NMR_p
3. Separate risk for smoking: AR with smoking=1 and (SBP = 120 & cholhdl = 4) - NMR_p

MR_p (Modifiable risk) : 1 (if syst BP > 120) + 2 (if cholhdl> 4) + 3 (if smoking =1)

Realistic reduction

NMR_r (**non-modifiable risk):**
AR if (SBP value – 12 mm Hg) & (smoking = 0) & (chol – chol* 20%/ hdl + hdl* 5%))

1. Separate risk for SBP: AR with SBP value and ((chol – chol* 20%/ hdl + hdl* 5%) & smoking = 0) – NMR_r
2. Separate risk for cholesterol: AR with cholhdl value and ((SBP – 12mmHg) & smoking = 0) – NMR_r
3. Separate risk for smoking: AR with smoking=1 and ((SBP – 12mmHg) & (chol – chol* 20%/ hdl + hdl* 5%)) NMR_r

MR_r (modifiable risk): 1 (if SBP > 120) + 2 (if cholhdl> 4) + 3 (if smoking =1)

SBP: systolic blood pressure
Choldhl: total cholesterol/HDL cholesterol