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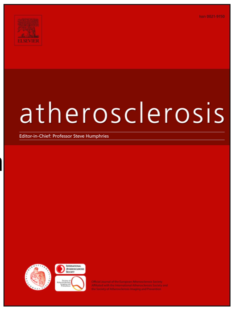

Ideal cardiovascular health and risk of acute myocardial infarction among Finnish men

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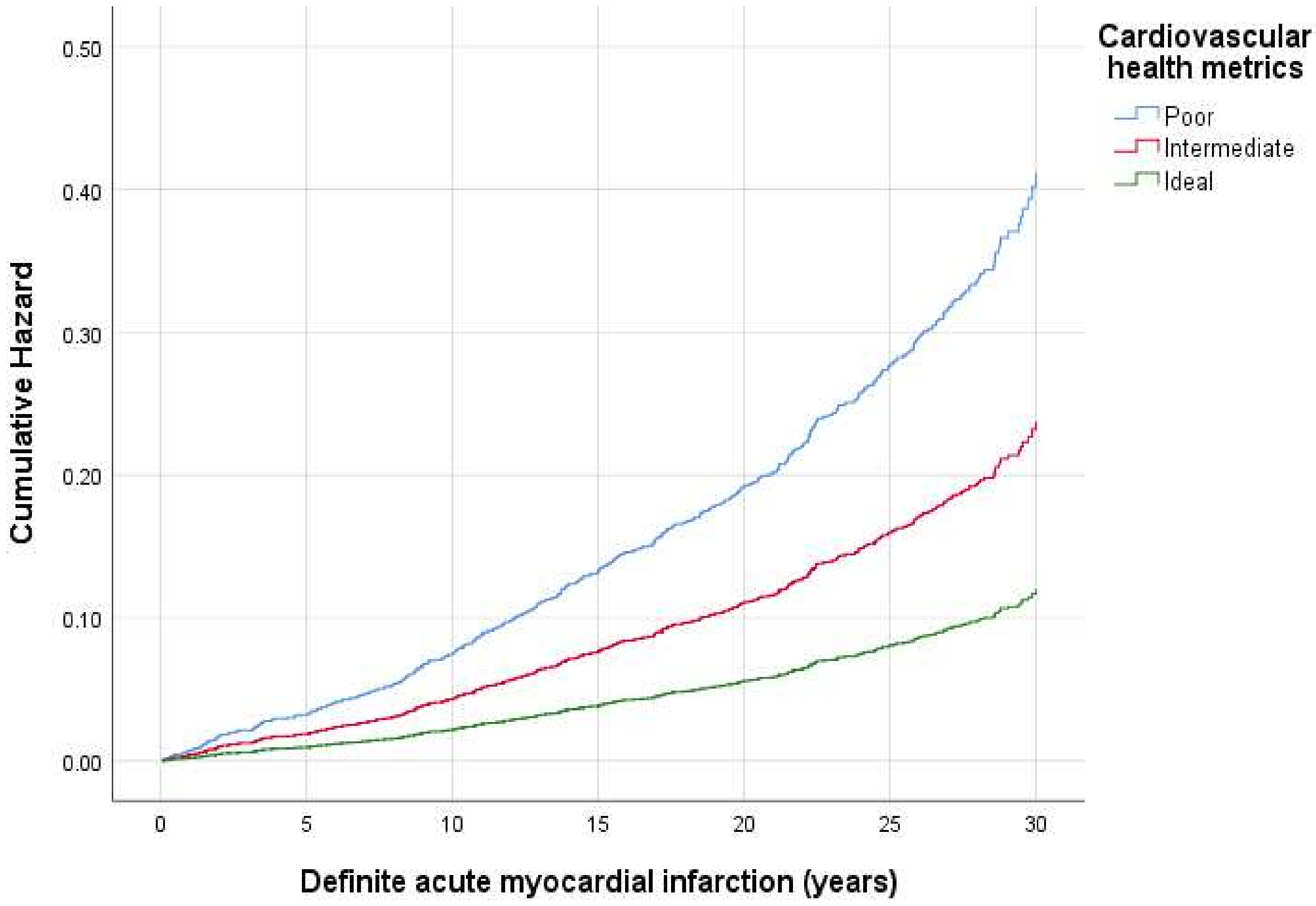

Hazard function for cardiovascular health metrics and risk of acute myocardial infarction

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Ideal cardiovascular health and risk of acute myocardial infarction among Finnish men

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Abstract

Background and aims: Acute myocardial infarction (AMI) is associated with high mortality globally and remains a public health burden. We sought to investigate the relation between the American Heart Association's cardiovascular health metrics (CVH) and the risk of AMI among middle-aged Finnish men.

Methods: We used the ongoing population-based Kuopio Ischaemic Heart Disease cohort study comprising men aged 40 to 62 years at baseline. The CVH metrics was computed among 2584 participants at baseline with health scores ranging from 0 to 7. This was categorized into three groups of CVH metrics as poor (0-2), intermediate (3-4) and ideal (≥5). Multivariate Cox regression models were used to estimate the hazard ratios (HR) and 95% confidence intervals (CIs) of CVH metrics for AMI.

Results: During a median follow-up period of 25.2 years, 513 cases of AMI were recorded. Only one participant was able to achieve all the seven ideal health metrics. The risk of AMI decreased continuously with increasing number of CVH metrics across the range 2-7 (for non-linearity, p=0.07). Men with ideal CVH metrics had a HR (95% CI) for AMI of 0.28 (CI 0.15 – 0.55, p <0.001) compared to those with poor CVH metrics after adjustment for age, alcohol intake and socioeconomic status. The associations remained consistent following further adjustment for history of coronary heart disease and history of type 2 diabetes.

Conclusions: Ideal CVH metrics was strongly and linearly associated with reduced risk of AMI among middle-aged Finnish men.

Keywords: Acute myocardial infarction, cardiovascular health metrics, ideal cardiovascular health, risk factor, men.

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1. Introduction

Cardiovascular disease (CVD) remains a global health burden. According to the World Health Organization (WHO), 17.9 million people died from CVD in 2016, accounting for 31% of all global mortality [1]. Acute myocardial infarction (AMI), a form of CVD, is associated with high mortality globally, and contributed to 7.3 million deaths out of 17.3 million CV deaths about a decade ago (2008) [2, 3]. The global CVD burden due to ischaemic heart disease is 45% in males, and 37% in females [2]. In 2012, the direct and indirect costs (productivity losses) of AMI in males were respectively 1.85 and 15.21 times more than in females [4], indicating higher economic burden among men when compared to women. Nevertheless, an active risk factor intervention is necessary to curtail AMI both for the economic perspective on men and the mortality consequences among younger women.

Some modifiable lifestyle factors such as physical inactivity, smoking, overweight or obesity, hypertension, hyperlipidaemia and diabetes, which are usually targeted for preventive measures, have been demonstrated to increase the risk of developing CVD [5]. Thus, about a decade ago, the American Heart Association (AHA) proposed the use of a metric for ideal cardiovascular health (CVH) as a means to assess the cardiovascular status of the population [6]. The assessment was developed aiming to decrease mortality from CVD and stroke, while improving the CVH of the American population by 20% by 2020 [6]. This metric focused on 7 cardiovascular–risk modifiable health behaviours and biological factors - smoking, body mass index (BMI), physical activity, fasting blood glucose, total cholesterol, blood pressure and diet [6]. Studies have established strong associations between the CVH metric and various cardiovascular outcomes [7-11]. However, more studies are needed to promote and achieve ideal CVH among different population groups worldwide. There remains limited research evidence on the association between AHA's ideal CVH and the risk of AMI in northern Europe. Wilsgaard and colleagues have conducted research using a Norwegian cohort (Tromsø Study) to estimate the association between CVH metrics and risk of incident myocardial infarction (MI) [12] involving men and women between the ages of 30 and 79, and there has been no other similar study in the Scandinavian region that has evaluated this association. To the best of our knowledge, no other population study has evaluated the association between ideal CVH and the

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risk of AMI in the Scandinavian region. In this context, we aimed to investigate the prospective relationship between AHA's CVH and risk of AMI among middle-aged Finnish men.

2. Materials and methods

2.1. Study population

The ongoing prospective population-based Kuopio Ischaemic Heart Disease (KIHD) study employed in this research was designed to investigate the different risk factors for developing CVD and other chronic diseases among middle-aged and older men and women living in Kuopio and the surrounding communities in Eastern Finland [13, 14].

The study commenced in 1984 with 3235 eligible men out of a baseline sample of 3433 men aged 42 to 60 years, randomly selected from the national population register. At baseline examination between March 1984 and December 1989, 2682 men (82.9% of those eligible) volunteered to participate in this study, 186 did not respond to the invitation and 367 declined to give informed consent. The current study is based on 2584 men with non-missing data on CVH metrics, relevant co-variates and AMI. Written informed consent was obtained from all individual participants included in the study. The study protocol conforms to the ethical guidelines of the 1975 Declaration of Helsinki. The KIHD research protocol was approved by the Research Ethics Committee of the University of Eastern Finland, Kuopio with reference number 143/97.

2.2.Measurements

A self-administered questionnaire was mailed to each participant prior to their visit to the study centre. The participants were then invited to the study centre for interviews and clinical examination. A trained research nurse was responsible for interviewing all the study participants, who also went through a health examination. Nutritional assessment was done using a 4-day food record diary. Information concerning education, type of occupation, smoking status and duration of regular smoking in years, alcohol consumption and past medical condition was obtained using detailed questionnaires and were checked during medical examination by a physician. Additionally, physical examination including height, weight and blood pressure (BP) were measured at baseline. Body mass index was calculated as the weight in kilograms divided by height in meters squared (kg/m^2). Resting blood pressure was measured with a random-zero

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sphygmomanometer (Hawskley, UK) between 8 and 10 am after 5 and 10 minutes of rest in a seated position [15, 16] Physical activity was measured using questionnaires involving a 12-month leisure activity history (modified from the Minnesota leisure time activity questionnaire), a 7-day leisure time activity recall, the 24-hour total activity recording and the occupational activity interview. All metabolic indices were calculated using the product of duration of each activity and the caloric coefficient of the specific activity and intensity class. The intensity was expressed in metabolic units (MET), which is the ratio of metabolic rate during activity to the metabolic rate at rest [17]. Adulthood socioeconomic status (SES) was assessed as a combined measure of income, education, occupation, occupational prestige, material standard of living, and housing conditions [18]. The SES scale ranges from 0 through 25; 0 indicating the highest, and 25 the lowest SES.

Participants provided blood specimens between the hours of 8 and 10 in the morning after having abstained from alcohol ingestion for 3 days, smoking for 12 hours and eating for 12 hours. After the subject had rested for 30 minutes in the supine position, blood sample was drawn from the antecubital vein with Terumo Venoject VT-100PZ vacuum (Terumo Corp., Tokyo), without the use of tourniquet. The cholesterol contents of serum lipoprotein fractions and triglycerides were measured enzymatically (Boehringer Mannheim). Serum high-density lipoprotein cholesterol (HDL-C) and its subfractions were separated from fresh serum samples using ultracentrifugation and precipitation. Blood glucose was measured by glucose dehydrogenase method (Merck, Darmstadt, FRG) after precipitation of proteins by trichloric acetic acid [16]

2.3.Collection and classification of AMI

The National Hospital Discharge Data Register was used to obtain data on AMI as part of the WHO MONICA Project in 1982. Symptoms, electrocardiographic findings and cardiac enzyme elevations were used as basis for diagnostic classification of coronary events [19]. The Ninth (code numbers 410-414) or Tenth (code numbers 120-125) International Classification of Diseases (ICD) was used to code and classify each suspected coronary event by a physician using the original patient records. The corresponding ICD-9 and ICD-10 codes for definite AMI are 410 and 121 respectively. All AMI cases that occurred from the study enrolment to end of 2014 were included. If a participant had multiple events, the first was considered as the end point [20]. Thus, censoring of AMI was done on the date of the first event; if no AMI but dead before

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first day of 2015, censoring was on the date of death; and if no AMI and alive to the end of 2014, censoring at the end of observation (31.12.2014).

2.4. Cardiovascular Health Metrics

In conformity with the AHA definition [6], the number of CVH metrics was constructed by recoding the seven metrics as dichotomous variables - 1 point for the AHA ideal category and 0 point for the other categories. The seven optimal CVH factors that were categorized into ideal, intermediate and poor are: 1) diet: based on healthy diet pattern consisting of 4 – 5 components of the following: ≥4.5 cups/day of fruits and vegetables, ≥two 3.5-ounce servings/week of fish, <1,500mg/day of sodium, ≤ 36ounces/week of sweets/sugars and ≥ three 1-ounce servings/day of whole grains. The salt intake for the present study was substituted with intake of processed meat, which has been demonstrated to contain much salt (sodium) [21]; 2) blood pressure: <120/<80 mmHg; 3) physical activity: ≥150minutes/week moderate-intensity physical activity (MET 3-6) or ≥75 minutes/week of vigorous intensity aerobic physical activity (MET >6) or equivalent combination; 4) BMI: <25 kg/m^2; 5) smoking: never smoked; 6) total cholesterol: < 5.18 mmol/l; and 7) fasting blood glucose: <5.55 mmol/l. Thus, all participants had number of CVH metrics ranging from 0 to 7 according to AHA ideal category met.

2.5.Statistical analysis

Descriptive statistics were used to summarize the baseline characteristics of the participants. Baseline characteristics were presented as means (standard deviation, SD) or median (interquartile range, IQR) for continuous variables and number and percentages for categorical variables. Analysis of variance was used to assess the differences in baseline characteristics of continuous variables,chi-squared test for categorical variables, and logistic regression for linear trends in changes in CVH metrics (after adjustment for age and SES). We explored the shape of the relationship between CVH metrics (as a continuous variable) and risk of AMI using a restricted cubic spline with knots at the 5th, 35th, 65th and 95th percentiles of CVH metrics distribution in a multivariate adjusted model. Multivariate Cox regression models were used to estimate the hazard ratios (HRs) and 95% confidence intervals (CIs) of AMI using baseline CVH metrics, after confirmation of no major departure from the proportionality assumptions using Schoenfeld residuals [22]. The number of CVH metrics was categorized into three groups of

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CVH (poor (0-2), intermediate (3-4), and ideal (≥5)), with poor CVH used as the reference comparison.

Hazard ratios (HRs) were calculated with adjustment in two models: i) model 1: age, alcohol consumption and SES; ii) model 2: model 1 plus history of CHD and history of type 2 diabetes mellitus. These covariates were selected based on previously established roles as risk factors and their potential as confounders as a result of their known associations with AMI and also taking into consideration factors used in derivation of the CVH metrics. All statistical analyses were performed using Microsoft windows software, IBM SPSS Statistics 25 (SPSS Inc., Chicago, IL, USA 9). Two-sided p value <0.05 was considered statistically significant.

3. Results

The baseline characteristics and the CVH metrics of the participants are shown in **Table 1.** The mean age (SD) of the study population was 53.1 (5.1) years. The number of participants (%) in the different categories of the CVH metrics were as follows: poor, 1608 (62.2); intermediate, 859 (33.2); and ideal, 117 (4.5). During the median follow-up years of 25.2 [IQR 14.7 - 27.6] years, 513 cases of AMI was recorded.

The distribution of the seven factors in CVH metrics and the variations in the number of CVH metrics among the KIHD study participants are shown in **Table 2.** The majority of the participants (78.1%) were physically active, whereas HDS was the least attained ideal component (1.9%). Only one participant attained all the seven AHA ideal components (7 CVH metric) and majority of the participants, 733 (28.4%), had one of the metrics.

A restricted cubic spline curve showed that the risk of AMI decreased continuously with increasing CVH metrics across the range 2-7 (p-value for nonlinearity=0.07) (**Figure 1**). **Table 3** shows the associations between CVH metrics and risk of AMI. Men who had ideal CVH metrics had a 72% reduced risk of AMI when compared with those who had poor CVH metrics (HR: 0.28; 95%CI: 0.15 - 0.55, p<0.001) after adjustment for age, alcohol consumption and SES. On further adjustment for history of CHD and history of type 2 diabetes mellitus, (model 2), the association was minimally attenuated (HR: 0.29; 95%CI: 0.15 – 0.57, p<0.001). Also, in the sensitivity analysis excluding participants with a previous history of CHD at baseline the association between CVH metrics categories and the risk of AMI remained statistically

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significant (**Supplementary Table 1**). The HR for the association of number of CVH metrics and risk of AMI, using participants with zero (0) score as reference, shows 87% reduced risk among those with 6 or more number of CVH metrics, after adjustment for age, alcohol intake and SES (HR: 0.13; 95%CI: 0.02-0.93, *p*=0.042) (**Table 3**). The association remained consistent on further adjustment forhistory of CHD and history of type 2 diabetes mellitus (model 2).

4. Discussion

In this ongoing prospective population-based study, middle-aged Finnish men with ideal CVH metrics had a reduced risk of AMI compared with those with poor CVH metrics. There was an inverse relationship between the number of CVH metrics and risk of AMI and a gradient decline in the number (percentage) of participants that attained higher numbers of health metrics from 1 to 7 in this cohort. The risk of AMI decreased continuously in a linear dose-response manner with increasing number of CVH metrics. These strong associations were independent of several established risk factors.

No previous study has evaluated the association between ideal CVH and risk of AMI among middle-aged Finnish men. Our current results were consistent with previous findings from the Tromsø study which has evaluated a relationship between CVH and AMI among a Norwegian population [12]; and the Prospective Epidemiological Study of Myocardial Infarction (PRIME) study [23]. In our study, men with ideal CVH (≥5 CVH metrics) at baseline had 71% lower risk of AMI compared with those that had poor CVH (0-2 CVH metrics). The Tromsø study reported about 13.7% reduction in incident MI in men with ideal health metric scores (≥4) compared to those with low health metric scores (≤3) [12], while the PRIME study reported 84 % reduced risk of MI in men with ideal CVH status (5 – 7) compared to those with poor CVH status (0 – 2) [23]. Other studies have also substantiated similar inverse association between CVH metrics and risk of CHD [24-27].

There was only one participant who achieved all the seven CVH metrics, similar to the cohort in the Prospective Epidemiological Study of Myocardial Infarction (PRIME) study [23]; also yielding a lower percentage (<0.1%) as compared to 0.1% in the Atherosclerosis Risk in Communities (ARIC) population [28] that achieved all the seven components of CVH. Similar to the northern Manhattan study (NOMAS) cohort [7], a small sample (4.5%) of our participants had 5 or more ideal health factors, which is not optimal. The highest percentage of our participants (35.1%) that suffered definite AMI was found among men who had only one of the CVH metrics. A CVH metrics from one to two non-significantly reduced the risk of AMI by 6% when compared with men with none. However, among men who achieved additional two components (i.e. having 3 number of CVH metrics), there was a 48% significant decrease for the risk of AMI compared with those that had none (**Table 3**). This also shows that an additional achievement of a CVH metric from two to three can reduce the risk of definite AMI by 33%. This result supports the necessity for measures to be initiated to improve the management of risk factors for AMI among Finnish men. Non-smoking, increasing physical activity, healthy diet, and weight loss campaigns should be reinforced and appropriate policies to support them should be encouraged. While adequate control of blood glucose, total cholesterol and BP should remain paramount among individuals and health professionals. Our data hypothetically demonstrates the benefits in reducing the risk of AMI from intermediate (42%) to ideal (71%) CVH metrics when compared with poor CVH metrics. This supports the concept that interventions aimed at improving intermediate (3-4) to ideal (≥5) CVH metrics will cause over 25% reduction in the risk of AMI and its associated burden. Thus, promoting evidence-based interventions addressing the achievement of 5 or more of the seven ideal health metrics will reduce the burden of AMI among the Finnish population. The findings of this study suggest the importance of CVH metrics as a measure for AMI prevention to necessitate prompt and appropriate preventive and treatment measures. This will help reduce the risks of developing adverse cardiovascular outcomes in general.

There were some limitations in this study. First, the result cannot be generalized among the entire northern Europe population, since it did not include women and other ethnicities. There is also possibility of the healthy participant bias which can affect the validity of the findings, and the low number of participants in the ideal CVH category especially after exclusion of men with CHD at baseline can affect the true estimates. Second, there is a possibility of misclassification bias given the use of self-administered questionnaire to obtain information on some of the components of the CVH metric. Also, the substitution of the salt intake in the AHA-definition with the intake of processed meat which might have some effect in the computation of the dietary component of CVH metrics used in this study. Third, given the long period of follow-up and the employment of baseline assessments, it is likely that the levels of CVH metrics may change over time, leading to the underestimation of true associations as a result of regression

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dilution bias. Nevertheless, the strength of the study lies in the relatively large number of participants, being a representative sample of middle-aged male population in Eastern Finland. They were well characterized and followed-up during the study period with well-documented outcome data.

In conclusion, ideal CVH metrics was strongly and continuously associated with the risk of AMI, among middle-aged Finnish men. Fewer men achieved ideal CVH levels; thus, applicability of AHA’s CVH metrics among Finnish population should be encouraged and promoted with a target to move the general population towards achieving ≥5 components of the CVH metrics. Considering that individual components of ideal CVH metric are not characterized by the same risk of AMI occurrence, a standardized metric is instrumental to assess risk of AMI in the general population. Ideal CVH metrics should be considered by healthcare practitioners and public health expects as a measure to reduce the risk of AMI.

Conflicts of interest

The authors declared they do not have anything to disclose regarding conflict of interest with respect to this manuscript.

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Author contributions

NI, SKK and JL contributed to the conception and design as well as the acquisition, analysis and interpretation of the work. AV contributed to the acquisition and analysis for the work. SK and JK contributed to the acquisition of the work. Manuscript preparation was mostly by NI with editing by SKK and JL. All critically revised the manuscript and gave final approval.

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Table 1: Baseline characteristics, outcomes and cardiovascular health metrics in the KIHD cohort

Characteristics (mean [SD] or median [IQR])	**Participants N, 2584**	**Acute myocardial infarction N, 513**	**Cardiovascular health metrics**			***p* value**[a]
			Poor N, 1608	Intermediate N, 859	Ideal N, 117	
Age in years	53.1 (5.1)	54.0 (4.5)	53.3 (5.0)	52.8 (5.2)	51.7 (5.8)	0.002
Socioeconomic status	12.3 (5.1)	12.9 (4.8)	12.9 (5.0)	11.4 (5.2)	10.0 (5.0)	<0.001
Alcohol/week (grams)	31.5 (6.2 – 91.5)	30.8 (5.4 – 88.3)	37.6 (8.3 – 105.0)	24.2 (4.4 – 78.0)	10.0 (0.3 – 32.5)	<0.001
History of coronary heart disease[b]	647 (25)	184 (35.9)	443 (27.5)	186 (21.7)	18 (15.4)	<0.001
History of diabetes mellitus[b]	153 (5.9)	62 (12.1)	109 (6.8)	40 (4.7)	4 (3.4)	0.05

[a]Statistical significance for categorical variables tested using chi-squared method, and analysis of variance procedure for continuous variables. [b]Values presented as number (%).
Socioeconomic status was defined, on a scale of 0 to 25, as a combined measure of income, education, occupation, occupational prestige, material standard of living and housing conditions with 0 being highest SES, and 25 lowest SES.
Cardiovascular health metrics categories: poor, 0 – 2 components; intermediate, 3 – 4 components; ideal, ≥5 components.

Table 2: Distribution of cardiovascular health metrics among the KIHD Study participants

Cardiovascular Health Metric	All participants N, 2584 [a]	Acute myocardial infarction N, 513[a]	*p* value for Trends
Physical activity			
[b] 150 mins/week of moderate-intensity or 75 mins/week of vigorous intensity or both	2018 (78.1)	393 (76.6)	0.352
[c] 1-149 mins/week of moderate intensity physical activity or 1-74 mins/week of vigorous intensity or both	21 (0.8)	3 (0.6)	0.356
[d] No physical activity	545 (21.1)	117 (22.8)	0.473
Body mass index			
[b] <25 kg/m^2	809 (31.3)	130 (25.3)	<0.001
[c] 25 – 29.9 kg/m^2	1328 (51.4)	261 (50.9)	0.001
[d] ≥ 30 kg/m^2	447 (17.3)	122 (23.8)	<0.001
Healthy Diet Score			
[b] 4 - 5	50 (1.9)	12 (2.3)	0.240
[c] 2 – 3	1244 (48.2)	272 (53.1)	0.015
[d] 0 – 1	1290 (49.9)	229 (44.6)	0.038
Blood pressure (mmHg)			
[b] SBP <120 and DBP <80	311 (12.0)	41(8)	<0.001
[c] SBP, 120 – 139 or DBP, 80 – 89	985 (38.2)	179 (34.9)	0.010
[d] SBP ≥ 140 or DBP ≥ 90	1288 (49.8)	293 (57.1)	<0.001
Fasting blood glucose (mmol/l) [e]			
[b] <5.55	1011 (39.1)	167 (32.6)	<0.001
[c] 5.55 – 6.99	1193 (46.2)	167 (46.7)	0.004
[d] ≥7.00	380 (14.7)	106 (20.7)	<0.001
Total cholesterol (mmol/l) [f]			

[b] < 5.18	662 (25.6)	99 (19.3)	<0.001
[c] 5.18 -6.21	1027 (39.7)	197 (38.4)	0.022
[d] ≥ 6.22	895 (34.6)	217 (42.3)	<0.001
Smoking status			
[b] Never smoked	834 (32.3)	128 (25.0)	<0.001
[c] Previous smokers	932 (36.1)	292 (35.8)	0.009
[d] Current smokers	818 (31.7)	201 (39.2)	<0.001
Number of CVH metrics [g]			
0	154 (6.0)	36 (7.0)	<0.001
1	733 (28.4)	180 (35.1)	0.783
2	721 (27.9)	165 (32.2)	0.969
3	525 (20.3)	78 (15.2)	0.021
4	334 (12.9)	45 (8.7)	0.012
5	94 (3.6)	8 (1.6)	0.009
6	22 (0.9)	1 (0.2)	0.082
7	1 (0)	-	1.000

[a] Values presented as number (%); [b] AHA ideal category (1 point); [c] AHA intermediate category (0 point); [d] AHA poor category (0 point); [e]mmol/l x 18 = mg/dl; [f]mmol/l x 38.6= mg/dl; g = b + c + d

AHA, American Heart Association; CVH, cardiovascular health; DBP, diastolic blood pressure; mmHg, millimeters of Mercury; mmol/l, millimole per litre; SBP, systolic blood pressure.

Trends across the surveys tested using logistic regression model adjusted for age and socioeconomic status.

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Table 3: Associations between cardiovascular health metrics and risk of acute myocardial Infarction

Cardiovascular health metrics	**Number of events/total**	**Model 1**		**Model 2**	
		HR (95% CI)	*p* value	HR (95% CI)	*p* value
	513/2584				
Poor [a]	381/1608	1		1	
Intermediate [a]	123/859	0.56 (0.46 – 0.69)	<0.001	0.58 (0.47 - 0.71)	<0.001
Ideal [a]	9/117	0.28 (0.15 – 0.55)	<0.001	0.29 (0.15 - 0.57)	<0.001
Number of CVH metric [b]					
0	36/154	1 (Reference)		1 (Reference)	
1	180/733	0.91 (0.64 – 1.30)	0.609	0.94 (0.66 – 1.35)	0.730
2	165/721	0.85 (0.59 – 1.22)	0.378	0.92 (0.64 – 1.32)	0.637
3	78/525	0.52 (0.34 – 0.77)	0.001	0.56 (0.37 – 0.83)	0.004
4	45/334	0.47 (0.30 -0.73)	0.001	0.51 (0.33 – 0.79)	0.003
5	8/94	0.29 (0.13 – 0.62)	0.001	0.32 (0.15 – 0.70)	0.004
≥6	1/23	0.13 (0.02 – 0.93)	0.042	0.12 (0.02 – 0.89)	0.038

HR, hazard ratio.

[a]The hazard ratios compared 'ideal' and 'intermediate' cardiovascular health with 'poor' cardiovascular health. [b] The hazard ratios were compared to those with zero (0) number of cardiovascular health metric.

Poor (0-2), intermediate (3-4), and ideal (≥5).

Model 1, Adjusted for age; alcohol consumption; socioeconomic status

Model 2, Model 1 plus history of coronary heart disease and history of type 2 diabetes mellitus.

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Supplementary Table 1: Associations between cardiovascular health metrics and risk of acute myocardial infarction excluding men with previous history of coronary heart disease at baseline

Cardiovascular health metrics	**Number of events/Total**	**Model 1**		**Model 2**	
		HR (95% CI)	*p* value	HR (95% CI)	*p* value
	329/1937				
Poor[a]	241/1165	1		1	
Intermediate[a]	84/673	0.57 (0.45– 0.74)	<0.001	0.57 (0.44 – 0.73)	<0.001
Ideal[a]	4/99	0.18 (0.07 – 0.48)	0.001	0.19 (0.07 – 0.50)	0.001
Number of CVH metric[b]					
0	20/104	1		1	
1	112/521	1.02 (0.63 – 1.64)	0.947	1.00(0.62 – 1.62)	0.989
2	109/540	0.96 (0.59 – 1.54)	0.849	0.95 (0.59 – 1.53)	0.827
3	56/407	0.63 (0.37 – 1.05)	0.073	0.63 (0.37 – 1.05)	0.074
4	28/266	0.47 (0.26 – 0.84)	0.010	0.46 (0.26 – 0.81)	0.008
5	3/79	0.17 (0.05 – 0.56)	0.004	0.17 (0.05 – 0.59)	0.005
≥6	1/20	0.21 (0.03 – 1.56)	0.127	0.21 (0.03 – 1.58)	0.129

HR, hazard ratio. [a] The hazard ratios compared 'ideal' and 'intermediate' cardiovascular health with 'poor' cardiovascular health. [b] The hazard ratios were compared to those with zero (0) number of cardiovascular health metric.

Poor (0-2), intermediate (3-4), and ideal (≥5)

Model 1, Adjusted for age; alcohol consumption; socioeconomic status

Model 2, Model 1 plus history of type 2 diabetes mellitus.

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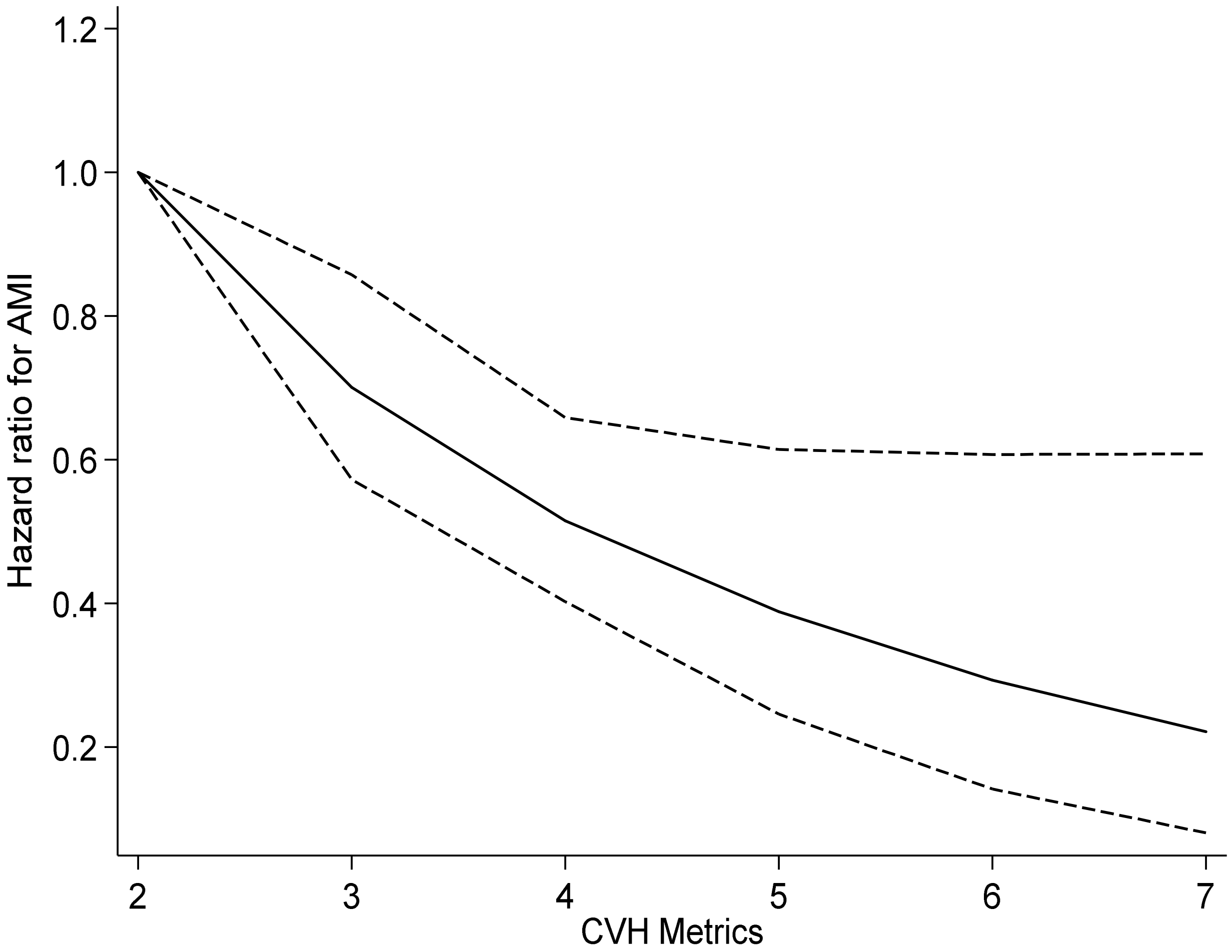
Figure 1. Cubic spline curve of hazard ratio for acute myocardial infarction (AMI) against cardiovascular health (CVH) metrics.



Restricted cubic spline functions were analysed with knots located at 5th, 35th, 65th and 95th percentiles of cardiovascular health metrics distribution in a multivariate adjusted model, with the reference category set at 2. The dashed lines represent the 95% confidence intervals.

Highlights

- Fewer participants achieved the ideal cardiovascular health.
- The more cardiovascular health metrics, lower the risk of acute myocardial infarction
- $\geq$6 cardiovascular health metrics had 87% reduced risk of acute myocardial infarction
- Findings are consistent on further adjustments with covariates.

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Declaration of interests

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

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