Does high intelligence improve prognosis? The association of intelligence with recurrence and mortality among Swedish men with coronary heart disease

Alma Sörberg Wallin,[1] Daniel Falkstedt,[2,3] Peter Allebeck,[2] Bo Melin,[3] Imre Janszky,[2,4] Tomas Hemmingsson[1,5]

[1]Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden
[2]Department of Public Health Sciences, Karolinska Institutet, Stockholm, Sweden
[3]Division of Psychology, Department of Clinical Neurosciences, Karolinska Institutet, Stockholm, Sweden
[4]Department of Public Health and General Practice, NTNU, Trondheim, Norway
[5]Centre for Social Research on Alcohol and Drugs, Stockholm University, Stockholm, Sweden

Correspondence to
Alma Sörberg Wallin, Institute of Environmental Medicine, Karolinska Institutet, Solnavägen 4, Stockholm 113 65, Sweden; alma.sorberg@ki.se

ABSTRACT

Background Lower intelligence early in life is associated with increased risks for coronary heart disease (CHD) and mortality. Intelligence level might affect compliance to treatment but its prognostic importance in patients with CHD is unknown.

Methods A cohort of 1923 Swedish men with a measure of intelligence from mandatory military conscription in 1969–1970 at age 18–20, who were diagnosed with CHD 1991–2007, were followed to the end of 2008. Primary outcome: recurrent CHD event. Secondary outcome: case fatality from the first event, cardiovascular and all-cause mortality. National registers provided information on CHD events, comorbidity, mortality and socioeconomic factors.

Results The fully adjusted HRs for recurrent CHD for medium and low intelligence, compared with high intelligence, were 0.98, (95% CIs 0.83 to 1.16) and 1.09 (0.89 to 1.34), respectively. The risks were increased for cardiovascular and all-cause mortality with lower intelligence, but were attenuated in the fully adjusted models (fully adjusted HRs for cardiovascular mortality 1.92 (0.94 to 3.94) and 1.98 (0.89 to 4.37), respectively; for all-cause mortality 1.63 (1.00 to 2.65) and 1.62 (0.94 to 2.78), respectively). There was no increased risk for case-fatality at the first event (fully adjusted ORs 1.06 (0.73 to 1.55) and 0.97 (0.62 to 1.50), respectively).

Conclusions Although we found lower intelligence to be associated with increased mortality in middle-aged men with CHD, there was no evidence for its possible effect on recurrence in CHD.

INTRODUCTION

An association between premorbid intelligence and later morbidity, including coronary heart disease (CHD), has been established in longitudinal studies.[1–4] However, no previous study has investigated whether intelligence affects prognosis of CHD. According to the hypothesis that higher intelligence affects health outcomes through a better ability to prevent and manage disease,[5–7] those with higher intelligence should be at lower risk for recurrence and early death after a CHD incidence. Adherence to treatment and recommendations might indeed be difficult. For instance, poor compliance in medication for secondary prevention cardiovascular diseases (CVD) is a frequent problem; several prospective studies have found that most patients stop taking at least one prescribed medication during the first year after an event.[8] Intelligence has previously been found to predict medication persistence in a population at risk for CVD.[6]

The aim of this study was to investigate if lower premorbid intelligence is associated with recurrence among men diagnosed with CHD. In addition, we wanted to investigate the association of intelligence with case-fatality and all-cause mortality in this group. We used the Swedish conscription cohort of 1969–1970, which consists of 49 231 men born in 1949–1951. This cohort contains information on physical condition, health behaviours and intelligence obtained by medical examinations, questionnaires and cognitive assessment. Record linkage with national registers provided data on morbidity, mortality and measures of socioeconomic factors in adulthood.

METHODS

The study was based on data from a nationwide, mandatory examination of 49 321 Swedish men who were conscripted for military service in 1969–1970, at age 18–20. The background of the Swedish conscription examination and the measurements included have been presented in detail elsewhere.[9 10] Only 2–3% of all Swedish men were exempted from conscription at that time, in most cases due to severe mental or physical disability. Ninety-eight per cent of all men conscripted in 1969 and 1970 were born in 1949–1951; the remaining 2% were born before 1949 and are excluded in order to increase homogeneity. Data from national registers were linked to the conscription data and anonymised by Statistics Sweden. This study includes those 2186 men (4.4%) who obtained a first diagnosis of CHD (see below) between 1991 and 2007, age about 40–56, for whom information was available on all variables in this study (figure 1). Ethical approval was obtained from the Regional Ethical Review Board in Stockholm, decision reference number 2004/5:9–639/5 and 2010/604:32.

Exposure: intelligence

Intelligence was assessed at conscription in 1969–1970 by four subtests measuring verbal, logic-inductive and visuospatial ability and technical comprehension. The cognitive assessment has been described in detail elsewhere.[4 11 12] The results were converted to standard-nine (stanine)
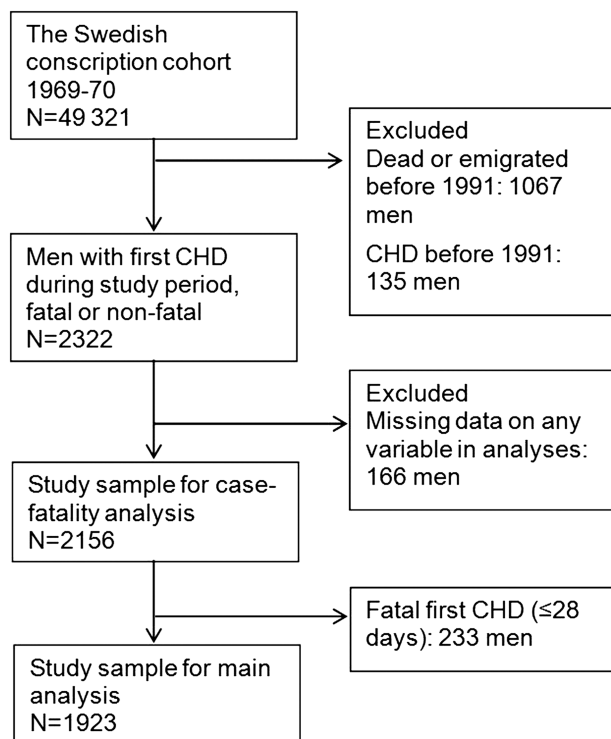
Figure 1 Flow chart of the study sample.

scales with a normal distribution for each subtest, with scores 1–9. These were combined and transformed into a new stanine scale as a global measure of general ability, corresponding to approximate IQ bands of: <74, 74–81, 82–89, 90–95, 96–104, 105–110, 111–118, 119–126, >126.[13] Of the men, 49 262 (99.9%) had an intelligence score in the data.

Outcome: recurrent CHD

Diagnoses of first and recurrent CHD (Swedish version of International Classification of Disease Ninth Edition (ICD-9) up to 1996, codes 410–414; thereafter ICD-10, I20-I25) were obtained from the Swedish national hospital discharge register, and the national cause of death register for out-of-hospital deaths in CHD, which are held by the National Board of Health and Welfare. In Sweden, hospital care is publically financed and available to all citizens. Men with a first event of CHD registered between 1 January 1991 and 31 December 2007 were included in the analyses. Follow-up started when a man was diagnosed with CHD, at any time during 1991–2007, and ended at the date of whichever occurred first: a second fatal or non-fatal event of CHD recorded in the national hospital or death registers (with a minimum of 28 days after the first event; diagnoses and deaths within 28 days were regarded as reflecting the first event), emigration, death from other causes, or 31 December 2008. The possible follow-up time therefore ranged from 1 to 17 years depending on the time of the first event.

First CHD events leading to death out of hospital and recorded in the cause of death register but not in hospital registers were included in analyses of case-fatality at baseline, but only men surviving their first CHD event were included in follow-up analyses.

Case fatality and mortality

Case-fatality in first CHD was defined as death with any underlying cause registered within 28 days of the first hospital admission for CHD, as is common in case-fatality research, or CHD as underlying cause in case of out-of-hospital death. Mortality with ICD-codes 390–459 (ICD-9) or I00-I99 (ICD-10) as underlying causes, that is, all CVD, were classified as CVD mortality.

Covariates

An overview of all covariates, including additional information about the variables and any categorisations, is presented in the online supplementary table S1. At conscription, all men underwent a 2-day examination during which health measures were obtained including weight and length, from which body mass index (BMI, kg/m^2) was calculated, and blood pressure. Information on cigarette smoking and alcohol use was self-reported in a questionnaire. Information on CVD mortality in parents before age 65 was included as an indicator of genetic risk for early CVD. Socioeconomic position in childhood (at age about 10) and adulthood (at age about 40) was registered in the national population and housing censuses. The original six and eight occupation-based socioeconomic groups[4] were collapsed into three and four, respectively, to retain statistical power. Information on income at about 40 years of age (in 1990) and marital status in the year of the first CHD event, or the preceding year in case of missing data, was obtained from the Longitudinal Database of Education, Income and Occupation (LOUISE). Education is highly correlated with intelligence and was not included in the main analyses due to the risk for multicollinearity (correlation about 0.55 in this cohort[14]) and overadjustment, but was added in an additional analysis.

Since intelligence is associated with various forms of morbidity and possibly the severity of conditions, comorbid conditions and complications might account for any differences in outcome between IQ categories. Hence, diagnoses obtained from the hospital discharge register, either registered as concomitant diagnoses at discharge after the first CHD event or as primary or concomitant diagnoses up to 28 days after or in the 7 years preceding the event, in correspondence to an extension of the Ontario AMI prediction rule applied by Rasmussen et al,[15] were included as either comorbid conditions or complications (diagnoses and corresponding ICD codes are shown in online supplementary table S1). Depression was also included among comorbid conditions since it is also predictive of recurrence in CHD.[16]

Statistical analyses

Intelligence was modelled in three groups: low (stanine score 1–3), medium (4–6) and high (7–9), using the highest performing group as reference. Descriptive statistics of IQ level and covariates were calculated for the full cohort and in subsamples based on men with a first CHD 1991–2007 (table 1), and of covariates for the three IQ categories (table 2). ORs for case-fatality among men with a first CHD event 1991–2007 were estimated by the logistic regression model. Among men surviving a first CHD event, HRs for a second CHD event and for all-cause and CVD mortality, during the period 1991–2008 in relation to level of intelligence at conscription were estimated by the Cox proportional hazards model. Proportionality of hazards was assessed in log-log survival plots and no major violations against the proportionality assumption were found. After adjustment for age at first CHD (model 1), early-life factors that were considered as potential confounders were added to the model (model 2), followed by factors measured at conscription or later (model 3). An additional analysis added education in three

Table 1 Characteristics of men with first CHD 1991–2008 and in the full cohort of conscripts

Variables	Full cohort n=49 321 Mean (SD)/N (%)	Men with CHD, fatal and non-fatal n=2156 Mean (SD)/N (%)	Survivors of first CHD (>28 days) n=1923 Mean (SD)/N (%)	Deceased during follow-up*; non-CHD deaths n=54 Mean (SD)/N (%)	Recurrent CHD during follow-up*, fatal and non-fatal n=902 Mean (SD)/N (%)
IQ	5.38 (2.06)	4.95 (2.07)	4.97 (2.07)	4.30 (1.54)	4.88 (2.11)
Early life factors					
Parent's CVD death, age <65	4951 (10.0)	393 (18.2)	343 (17.8)	8 (14.8)	166 (18.4)
Low socioeconomic position in childhood	26 898 (54.5)	1321 (61.3)	1171 (60.9)	29 (53.7)	562 (62.3)
Factors in adolescence					
BMI	21.00 (3.19)	21.6 (3.02)	21.6 (2.94)	21.5 (3.32)	21.8 (3.13)
Smoking 1–10 cig/day	15 489 (31.9)	703 (32.6)	620 (32.2)	18 (33.3)	296 (32.8)
Smoking >10 cig/day	12 935 (26.7)	852 (39.5)	749 (40.0)	25 (46.3)	381 (42.2)
Risk use of alcohol	6422 (13.6)	373 (17.3)	320 (16.6)	13 (24.1)	168 (18.6)
Systolic blood pressure	126.1 (11.8)	127.7 (12.3)	127.4 (12.0)	127.9 (12.6)	127.2 (12.2)
Factors in adulthood†					
Occupation					
Non-manual	20 676 (41.9)	779 (36.1)	707 (36.8)	11 (20.4)	300 (33.3)
Manual	17 600 (35.7)	895 (41.5)	790 (41.1)	25 (46.3)	391 (43.4)
Self-employed/farmer	3864 (7.83)	165 (7.65)	152 (7.90)	2 (3.70)	72 (7.98)
Unclassified	5536 (11.2)	317 (14.7)	274 (14.3)	16 (29.6)	139 (15.4)
Income‡	190.6 (88.0)	180.4 (80.2)	183.0 (80.5)	143.9 (76.5)	180.6 (79.4)
Single household	13 410 (28.1)	900 (41.7)	767 (39.9)	37 (68.5)	353 (39.1)
Other diagnoses					
Comorbidity§	–	75 (3.48)	70 (3.64)	8 (14.8)	49 (5.43)
Complications¶	–	119 (5.52)	107 (5.56)	7 (13.0)	65 (7.21)

*Not within 28 days of first CHD.
†Occupation and income in 1990, at age about 40. Single household at the year or preceding year of first CHD event in the samples; single household in 1990 in the full cohort for comparison.
‡In 1000 Swedish kronor/year.
§Diabetes with complications, pulmonary oedema, acute or chronic renal failure, cerebrovascular disease, malignancy and depression.
¶Cardiogenic shock, cardiac dysrhythmias and congestive heart failure.
BMI, body mass index; CHD, coronary heart disease; CVD, cardiovascular diseases.

levels: ≤9, 9–12 and ≥12 completed years. Additional analyses restricted to myocardial infarction (MI; ICD-9 410, ICD-10 I21–22), applied to both the inclusion criteria (first event) and outcome (recurrence), were performed. Possible interaction by adult socioeconomic position[17] was examined in stratified analyses in groups of white-collar or blue-collar occupations. Also, due to the higher mortality among people with lower intelligence, which might cause an underestimation of the IQ-recurrence association, we performed an analysis combining recurrences and deaths from any causes as end points. All statistical analyses were performed in SAS V.9.2 and V.9.3.

RESULTS

Data were available for 2156 men with a first CHD in 1991–2007 and for 1923 men who survived for follow-up through 2008 (7543.6 person years, mean 3.9 years of follow-up time). Men with CHD had lower IQ score, a greater proportion of CVD risk factors (measured at conscription), manual occupations or no registered occupation in 1990 and lower income compared to the full cohort (table 1). Men who died from other causes than CHD during follow-up had a lower IQ score and a poorer CVD risk factor profile, more disadvantageous socioeconomic conditions and more often comorbid diagnoses or complications in the hospital records, compared to the total group of men with CHD. Men with a second (recurrent) event did not differ substantially from the total group of men with CHD concerning the factors included. Among the 1923 (89%) men who survived for 28 days after their first CHD event,

902 (47%) had a recurrent event during follow-up of which 17 were fatal. Sixty-one per cent of the recurrent events occurred within 1 year after the first. Of the first-event survivors, 146 (7.6%) died from any cause. Of the deceased during follow-up, 37 (25%) had no recurrent CHD event, and 86 (59%) died from other causes than CHD. Among the 74 men who died from CVD, 51 (69%) had a recurrent CHD event prior to the fatal event.

Table 2 shows the prevalence and distribution of risk factors in the three IQ categories. The prevalence of smoking and risk use of alcohol, and average BMI and systolic blood pressure, increased somewhat with decreasing IQ category. Non-manual employees had higher IQ to a greater extent while manual employees more often had lower IQ. Parent's early CVD death, diastolic blood pressure, and comorbidity and complications were not associated with IQ.

Table 3 shows the associations of intelligence at conscription with case-fatality at first CHD event, and mortality from CVD and all causes during follow-up among 28-day survivors of the first event. There was a tendency of higher case-fatality with decreasing IQ level but it was entirely explained by CVD risk factors and, in particular, socioeconomic and marital status. Men with medium and low IQ had a clearly higher all-cause mortality rate than men with high IQ. After adjusting for confounders the point estimates were attenuated, reaching just below the conventional level of statistical significance.

Table 4 shows that intelligence in adolescence was not associated with recurrence among men with CHD in this cohort,

Table 2 Distribution of risk factors in IQ categories among men in the study sample

	N exposed	IQ Low (1–3) N=555	Medium (4–6) N=1080	High (7–9) N=521	p Value
Early life factors					
Parent's CVD death, age <65	394	18.9	18.2	17.5	0.83
Low socioeconomic position in childhood	1321	73.2	61.9	47.2	<0.001
Factors in adolescence					
BMI	–	21.8	21.7	21.3	0.01
Smoking 1–10 cigarette/day	718	35.3	33.7	27.5	0.01
Smoking >10 cigarette/day	863	43.2	40.6	33.4	0.003
Risk use of alcohol	380	25.2	16.0	11.5	<0.001
Systolic blood pressure	–	129.0	127.8	126.1	<0.001
Factors in adulthood*					
Occupation					
Non-manual	784	14.05	36.5	58.9	<0.001
Manual	905	62.9	40.5	20.9	<0.001
Self-employed/farmer	170	5.59	9.17	6.72	0.02
Unclassified	327	17.5	13.9	13.4	0.10
Income†	–	158.1	177.9	209.3	<0.001
Single household		50.5	39.5	37.0	<0.001
Other diagnoses					
Comorbidity‡	75	3.78	3.24	3.65	0.83
Complications§	119	5.59	5.19	6.14	0.73

*Occupation and income in 1990, at age about 40. Single household at the year or preceding year of first CHD event.
†In 1000 Swedish kronor/year.
‡Diabetes with complications, pulmonary oedema, acute or chronic renal failure, cerebrovascular disease, malignancy and depression.
§Cardiogenic shock, cardiac dysrhythmias and congestive heart failure.
BMI, body mass index; CHD, coronary heart disease; CVD, cardiovascular diseases.

neither during the full 17 years follow-up period nor in the analysis limited to 2 years' follow-up. All of the estimates, crude or adjusted, were close to 1.0 and none reached conventional levels of statistical significance. Adjusting for education had no impact on the risk for CHD recurrence (data available on request). Restricting the study group to men with MI showed a similar pattern, although statistical power was low due to the smaller number of events.

There was no clear evidence of interaction by socioeconomic position in the stratified analyses (data available on request). There was no difference between blue-collar and white-collar occupations at the medium IQ level, while the HR point estimate was slightly higher at the low IQ level among white-collar employees compared to blue-collar workers, but statistical power was low due to the small number of events in the stratified groups. Analyses stratified by age (40–50 and 51–58 years at first CHD) did not show any statistically significant differences either.

In an analysis combining recurrent events and deaths from all causes (37 deaths) as end points, the HRs were slightly higher compared to the main analysis (age adjusted: medium IQ 1.08, 0.92–1.28; low IQ 1.22, 1.01–1.47; fully adjusted: medium IQ 1.02, 0.87–1.21; low IQ 1.12, 0.92–1.37). Including fatal first events in the analysis yielded similar results (data available on request).

Table 3 IQ and case-fatality at first CHD event 1991–2008 and subsequent mortality

	28-day case fatality (1991–2007) N=2156, 233 cases OR (95% CI)		CVD mortality (mean 1919 days) N=1923, 74 cases HR (95% CI)		All-cause mortality (mean 1816 days) N=1923, 146 cases HR (95% CI)	
Adjusted for	Medium IQ	Low IQ	Medium IQ	Low IQ	Medium IQ	Low IQ
Age	1.33 (0.93 to 1.90)	1.46 (0.98 to 2.18)	1.94 (0.97 to 3.88)	2.32 (1.12 to 4.85)	1.74 (1.08 to 2.80)	2.20 (1.33 to 3.64)
+ Early life factors (potential confounders)*	1.31 (0.91 to 1.88)	1.42 (0.94 to 2.14)	2.01 (1.00 to 4.06)	2.48 (1.17 to 5.27)	1.76 (1.09 to 2.84)	2.23 (1.33 to 3.73)
+ Factors in adolescence and adulthood (potential mediators)†	1.06 (0.73 to 1.55)	0.97 (0.62 to 1.50)	1.92 (0.94 to 3.94)	1.98 (0.89 to 4.37)	1.63 (1.00 to 2.65)	1.62 (0.94 to 2.78)

High IQ is the reference in all analyses.
*Childhood socioeconomic position, parent's CVD death at age <65.
†BMI, smoking, risk use of alcohol, systolic blood pressure, occupational class, income, single household and comorbidity/complications.
BMI, body mass index; CHD, coronary heart disease; CVD, cardiovascular diseases.

Table 4 IQ and recurrence among survivors of a first CHD event 1991–2008

Adjusted for	Recurrence up to 2008 (mean 655, median 184 days) N=1923, 902 cases HR (95% CI)		Recurrence up to 2 years (mean 178, median 103 days) N=1702,* 606 cases HR (95% CI)		Analyses restricted to MI, up to 2008 (mean 1329, median 950 days) N=1130, 175 cases HR (95% CI)	
	Medium IQ	Low IQ	Medium IQ	Low IQ	Medium IQ	Low IQ
Ages	1.02 (0.87 to 1.20)	1.14 (0.95 to 1.38)	0.88 (0.72 to 1.07)	1.05 (0.84 to 1.30)	1.04 (0.71 to 1.51)	1.08 (0.71 to 1.63)
+Early life factors (potential confounders)†	1.03 (0.87 to 1.22)	1.16 (0.96 to 1.40)	0.90 (0.74 to 1.10)	1.08 (0.86 to 1.35)	1.05 (0.72 to 1.54)	1.10 (0.72 to 1.68)
+ Factors in adolescence and adulthood (potential mediators)‡	0.98 (0.83 to 1.16)	1.09 (0.89 to 1.34)	0.86 (0.70 to 1.06)	1.05 (0.82 to 1.33)	0.96 (0.65 to 1.43)	0.93 (0.59 to 1.46)

High IQ is the reference in all analyses.
*Intake ended 2006–12–31.
†Childhood socioeconomic position, parent's CVD death at age <65.
‡BMI, smoking, risk use of alcohol, systolic blood pressure, occupational class, income, single household and comorbidity/complications.
BMI, body mass index; CHD, coronary heart disease; CVD, cardiovascular diseases.

DISCUSSION

In this group of Swedish middle-aged men with CHD, we found no association of premorbid intelligence with CHD recurrence. By contrast, the risk of later all-cause and CVD mortality was higher among men with medium or low premorbid IQ compared to men in the highest IQ category, in line with findings in the normal population.[13] These associations were attenuated after adjustment for traditional CVD risk factors, comorbidity, socioeconomic factors and marital status.

Several studies in various cohorts have found associations between intelligence measured early in life and later CVD morbidity, CVD mortality and all-cause mortality in general populations,[2–4 18 19] and we found that the risk for mortality from CVD or all causes increased with decreasing IQ also among middle-aged men with CHD. Yet, we are not aware of any previous studies investigating the role of premorbid intelligence in prognosis after a CHD event. Studies that have included health behaviours in models of the association between intelligence and later morbidity and mortality, such as smoking and alcohol consumption,[20–23] have been inconsistent and at most found little attenuation from these factors, implying that health behaviours are not important mediators. The prognostic value of health literacy, which is related to general intelligence,[24] on adherence to treatment in CVD and other conditions such as diabetes has been inconsistent in review studies.[25 26]

Interpretation of the results

One of the hypotheses often put forward to explain the association of IQ with later morbidity and mortality is via the ability to manage one's own health condition.[27 28] Some have indeed found associations between higher intelligence and health behaviours, for instance quitting smoking,[29 30] having a healthy diet,[31 32] physical exercise[32] and persisting with prescribed medications[6] (but null findings are also reported[33 34]). Gottfredson argues that those with higher intelligence more easily understand and adapt to health messages, and that IQ-related differences in health outcomes should increase rather than attenuate with increasing health information and medical support.[7] Lifestyle interventions and pharmacological treatment are central in secondary prevention of CVD,[35] and differences in adherence to medications can indeed have a rapid impact. In a prospective study on patients with acute MI, non-adherence to medication 1 month after the event was associated with increased mortality within 1 year; even stopping one of three

prescribed medications was associated with an 80–180% higher risk depending on medication type.[36] Intelligence has been found to be associated with medication persistence in a randomised controlled trial among people aged 55–72 with an elevated risk for future CVD (indicated by the ankle brachial index).[6] In a cohort of Danish men, lower IQ measured in adolescence (lowest vs highest tertile) was associated with low persistence with prescribed antihypertensives, defined as not refilling prescriptions for at least a year up to age 54, among the 1571 men obtaining such prescriptions from age 41. Given these previous findings, associations of IQ with medication adherence would be expected to cause differences also between IQ categories in CHD recurrence. Moreover, men in the present study with high IQ at conscription had lower prevalence of smoking and risk use of alcohol, and lower BMI and systolic blood pressure, and more advantageous socioeconomic conditions than men with medium or low IQ.

Despite these differences, there were no differences between IQ levels regarding the risk of a second CHD event during follow-up. One possible explanation is that medical treatment and rehabilitation is given according to patients' needs, which might mitigate inequalities based on individual as well as socioeconomic factors. The attention, care and support given by medical professionals might also outweigh individual differences. Furthermore, this is a relatively young group of men with diagnosed CHD at an early age (41–58) when factors not related to life style, for example genetic factors, might be more influential and thus more difficult for the individual to affect.[37] In addition, a form of selection bias might occur if men with high intelligence developed CHD due to unmeasured factors associated with better or worse prognosis. Such bias can distort causal inference in any study restricted to already sick individuals.[38]

Although we found no differences between IQ levels in regards to recurrence, it is possible that the higher mortality rate among men with medium and low IQ, compared to men with high IQ, reflected a long-term effect of poorer disease management and lower adherence to treatment. Most deaths occurred long after recurrent events of CHD, so there is a time difference between the outcomes. It is also possible that factors that were present already early in life[27 28] that were not captured by the covariates in our data contributed to the long-term differences in mortality between intelligence levels. Factors early in life have been found to predict CVD and mortality later in life.[39 40]

Moreover, lifestyle risk factors such as high BMI and elevated blood pressure in adolescence[4] and socioeconomic factors in adulthood[3 4 19] have been found to partly explain associations of early IQ with CVD and mortality later in life. Here, we found that high BMI, blood pressure and smoking in late adolescence also attenuated the associations of low IQ with case-fatality and long-term mortality after first CHD, along with socioeconomic and social factors measured in middle age. Parent's early death from CVD and socioeconomic position in the men's childhood did not explain the associations, in line with previous findings on associations of intelligence with morbidity and mortality in general populations.[2–4 19]

Strengths and limitations

In this nearly complete cohort of all Swedish men born in 1949–1951, intelligence was measured in adolescence long before CHD developed, which minimised the risk for reverse causation, that is, precursors of CHD affecting cognitive ability. Information on CHD events, comorbid diagnoses, mortality and socioeconomic factors were obtained from national records using the unique identification number held by all citizens, yielding reliable data and a virtually complete follow-up. The study also had a perfect participation rate without self-selection. However, patients who did not stay overnight at the hospital or had a silent event that did not lead to hospitalisation were not recorded in our data, and we had no clinical information on severity of the disease. Moreover, the participants were followed until about 58 years of age when CHD is still quite rare and the number of cases was consequently small, limiting statistical power. Also, the results cannot necessarily be generalised to CHD later in life, to women, or to countries with a dissimilar healthcare system. There is a strong but far from perfect correlation between measures of IQ early and IQ later in life,[41] and, therefore, our exposure may not fully capture IQ during the follow-up. Moreover, those with higher intelligence might have had less severe events, in concordance with the association between intelligence and health. Finally, our adjustment for comorbidities was not perfect since we could adjust only for comorbidities requiring hospitalisations.

What is already known on this subject

▶ Higher intelligence early in life is associated with decreased risk for coronary heart disease (CHD) and mortality but its prognostic importance in patients with CHD is unknown.

▶ Differences in the ability to manage health conditions has been suggested as one explanation for the association between intelligence and health outcomes.

What this study adds

▶ In this cohort of 1923 men, obtaining their first CHD diagnosis in middle age, lower intelligence was associated with all-cause mortality but not with the risk of recurrence.

▶ We found no evidence of intelligence level being an important factor in secondary prevention of CHD.

CONCLUSION

Among middle-aged Swedish men with CHD, premorbid intelligence was not associated with the risk for recurrence. By contrast, lower intelligence was associated with higher case-fatality rate at first event and higher mortality during 17 years of follow-up. Although lower intelligence is a risk factor for morbidity and mortality in a life course perspective, we found no evidence of lower intelligence having a negative effect in secondary prevention of CHD.

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