

Supplementary information

Stress resilience and physical fitness in adolescence and risk of coronary heart disease in middle age

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Methods

Study population

From a total of 284 198 men identified, complete data were available for 237 980 after exclusions for the following criteria: data inconsistencies such as errors in the personal identification number, female sex or uncertain vital status (n=2564); implausible values for height (less than 144 cm), weight (above 178 kg), body mass index, BMI, (below 15), systolic blood pressure (below 50 or above 230 mmHg) and diastolic blood pressure (below 30 or above 135 mmHg) (n=225); emigration, death or a diagnosis of CHD before study entry in 1987 (n=9842); and missing data for stress resilience and potential confounding factors (n=37196; including 2523 men with a diagnosis of CHD at some time).

International Classification of Diseases (ICD) codes

CHD codes used in this study were 410-414 in ICD-8 and ICD-9, and I20-25 in ICD-10. The codes used for acute MI were 410 in ICD-8 and ICD-9, and I21 in ICD 10. For angina pectoris, they were 413 in ICD-8, 413 and 411B in ICD-9, and I20 in ICD-10.

Codes for psychiatric diagnoses at conscription used were 290-299 (psychoses, n=435), 300-309 (neuroses, personality disorders and other nonpsychotic mental disorders, n= 34 503), and 310-315 (mental retardation, n=4 809).

Statistical analysis

To investigate possible interactions between categorically modelled stress resilience and continuously modelled physical fitness, we used the multivariable fractional polynomials interaction (MFPI) algorithm developed by Royston and Sauerbrei, “designed to investigate the interaction of a categorical covariate with a covariate specified by any combination of the fp1(), fp2(), or linear() options”. We considered three models (linear, FP1, and FP2) for

physical fitness in its interaction with resilience, and selected the linear interaction model as the most appropriate.

Royston P, Sauerbrei W. Two techniques for investigating interactions between treatment and continuous in clinical trials. The Stata Journal 2009;2:230-252.

We then tested the significance of the interaction terms using the commonly applied likelihood ratio test (LRT). More specifically, the model was adjusted for the covariates included in Model 2 (table 2) including an interaction term (stress resilience as a categorical variable by physical fitness modelled continuously), including adjustment for the main effects, thus identifying multiplicative interactions.

Kirkwood R, Sterne J. Essential Medical Statistics. Blackwell Science Ltd 2003 Second edition. p 322-330.

Table S1 Risk of coronary heart disease (all CHD) associated with stress resilience, physical fitness, BMI and other characteristics

	Events/N	Unadjusted	Adjusted		
		Model 1 HR (95% CI)	Model 2 HR (95% CI)	Model 3 HR (95% CI)	Model 4 HR (95% CI)
Main exposure:					
Stress resilience					
1.High (7-9)	1972/56 3018	Reference	Reference	Reference	Reference
2.Moderate(4-6)	5666/139 806	1.24(1.18 to 1.30)	1.18(1.12 to 1.25)	1.09(1.02 to 1.15)	1.04(0.98 to 1.09)
3.Low (1-3)	2943/51 688	1.65(1.56 to 1.75)	1.54(1.45 to 1.63)	1.28(1.21 to 1.36)	1.17(1.10 to 1.25)
Potential confounders:					
Parental SEI 1960					
Manual workers	4901/98 884	1.33(1.27 to 1.39)	1.21(1.15 to 1.27)	1.11(1.06 to 1.17)	1.09(1.04 to 1.15)
Agricultural workers	551/9233	1.60(1.46 to 1.75)	1.37(1.24 to 1.50)	1.21(1.10 to 1.33)	1.18(1.07 to 1.30)
Farm owners/managers	910/23 752	1.01(0.94 to 1.09)	0.93(0.86 to 1.00)	0.86(0.79 to 0.83)	0.85(0.79 to 0.92)
Office workers	2445/66 009	Reference	Reference	Reference	Reference
Business/owners managers	1009/25 522	1.06(0.99 to 1.14)	1.02(0.95 to 1.10)	0.99(0.92 to 1.06)	0.97(0.90 to 1.04)
Others /unknown	765/14 580	1.43(1.32 to 1.55)	1.28(1.18 to 1.39)	1.18(1.09 to 1.29)	1.16(1.07 to 1.27)
Household crowding, 1960					
≤ 2 people/room	7780/185 879	Reference	Reference	Reference	Reference
> 2 people/room	2801/52 101	1.29(1.24 to 1.35)	1.17(1.12 to 1.23)	1.12(1.08 to 1.18)	1.12(1.07 to 1.17)
Cognitive function (per unit change, 1-9)		0.88(0.87 to 0.89)		0.91(0.90 to 0.92)	0.91(0.90 to 0.92)
Diastolic bloodpressure (per 1mm Hg change)		1.02(1.01 to 1.02)		1.01(1.01 to 1.02)	1.01(1.01 to 1.01)
Systolic bloodpressure (per 1mm Hg change)		1.01(1.01 to 1.01)		1.01(1.01 to 1.01)	1.01(1.01 to 1.01)
CVD diagnosis					
Yes	107/6631	1.13(1.01 to 1.26)		1.07(0.96 to 1.18)	1.07(0.90 to 1.32)
No	3304/231 248	Reference		Reference	Reference
Mediators:					
Physical fitness (per unit change, 0-9)		0.93(0.92 to 0.94)			0.93(0.92 to 0.94)
Body Mass Index (kg/m2)					
Underweight (<18.49)	1036/27 631	0.88(0.83 to 0.94)			0.78(0.73 to 0.83)
Normal weight (18.5- 24.99)	8136/192 304	Reference			Reference
Overweight (25.0-29.99)	1143/15 614	1.76(1.66 to 1.88)			1.63(1.53 to 1.74)
Obese (>= 30.0)	266/2391	2.79(2.47 to 3.15)			2.23(1.97 to 2.52)

Model 1. Unadjusted.

Model 2. Adjusted for childhood factors (birth year, region, parental SEI and household crowding).

Model 3. Adjusted for 2+ characteristics in adolescence (cognitive function, diastolic and systolic blood pressure and CVD diagnosis at conscription).

Model 4. Adjusted for 2+3+ physical fitness and body mass index in adolescence.

SEI, socioeconomic index; CVD, cardiovascular disease.

Table S2 Risk of coronary heart disease (all CHD) associated with stress resilience, physical fitness and other characteristics, additionally adjusted for psychiatric disease in adolescence

	Events/N	Unadjusted	Adjusted		
		Model 1 HR (95% CI)	Model 2 HR (95% CI)	Model 3 HR (95% CI)	Model 4 HR (95% CI)
Main exposure:					
Stress resilience					
1.High (7-9)	1972/56 3018	Reference	Reference	Reference	Reference
2.Moderate(4-6)	5666/139 806	1.24(1.18 to 1.30)	1.18(1.12 to 1.25)	1.08(1.03 to 1.14)	1.03(0.98 to 1.09)
3.Low (1-3)	2943/51 688	1.65(1.56 to 1.75)	1.54(1.45 to 1.63)	1.18(1.10 to 1.26)	1.08(1.01 to 1.16)
Potential confounders:					
Parental SEI 1960					
Manual workers	4901/98 884	1.33(1.27 to 1.39)	1.21(1.15 to 1.27)	1.11(1.06 to 1.17)	1.09(1.04 to 1.15)
Agricultural workers	551/9233	1.60(1.46 to 1.75)	1.37(1.24 to 1.50)	1.21(1.10 to 1.33)	1.19(1.08 to 1.31)
Farm owners/managers	910/23 752	1.01(0.94 to 1.09)	0.93(0.86 to 1.00)	0.86(0.80 to 0.93)	0.85(0.79 to 0.92)
Office workers	2445/66 009	Reference	Reference	Reference	Reference
Business/owners managers	1009/25 522	1.06(0.99 to 1.14)	1.02(0.95 to 1.10)	0.99(0.92 to 1.06)	0.97(0.90 to 1.04)
Others /unknown	765/14 580	1.43(1.32 to 1.55)	1.28(1.18 to 1.39)	1.18(1.09 to 1.29)	1.16(1.07 to 1.26)
Household crowding, 1960					
≤ 2 people/room	7780/185 879	Reference	Reference	Reference	Reference
> 2 people/room	2801/52 101	1.29(1.24 to 1.35)	1.17(1.12 to 1.23)	1.12(1.07 to 1.17)	1.12(1.07 to 1.17)
Cognitive function					
(per unit change, 1-9)		0.88(0.87 to 0.89)		0.91(0.90 to 0.92)	0.92(0.91 to 0.93)
Diastolic bloodpressure					
(per 1mm Hg change)		1.02(1.01 to 1.02)		1.01(1.01 to 1.01)	1.01(1.01 to 1.01)
Systolic bloodpressure					
(per 1mm Hg change)		1.01(1.01 to 1.01)		1.01(1.01 to 1.01)	1.01(1.01 to 1.01)
CVD diagnosis					
Yes	107/6631	1.13(1.01 to 1.26)		1.07(0.96 to 1.20)	1.07(0.96 to 1.20)
No	3304/231 248	Reference		Reference	Reference
Psychiatric diagnosis					
Yes		1.55(1.47 to 1.63)		1.21(1.14 to 1.28)	1.20(1.13 to 1.27)
No		Reference		Reference	Reference
Mediators:					
Physical fitness					
(per unit change, 0-9)		0.93(0.92 to 0.94)			0.93(0.92 to 0.95)
Body Mass Index (kg/m2)					
Underweight (<18.49)	1036/27 631	0.88(0.83 to 0.94)			0.78(0.73 to 0.83)
Normal weight (18.5-24.99)	8136/192 304	Reference			Reference
Overweight (25.0-29.99)	1143/15 614	1.76(1.66 to 1.88)			1.63(1.53 to 1.74)
Obese (>= 30.0)	266/2391	2.79(2.47 to 3.15)			2.23(1.97 to 2.52)

Model 1. Unadjusted.

Model 2. Adjusted for childhood factors (birth year, region, parental SEI and household crowding).

Model 3. Adjusted for 2+ characteristics in adolescence (cognitive function, diastolic and systolic blood pressure, CVD and psychiatric diagnosis at conscription).

Model 4. Adjusted for 2+3+ physical fitness and body mass index in adolescence.

SEI, socioeconomic index; CVD, cardiovascular disease.

Table S3 Risk of coronary heart disease (all CHD=8940) associated with stress resilience, physical fitness and body mass, excluding men with estimated fitness tests (12%).

	Event rates/ 1000 p-yrs (95% CI)	Unadjusted	Adjusted		
		Model 1 HR (95% CI)	Model 2 HR (95% CI)	Model 3 HR (95% CI)	Model 4 HR (95% CI)
Main exposure:					
Stress resilience					
1.High (7-9)	1.56(1.49 to 1.63)	Reference	Reference	Reference	Reference
2.Moderate(4-6)	1.92(1.87 to 1.98)	1.24(1.18 to 1.30)	1.18(1.12 to 1.25)	1.09(1.02 to 1.15)	1.03(0.97 to 1.09)
3.Low (1-3)	2.49(2.40 to 2.60)	1.65(1.56 to 1.75)	1.54(1.45 to 1.63)	1.28(1.21 to 1.36)	1.14(1.06 to 1.22)
Mediators:					
Physical fitness (per unit change, 0-9)		0.93(0.92 to 0.94)			0.92(0.91 to 0.94)
Body Mass Index (kg/m2)					
Underweight (<18.49)	1.61(1.51 to 1.73)	0.88(0.83 to 0.94)			0.75(0.70 to 0.81)
Normal weight (18.5-24.99)	1.86(1.81 to 1.90)	Reference			Reference
Overweight (25.0-29.99)	3.23(3.03 to 3.44)	1.76(1.66 to 1.88)			1.64(1.53 to 1.76)
Obese (>= 30.0)	5.27(4.61 to 6.03)	2.79(2.47 to 3.15)			2.36(2.06 to 2.72)

Model 1. Unadjusted.

Model 2. Adjusted for childhood factors (birth year, region, parental SEI and household crowding).

Model 3. Adjusted for 2+ characteristics in adolescence (cognitive function, diastolic and systolic blood pressure and CVD diagnosis at conscription).

Model 4. Adjusted for 2+3+ physical fitness and body mass index in adolescence.

SEI, socioeconomic index; CVD, cardiovascular disease.

Table S4 Stress resilience and coronary heart disease (CHD) divided by diagnoses and fatality, additionally adjusted for psychiatric disease in adolescence

	Event rates/ 1000 person-years (95% CI)	Unadjusted Model 1 HR (95% CI)	Adjusted Model 2 HR (95% CI)	Model 3 HR (95% CI)	Model 4 HR (95% CI)
Acute myocardial infarction					
(n=5820)					
Stress resilience					
High 7-9	0.86(0.81 to 0.92)	Reference	Reference	Reference	Reference
Moderate 4-6	1.08(1.04 to 1.12)	1.24(1.16 to 1.33)	1.19(1.11 to 1.27)	1.09(1.02 to 1.72)	1.02(0.95 to 1.10)
Low 1-3	1.44(1.38 to 1.51)	1.68(1.56 to 1.81)	1.56(1.45 to 1.69)	1.21(1.11 to 1.32)	1.09(0.99 to 1.17)
Fatal myocardial infarction					
(n=766)					
Stress resilience					
High 7-9	0.09(0.08 to 0.11)	Reference	Reference	Reference	Reference
Moderate 4-6	0.14(0.13 to 0.15)	1.48(1.20 to 1.81)	1.39(1.13 to 1.71)	1.25(1.01 to 1.54)	1.17(0.954to 1.45)
Low 1-3	0.22(0.19 to 0.25)	2.32(1.86 to 2.89)	2.13(1.71 to 2.66)	1.57(1.22 to 2.02)	1.41(1.08 to 1.83)
Angina pectoris					
(n=6171)					
Stress resilience					
High 7-9	0.92(0.86 to 0.97)	Reference	Reference	Reference	Reference
Moderate 4-6	1.15(1.11 to 1.19)	1.26(1.22 to 1.35)	1.20(1.12 to 1.28)	1.10(1.02 to 1.18)	1.04(0.97 to 1.12)
Low 1-3	1.52(1.45 to 1.59)	1.67(1.56 to 1.80)	1.55(1.44 to 1.67)	1.20(1.10 to 1.31)	1.10(1.01 to 1.21)
Fatal CHD					
(n=1280)					
Stress resilience					
High 7-9	0.17(0.15 to 0.19)	Reference	Reference	Reference	Reference
Moderate 4-6	0.23(0.21 to 0.24)	1.35(1.15 to 1.58)	1.28(1.09 to 1.50)	1.14(0.97to 1.34)	1.10(0.93 to 1.30)
Low 1-3	0.38(0.34 to 0.42)	2.29(1.94 to 2.71)	2.11(1.79 to 2.50)	1.50(1.23 to 1.82)	1.40(1.15 to 1.71)

Model 1. Unadjusted.

Model 2. Adjusted for childhood factors (birth year, region, parental SEI, household crowding).

Model 3. Adjusted for 2+characteristics in adolescence (cognition, systolic and diastolic blood pressure, CVD and psychiatric diagnosis at conscription).

Model 4. Adjusted for 2+3+physical fitness and body mass index in adolescence.

CVD, cardiovascular disease, SEI, socioeconomic index