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Low stress resilience in late adolescence and risk of hypertension in adulthood

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Abstract

Objective—Greater blood pressure reactivity to psychological stress has been associated with higher risk of developing hypertension. We hypothesised that low stress resilience based on psychological assessment early in life is associated with hypertension in adulthood.

Methods—National cohort study of 1 547 182 military conscripts in Sweden during 1969–1997 (97–98% of all 18-year-old males) without prior history of hypertension, who underwent standardised psychological assessment by trained psychologists for stress resilience (1–9 scale), and were followed up for hypertension identified from outpatient and inpatient diagnoses during 1969–2012 (maximum age 62).

Results—93 028 men were diagnosed with hypertension in 39.4 million person-years of follow-up. Adjusting for body mass index (BMI), family history and socioeconomic factors, low stress resilience at age 18 was associated with increased risk of hypertension in adulthood (lowest vs highest quintile: HR 1.43; 95% CI 1.40 to 1.46; $p < 0.001$; incidence rates, 278.7 vs 180.0 per 100 000 person-years), including a strong linear trend across the full range of stress resilience ($p_{\text{trend}} < 0.0001$). We also found a positive additive interaction between stress resilience and BMI ($p < 0.001$), indicating that low stress resilience accounted for more hypertension cases among those with high BMI. Men with a combination of low stress resilience and high BMI had a more than threefold risk of hypertension.

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Conclusions—These findings suggest that low stress resilience may contribute to etiological pathways for hypertension and accounts for more cases among those with high BMI. If confirmed, this knowledge may help inform better preventive interventions by addressing psychosocial risk factors and stress management across the lifespan.

INTRODUCTION

Hypertension currently affects one in three adults and contributes to one in seven deaths in the USA.¹ Globally, hypertension is increasing in prevalence and may affect >1.5 billion people by 2025, related in part to increasing rates of obesity, unhealthy diet and sedentary lifestyle.² Substantial evidence has shown that psychosocial factors also contribute to the development of hypertension. For example, adverse childhood family environment,³ 'type A' behaviour patterns such as time urgency/impatience and hostile attitudes,⁴ chronic financial stress,⁵ anxiety⁶ and depression⁷ have been associated with a higher risk of hypertension. Studies also have reported that greater blood pressure reactivity to psychological stress is associated with subsequent development of hypertension.^{8,9} However, to our knowledge, no studies have examined psychological assessment of stress resilience early in life in relation to hypertension risk in adulthood. Such knowledge may improve our understanding of psychosocial pathways and help inform more effective interventions to prevent hypertension across the lifespan.

We conducted a national cohort study to examine stress resilience in late adolescence in relation to hypertension risk in adulthood. Stress resilience was assessed by standardised psychological assessments of ~1.5 million 18-year-old male military conscripts in Sweden during 1969–1997, who were subsequently followed up to a maximum age of 62 years. Our aim was to determine whether low stress resilience in late adolescence is associated with subsequent development of hypertension in a large national cohort.

METHODS

Study population

We identified 1 547 478 males (age 18 years) who underwent a military conscription examination during 1969–1997. This examination was compulsory for all 18-year-old males nationwide each year except for 2–3% who either were incarcerated or had severe chronic medical conditions or disabilities documented by a physician. We excluded 296 (0.02%) individuals who had a prior diagnosis of hypertension identified from hospital discharge diagnoses. A total of 1 547 182 (>99.9% of the original cohort) remained for inclusion in the study. To ensure confidentiality, all names and national identification numbers were replaced by anonymous serial numbers in adherence to the Personal Data Act (1998:204) and the Act (1995:606) and Ordinance (1995:1060) on Certain Personal Registers.

Stress resilience ascertainment

Stress resilience assessments were obtained from the Swedish Military Conscription Registry, which contains information from a 2-day standardised physical and psychological examination administered annually to all Swedish military conscripts starting in 1969. Stress resilience was assessed using a 20–30 min semi-structured interview administered by trained

psychologists.¹⁰ The overall objective of the interview was to assess the conscript's ability to cope with the psychological requirements of military service, including stress resilience during armed combat. In the interview, the psychologist asked about adjustment problems and conflicts, as well as successes, responsibilities taken on and initiatives shown or experienced in school, work, home or in leisure activities.¹⁰ Emotional stability, social maturity and active/passive interests were rated by the psychologist, who then assigned a summary score on a 'standardised nine' (1–9) scale, which is constructed to have a normal distribution with a mean of 5 and an SD of 2. Consequently, this score had a consistent distribution throughout the study period. A validation study in which 30 recorded interviews from 1972 to 1973 were scored by 30 psychologists reported high inter-rater reliability (correlation 0.86).¹¹ These data have previously been used to examine stress resilience in relation to other outcomes, including coronary heart disease.¹²

Hypertension ascertainment

The study cohort was followed up from the time of the military conscription examination through 31 December 2012 for essential (primary) hypertension, which was identified using International Classification of Diseases (ICD) diagnosis codes (400–401 in ICD-8, 401 in ICD-9 and I10 in ICD-10) in the Swedish Hospital Registry and Swedish Outpatient Registry. The Swedish Hospital Registry contains all primary and secondary hospital discharge diagnoses from six populous counties in southern Sweden starting in 1964, and with nationwide coverage starting in 1987; and the Swedish Outpatient Registry contains outpatient diagnoses from all specialty clinics nationwide starting in 2001. Throughout the study period, the predominant criteria for diagnosis of hypertension were a systolic blood pressure (SBP) ≥ 140 mm Hg and/or diastolic blood pressure (DBP) ≥ 90 mm Hg, based on WHO and European Society of Hypertension/European Society of Cardiology guidelines.^{13,14}

Adjustment variables

Other variables that may be associated with hypertension were obtained from the Swedish Military Conscription Registry and national census data, which were linked using an anonymous personal identification number. The association between stress resilience and hypertension was adjusted for the following variables: year of the military conscription examination (modelled simultaneously as a continuous and categorical (1969–1979, 1980–1989, 1990–1997) variable to account for a potential non-linear effect); body mass index (BMI=[weight in kg]/[height in m]²; modelled simultaneously as a continuous and categorical variable to account for a potential non-linear effect, using Centers for Disease Control and Prevention (CDC) definitions for children and adolescents aged 2–19 years to facilitate comparability with US studies: 'overweight or obese' is defined as ≥ 85 th percentile on the CDC's 2000 sex-specific BMI-for-age growth charts, which corresponds to BMI ≥ 25.6 for 18-year-old males¹⁵); type 2 diabetes (identified using ICD-9 code 250 (excluding 250.X1 and 250.X3) during 1987–1996, and ICD-10 code E11 during 1997–2012, and modelled as a time-dependent variable); family history of hypertension in a parent or sibling (identified from medical diagnoses in the Swedish Hospital Registry during 1964–2012 and the Swedish Outpatient Registry during 2001–2012, using the same hypertension ICD codes as above plus ICD-7 codes 444–445 from 1964 to 1968; examined in any parent

or sibling, and further stratified as hypertension in only one parent, both parents or any sibling); highest education level attained during the study period (<12, 12–14 and 15 years); and neighbourhood socioeconomic status at baseline (SES, included because neighbourhood SES characteristics have been associated with psychosocial stress¹⁶ and hypertension;¹⁷ comprised of an index that includes low education level, low income, unemployment and social welfare receipt, as previously described;¹⁸ and categorised as low (>1 SD below the mean), medium (within 1 SD from the mean) or high (>1 SD above the mean)).

Missing data for each variable were imputed using a standard multiple imputation procedure that included all covariates, the outcome (hypertension) and the Nelson–Aalen estimate of the cumulative hazard in the imputation model.¹⁹ Missing data were relatively infrequent for stress resilience (7.2%), BMI (7.2%), education level (0.4%) and neighbourhood SES (9.1%). Data were complete for all other variables. As an alternative to multiple imputation, sensitivity analyses were performed after restricting to individuals with complete data for all variables (N=1 327 760; 86.5%).

Statistical analysis

Cox proportional hazards regression was used to compute HRs and 95% CIs for the association between stress resilience and subsequent risk of hypertension. The Cox model time scale was elapsed time since the military conscription examination (which also corresponds to attained age because baseline age was the same (18 years) for all conscripts). Individuals were censored at emigration (n=85 131; 5.5%) or death (n=58 171; 3.8%). Stress resilience was modelled alternatively as a categorical variable (1–9) or an ordinal variable to test for trend. In the first set of models, stress resilience and each covariate was modelled separately in relation to hypertension, adjusted for year of the military conscription examination. A second (fully adjusted) model included stress resilience, year of the military conscription examination, BMI, type 2 diabetes, family history of hypertension, education level and neighbourhood SES (as defined above). The proportional hazards assumption was assessed by graphical examination of log–log plots and was met in all models.

Interactions between stress resilience and BMI were examined on either the additive or multiplicative scale in relation to hypertension risk. Additive interactions were assessed using the ‘relative excess risk due to interaction’ (RERI), which is computed for binary variables as: $RERI_{HR} = HR_{11} - HR_{10} - HR_{01} + 1$.²⁰ Multiplicative interactions were assessed using the ratio of HRs: $HR_{11}/(HR_{10} \times HR_{01})$. All statistical tests were two-sided and used an α -level of 0.05. All analyses were conducted using Stata V.14.1.

RESULTS

Among the 1 547 182 men in this cohort, 93 028 (6.0%) were subsequently diagnosed with hypertension in 39.4 million person-years of follow-up (mean follow-up 25.7 years). The median age at the end of follow-up was 47.2 years (mean 47.4, SD 7.9, range 19.0–62.0). The median age at diagnosis of hypertension was 49.8 years (mean 48.5, SD 7.2, range 18.0–62.0).

Stress resilience

Low stress resilience was associated with subsequent increased risk of hypertension (table 1). In the fully adjusted model, men in the lowest quintile of stress resilience had more than a 40% increased risk of developing hypertension relative to those in the highest quintile (HR 1.43; 95% CI 1.40 to 1.46; $p < 0.001$; incidence rates, 278.7 vs 180.0 per 100 000 person-years). There was a highly significant linear trend in hypertension risk across the full range of stress resilience ($p_{\text{trend}} < 0.0001$). The small difference in risk estimates between adjusted models 1 and 2 was explained almost entirely by adjusting for education, whereas other adjustment variables made little difference (table 1). Figure 1 shows the fully adjusted HRs and 95% CIs for hypertension across the full range of stress resilience, modelled as a continuous variable using cubic spline curves. A relatively steep slope of increasing risk of hypertension is seen for men with below-average stress resilience relative to average. Figure 2 shows the absolute incidence rates for hypertension (per 100 000 person-years) by stress resilience level (continuous variable using cubic spline curves).

Other risk factors

High BMI and type 2 diabetes were independent risk factors for subsequent development of hypertension. In the fully adjusted model, overweight/obesity (85th percentile on the CDC's 2000 sex-specific BMI-for-age growth chart) and type 2 diabetes were each associated with more than a 2.5-fold risk of hypertension. A first-degree family history of hypertension was associated with more than a 1.5-fold risk of developing hypertension, with a positive gradient by whether there was a history of hypertension in only one parent, both parents or a sibling (table 1). High education level and high neighbourhood SES were associated with lower risk of hypertension ($p_{\text{trend}} < 0.0001$). In a sensitivity analysis that was restricted to men with no missing data, all risk estimates were very similar to the main results (data not shown).

Interaction between stress resilience and BMI

The joint effects of stress resilience and BMI in relation to hypertension risk are shown in table 2. Low stress resilience was associated with increased risk of hypertension among men with either normal or high BMI (HRs 1.38 and 1.31, respectively; table 2, right-most column). Men with a combination of low stress resilience and high BMI had the highest risk of hypertension, which was more than threefold relative to the reference group who had high stress resilience and normal BMI (HR 3.46; 95% CI 3.33 to 3.59). The interaction between low stress resilience and high BMI was non-significant on the multiplicative scale, but was highly significant on the additive scale ($p < 0.001$), indicating that low stress resilience was associated with more hypertension cases among men with high BMI. If this association is causal, interventions to improve stress resilience would have the largest public health impact on preventing hypertension among those with high BMI.

DISCUSSION

In this large national cohort study, we found that low stress resilience in 18-year-old males was associated with increased risk of developing hypertension in adulthood, independently of BMI at baseline, diabetes, family history of hypertension and socioeconomic factors.

These findings suggest that low stress resilience may play an important long-term role in etiological pathways for hypertension. If confirmed, this knowledge may help inform preventive interventions by better addressing psychosocial risk factors and stress management.

Previous smaller studies have suggested that blood pressure reactivity to various psychological stressors is associated with subsequent higher risk of hypertension.^{8,9} A meta-analysis of six cohort studies with a total of 34 556 adults and median follow-up of 11.5 years found that those with greater blood pressure reactivity to psychological stressor tasks had a 21% higher odds of developing hypertension or a significant increase in baseline blood pressure compared with those with low reactivity (OR 1.21; 95% CI 1.14 to 1.28; $p < 0.001$).²¹ Studies that have examined chronic stress exposures rather than cardiovascular reactivity to stress also have supported a psychosocial component in the development of hypertension. For example, a US cohort study of 2739 young adults reported that adverse childhood family environment was associated with negative emotions that predicted subsequent increases in SBP.³ In an overlapping cohort of 3308 young adults, 'type A' behaviours including time urgency/impatience and hostile attitudes were strongly associated with increased hypertension risk in a dose-response manner.⁴ A UK study of 160 middle-aged adults with 3 years of follow-up reported that chronic financial stress was associated with subsequent higher baseline SBP.⁵ A Swedish study of 237 980 military conscripts (a subset of the present study cohort) found that low stress resilience was associated with a modestly increased risk of coronary heart disease, but did not examine hypertension or other risk factors for heart disease.¹²

High BMI and type 2 diabetes were the strongest risk factors for hypertension in the present study. The ~2.5-fold risk of hypertension that we observed among overweight or obese males is consistent with previously reported estimates for adult men or women.²² The ~1.5-fold risk we observed among those with a family history of hypertension and an inverse relationship between education level and hypertension risk also were in agreement with previous findings.²³ In addition, we found that low neighbourhood SES was associated with higher risk of hypertension, consistent with previously reported associations between neighbourhood deprivation characteristics such as poor walkability, availability of healthy foods, safety or social cohesion and hypertension risk.¹⁷

The mechanisms by which low stress resilience may contribute to the development of hypertension are complex and likely involve both physiological and behavioural factors. According to the 'reactivity hypothesis', exaggerated blood pressure responses to psychological stress may cause arterial damage and dysfunction over time, leading to the development of hypertension and cardiovascular disease.²⁴ Previous studies have found that blood pressure reactivity to psychological stress in children, adolescents or adults predicts future baseline blood pressure and cardiovascular disease risk.^{8,9,25} Exaggerated blood pressure responses to psychological stress may originate at the cognitive-emotional level in how events are consciously evaluated, the hypothalamic or brainstem level causing greater physiological response even with normal psychological input or the peripheral level through altered tissue function.²⁴ Abnormal responses at any of these levels may cause exaggerated blood pressure increases and resultant shear stress, eventually altering arterial structure and

function. High SBP reactivity to psychological stress tasks, for example, has been associated with increased carotid artery intima-media thickness in youth.²⁶ In addition to these pathways, low stress resilience may contribute to unhealthy lifestyle behaviours that are known risk factors for hypertension. A Danish cohort study of 7066 adults with 10 years of follow-up found that self-reported perceived stress was associated with subsequent physical inactivity, unsuccessful smoking cessation or alcohol reduction, and use of antihypertensive medications.²⁷ Stress-related disorders such as anxiety⁶ and depression⁷ also are associated with physical inactivity, unhealthy diet and smoking, which are established risk factors for hypertension.²⁸

The present study provides further evidence that interventions to prevent hypertension should address psychosocial and stress-related factors. Moreover, we found that such interventions are likely to have the largest public health impact among persons with high BMI. Most stress reduction programmes have focused on treatment rather than prevention of hypertension, with mixed results. A systematic review of seven meta-analyses found that stress reduction programmes yield reliable decreases in SBP of 6–10 mm Hg and slightly larger reductions for multicomponent interventions.²⁹ The most effective psychological treatments were reported to yield the same reductions in SBP (but not DBP) as commonly used antihypertensive medications.²⁹ However, a later meta-analysis of 17 trials with 960 participants reported that meditation interventions but not stress management programmes resulted in significant blood pressure reductions.³⁰ Additional studies of stress reduction for the prevention of hypertension are warranted, particularly in high-risk groups such as persons with high BMI.

Strengths of the present study include its large national cohort design with prospective assessment of stress resilience in late adolescence and sufficient follow-up to examine hypertension in adulthood. Prospective ascertainment of the exposure and outcome prevented bias that may result from self-reporting. Stress resilience was assessed using systematic interviews by trained psychologists with high inter-rater reliability. We were able to adjust for other established risk factors for hypertension, including BMI, diabetes, family history of hypertension, and individual and neighbourhood socioeconomic factors, which also were prospectively ascertained and not self-reported.

Limitations included a lack of information for certain other risk factors for hypertension, such as smoking and diet. This cohort consisted of Swedish military conscripts, and therefore included only men. However, a smaller Danish cohort study reported that perceived stress was associated with subsequent antihypertensive medication use among men and women, without gender differences.²⁷ Outpatient diagnoses in the present study were available starting in 2001, and hence hypertension prior to this period was under-reported. This under-reporting is expected to be non-differential with respect to stress resilience level, and therefore to influence results conservatively (ie, towards the null hypothesis).

In summary, this large national cohort study examined stress resilience in 18-year-old males in relation to hypertension risk in adulthood. We found that low stress resilience was associated with higher risk of developing hypertension and accounted for more cases among

those with high BMI. These findings suggest that stress resilience may play an important long-term role in etiological pathways for hypertension. If confirmed, this knowledge may help inform more effective preventive interventions by better addressing psychosocial risk factors and stress management across the lifespan.

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Key messages**What is already known on this subject?**

Greater blood pressure reactivity to psychological stress has been associated with higher risk of developing hypertension. However, no studies have examined psychological assessment of stress resilience early in life in relation to hypertension risk in adulthood.

What might this study add?

In a large national cohort, we found that low stress resilience in late adolescence was associated with higher risk of developing hypertension in adulthood, independently of body mass index, family history of hypertension and socioeconomic factors.

How might this impact on clinical practice?

These findings suggest that low stress resilience may play an important long-term role in etiological pathways for hypertension. If confirmed, this knowledge may help inform more effective preventive interventions by addressing psychosocial risk factors and stress management across the lifespan.

Figure 1.

Adjusted HRs and 95% CIs for association between stress resilience in 18-year-old males and subsequent risk of hypertension (adjusted for year of military conscription examination, body mass index, type 2 diabetes, family history of hypertension, education and neighbourhood socioeconomic status).

Figure 2. Hypertension incidence rates in adult men (median attained age 47 years, maximum 62) by stress resilience at age 18 years.

Adjusted HRs for associations between stress resilience or other factors among 18-year-old males and subsequent risk of hypertension

Table 1

	Hypertension		Adjusted model 1*			Adjusted model 2†		
	No (N=1 454 154)	Yes (N=93 028)	HR	95% CI	p Value	HR	95% CI	p Value
Stress resilience								
1 (lowest)	29 170 (2.0)	2551 (2.7)	1.30	1.25 to 1.35	<0.001	1.23	1.18 to 1.28	<0.001
2	79 783 (5.5)	6250 (6.7)	1.22	1.18 to 1.25	<0.001	1.18	1.14 to 1.21	<0.001
3	160 596 (11.0)	13 215 (14.2)	1.21	1.18 to 1.23	<0.001	1.15	1.12 to 1.18	<0.001
4	266 016 (18.3)	18 390 (19.8)	1.10	1.08 to 1.12	<0.001	1.08	1.06 to 1.10	<0.001
5 (reference)	373 074 (25.7)	23 760 (23.5)	1.00			1.00		
6	252 402 (17.4)	13 303 (14.3)	0.86	0.84 to 0.88	<0.001	0.87	0.85 to 0.89	<0.001
7	185 213 (12.7)	9330 (10.0)	0.81	0.79 to 0.79	<0.001	0.84	0.82 to 0.86	<0.001
8	83 763 (5.8)	4670 (5.0)	0.82	0.80 to 0.85	<0.001	0.86	0.84 to 0.89	<0.001
9 (highest)	24 137 (1.7)	1559 (1.7)	0.84	0.79 to 0.88	<0.001	0.86	0.82 to 0.91	<0.001
Per higher category (trend)			0.92	0.92 to 0.93	<0.001	0.94	0.93 to 0.94	<0.001
Lowest vs highest quintile			1.53	1.50 to 1.57	<0.001	1.43	1.40 to 1.46	<0.001
BMI‡								
Normal	1 347 242 (92.6)	80 030 (86.0)	1.00			1.00		
Overweight or obese	106 912 (7.4)	12 998 (14.0)	2.67	2.62 to 2.72	<0.001	2.54	2.49 to 2.59	<0.001
Per 1 BMI unit (trend)			1.08	1.07 to 1.08	<0.001	1.08	1.07 to 1.08	<0.001
Type 2 diabetes								
No	1 430 186 (98.4)	82 346 (88.5)	1.00			1.00		
Yes	23 968 (1.6)	10 682 (11.5)	3.33	2.99 to 3.72	<0.001	2.76	2.48 to 3.08	<0.001
Family history of hypertension								
No	742 697 (51.1)	32 607 (35.1)	1.00			1.00		
Yes	711 457 (48.9)	60 421 (64.9)	1.60	1.57 to 1.62	<0.001	1.58	1.56 to 1.60	<0.001
Only one parent	528 142 (36.3)	38 939 (41.9)	1.13	1.12 to 1.15	<0.001	1.13	1.11 to 1.14	<0.001
Both parents	108 982 (7.5)	11 943 (12.8)	1.52	1.49 to 1.55	<0.001	1.50	1.47 to 1.53	<0.001
Sibling	103 959 (7.1)	14 512 (15.6)	1.95	1.92 to 1.99	<0.001	1.93	1.89 to 1.96	<0.001
Education (years)								
<12	215 583 (14.8)	21 196 (22.8)	1.10	1.08 to 1.11	0.04	1.05	1.03 to 1.06	0.001

	Hypertension		Adjusted model 1 [*]			Adjusted model 2 [‡]		
	No (N=1 454 154)	Yes (N=93 028)	HR	95% CI	p Value	HR	95% CI	p Value
12-14	642 388 (44.2)	41 096 (44.2)	1.00			1.00		
≥15	596 183 (41.0)	30 736 (33.0)	0.76	0.75 to 0.77	<0.001	0.84	0.83 to 0.86	<0.001
Per higher category (trend)			0.83	0.82 to 0.83	<0.001	0.89	0.89 to 0.90	<0.001
Neighbourhood SES								
Low	222 647 (15.3)	16 705 (18.0)	1.06	1.04 to 1.08	<0.001	1.02	1.01 to 1.04	0.006
Medium	957 958 (65.9)	64 072 (68.9)	1.00			1.00		
High	273 549 (18.8)	12 251 (13.2)	0.86	0.84 to 0.87	<0.001	0.92	0.90 to 0.94	<0.001
Per higher category (trend)			0.90	0.89 to 0.91	<0.001	0.95	0.94 to 0.96	<0.001

* Each variable was modelled separately in relation to hypertension, adjusted for year of military conscription examination.

[‡] The model included year of military conscription examination, stress resilience, BMI, type 2 diabetes, family history of hypertension, education and neighbourhood SES. All reported risk estimates were obtained by modelling the respective variable alternatively as a categorical variable (with reference category indicated by HR of 1.00) or continuous variable (for trend tests).

[‡] BMI was categorised using CDC definitions for children and adolescents aged 2–19 years: ‘overweight or obesity’ is defined as 85th percentile on the CDC’s 2000 sex-specific BMI-for-age growth charts, which corresponds to BMI 25.6 for 18-year-old males.

BMI, body mass index; CDC, Centers for Disease Control and Prevention; SES, socioeconomic status.

Table 2
Interactions between stress resilience and body mass index (BMI) among 18-year-old males in relation to subsequent risk of hypertension

	Stress resilience						HRs (95% CI) for medium stress resilience within strata of BMI	HRs (95% CI) for low stress resilience within strata of BMI
	High (levels 7–9)		Medium (levels 4 –6)		Low (levels 1– 3)			
	No. of cases/total	HR (95% CI)	No. of cases/total	HR (95% CI)	No. of cases/total	HR (95% CI)		
<i>BMI</i>								
Normal	13 557/289 138	1.00	45 300/848 871	1.12 (1.10 to 1.14); p<0.001	21 173/289 263	1.38 (1.35 to 1.41); p<0.001	1.12 (1.10 to 1.14); p<0.001	1.38 (1.35 to 1.41); p<0.001
Overweight or obese	1994/17 140	2.64 (2.52 to 2.76); p<0.001	7338/71 349	2.85 (2.76 to 2.93); p<0.001	3666/29 427	3.46 (3.33 to 3.59); p<0.001	1.08 (1.03 to 1.13); p=0.004	1.31 (1.24 to 1.38); p<0.001
HRs (95% CI) for BMI within strata of stress resilience		2.64 (2.52 to 2.76); p<0.001		2.54 (2.48 to 2.60); p<0.001		2.51 (2.42 to 2.60); p<0.001		
Interaction on additive scale: RERI (95% CI)			0.09 (–0.05 to 0.22); p=0.20		0.44 (0.28 to 0.61); p<0.001			
Interaction on multiplicative scale: HR ratio (95% CI)			0.96 (0.91 to 1.01); p=0.16		0.95 (0.90 to 1.01); p=0.08			

HRs are adjusted for year of the military conscription examination, type 2 diabetes, family history of hypertension, education and neighbourhood SES.

RERI, relative excess risk due to interaction; SES, socioeconomic status.