

Online Supplement

Social isolation and loneliness as risk factors for myocardial infarction, stroke, and mortality:

UK Biobank cohort study of 479,054 men and women

Online Supplement Appendix

eTable 1. Descriptive characteristics of the study sample (isolated vs. non-isolated individuals)

eTable 2. Descriptive characteristics of the study sample (lonely vs. non-lonely)

eTable 3. Frequencies of complete and imputed variables

eFigure 1. Proportions of the loneliness-mortality after AMI or stroke excess risk mediated by biological, behavioural, socioeconomic, and health related factors. PERM = Percentage of Excess Risk Mediated.

eFigure 2. Age, sex, and ethnicity adjusted associations between social isolation and loneliness with AMI incidence among sub-groups.

eFigure 3. Age, sex, and ethnicity adjusted associations between social isolation and loneliness with stroke incidence among sub-groups.

eFigure 4. Complete case associations between social isolation with AMI and stroke.

eFigure 5. Complete case associations between social isolation with AMI and stroke.

efigure 6. Proportions of the single loneliness item (“Do you feel lonely?”)-AMI and stroke excess risk mediated by biological, behavioral, socioeconomic, and health related factors. PERM = Percentage of Excess Risk Mediated.

Online Supplement

eTable 1. Descriptive characteristics of the study sample (isolated vs. non-isolated individuals)

		Socially isolated	Not socially isolated	
		Mean (SD) or N (%)	Mean (SD) or N (%)	P-value ¹
Age (years)		56.4 (7.83)	56.34 (8.11)	0.16
Sex				<0.001
	Women	22443 (53 %)	238443 (56 %)	
	Men	20152 (47 %)	189266 (44 %)	
Ethnicity				<0.001
	Nonwhite	3038 (7 %)	21310 (5 %)	
	White	39557 (93 %)	406399 (95 %)	
Deprivation index		0.01 (3.49)	-1.5 (2.97)	<0.001
Education				<0.001
	No secondary education	9680 (23 %)	67222 (16 %)	
	Secondary education	19515 (46 %)	214441 (51 %)	
	University degree	12890 (31 %)	142586 (34 %)	
Household income				<0.001
	Less than 31000 £	15711 (42 %)	73417 (20 %)	
	£18,000 to £29,999	9420 (25 %)	93595 (25 %)	
	£30,000 to £51,999	6982 (19 %)	100364 (27 %)	
	£52,000 to £100,000	4127 (11 %)	80282 (22 %)	
	greater than £100,000	979 (3 %)	21536 (6 %)	
Chronic illness				<0.001
	No	17545 (43 %)	216035 (52 %)	
	Yes	23310 (57 %)	199680 (48 %)	
Loneliness				<0.001
	No	33880 (84 %)	386959 (95 %)	
	Yes	6281 (16 %)	21365 (5 %)	
Body-mass index (kg ² /m)		27.74 (5.38)	27.3 (4.68)	<0.001
Diastolic blood pressure (mm Hg)		82.77 (10.4)	82.26 (10.09)	<0.001
Systolic blood pressure (mm Hg)		137.89 (18.73)	137.8 (18.63)	0.38
Handgrip strength (kg)		29.86 (11)	30.65 (11.01)	<0.001
Smoker				<0.001

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	No	34605 (82 %)	385786 (90 %)	
	Yes	7790 (18 %)	40556 (10 %)	
Ex-smoker				<0.001
	No	28639 (68 %)	279932 (66 %)	
	Yes	13756 (32 %)	146410 (34 %)	
Alcohol				<0.001
	Twice or less per week	28757 (68 %)	235348 (55 %)	
	At least three times per week	13767 (32 %)	192118 (45 %)	
Moderate physical ²		3.24 (2.51)	3.63 (2.31)	<0.001
Vigorous physical ²		1.46 (2.05)	1.91 (1.93)	<0.001
Depressed mood (range 1-4)		1.47 (0.79)	1.27 (0.58)	<0.001
Unenthusiasm / disinterest (range 1-4)		1.46 (0.78)	1.25 (0.57)	<0.001
Tenseness / restlessness (range 1-4)		1.44 (0.74)	1.3 (0.58)	<0.001
Tiredness / lethargy (range 1-4)		1.88 (0.95)	1.66 (0.8)	<0.001
AMI		693 (1.6 %)	4874 (1.1%)	<0.001
Stroke		403 (1.0 %)	2971 (0.7%)	<0.001
Died after AMI		144 (21 %)	718 (14.7 %)	<0.001
Died after Stroke		132 (33 %)	688 (23.2 %)	<0.001

¹P-values were calculated using Student's t-test for continuous variables and Pearson's chi-squared test for categorical variables

²Number of days per week of physical activity lasting more than 10 min

Online Supplement

eTable 2. Descriptive characteristics of the study sample (lonely vs. non-lonely)

		Lonely	Not lonely	
		Mean (SD) or N (%)	Mean (SD) or N (%)	P-value
Age (years)		55.68 (7.97)	56.38 (8.09)	<0.001
Sex				<0.001
	Women	15297 (54 %)	238878 (56 %)	
	Men	13216 (46 %)	189844 (44 %)	
Ethnicity				<0.001
	Nonwhite	2055 (7 %)	19690 (5 %)	
	White	26458 (93 %)	409032 (95 %)	
Deprivation index		-0.46 (3.42)	-1.43 (3.01)	<0.001
Education				<0.001
	No secondary education	6351 (23 %)	66970 (16 %)	
	Secondary education	14447 (52 %)	211330 (50 %)	
	University degree	7141 (26 %)	143637 (34 %)	
Household income				<0.001
	Less than 31000 £	8672 (36 %)	76109 (21 %)	
	£18,000 to £29,999	6315 (26 %)	92678 (25 %)	
	£30,000 to £51,999	5280 (22 %)	98725 (27 %)	
	£52,000 to £100,000	3140 (13 %)	79261 (22 %)	
	greater than £100,000	624 (3 %)	21512 (6 %)	
Chronic illness				<0.001
	No	11180 (41 %)	216600 (52 %)	
	Yes	16004 (59 %)	201230 (48 %)	
Social isolation				<0.001
	No	21365 (77 %)	386959 (92 %)	
	Yes	6281 (23 %)	33880 (8 %)	
Body-mass index (kg ² /m)		28.19 (5.37)	27.28 (4.7)	<0.001
Diastolic blood pressure (mm Hg)		82.3 (10.37)	82.27 (10.11)	0.63
Systolic blood pressure (mm Hg)		136.57 (18.33)	137.83 (18.66)	<0.001
Handgrip strength (kg)		29.64 (11.21)	30.66 (10.99)	<0.001
Smoker				<0.001

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	No	23542 (83 %)	385114 (90 %)	
	Yes	4843 (17 %)	42311 (10 %)	
Ex-smoker				<0.001
	No	19058 (67 %)	280562 (66 %)	
	Yes	9327 (33 %)	146863 (34 %)	
Alcohol				<0.001
	Twice or less per week	18416 (65 %)	237473 (55 %)	
	At least three times per week	10060 (35 %)	191028 (45 %)	
Moderate physical ²		3.37 (2.44)	3.61 (2.32)	<0.001
Vigorous physical ²		1.69 (2.02)	1.88 (1.94)	<0.001
Depressed mood (range 1-4)		1.93 (0.93)	1.25 (0.55)	<0.001
Unenthusiasm / disinterest (range 1-4)		1.85 (0.91)	1.23 (0.55)	<0.001
Tenseness / restlessness (range 1-4)		1.81 (0.89)	1.28 (0.57)	<0.001
Tiredness / lethargy (range 1-4)		2.24 (1.01)	1.64 (0.79)	<0.001
AMI		465 (1.6 %)	4965 (1.2 %)	<0.001
Stroke		257 (0.9 %)	3030 (0.7 %)	<0.001
Died after AMI		81 (17.4 %)	770 (15.5 %)	0.28
Died after Stroke		67 (26.1 %)	720 (23.8 %)	0.41

¹P-values were calculated using Student's t-test for continuous variables and Pearson's chi-squared test for categorical variables

²Number of days per week of physical activity lasting more than 10 min

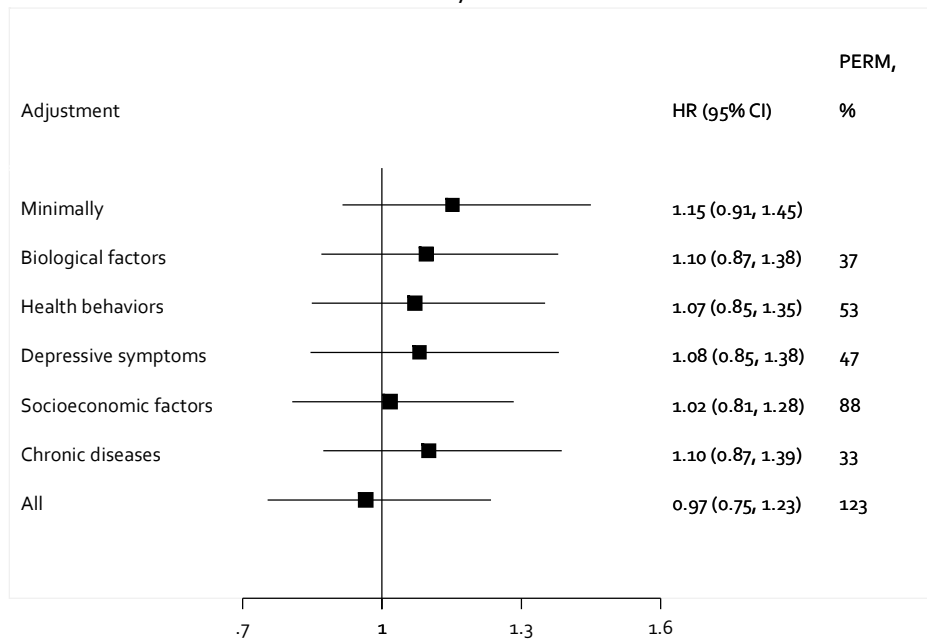
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eTable 3. Frequencies of complete and imputed variables

Variable	Complete	Imputed	Total
BMI (kg/m ²)	476665	2389	479054
Diastolic BP (mm Hg)	450811	28243	479054
Systolic BP (mm Hg)	450806	28248	479054
Handgrip strength (kg)	477230	1824	479054
Moderate physical	455217	23837	479054
Vigorous physical	455072	23982	479054
Education	471012	8042	479054
Annual household income	408263	70791	479054
Depressed mood	457846	21208	479054
Unenthusiasm / disinterest	462112	16942	479054
Tenseness / restlessness	459829	19225	479054
Tiredness / lethargy	464264	14790	479054
Social isolation	470304	8750	479054
Loneliness	457235	21819	479054
Feeling lonely -item	471481	7573	479054
Smoker	477384	1670	479054
Ex-Smoker	477384	1670	479054
Alcohol intake frequency	478705	349	479054
Chronic illness	464781	14273	479054
Deprivation Index	478452	602	479054

Loneliness

Mortality after AMI



Mortality after stroke

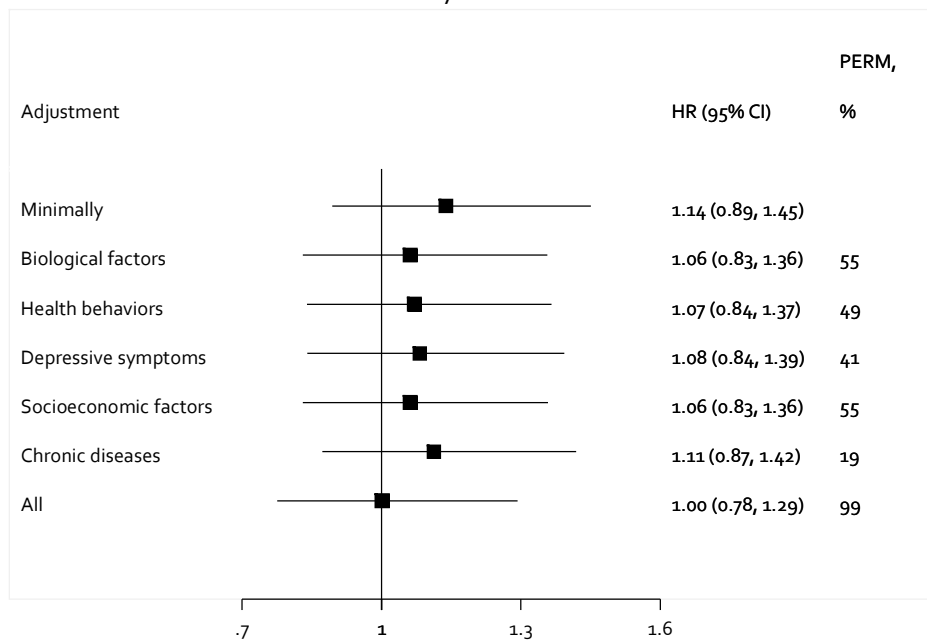
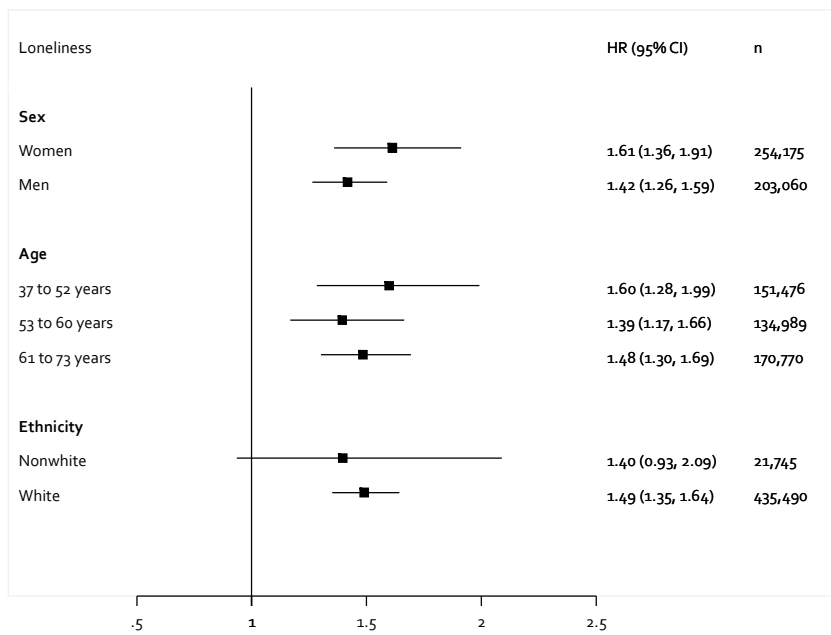
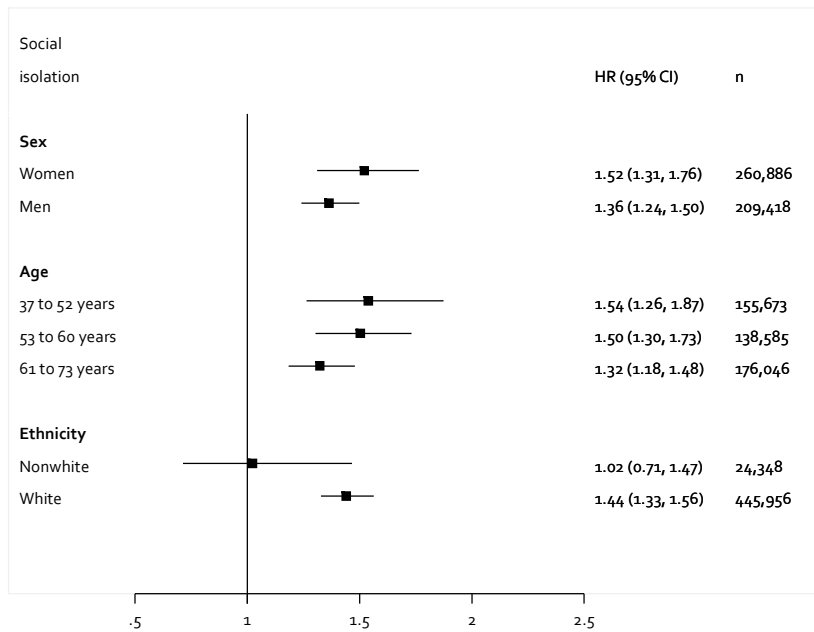


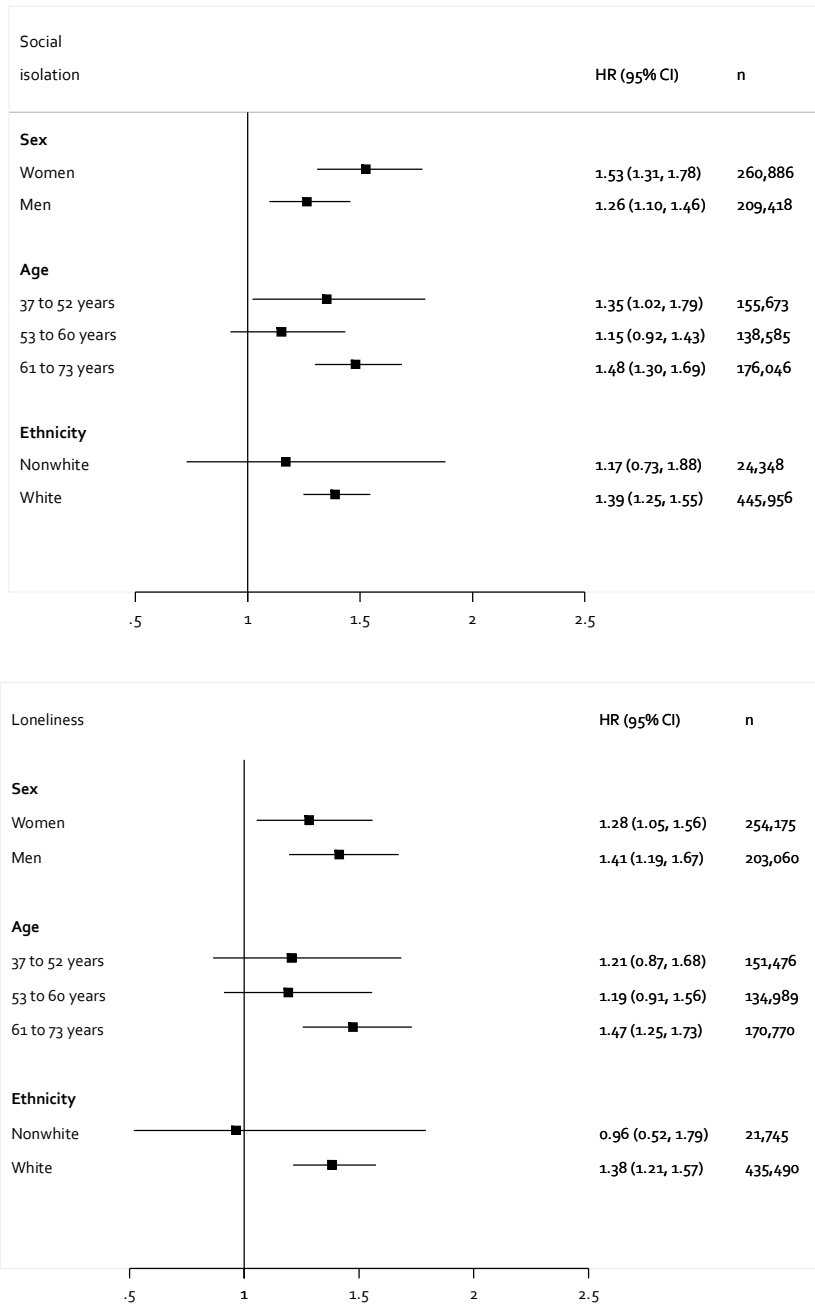
Figure 1. Proportions of the loneliness-mortality after AMI or stroke excess risk mediated by biological, behavioural, socioeconomic, and health related factors. PERM = Percentage of Excess Risk Mediated.

AMI



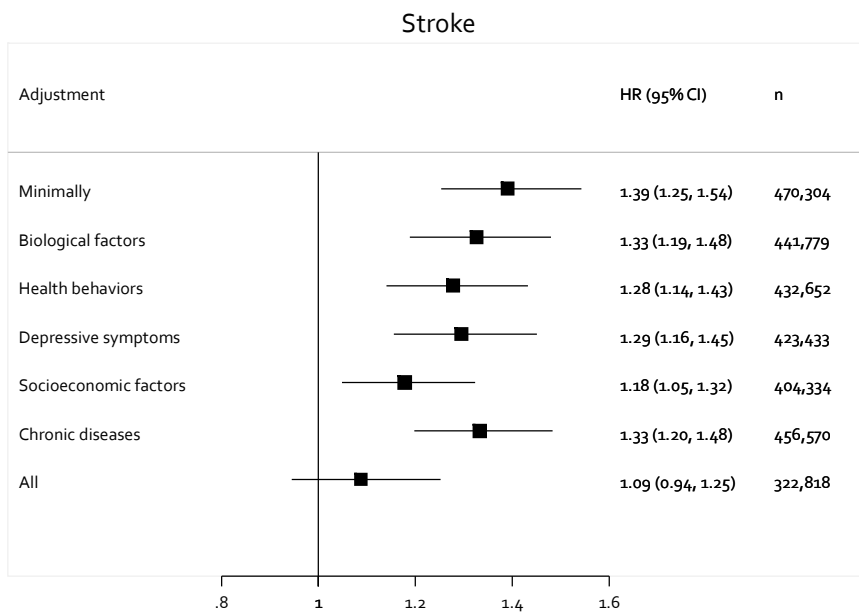
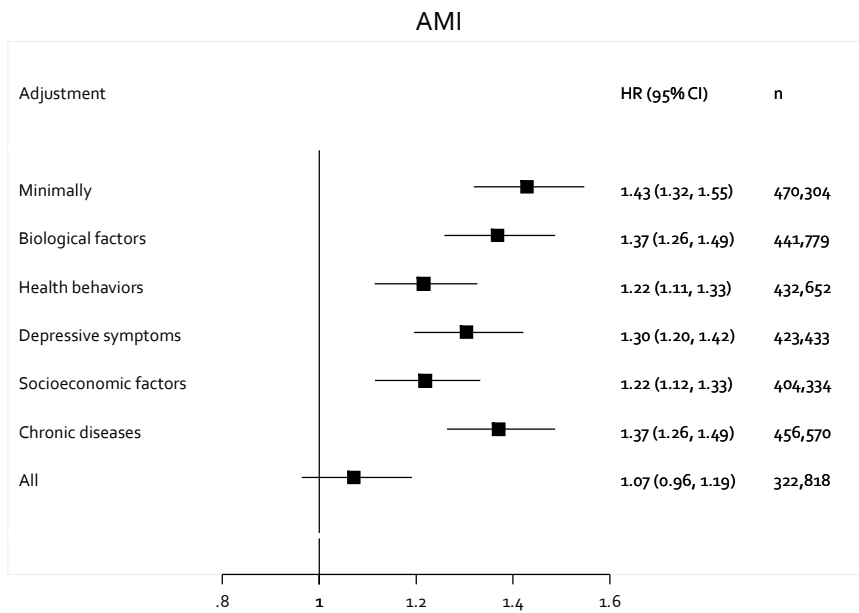
eFigure 2. Age, sex, and ethnicity adjusted associations between social isolation and loneliness with AMI incidence among sub-groups.

Stroke



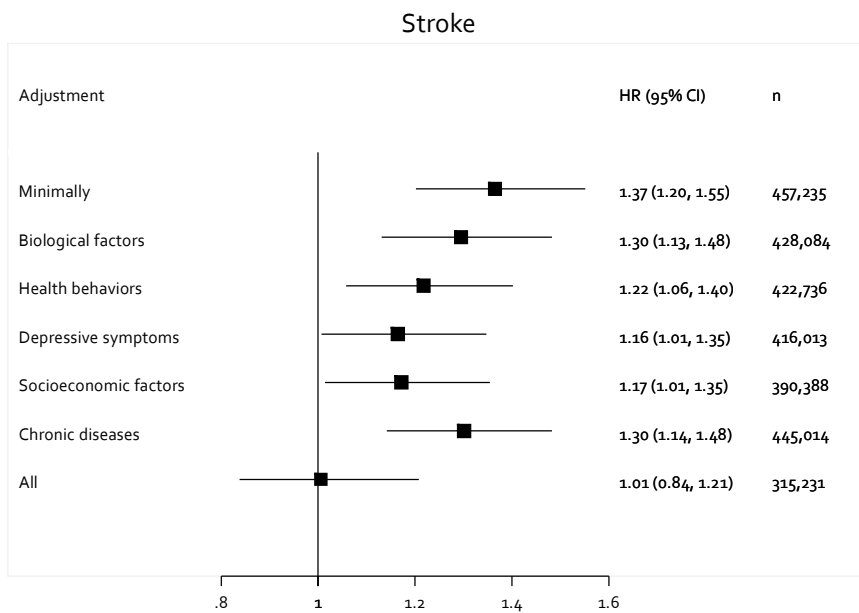
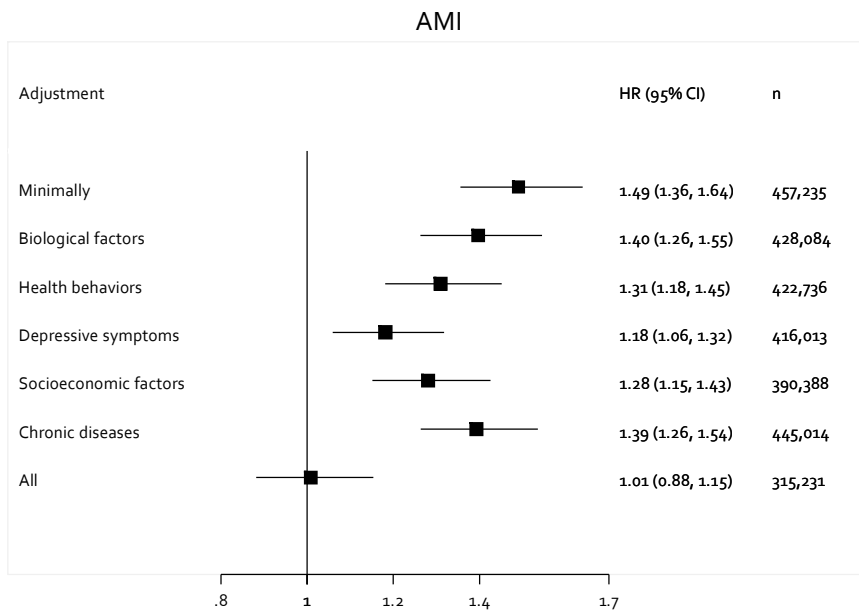
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Social isolation



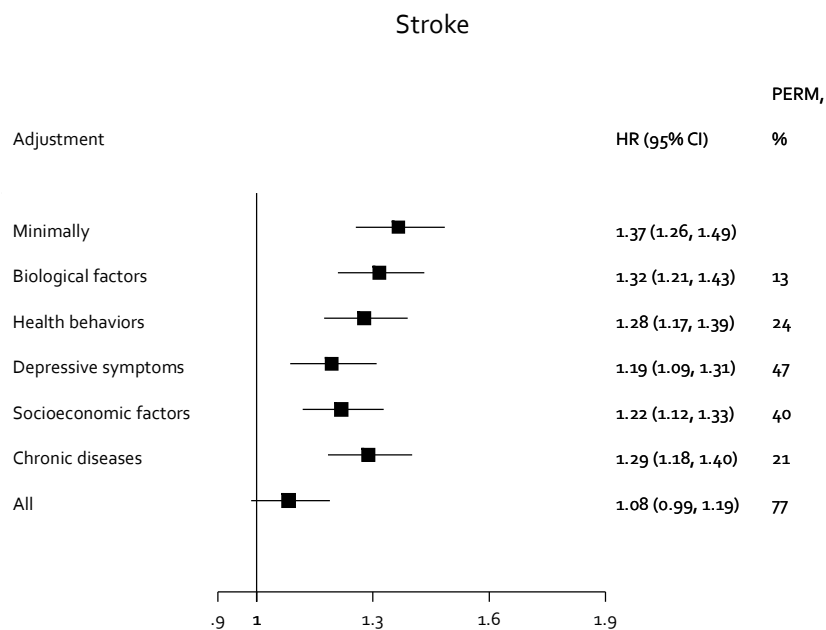
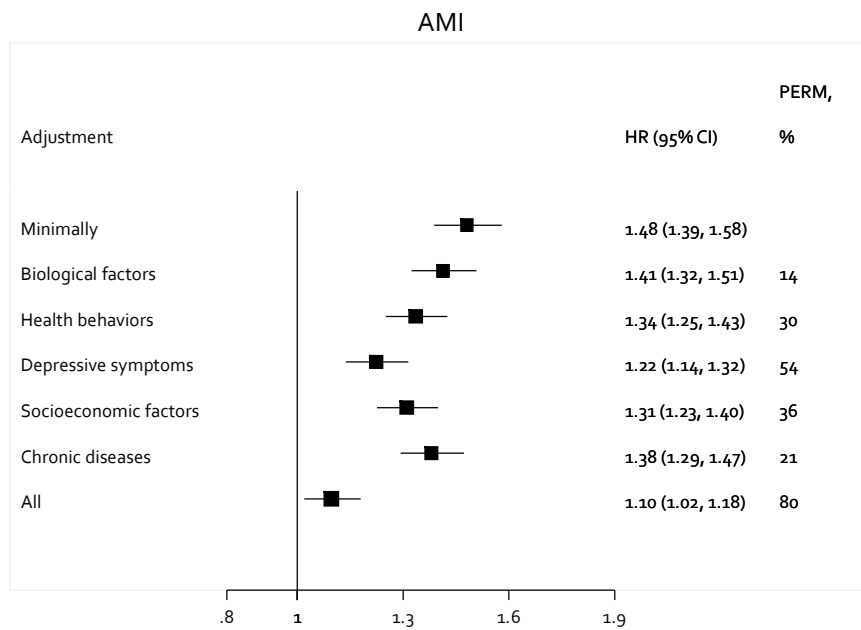
eFigure 4. Complete case associations between social isolation with AMI and stroke.

Loneliness



eFigure 5. Complete case associations between loneliness with AMI and stroke.

Feeling lonely



eFigure 6. Proportions of the single loneliness item (“Do you feel lonely?”)-AMI and stroke excess risk mediated by biological, behavioral, socioeconomic, and health related factors. PERM = Percentage of Excess Risk Mediated.