

Supplementary Table 1. Comorbidity categories and the associated codes and conditions.

Category	Code	Meaning
CVD	1065	hypertension
	1066	heart/cardiac problem
	1067	peripheral vascular disease
	1068	venous thromboembolic disease
	1072	essential hypertension
	1073	gestational hypertension/pre-eclampsia
	1074	angina
	1075	heart attack/myocardial infarction
	1076	heart failure/pulmonary odema
	1077	heart arrhythmia
	1078	heart valve problem/heart murmur
	1079	cardiomyopathy
	1080	pericardial problem
	1081	stroke
	1082	transient ischaemic attack (tia)
	1083	subdural haemorrhage/haematoma
	1086	subarachnoid haemorrhage
	1087	leg claudication/ intermittent claudication
	1088	arterial embolism
	1093	pulmonary embolism dvt
	1094	deep venous thrombosis (dvt)
	1426	myocarditis
	1471	atrial fibrillation
	1473	high cholesterol
	1483	atrial flutter
	1484	wolff parkinson white / wpw syndrome
	1485	irregular heart beat
	1487	svt / supraventricular tachycardia
	1488	mitral valve prolapse
	1489	mitral stenosis
	1490	aortic stenosis
	1491	brain haemorrhage
	1492	aortic aneurysm
	1493	other venous/lymphatic disease
	1494	varicose veins
	1495	lymphoedema
	1496	alpha-1 antitrypsin deficiency
	1583	ischaemic stroke
	1584	mitral valve disease
	1585	mitral regurgitation / incompetence
	1586	aortic valve disease
	1587	aortic regurgitation / incompetence
	1588	hypertrophic cardiomyopathy (hcm / hocm)
	1589	pericarditis
	1590	pericardial effusion

	1591	aortic aneurysm rupture
	1592	aortic dissection
	1593	varicose ulcer
Diabetes	1220	diabetes
	1221	gestational diabetes
	1222	type 1 diabetes
	1223	type 2 diabetes
Endocrine	1224	thyroid problem (not cancer)
	1225	hyperthyroidism/thyrotoxicosis
	1226	hypothyroidism/myxoedema
	1228	thyroid radioablation therapy
	1229	parathyroid gland problem (not cancer)
	1230	parathyroid hyperplasia/adenoma
	1232	disorder of adrenal gland
	1233	adrenal tumour
	1234	adrenocortical insufficiency/addison's disease
	1235	hyperaldosteronism/conn's syndrome
	1236	phaeochromocytoma
	1237	disorder of pituitary gland
	1238	pituitary adenoma/tumour
	1239	cushings syndrome
	1428	thyroiditis
	1429	acromegaly
	1430	hypopituitarism
	1431	hyperprolactinaemia
	1508	jaundice (unknown cause)
	1521	diabetes insipidus
	1522	grave's disease
	1610	thyroid goitre
	1611	hyperparathyroidism
	1667	alopecia / hair loss
	1679	undescended testicle
	1682	benign insulinoma
Gastrointestinal/abdominal	1134	oesophageal disorder
	1135	stomach disorder
	1136	liver/biliary/pancreas problem
	1137	other abdominal problem
	1138	gastro-oesophageal reflux (gord) / gastric reflux
	1139	oesophagitis/barretts oesophagus
	1140	oesophageal stricture
	1141	oesophageal varicies
	1142	gastric/stomach ulcers
	1143	gastritis/gastric erosions
	1154	irritable bowel syndrome
	1155	hepatitis
	1156	infective/viral hepatitis
	1157	non-infective hepatitis

1158 liver failure/cirrhosis
1159 bile duct disease
1160 bile duct obstruction/ascending cholangitis
1161 gall bladder disease
1162 cholelithiasis/gall stones
1163 cholecystitis
1164 pancreatic disease
1165 pancreatitis
1190 peritonitis
1191 gastrointestinal bleeding
1400 peptic ulcer
1432 carcinoid syndrome/tumour
1456 malabsorption/coeliac disease
1457 duodenal ulcer
1458 diverticular disease/diverticulitis
1459 colitis/not crohns or ulcerative colitis
1460 rectal or colon adenoma/polyps
1461 inflammatory bowel disease
1462 crohns disease
1463 ulcerative colitis
1475 sclerosing cholangitis
1501 pyloric stenosis
1503 anal problem
1504 anal fissure
1505 haemorrhoids / piles
1506 primary biliary cirrhosis
1509 gastroenteritis/dysentry
1510 dyspepsia / indigestion
1511 abdominal hernia
1512 umbilical hernia
1513 inguinal hernia
1562 food intolerance
1599 constipation
1600 bowel / intestinal perforation
1601 bowel / intestinal infarction
1602 bowel / intestinal obstruction
1603 rectal prolapse
1604 alcoholic liver disease / alcoholic cirrhosis

Musculoskeletal

1293 bone disorder
1294 back problem
1295 joint disorder
1297 muscle/soft tissue problem
1308 osteomyelitis
1309 osteoporosis
1310 paget's disease
1311 spine arthritis/spondylitis
1312 prolapsed disc/slipped disc

1313 ankylosing spondylitis
1322 myositis/myopathy
1406 muscle or soft tissue injuries
1437 myasthenia gravis
1464 rheumatoid arthritis
1465 osteoarthritis
1466 gout
1467 other joint disorder
1474 hiatus hernia
1477 psoriatic arthropathy
1478 cervical spondylosis
1480 dermatomyositis
1481 polymyositis
1524 spina bifida
1532 disc problem
1533 disc degeneration
1534 back pain
1535 scoliosis
1536 spinal stenosis
1537 joint pain
1538 arthritis (nos)
1540 plantar fasciitis
1541 carpal tunnel syndrome
1542 fibromyalgia
1544 dupuytren's contracture
1545 neck problem/injury
1617 osteopenia
1618 soft tissue inflammation
1619 tendonitis / tendinitis / tenosynovitis
1620 bursitis
1621 synovitis
1622 epicondylitis
1623 tennis elbow / lateral epicondylitis
1624 housemaid's knee (prepatellar bursitis)
1625 cellulitis

Neurological

1240 neurological injury/trauma
1244 infection of nervous system
1245 brain abscess/intracranial abscess
1246 encephalitis
1247 meningitis
1248 spinal abscess
1249 cranial nerve problem/palsy
1250 bell's palsy/facial nerve palsy
1251 spinal cord disorder
1252 paraplegia
1254 peripheral nerve disorder
1255 peripheral neuropathy

1256 acute infective polyneuritis/guillain-barre syndrome
1257 trapped nerve/compressed nerve
1258 chronic/degenerative neurological problem
1259 motor neurone disease
1260 myasthenia gravis
1261 multiple sclerosis
1262 parkinsons disease
1263 dementia/alzheimers/cognitive impairment
1264 epilepsy
1265 migraine
1266 head injury
1267 spinal injury
1394 peripheral nerve injury
1397 other demyelinating disease (not multiple sclerosis)
1415 ear/vestibular disorder
1420 otosclerosis
1421 meniere's disease
1425 cerebral aneurysm
1433 cerebral palsy
1434 other neurological problem
1436 headaches (not migraine)
1468 diabetic neuropathy/ulcers
1476 sciatica
1499 labyrinthitis
1500 vertigo
1523 trigeminal neuralgia
1525 benign / essential tremor
1561 raynaud's phenomenon/disease
1597 tinnitus / tinitis
1616 insomnia
1659 meningioma / benign meningeal tumour
1683 benign neuroma

Psychological

1243 psychological/psychiatric problem
1286 depression
1287 anxiety/panic attacks
1288 nervous breakdown
1289 schizophrenia
1290 deliberate self-harm/suicide attempt
1291 mania/bipolar disorder/manic depression
1408 alcohol dependency
1409 opioid dependency
1410 other substance abuse/dependency
1469 post-traumatic stress disorder
1470 anorexia/bulimia/other eating disorder
1531 post-natal depression
1614 stress
1615 obsessive compulsive disorder (ocd)

Renal	1192	renal/kidney failure	
	1193	renal failure requiring dialysis	
	1194	renal failure not requiring dialysis	
	1196	urinary tract infection/kidney infection	
	1197	kidney stone/ureter stone/bladder stone	
	1200	ureteric obstruction/hydronephrosis	
	1201	bladder problem (not cancer)	
	1202	urinary frequency / incontinence	
	1207	prostate problem (not cancer)	
	1210	scrotal problem (not cancer)	
	1214	testicular problems (not cancer)	
	1396	enlarged prostate	
	1404	male infertility	
	1405	other renal/kidney problem	
	1427	polycystic kidney	
	1514	cystitis	
	1515	pyelonephritis	
	1516	bph / benign prostatic hypertrophy	
	1517	prostatitis	
	1518	erectile dysfunction / impotence	
	1519	kidney nephropathy	
	1520	iga nephropathy	
	1607	diabetic nephropathy	
	1608	nephritis	
	1609	glomerulonephritis	
	Respiratory	1111	asthma
		1112	chronic obstructive airways disease/copd
1113		emphysema/chronic bronchitis	
1114		bronchiectasis	
1115		interstitial lung disease	
1117		other respiratory problems	
1120		asbestosis	
1121		pulmonary fibrosis	
1122		fibrosing alveolitis/unspecified alveolitis	
1123		sleep apnoea	
1124		respiratory failure	
1125		pleurisy	
1126		spontaneous pneumothorax/recurrent pneumothorax	
1398		pneumonia	
1411		lung abscess	
1412		bronchitis	
1413		nasal/sinus disorder	
1414		throat or larynx disorder	
1416		chronic sinusitis	
1417		nasal polyps	
1418	chronic laryngitis		
1419	vocal cord polyp		

1472 emphysema
1486 sick sinus syndrome
1497 pneumothorax
1498 empyema
1595 pleural plaques (not known asbestosis)
1596 pleural effusion

Supplementary Table 2. Mean chronotype score in demographic groups.

	Mean (SD) Chronotype score (1= definite morning type to 4= definite evening type)		P value ^a
	Yes	No	
Age groups			<.0001
37-52 years (%)	2.30 (0.95)		
53-62 years (%)	2.16 (0.93)		
63-73 years (%)	2.11 (0.92)		
Gender			<.0001
Women	2.18 (0.93)		
Men	2.21 (0.94)		
Ethnicity			<.0001
White	2.20 (0.93)		
Non-white	2.13 (1.00)		
Smoking Status (%)*			<.0001
Never	2.14 (0.91)		
Previous	2.21 (0.94)		
Current	2.44 (1.01)		
No answer	2.06 (0.97)		
Prevalent Comorbidities:	Yes	No	
CVD*	2.17 (0.94)	2.21 (0.93)	.0001
Diabetes*	2.21 (0.99)	2.19 (0.93)	.0018
Neurological*	2.24 (0.95)	2.19 (0.93)	<.0001
Endocrine	2.20 (0.95)	2.19 (0.94)	.51
Renal*	2.18 (0.94)	2.19 (0.94)	.03
Respiratory*	2.23 (0.96)	2.19 (0.93)	<.0001
Musculoskeletal	2.19 (0.95)	2.19 (0.93)	.85
Gastrointestinal/ abdominal*	2.22 (0.95)	2.19 (0.93)	<.0001
Psychological*	2.38 (0.98)	2.18 (0.93)	<.0001

^a Based on Student's t test (dichotomous variables) or analyses of variance (variables with >2 groups).

Supplementary Table 3. Analysis of chronotype and mortality risk using 5-level chronotype variable (-2 definite evening type to 2 definite morning type).

	All-Cause Mortality	CVD Mortality
	Hazard Ratio (95% CI) ^a	Hazard Ratio (95% CI) ^a
Number of Deaths ^a	11,773	2,385
Chronotype (-2 definite evening to 2 definite morning)	0.98 (0.97 to 0.996) p=.012	0.97 (0.94 to 0.998) p=.037
Age (per 10 years)	2.32 (2.25 to 2.39) p<.001	2.44 (2.28 to 2.61) p<.001
Male Sex	1.59 (1.53, 1.65) p<.001	2.81 (2.56 to 3.10) p<.001
BMI (per 5 kg/m ²)	1.02 (1.002 to 1.04) p=.033	1.19 (1.14 to 1.24) p<.001
Smoking Status		
Never	1.0 (referent)	1.0 (referent)
Previous	1.34 (1.28 to 1.39) p<.001	1.29 (1.17 to 1.42) p<.001
Current	2.58 (2.45 to 2.72) p<.001	3.01 (2.69 to 3.37) p<.001
No answer	1.65 (1.30 to 2.09) p<.001	1.68 (1.02 to 2.76) p=.04
Sleep duration (h)	1.04 (1.02 to 1.05) p<.001	1.02 (0.99 to 1.05) p=.20
Prevalent Comorbidities:		
CVD	1.28 (1.24 to 1.34) p<.001	2.03 (1.84 to 2.22) p<.001
Diabetes	1.72 (1.62 to 1.82) p<.001	2.10 (1.89 to 2.35) p<.001
Neurological	1.17 (1.10 to 1.24) p<.001	1.23 (1.08 to 1.39) p=.002
Endocrine	1.01 (0.94 to 1.09) p=.80	1.004 (0.84 to 1.20) p=.97
Renal	1.02 (0.94 to 1.09) p=.68	1.07 (0.92 to 1.24) p=.36
Respiratory	1.30 (1.24 to 1.36) p<.001	1.30 (1.18 to 1.43) p<.001
Musculoskeletal	1.001 (0.96 to 1.04) p=.95	1.04 (0.95 to 1.14) p=.40
Gastrointestinal/ abdominal	1.05 (0.999 to 1.10) p=.056	0.93 (0.83 to 1.03) p=.18
Psychological	1.27 (1.19 to 1.35) p<.001	1.28 (1.12 to 1.48) p=.001
White ethnicity	1.39 (1.25 to 1.54) p<.001	1.21 (0.99 to 1.48) p=.069
Socioeconomic deprivation (Townsend Index)	1.05 (1.05 to 1.06) p<.001	1.07 (1.06 to 1.08) p<.001
Pseudo r ²	.03	.06

^a No missing data