Web appendices

Contents

Web appendix 1: List of morbidity outcomes

eTable 1. ICD-10 codes used in the assessment of morbidity (52 outcomes) and mortality (4 outcomes). Disease cases were identified from linked electronic health records (hospital discharge, death or entitlement for drug reimbursement registry). ICD-10 chapters and codes of diseases that were included in this analysis are described below.

ICD-10 Chapter		ICD-10 code	Data source (1=hospitalization and death; 2=drug reimbursement entitlement)	Baseline cases excluded*
I	**Infections**	A01-B89	1	
	Bacterial infections	A01-A79	1	
II	**Cancer**	C00-C97	1	X
	Melanoma	C43-C44	1,2	X
	Breast cancer	C50	1,2	X
	Prostate cancer	C61	1,2	X
	Leukaemia, lymphoma	C810-C96	1,2	X
IV	**Endocrine diseases**	E00-E90	1	X
	Diabetes	E10-E14	1,2	X
V	**Mental and behavioural disorders**	F00-F99	1	X
	Disorders due to substance abuse	F10-F19	1	X
	Psychotic disorders	F20-F29	1,2	X
	Mood disorders	F30-F39	1	X
VI	**Diseases of the nervous system**	G00-G99	1	X
	Epilepsy	G40-G42	1,2	X
	TIA	G45-G46	1	X
	Sleep disorders	G47	1,2	X
VII	**Diseases of the eye**	H00-H59	1	X
VIII	**Diseases of the ear**	H60-H99	1	X
IX	**Diseases of the circulatory system**	I00-I99	1	X
	Hypertension	I10-I15	1,2	X
	Ischemic heart diseases	I20-I25	1,2	X
	Angina pectoris	I20	1,2	X
	Myocardial infarction	I21	1,2	X
	Arrhythmias	I46-I49	1,2	X
	Heart failure	I50	1,2	X
	Cerebrovascular diseases	I60-I69	1	X
	Stroke	I60-I61, I63-I64	1	X
	Cerebral infarction	I63	1	X
	Deep vein thrombosis	I80-I82	1	
X	**Diseases of the respiratory system**	J00-J99	1	X

	Influenza and pneumonia	J09-J18	1	
	Chronic obstructive bronchitis	J43-J44, J47	1,2	X
	Asthma	J45-J46	1,2	X
XI	**Diseases of the digestive system**	K00-K93	1	X
	Appendicitis	K35	1	
	Inflammatory bowel disease	K50-K52	1,2	X
	Diseases of liver	K70-K77	1,2	
XII	**Diseases of the skin**	L00-L99	1	X
XIII	**Diseases of the musculoskeletal system**	M00-M99	1	X
	Rheumatoid arthritis and related	M05-M06,M08,13,M30-35, M45	1,2	X
	Osteoarthritis	M15-M19	1	
	Sciatica	M50-M51	1	
	Back pain	M54	1	
	Soft tissue disorders	M60-M79	1	
XIV	**Diseases of the genitourinary system**	N00-N99	1	X
XV	**Pregnancy complications**	O00-O03,O05-O29	1	X
XVIII	**Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified**		1	
	Circulatory and respiratory symptoms	R00-R09	1	
	Digestive and abdominal symptoms	R10-R19	1	
XIX	**Injury and poisoning**		1	
	Injury	S00-T35	1	
XX	**External causes**		1	
	Road accidents	V01-V99	1	
	Falls	W00-W19	1	
	Overall mortality		1	
	Death, cancer	C00-C97	1	
	Death, CVD	I20-I25,I60-I69	1	
	Death, other reason	EI C00-C97,I20-I25,I60-I69	1	

*Participants with a history of the disease at baseline were excluded from the analysis

Web appendix 2: Description of the cohort studies in primary analyses

For primary analysis, we pooled individual-participant data from two Finnish prospective cohort studies: the Finnish Public Sector (FPS) study and the Health and Social Support (HeSSup) study.

Finnish Public Sector study (FPS)
The Finnish Public Sector study is a prospective cohort study comprising the entire public sector personnel of 10 towns (municipalities) and 21 hospitals in the same geographical areas. Participants were individuals who had been employed in the study organisations for at least six months prior to data collection. The FPS comprised 44 635 men and women who responded to a survey conducted between March 1, 2000, and June 30, 2002 (response rate 68%); had data on working hours; and were linked to electronic health records until Dec 31, 2016, and to mortality records until Dec 31, 2018. Ethical approval was obtained from the ethics committee of the Helsinki and Uusimaa Hospital District. Participants' occupational titles from the employers' records (>1900 different five-digit occupational titles) were classified into high (upper non-manual including e.g. physicians, teachers); intermediate (lower non-manual, e.g. technicians, registered nurses); and low (manual, e.g. cleaners, maintenance workers) SES on the basis of Statistics Finland's occupational classification system. The most common occupations in the Finnish municipal sector are those related to health care, social services and education, representing nearly 50% of all occupational groups.

Self-reported height, weight, smoking status, alcohol consumption and physical activity were collected from the questionnaires. Alcohol consumption was based on the reported amounts of beer, wine or other mild alcoholic beverages and hard liquors. For each category, seven pre-defined answer alternatives were given and weekly consumption was estimated based on the responses. The weekly amount of walking, brisk walking, jogging or running was asked with the following categories "not at all", "less than half an hour", "approximately one hour", "2-3 hours" and "4 hours of more". Physical inactivity was defined as less than 0.5 hour of each (brisk walking, jogging or running) per week. The weekly amount of both moderate and vigorous activities was calculated for classifying moderate or optimal activity.

Health and Social Support (HeSSup) study
The Health and Social Support (HeSSup) study is a prospective cohort study of a stratified random sample of the Finnish population in the following four age groups: 20–24, 30–34, 40–44, and 50–54. The participants were identified from the Finnish population register and posted an invitation to participate, along with a baseline questionnaire, in 1998. In the HeSSup study, the analytic sample comprised of men and women who responded to a survey conducted between June 7, 1998, and May 23, 2000 (response rate 40%) and had data on working hours, who were successfully linked to national hospitalisation up to Dec 31, 2012, and mortality registers up to Dec 31, 2015. Of the 25 898 individuals who responded to the questionnaire, 14 964 (6 745 men and 8 219 women aged 20 to 54) were in employment and had data on working hours and were thus eligible for the study. The Turku University Central Hospital Ethics Committee approved the study. SES was defined based on participant's highest educational achievement to high (higher education, university) intermediate (higher or lower secondary, eg college/vocational school), and low (primary education only).

Self-reported height, weight and smoking status were collected from the questionnaires. Physical activity and alcohol consumption were based on responses from the questionnaire.The weekly amount of walking, brisk walking, jogging or running was asked with the following categories "not at all", "less than half an hour", "approximately one hour", "2-3 hours" and "4 hours of more". Physical inactivity was defined as less than 0.5 hour of each (brisk walking, jogging or running) per week. The weekly amount of both moderate and vigorous activities was calculated for classifying moderate or optimal activity. Alcohol consumption was based on the reported amounts of beer, wine or other mild alcoholic

beveragesand hard liquors. For each category, seven pre-defined answer alternatives were given and weekly consumption was estimated based on the responses.

Assessment of baseline lifestyle factors

Lifestyle factors were body mass index (BMI) (calculated as weight in kilograms divided by height in meters squared), smoking, leisure-time physical activity, and alcohol consumption. The scoring system for each lifestyle factor was as follows:

- BMI: less than 18.5 (underweight) 18.5 to 24.9 (normal), 25.0 to 29.9 (overweight), and greater than or equal to 30.0 (obese).
- Smoking: never and former smokers vs. and current smokers.
- Physical inactivity: Meeting the World Health Organization recommendations (≥2.5 hours of moderate activity/week or ≥1.25 hours of vigorous activity/week: optimal), or partly meeting the recommendations (activity levels falling between the optimal and poor levels) vs. no or very little moderate/vigorous leisure-time physical activity.
- Alcohol consumption (total number of alcoholic drinks a participant consumed in a week; 1 drink being equivalent to approximately 10 g of ethanol): 0 drinks per week (no alcohol); 1 to 12 (women) or 1 to 24 (men) drinks per week (moderate); and greater than or equal to 13 (women) or greater than or equal to 25 (men) drinks per week (at-risk drinking).

We calculated BMI using height and weight (weight in kilograms divided by height in meters squared), which were self-reported (in FPS and HeSSup). Participants with BMI values <15 or >50 kg/m^2 as probable outliers or erroneous values, were excluded from the analyses.

eTable 2. Baseline characteristics of the study population by category of weekly working hours in primary analysis. Figures are numbers (column percentages).

	<35 h/wk	**35-40 h/wk**	**41-48 h/wk**	**49-54 h/wk**	**≥55 h/wk**	**P for ≥55h vs 35-40h/week**	**P for heterogeneity**
Study							
FPS	3586 (69.1)	31770 (79.6)	6343 (69.6)	1518 (57.6)	1418 (51.6)		
HeSSup	1606 (30.9)	8135 (20.4)	2777 (30.4)	1117 (42.4)	1329 (48.4)	<0.001	<0.001
Sex		69.7					
Men	1041 (20.0)	8086 (20.3)	3588 (39.3)	1312 (49.8)	1486 (54.1)		
Women	4151 (80.0)	31819 (79.7)	5532 (60.7)	1323 (50.2)	1261 (45.9)	<0.001	<0.001
Age group, y							
<=50	3633 (70.0)	27984 (70.1)	6485 (71.1)	1837 (69.7)	1889 (68.8)		
>50	1559 (30.0)	11921 (29.9)	2635 (28.9)	798 (30.3)	858 (31.2)	0.13	0.15
Socioeconomic status							
Low	646 (12.5)	8388 (21.0)	1299 (14.3)	413 (15.7)	651 (23.8)		
High	4538 (87.5)	31479 (79.0)	7814 (85.7)	2213 (84.3)	2089 (76.2)	<0.001	<0.001
Body mass index, kg/m²							
<18.5	104 (2.1)	481 (1.3)	96 (1.1)	29 (1.1)	31 (1.2)		
18.5 – 24.9	3050 (60.8)	21551 (55.8)	4722 (53.3)	1318 (51.5)	1269 (47.7)		
25.0 – 29.9	1418 (28.3)	12199 (31.6)	3040 (34.3)	934 (36.5)	1002 (37.7)		
≥30	443 (8.8)	4375 (11.3)	1001 (11.3)	279 (10.9)	356 (13.4)	<0.001	<0.001
Current smoking							
No	4259 (84.0)	30855 (80.1)	7047 (80.1)	2011 (79.8)	2004 (76.0)		
Yes	808 (16.0)	7519 (19.6)	1748 (19.9)	510 (20.2)	633 (24.0)	<0.001	<0.001
Alcohol consumption							
None	733 (14.3)	5623 (14.4)	860 (9.6)	283 (11.0)	298 (11.1)		
Moderate	3902 (76.2)	30359 (77.5)	7236 (80.7)	2058 (80.0)	2117 (78.9)		
Heavy	487 (9.5)	3203 (8.1)	873 (9.7)	232 (9.0)	267 (10.0)	<0.001	<0.001
Physical activity							
Inactive	4069 (80.2)	31274 (80.1)	7173 (80.3)	1993 (78.0)	2011 (75.6)		
Active	1007 (19.8)	7756 (19.9)	1758 (19.7)	561 (22.0)	649 (24.4)	<0.001	<0.001

Web appendix 3: Description of the cohort studies in replication analyses

The Whitehall II study

The Whitehall II study is a prospective cohort study set up to investigate socioeconomic determinants of health. At study baseline in 1985-1988, 10 308 civil service employees (6 895 men and 3 413 women) aged 35-55 and working in 20 civil service departments in London were invited to participate in the study. The Whitehall II comprises 7650 government workers who responded to a survey on working hours between Aug 7, 1991, and May 10, 1993 (response rate 74%) and were linked electronically to national hospitalization and mortality registers from Jan 1, 1997 (when these records achieved a high level of national coverage) to March 31, 2017. The Whitehall II study protocol was approved by the University College London Medical School committee on the ethics of human research. Written informed consent was obtained at each data collection wave. SES was assessed using civil service occupation-based employment grade categories: high (Administrative grades 1 to 7), intermediate (Professional and Executive grades including senior executive officers, higher executive officers and executive officers) and low (clerical grades including office support staff).

Swedish Longitudinal Occupational Survey of Health (SLOSH)

The SLOSH is an on-going prospective cohort study following up individuals who participated in the Swedish Work Environment Survey (SWES) in 2003 or 2005. SWES, conducted biennially by Statistics Sweden, is based on a sample of gainfully employed people aged 16-64 years drawn from the Labour Force Survey (LFS). These individuals were first sampled into LFS through stratification by county, sex, citizenship and inferred employment status. Data from the 2008 data collection wave of SLOSH were used in the replication analyses. The data were collected using postal self-completion questionnaires (response rate 61%). SLOSH has been approved by the Regional Research Ethics Board in Stockholm. The SLOSH comprises 9081 Swedish workers who responded to a survey on working hours between April 21, 2008 and November 5, 2008 and were linked electronically to national hospitalization and mortality registers from Jan 1, 1997 to Dec 31, 2018 (for mortality records until Dec 31, 2020).

Work, Lipids and Fibrinogen (WOLF) study (two cohorts)

WOLF Stockholm is a prospective cohort study of 5 560 people aged 19–70 and working in companies in Stockholm county. The WOLF Norrland is a prospective cohort of 4671 participants aged 19-65 working in companies in Jämtland and Västernorrland counties. Thus, the combined WOLF comprises 10231 workers (response rate 79%). At study baseline the participants underwent a clinical examination and completed a set of health questionnaires. For WOLF Stockholm, the baseline assessment was undertaken at 20 occupational health units between November 1992 and June 1995 and for WOLF Norrland at 13 occupational health service units in 1996-98. The Regional Research Ethics Board in Stockholm, and the ethics committee at Karolinska Institutet, Stockholm, Sweden approved the study. The average follow-up time was 14 years.

Danish Work Environment Cohort (DWECS) study (two cohorts)

The DWECS is a split panel survey of working age Danish people. The cohort for DWECS-00 was established in 1990, when a simple random sample of men and women, aged 18-59, was drawn from the Danish population register. The participants have been followed up at five year intervals and data from the years 2000 and 2005 were used in this study. The DWECS-00 comprises 5467 people (2913 men and 2554 women, response rate 75%). In 2005, an additional independent random sample of 8545 individuals, DWECS-05, were invited to participate. A total of 4978 people (2398 men and 2580 women) agreed to do so and had data on relevant variables (58%). In Denmark, questionnaire- and register-based studies do not require ethics committee approval. DWECS was approved by and registered with the Danish Data protection agency (registration number: 2007-54-0059).

Copenhagen Psychosocial Questionnaire (COPSOQ) study (two cohorts)

The COPSOQ study has also two independent subcohorts. The COPSOQ-I is a prospective cohort study of a random sample of Danish residents selected from the Danish population register. The participants were aged 20-60 years of age and were in paid employment at the study baseline in 1997. A baseline questionnaire and an invitation to take part was posted to 4 000 people and 2 454 individuals agreed to participate (response rate 61%), of which 1858 were gainfully employed. COPSOQ-II was carried out in 2004-2005. It included a follow up of respondents from COPSOQ I and a representative sample of Danish residents aged 20-60 at study baseline. The questionnaire was sent to 8 000 individuals and 4 732 individuals responded (response rate 59%). The questionnaire could be completed via post or via the internet. There were 3 817 gainfully employed first time participants who were successfully linked with register data. The COPSOQ-I comprises 1772 people, and the COPSOQ-II comprises 3387 people as the final

samples used in the analyses. In Denmark, questionnaire- and register-based studies do not require approval from the Danish National Committee on Biomedical Research Ethics (Den Centrale Videnskabetiske komité). COPSOQ-I and COPSOQ II were approved by and registered with the Danish Data protection agency (registration numbers: 2008 - 54 -15 0553, 2004-54-1493).

Burnout, Motivation, Job Satisfaction (PUMA) study

PUMA is an intervention study of burn-out among employees in the human service sector. Selection criteria for the participating organisations was that they had between 200 and 500 employees, that occupational groups within each organisation were willing to participate and that the organisations would commit to the entire five-year study period. Participants gave consent to having their national identity numbers collected and used in later record linkages to Danish hospitalisation and cause of death registries (Hospitalsindlæggelsesregisteret, Dødsårsagsregisteret. At study baseline in 1999-2000, 1 914 participants agreed to take part (response rate 80%). The analytic sample used in replication analyses comprised 1834 people. PUMA was approved by the Scientific Ethical Committees (Videnskabsetisk Komiteer) in the counties in which the study was conducted and approved by and registered with the Danish Data Protection Agency (registration number: 2000-54-0048).

eTable 3. Baseline characteristics of the study population by category of weekly working hours in replication analysis. Figures are numbers (column percentages).

Cohort		<35 h/wk	35-40 h/wk	41-48 h/wk	49-54 h/wk	≥55 h/wk	P for ≥55h vs 35-40h/week
	Sex						
WHII	Men	208 (54.0)	2494 (63.2)	1155 (77.6)	832 (77.1)	639 (85.3)	
	Women	177 (46.0)	1455 (36.8)	333 (22.4)	247 (22.9)	110 (14.7)	<0.001
SLOSH	Men	542 (28.7)	1425 (44.34)	1121 (52.8)	565 (60.4)	557 (60.4)	
	Women	1346 (71.3)	1789 (55.7)	1000 (47.2)	371 (39.6)	365 (39.6)	<0.001
WOLF	Men	215 (28.1)	3608 (68.7)	2561 (75.9)	449 (81.6)	231 (80.5)	
	Women	550 (71.9)	1646 (31.3)	814 (24.1)	101 (18.4)	56 (19.5)	<0.001
DWECS00	Men	162 (18.3)	1621 (53.4)	501 (63.6)	269 (81.5)	360 (84.3)	
	Women	723 (81.7)	1416 (46.6)	287 (36.4)	61 (18.5)	67 (15.7)	<0.001
DWECS05	Men	205 (21.1)	1243 (47.9)	426 (59.3)	222 (72.1)	302 (79.3)	
	Women	769 (79.0)	1353 (52.1)	293 (40.8)	86 (27.9)	79 (20.7)	<0.001
COPSOQ-I	Men	63 (17.6)	583 (55.5)	142 (68.3)	74 (85.1)	56 (82.4)	
	Women	296 (82.5)	467 (44.5)	66 (31.7)	13 (14.9)	12 (17.7)	<0.001
COPSOQ-II	Men	60 (11.1)	856 (48.0)	405 (59.9)	146 (69.2)	144 (81.4)	
	Women	481 (88.9)	926 (52.0)	271 (40.1)	65 (30.8)	33 (18.6)	<0.001
PUMA	Men	15 (2.5)	225 (21.1)	45 (36.9)	20 (60.6)	10 (62.5)	
	Women	579 (97.5)	844 (79.0)	77 (63.1)	13 (39.4)	6 (37.5)	<0.001
	Age group, y						

WHII	<=50	139 (36.1)	2353 (59.6)	961 (64.6)	701 (65.0)	496 (66.2)	
	>50	246 (63.9)	1596 (40.4)	527 (35.4)	378 (35.0)	253 (33.8)	<0.001
SLOSH	<=50	919 (48.7)	1852 (57.6)	1193 (56.2)	490 (52.4)	462 (50.1)	
	>50	969 (41.3)	1362 (42.4)	928 (43.8)	446 (47.6)	460 (49.9)	0.48
WOLF	<=50	492 (64.3)	3844 (73.2)	2517 (74.6)	423 (76.9)	226 (78.8)	
	>50	273 (35.7)	1410 (26.8)	858 (25.4)	127 (23.1)	61 (21.3)	0.04
DWECS00	<=50	586 (66.2)	2290 (75.4)	574 (72.8)	248 (75.2)	313 (73.3)	
	>50	299 (33.8)	747 (24.6)	214 (27.2)	82 (24.9)	144 (26.7)	0.35
DWECS05	<=50	660 (67.8)	1885 (72.6)	527 (73.3)	217 (70.5)	257 (67.5)	
	>50	314 (32.2)	711 (28.4)	192 (26.7)	91 (29.6)	124 (32.6)	0.04
COPSOQ-I	<=50	267 (74.4)	819 (78.0)	162 (77.9)	59 (67.8)	54 (79.4)	
	>50	92 (25.6)	231 (22.0)	46 (22.1)	28 (32.2)	14 (20.6)	0.79
COPSOQ-II	<=50	378 (68.9)	1230 (69.0)	486 (71.9)	163 (77.3)	130 (73.5)	
	>50	163 (30.1)	552 (31.0)	190 (28.1)	48 (22.8)	47 (26.6)	0.22
PUMA	<=50	412 (69.4)	791 (74.0)	94 (77.1)	25 (75.8)	9 (56.3)	
	>50	182 (30.6)	278 (26.0)	28 (23.0)	8 (24.2)	7 (43.8)	0.11
	Socioeconomic status						
WHII	Low	131 (34.0)	1058 (26.8)	146 (9.8)	91 (8.4)	48 (6.4)	
	Intermediate	155 (40.2)	2172 (55.0)	716 (48.1)	468 (43.4)	286 (38.2)	
	High	99 (25.7)	719 (18.2)	626 (42.1)	520 (48.2)	415 (55.4)	<0.001
SLOSH	Low	780 (46.0)	1047 (34.9)	420 (21.1)	174 (22.0)	265 (36.6)	
	Medium	780 (44.0)	1439 (48.0)	955 (48.0)	347 (43.9)	283 (39.0)	
	High	169 (10.0)	513 (17.1)	614 (30.9)	269 (34.0)	177 (24.4)	<0.001
WOLF	Low	266 (35.2)	3021 (57.9)	1078 (32.3)	74 (14.0)	27 (10.0)	
	Medium	421 (55.8)	1918 (36.8)	1710 (51.2)	252 (47.8)	96 (35.6)	
	High	68 (9.0)	278 (5.3)	551 (16.5)	201 (38.1)	147 (54.4)	<0.001
DWECS00	Low	409 (46.2)	1402 (46.2)	287 (36.4)	122 (37.0)	146 (34.2)	
	Medium	292 (33.0)	892 (29.4)	221 (28.1)	86 (26.1)	171 (40.1)	

	High	184 (20.8)	743 (24.5)	280 (35.5)	122 (37.0)	110 (25.8)	<0.001
DWECS05	Low	428 (43.9)	1033 (39.8)	255 (35.5)	105 (34.1)	175 (45.9)	
	Medium	319 (32.8)	780 (30.1)	177 (24.6)	84 (27.3)	99 (26.0)	
	High	227 (23.3)	783 (30.2)	287 (39.9)	119 (38.6)	107 (28.1)	0.07
COPSOQ-I	Low	158 (44.0)	503 (47.9)	75 (36.1)	19 (21.8)	24 (35.3)	
	Medium	109 (30.4)	289 (27.5)	60 (28.9)	27 (31.0)	27 (39.7)	
	High	92 (25.6)	258 (24.6)	73 (35.1)	41 (47.1)	17 (25.0)	0.06
COPSOQ-II	Low	245 (45.3)	782 (43.9)	255 (37.7)	68 (32.2)	86 (48.6)	
	Medium	170 (31.4)	535 (30.0)	173 (25.6)	56 (26.5)	32 (18.1)	
	High	126 (23.3)	465 (26.1)	248 (36.7)	87 (41.2)	59 (33.3)	0.003
PUMA	Low	309 (52.0)	434 (40.6)	30 (24.6)	10 (30.3)	*	
	Medium	105 (17.7)	410 (38.4)	28 (23.0)	9 (27.3)	*	
	High	180 (30.3)	225 (21.0)	64 (52.5)	14 (42.4)	*	

* less than five cases in a cell. The exact numbers cannot be reported.

eTable 4. Cohort descriptions

	FPS	HeSSup	Whitehall II	SLOSH	WOLF	DWECS00	DWECS05	COPSOQ-I	COPSOQ-II	PUMA	Replication, pooled (weighted mean)
Total N	44635	14964	7650	9081	10231	5467	4978	1772	3387	1834	
Baseline year	2000-2002	1998-2000	1991-1993	2008	1992-1997	2000	2005	1997	2004-2005	1999-2000	
End of maximum follow-up, year, morbidity	2016	2012	2017	2018	2009	2010	2010	2010	2010	2010	
End of maximum follow-up, year, mortality	2018	2015	2017	2020	2009	2010	2010	2010	2010	2010	
Mean follow-up time, until 65 (SD), morbidity	13.8 (2.8)		11.5 (5.9)	8.8 (3.0)	13.0 (3.4)	5.6 (3.7)	3.7 (1.8)	6.6 (4.7)	4.1 (2.2)	5.9 (4.0)	8.1
Mean follow-up time, maximum (SD), morbidity	15.1 (1.6)		20.8 (4.0)	10.4 (1.2)	14.2 (2.0)	5.8 (3.8)	3.7 (1.8)	6.8 (4.9)	4.1 (2.2)	6.1 (4.1)	8.9
Mean follow-up time, until 65 (SD), mortality	15.3 (3.5)		11.6 (5.8)	8.5 (0.6)	13.0 (3.4)	9.4 (1.9)	5.0 (0.5)	12.1 (2.3)	5.9 (0.5)	10.5 (1.9)	9.4
Mean follow-up time, maximum (SD), mortality	17.3 (1.8)		20.9 (3.9)	11.7 (1.0)	14.2 (2.0)	9.8 (1.3)	5.0 (0.5)	12.7 (1.7)	5.9 (0.5)	11.0 (1.1)	8.1

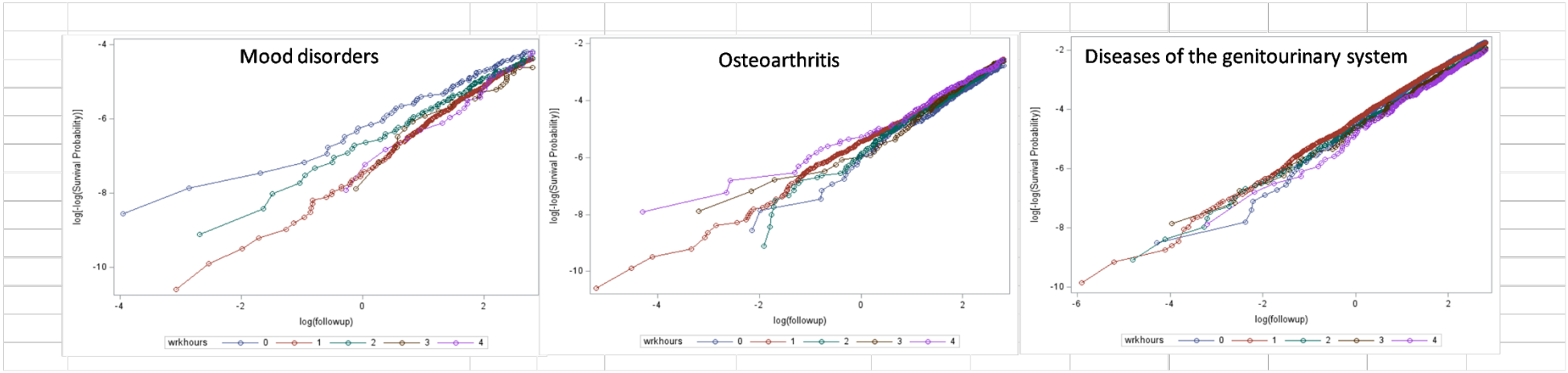
* Less than 5 cases. The exact number cannot be reported.

Web appendix 4: Tests of proportionality assumption and graphical illustrations where the assumption is not met

eTable 5. Interaction between log(time) and working hours

Disease	Total	Event	ChiSq (df=4)	ProbChiSq
Infections	59085	1865	1.80	0.7720
Bacterial infections	59530	1645	0.55	0.9689
Cancer	58996	3586	1.84	0.7659
Melanoma	59483	549	6.53	0.1626
Breast cancer	43715	1615	7.58	0.1082
Prostate cancer	15481	279	1.02	0.9068
Leukaemia, lymphoma	59469	336	2.37	0.6674
Endocrine diseases	59020	1861	1.11	0.8924
Diabetes	58926	3138	6.18	0.1862
Mental and behavioural disorders	59199	1231	5.92	0.2050
Disorders due to substance abuse	59530	378	8.63	0.0710
Mood disorders	59370	658	11.12	0.0252
Diseases of the nervous system	58549	3814	0.59	0.9643
Epilepsy	59136	335	4.29	0.3685
TIA	59501	450	2.84	0.5844
Sleep disorders	59530	1488	4.40	0.3542
Diseases of the eye	59136	2682	1.45	0.8361
Diseases of the ear	59237	733	1.14	0.8885
Diseases of the circulatory system	57376	6246	7.21	0.1254
Hypertension	55737	4384	0.83	0.9340
Ischemic heart diseases	59153	1587	1.27	0.8666
Angina pectoris	59235	715	2.19	0.7004
Myocardial infarction	59473	523	4.78	0.3107
Arrhythmias	59266	1898	8.23	0.0833
Cerebrovascular diseases	59452	776	0.97	0.9142
Stroke	59471	643	1.27	0.8668
Cerebral infarction	59502	407	1.35	0.8535
Diseases of the respiratory system	57616	4098	5.75	0.2184
Influenza and Pneumonia	59530	1268	1.99	0.7369
Asthma	57455	2116	7.22	0.1245
Diseases of the digestive system	57398	7135	7.24	0.1236
Appendicitis	59530	837	1.72	0.7866
Diseases of liver	59530	438	1.59	0.8103
Diseases of the skin	59265	714	2.47	0.6495
Diseases of the musculoskeletal system	55602	10907	8.84	0.0651
Rheumatoid arthritis and related disorders	58756	1278	1.09	0.8963
Osteoarthritis	59530	3631	9.74	0.0450
Sciatica	59530	1116	2.70	0.6099
Back pain	59530	476	5.96	0.2018
Soft tissue disorders	59530	3848	8.84	0.0651
Diseases of the genitourinary system	56402	7342	9.70	0.0457
Pregnancy complications	43070	1407	4.32	0.3642
Circulatory and respiratory symptoms	59530	1401	2.05	0.7268
Digestive and abdominal symptoms	59530	1446	1.38	0.8473

Injury	59530	6560	6.06	0.1944
Falls	44635	2601	1.01	0.9078
Death	59530	1650	5.40	0.2485
Death / Cancer	59530	809	6.20	0.1848
Death / CVD	59530	234	5.24	0.2637
Death / nonCancer, nonCVD	59530	607	3.67	0.4520



eFigure 1. log-log plot: log(follow-up) versus log(-log(survival)) for those outcomes where proportionality assumption was not met.

Web appendix 5: Statistical code

```
*************************************************************************;
** Table 1, Figure 2-3, eTable6-10,15 **;
*************************************************************************;
** disease=dg, exposure=altiste, output file=resfile **;
** data sets: Tyoaika_taudit (diseases), hlot (persons) **;
*************************************************************************;
%macro coxit (dg,altiste,resfile);
data tauti;
   set lib.Tyoaika_taudit;
   IF dgnro=&dg;
data t1;
   merge hlot(in=i) tauti;
   by tutknro;
   if i;
data t2;
   set t1;
   if .<slaalkupvm<=seurloppupvm then status=1; else status=0;
   seuraika=(min(slaalkupvm,kuolinpvm,seurloppupvm)-alkupvm+1)/365.25;
   if &dg IN (79,81,82,83,84) then do;
   if .<slaalkupvm<=mortseurloppupvm then status=1; else status=0;
   seuraika=(min(slaalkupvm,kuolinpvm,mortseurloppupvm)-alkupvm+1)/365.25; end;
   if &dg IN (4,5,6,7,8,9,10,11,12,15,18,20,21,22,24,25,26,28,33,34,35,36,38,39,40,41,42,43,44,
48,49,52,59,60,66,1,13,14,17,23,30,31,32,46,50,56,58,65,67) and exslaalkupvm>. then extauti=1;
   if seuraika<=0 or extauti=1 or (sex=1 and &dg IN (8,67,68,69,70)) or (sex=2 and &dg=9)
     then do; status=.; seuraika=.; end;
   if study=2 and &dg IN (75,76,77,78) then do; status=.; seuraika=.; end;
   if status=1 then age_disease=age+seuraika;
   lnseuraika=log(seuraika/10000); run;
proc freq data=t2 noprint; where status>.; tables &altiste / out=freqt; data freqt; set freqt; Total=count;
   proc freq data=t2 noprint; where status=1; tables &altiste / out=freq1; data freq1; set freq1; Event=count;
proc means data=t2 nway noprint;
   var age_disease; class &altiste; output out=ka mean=;
proc genmod data=t2;
   class &altiste;
   model status = sex age study &altiste / dist=poisson offset=lnseuraika;
   lsmeans &altiste / exp cl;
   ods output LSMeans=lm;
proc phreg data=t2;
   class &altiste(ref='1');
   model seuraika*status(0) = sex age study &altiste / rl;
   ods output ParameterEstimates=pe1 CensoredSummary=cs; run;
proc phreg data=t2;
   where &altiste>0;
   model seuraika*status(0) = sex age study &altiste / rl;
   ods output ParameterEstimates=pe2 CensoredSummary=cs; run;
   data pe1; set pe1; if Parameter='wrkhours'; wrkhours=1*ClassVal0;
   data pe2; set pe2; if Parameter='wrkhours'; wrkhours=4;
   rename HazardRatio=HR_trend HRLowerCL=HR_trend_LCL HRUpperCL=HR_trend_UCL
ProbChiSq=P_trend;
   data res; merge pe1 pe2 freqt freq1 ka lm; by wrkhours; dgnro=&dg;
   incidence_10000=ExpEstimate;
   keep parameter wrkhours dgnro Total Event HazardRatio HRLowerCL HRUpperCL ProbChiSq
   HR_trend HR_trend_LCL HR_trend_UCL P_trend age_disease incidence_10000;
   data res; merge res(in=i) lib.Tautiselitteet; by dgnro; if i;
proc append base=&resfile data=res;
run;
%mend;
```

```
*********************************************************************;
** all diseases **;
proc datasets lib=work memtype=data nolist; delete results_all; quit;
%MACRO coxkaikki;
%DO I = 1 %TO 84;
  %coxit(&I,wrkhours,results_all);
%END;
%MEND coxkaikki;
%coxkaikki;
proc print data=results_all;
   id dgnro;
   var selite wrkhours Total Event HazardRatio HRLowerCL HRUpperCL ProbChiSq
   HR_trend HR_trend_LCL HR_trend_UCL P_trend incidence_10000 age_disease;
run;
*********************************************************************;
**  selected diseases **;
proc datasets lib=work memtype=data nolist; delete results; quit;
%coxit(79,wrkhours,results);
%coxit(15,wrkhours,results);
%coxit(34,wrkhours,results);
%coxit(41,wrkhours,results);
%coxit(81,wrkhours,results);
%coxit(82,wrkhours,results);
proc print data=results;
   id dgnro;
   var selite wrkhours Total Event HazardRatio HRLowerCL HRUpperCL ProbChiSq
   HR_trend HR_trend_LCL HR_trend_UCL P_trend incidence_10000 age_disease;
run;
*********************************************************************;
** Table 2 (PAF) **;
*********************************************************************;
data paf;
   set results;
   prop=0.0505; *exposed*;
   PAF=prop*(HazardRatio-1)/(1+prop*(HazardRatio-1))*100;
   PAF_lower=prop*(HRLowerCL-1)/(1+prop*(HRLowerCL-1))*100;
   PAF_upper=prop*(HRUpperCL-1)/(1+prop*(HRUpperCL-1))*100;
proc print data=paf; where wrkhours=4;
   id dgnro;
   var selite wrkhours HazardRatio HRLowerCL HRUpperCL PAF PAF_lower PAF_upper;
run;

*********************************************************************;
**  false-discovery-rate (FDR) correction  **;
data pdata;
input raw_p;
cards;
0.0043
0.0041
0.9855
0.8521
0.0871
0.1220
0.00009
0.1830
0.0362
0.2373
;
run;
proc multtest inpvalues=pdata bonferroni fdr;
run;

*********************************************************************;
```

```
** Figure 5 **;
************************************************************************;
** outcome disease = vasdg, exposure disease = altdg, **;
** data sets: Tyoaika_taudit (diseases), hlot2 (persons) **;
************************************************************************;
%macro coxtimedep (altdg,vasdg,resfile);
data hlot2;
   set hlot;
   IF wrkhours=4;
data altiste;
   set lib.Tyoaika_taudit;
   IF dgnro=&altdg;
   altistepvm=min(exslaalkupvm,slaalkupvm);
   keep tutknro altistepvm;
data tauti;
   set lib.Tyoaika_taudit;
   IF dgnro=&vasdg;
   rename exslaalkupvm=extautipvm slaalkupvm=tautipvm;
   keep tutknro exslaalkupvm slaalkupvm;
data t1;
   merge hlot2(in=i) altiste tauti;
   by tutknro;
   if i;
run;
data t2;
   set t1;
   if &vasdg IN (79,81,82,83,84) then seurloppupvm=mortseurloppupvm;

   if altistepvm>seurloppupvm then altistepvm=.;
   if tautipvm>seurloppupvm then tautipvm=.;

   if .<altistepvm<alkupvm then altistepvm=alkupvm;
   altaika=round((altistepvm-alkupvm+1)/365.25,0.01);
   if .<tautipvm<altistepvm then do; altaika=.; tauti_alt=1; end;

   if tautipvm>. then status=1; else status=0;
   seuraika=(min(tautipvm,kuolinpvm,seurloppupvm)-alkupvm+1)/365.25;
   seuraika=round(seuraika,0.01);

   if altaika=. then altaika=seuraika;
   if 0<=altaika<seuraika then altistus=1; else altistus=0;
   if altaika=0 then altistus0=1; else altistus0=0;

   if &vasdg IN
(4,5,6,7,8,9,10,11,12,15,18,20,21,22,24,25,26,28,33,34,35,36,38,39,40,41,42,43,44,48,49,52,59,60,66,1,13,14,
17,23,30,31,32,46,50,56,58,65,67) and extautipvm>. then extauti=1;
   if (sex=1 and &altdg IN (8,67,68,69,70)) or (sex=2 and &altdg=9) or
     (sex=1 and &vasdg IN (8,67,68,69,70)) or (sex=2 and &vasdg=9) then status=.;
   if study=2 and (&altdg IN (75,76,77,78) or &vasdg IN (75,76,77,78)) then status=.;
   if extauti=1 or status=. then delete;
run;
proc freq data=t2 noprint;
   tables altistus*status / out=altn;
   data alt0; set altn; if altistus=1 and status=0; alt_status0=count; keep alt_status0;
   data alt1; set altn; if altistus=1 and status=1; alt_status1=count; keep alt_status1;
proc phreg data=t2;
   model seuraika*status(0) = sex age study timedep_altistus / rl;
   if seuraika<=altaika then timedep_altistus=0; else timedep_altistus=1;
   ods output ParameterEstimates=pe CensoredSummary=cs;
   data pe; set pe(firstobs=4);
   data res; merge pe cs alt0 alt1; vastedg=&vasdg; altistedg=&altdg;
   alt_Total=sum(alt_status0,alt_status1); alt_Event=alt_status1;
```

```
    keep parameter altistedg vastedg Total Event HazardRatio HRLowerCL HRUpperCL ProbChiSq alt_Total
  alt_Event;
    data vTautiselitteet; set lib.Tautiselitteet; rename dgnro=vastedg selite=vselite;
    data aTautiselitteet; set lib.Tautiselitteet; rename dgnro=altistedg selite=aselite;
    data res; merge res(in=i) vTautiselitteet; by vastedg; if i;
    data res; merge res(in=i) aTautiselitteet; by altistedg; if i; run;
  proc append base=&resfile data=res;
  run;
  %mend;
  ************************************************************************;
  **  selected diseases **;
  proc datasets lib=work memtype=data nolist; delete results; quit;
  %coxtimedep(2,15,results);
  %coxtimedep(2,9,results);
  %coxtimedep(15,2,results);
  %coxtimedep(9,2,results);
  proc print data=results;
    id altistedg;
    var aselite vastedg vselite HazardRatio HRLowerCL HRUpperCL ProbChiSq Total Event alt_Total
  alt_Event;
  run;

************************************************************************;
**  eTable 5  (proportionality tests) **;
************************************************************************;
%macro coxph (dg,altiste,resfile);
data tauti;
   set lib.Tyoaika_taudit;
   IF dgnro=&dg;
data t1;
   merge hlot(in=i) tauti;
   by tutknro;
   if i;
data t2;
   set t1;
   if .<slaalkupvm<=seurloppupvm then status=1; else status=0;
   seuraika=(min(slaalkupvm,kuolinpvm,seurloppupvm)-alkupvm+1)/365.25;
   if &dg IN (79,81,82,83,84) then do;
   if .<slaalkupvm<=mortseurloppupvm then status=1; else status=0;
   seuraika=(min(slaalkupvm,kuolinpvm,mortseurloppupvm)-alkupvm+1)/365.25; end;
   if &dg IN (4,5,6,7,8,9,10,11,12,15,18,20,21,22,24,25,26, 28,33,34,35,36,38,39,40,41,42,43,44,
     48,49,52,59,60,66,1,13,14,17,23,30,31,32,46,50,56,58,65,67) and exslaalkupvm>. then extauti=1;
   if seuraika<=0 or extauti=1 or (sex=1 and &dg IN (8,67,68,69,70)) or (sex=2 and &dg=9)
     then do; status=.; seuraika=.; end;
   if study=2 and &dg IN (75,76,77,78) then do; status=.; seuraika=.; end;
   alt0=0; alt2=0; alt3=0; alt4=0;
   if &altiste=0 then alt0=1;
   if &altiste=2 then alt2=1;
   if &altiste=3 then alt3=1;
   if &altiste=4 then alt4=1;
proc phreg data=t2;
   class ses;
   model seuraika*status(0) = sex age ses study alt0 alt2 alt3 alt4 alttime0 alttime2 alttime3 alttime4 / rl;
   alttime0=alt0*log(seuraika);
   alttime2=alt2*log(seuraika);
   alttime3=alt3*log(seuraika);
   alttime4=alt4*log(seuraika);
   proportionality_test: test alttime0, alttime2, alttime3, alttime4;
   ods output CensoredSummary=cs TestStmts=ph;
   data res; merge cs ph; dgnro=&dg;
   keep dgnro Total Event label WaldChiSq DF ProbChiSq;
   data res; merge res(in=i) lib.Tautiselitteet; by dgnro; if i;
proc append base=&resfile data=res;
```

```
run;
%mend;
** all diseases **;
proc datasets lib=work memtype=data nolist; delete results; quit;
%MACRO coxkaikki;
%DO I = 1 %TO 83;
  %coxph(&I,wrkhours,results);
%END;
%MEND coxkaikki;
%coxkaikki;
proc print data=results;
   id dgnro;
   var selite Total Event label WaldChiSq DF ProbChiSq;
run;

*************************************************************************;
**  eFigure 1  (log-log plot)  **;
*************************************************************************;
proc lifetest data=t2 notable plots=(logsurv, lls);
time seuraika*status(0);
strata wrkhours;
run;

*************************************************************************;
**  eFigure 2 (Kaplan-Meier)  **;
*************************************************************************;
data d1;
   set lib.Tyoaika_taudit;
   IF dgnro=79;
data d2;
   merge hlot(in=i) d1;
   by tutknro;
   if i;
data d3;
   set d2;
   if .<slaalkupvm<=seurloppupvm then status=1; else status=0;
   seuraika=(min(slaalkupvm,kuolinpvm,seurloppupvm)-alkupvm+1)/365.25;
   if dgnro IN (79,81,82,83,84) then do;
   if .<slaalkupvm<=mortseurloppupvm then status=1; else status=0;
   seuraika=(min(slaalkupvm,kuolinpvm,mortseurloppupvm)-alkupvm+1)/365.25; end;
   if dgnro IN (4,5,6,7,8,9,10,11,12,15,18,20,21,22,24,25,26,28,33,34,35,36,38,39,40,41,42,43,44,
     48,49,52,59,60,66,1,13,14,17,23,30,31,32,46,50,56,58,65,67) and exslaalkupvm>. then extauti=1;
   if seuraika<=0 or extauti=1 or (sex=1 and dgnro IN (8,67,68,69,70)) or (sex=2 and dgnro=9)
     then delete;
   if study=2 and dgnro IN (75,76,77,78) then do; status=.; seuraika=.; end;
   age_end=age+seuraika;
run;
************************;
proc phreg data=d3;
model (age age_end)*status(0) = ;
strata wrkhours;
baseline out=apu1 survival=survival;
run;
data apu2;
set apu1;
rename age_end=time wrkhours=group;
run;
data apu3;
set apu2;
by group;
retain prehazard 0;
hazard=1-survival;
if (hazard>. and hazard NE prehazard) or first.group;
```

```
prehazard=hazard;
keep group time hazard;
data apu4;
set apu3;
retain prehazard pregroup 0;
if group=pregroup then do;
cumhazard=prehazard; output; end;
cumhazard=hazard; output;
pregroup=group;
prehazard=hazard;
keep group time cumhazard;
data apu4;
set apu4;
cumhazard=100*cumhazard;
run;
proc print data=apu4; ** => Excel figure **;
run;

*************************************************************************;
**  eTable 11 (time-dependent working hours)  **;
*************************************************************************;
%macro coxit2 (dg,altiste,resfile);
data tauti;
   set lib.Tyoaika_taudit;
   IF dgnro=&dg;
data t1;
   merge hlot(in=i) tauti lib.Tyoaika_2004;
   by tutknro;
   if i;
data t2;
   set t1;
   if .<slaalkupvm<=seurloppupvm then status=1; else status=0;
   seuraika=(min(slaalkupvm,kuolinpvm,seurloppupvm)-alkupvm+1)/365.25;
   if &dg IN (79,81,82,83,84) then do;
   if .<slaalkupvm<=mortseurloppupvm then status=1; else status=0;
   seuraika=(min(slaalkupvm,kuolinpvm,mortseurloppupvm)-alkupvm+1)/365.25; end;
   if &dg IN (4,5,6,7,8,9,10,11,12,15,18,20,21,22,24,25,26,28,33,34,35,36,38,39,40,41,42,43,44,
     48,49,52,59,60,66,1,13,14,17,23,30,31,32,46,50,56,58,65,67) and exslaalkupvm>. then extauti=1;
   if seuraika<=0 or extauti=1 or (sex=1 and &dg IN (8,67,68,69,70)) or (sex=2 and &dg=9)
     then do; status=.; seuraika=.; end;
   if study=2 and &dg IN (75,76,77,78) then do; status=.; seuraika=.; end;
   if wrkhours2=. then wrkhours2=wrkhours;
   alt10=0; alt12=0; alt13=0; alt14=0;
   if wrkhours=0 then alt10=1;
   if wrkhours=2 then alt12=1;
   if wrkhours=3 then alt13=1;
   if wrkhours=4 then alt14=1;
   alt20=0; alt22=0; alt23=0; alt24=0;
   if wrkhours2=0 then alt20=1;
   if wrkhours2=2 then alt22=1;
   if wrkhours2=3 then alt23=1;
   if wrkhours2=4 then alt24=1;
proc phreg data=t2;
   class ses;
   model seuraika*status(0) = sex age ses study td_wrkho td_wrkh2 td_wrkh3 td_wrkh4 / rl;
   if study=1 then do;
     if 0<=seuraika<4 then do; td_wrkho=alt10; td_wrkh2=alt12; td_wrkh3=alt13; td_wrkh4=alt14; end;
     if seuraika>=4 then do; td_wrkho=alt20; td_wrkh2=alt22; td_wrkh3=alt23; td_wrkh4=alt24; end;
   end;
   if study=2 then do;
     if 0<=seuraika<5 then do; td_wrkho=alt10; td_wrkh2=alt12; td_wrkh3=alt13; td_wrkh4=alt14; end;
     if seuraika>=5 then do; td_wrkho=alt20; td_wrkh2=alt22; td_wrkh3=alt23; td_wrkh4=alt24; end;
   end;
```

```
   ods output ParameterEstimates=pe1; run;
   data res; set pe1; if substr(Parameter,1,3)='td_'; dgnro=&dg;
   keep parameter dgnro HazardRatio HRLowerCL HRUpperCL ProbChiSq;
   data res; merge res(in=i) lib.Tautiselitteet; by dgnro; if i;
proc append base=&resfile data=res;
run;
%mend;
**  selected diseases **;
proc datasets lib=work memtype=data nolist; delete results; quit;
%coxit2(2,wrkhours,results);
%coxit2(15,wrkhours,results);
%coxit2(58,wrkhours,results);
%coxit2(73,wrkhours,results);
%coxit2(82,wrkhours,results);
%coxit2(79,wrkhours,results);
proc print data=results;
   id dgnro;
   var selite parameter HazardRatio HRLowerCL HRUpperCL ProbChiSq;
run;

*************************************************************************;
**  eTable 12 (multimorbidity)  **;
*************************************************************************;
data valtaudit1; ** selected diseases **;
   set lib.Tyoaika_taudit;
   IF dgnro IN (2,15,58,73,82);
proc freq data=valtaudit1 noprint; where dgnro=15 and exslaalkupvm>.;
   tables tutknro / out=poisprev; ** prevalent disease **;
data valtaudit2;
   set valtaudit1;
   if slaalkupvm>.;
proc sort data=valtaudit2;
   by tutknro slaalkupvm;
run;
data ekatauti; ** 1. disease **;
   set valtaudit2;
   by tutknro;
   if first.tutknro;
   rename dgnro=dgnro1 slaalkupvm=slaalkupvm1;
   keep tutknro dgnro slaalkupvm;
run;
data tokatauti;
   set valtaudit2;
   by tutknro;
   if first.tutknro then delete;
data tokatauti; ** 2. disease **;
   set tokatauti;
   by tutknro;
   if first.tutknro;
   rename dgnro=dgnro2 slaalkupvm=slaalkupvm2;
   keep tutknro dgnro slaalkupvm;
run;
data multi1; ** disease pairs **;
   merge ekatauti tokatauti(in=i);
   by tutknro;
   if i;
run;
************************************************;
data t1;
   merge hlot(in=i) poisprev(in=j) multi1;
   by tutknro;
   if i and NOT j;
data t2;
```

```
   set t1;
   if .<slaalkupvm2<=seurloppupvm then status=1; else status=0;
   seuraika=(min(slaalkupvm2,kuolinpvm,seurloppupvm)-alkupvm+1)/365.25;
   if status=0 then dgpari='';
   if seuraika<=0 then delete;
run;
** multimorbidity HR **;
proc phreg data=t2;
   class wrkhours(ref='1') ses;
   model seuraika*status(0) = sex age ses study wrkhours / rl;
run;

*************************************************************************************;
**  eTable 13 **;
*************************************************************************************;
proc genmod data=hlot2;
   class wrkhours ses;
   model resp = wrkhours  / dist=bin link=log;
*    model resp = sex age ses study wrkhours  / dist=bin link=log;
   lsmeans wrkhours / exp cl;
   ** Risk Ratios **;
   estimate '0 vs 1' wrkhours 1 -1 0 0;
   estimate '2 vs 1' wrkhours 0 -1 1 0;
   estimate '3 vs 1' wrkhours 0 -1 0 1;
   estimate '4 vs 1' wrkhours 0 -1 0 0 1;
run;

*************************************************************************************;
**  eTable 16  **;
*************************************************************************************;
proc means data=lib.Tyoaika_taudit nway noprint;
where dgnro IN (2,15,58,73); ** selected diseases **;
   var exslaalkupvm slaalkupvm;
   class tutknro;
   output out=taudit min=;
run;
data hlot3;
   merge hlot1(in=i) taudit;
   by tutknro;
   if i;
data hlot4;
   set hlot3;
   ** long working hours, no disease **;
 IF wrkhours=4 and wrkhours2>. and exslaalkupvm=.;
   if 0<=wrkhours2<=3 then wrkhours2=0;
   if alkupvm<=slaalkupvm<=vastauspvm2 then sick=1;
   else sick=0;
run;
proc genmod data=hlot4;
   class ses;
   model wrkhours2(ref='0') = sex age ses study sick  / dist=bin link=log;
*    model wrkhours2(ref='0') = sex age ses study sick sex*sick  / dist=bin link=log;
   estimate '1 vs 0' sick 1;
run;
```

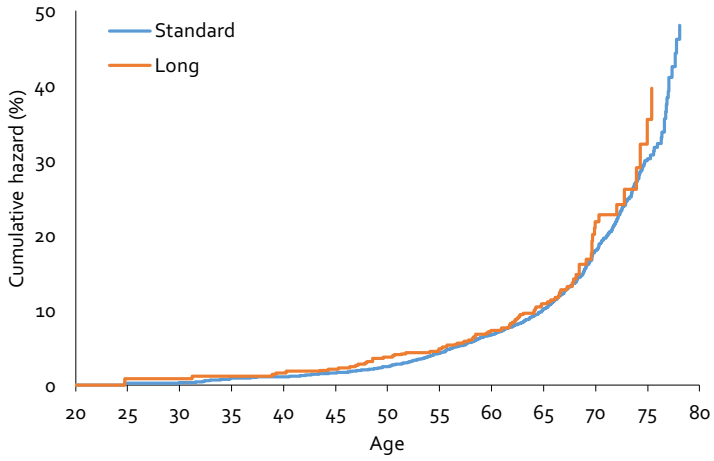
Web appendix 6: Supplementary results to primary analysis

eTable 6. Hazard ratios for long (>55 h/wk) versus regular (35-40 h/wk) working hours at baseline in relation to risk of 46 disease and 4 death outcomes in primary analysis (follow-up until 65).

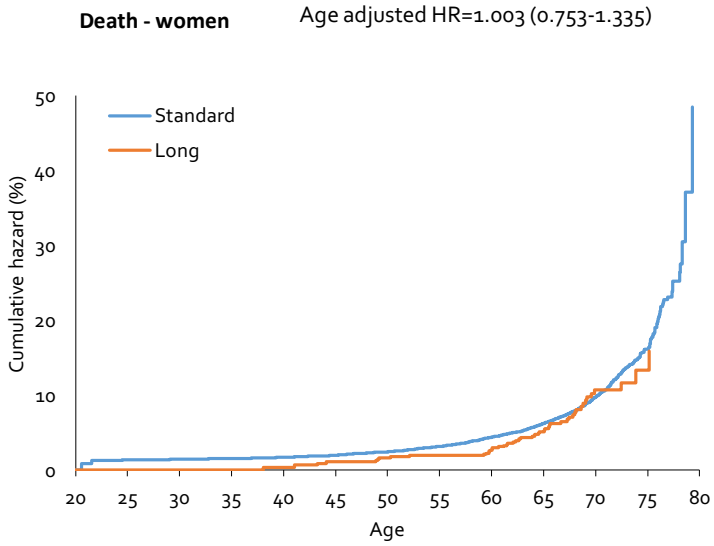
			Model 1		Model 2	
ICD-10 disease chapter **Disease endpoint**	**35-40 h/wk** **N(cases)/N(total)**	**≥55 h/wk** **N(cases)/N(total)**	**HR**	**95% CI**	**HR**	**95% CI**
1. Infections	1414/39598	133/2729	1.45*	1.19-1.75	1.37*	1.13-1.67
2. Bacterial infections	1252/39905	117/2747	1.47*	1.19-1.80	1.41*	1.15-1.74
3. Cancer	3001/39510	191/2738	0.98	0.83-1.15	1.00	0.85-1.18
4. Melanoma	573/39870	34/2746	1.15	0.74-1.77	1.00	0.65-1.56
5. Breast cancer	1361/31581	70/1257	1.38*	1.06-1.79	1.23	0.95-1.60
6. Prostate cancer	218/8081	47/1485	1.33	0.90-1.96	1.34	0.91-1.98
7. Leukaemia, lymphoma	302/39864	25/2744	1.48	0.93-2.35	1.35	0.85-2.16
8. Endocrine diseases	1352/39575	139/2714	1.25*	1.05-1.50	1.25	1.04-1.50
9. Diabetes	2641/39505	202/2715	1.32*	1.13-1.54	1.18	1.01-1.38
10. Mental and behavioural disorders	923/39677	62/2733	0.94	0.71-1.23	0.83	0.62-1.09
11. Disorders due to substance abuse	265/39905	25/2747	1.22	0.79-1.88	0.85	0.54-1.32
12. Mood disorders	459/39800	30/2743	0.97	0.66-1.41	0.95	0.64-1.39
13. Diseases of the nervous system	2881/39233	223/2706	1.20*	1.04-1.39	1.26*	1.09-1.45
14. Epilepsy	264/39630	27/2733	1.72*	1.13-2.62	1.62	1.05-2.48
15. TIA	366/39886	29/2745	1.40	0.94-2.08	1.29	0.86-1.93
16. Sleep disorders	1123/39905	103/2747	1.72*	1.39-2.13	1.33	1.07-1.65
17. Diseases of the eye	2743/39636	144/2733	0.85	0.70-1.05	0.83	0.67-1.01
18. Diseases of the ear	535/39701	41/2733	1.10	0.78-1.54	1.10	0.78-1.55
19. Diseases of the circulatory system	4740/38391	370/2654	1.18*	1.05-1.32	1.09	0.97-1.22
20. Hypertension	3264/37235	241/2580	1.09	0.95-1.25	1.01	0.88-1.16
21. Ischemic heart diseases	1330/39664	117/2724	1.46*	1.19-1.79	1.12	0.91-1.38
22. Angina pectoris	566/39712	63/2733	1.68*	1.26-2.25	1.28	0.95-1.72
23. Myocardial infarction	410/39873	40/2741	1.69*	1.20-2.36	1.17	0.83-1.65
24. Arrhythmias	1783/39742	128/2728	1.28	1.03-1.58	1.09	0.87-1.36
25. Cerebrovascular diseases	635/39855	58/2740	1.38	1.02-1.86	1.18	0.87-1.59
26. Stroke	543/39868	51/2743	1.41	1.02-1.95	1.18	0.85-1.64
27. Cerebral infarction	356/39887	38/2745	1.71*	1.17-2.50	1.36	0.93-2.00
28. Diseases of the respiratory system	3029/38616	211/2636	0.95	0.82-1.11	0.95	0.82-1.11
29. Influenza and pneumonia	1043/39905	71/2747	1.10	0.85-1.43	1.04	0.80-1.36
30. Asthma	1644/38467	98/2662	0.93	0.75-1.16	1.07	0.86-1.34
31. Diseases of the digestive system	5171/38427	401/2659	1.16*	1.04-1.29	1.05	0.94-1.16
32. Appendicitis	591/39905	43/2747	1.05	0.76-1.44	1.02	0.74-1.41
33. Diseases of liver	366/39905	29/2747	1.31	0.86-1.99	1.22	0.80-1.87

34. Diseases of the skin	536/39739	43/2733	1.01	0.72-1.42	1.01	0.71-1.43
35. Diseases of the musculoskeletal system	7985/37123	597/2604	1.11*	1.02-1.21	1.15*	1.06-1.26
36. Rheumatoid arthritis and related disorders	1011/39398	76/2718	1.32	1.03-1.69	1.54*	1.20-1.98
37. Osteoarthritis	2935/39905	192/2747	1.05	0.89-1.23	1.08	0.92-1.27
38. Sciatica	743/39905	82/2747	1.62*	1.28-2.05	1.62*	1.28-2.05
39. Back pain	333/39905	30/2747	1.24	0.83-1.84	1.25	0.83-1.87
40. Soft tissue disorders	2861/39905	205/2747	1.05	0.91-1.22	1.08	0.93-1.25
41. Diseases of the genitourinary system	5599/37592	307/2664	0.78*	0.69-0.89	1.04	0.92-1.18
42. Pregnancy complications	2935/39905	36/1240	0.82	0.59-1.15	1.01	0.72-1.41
43. Circulatory and respiratory symptoms	994/39905	110/2747	1.66*	1.35-2.04	1.49*	1.21-1.84
44. Digestive and abdominal symptoms	1116/39905	76/2747	0.93	0.72-1.19	1.13	0.87-1.46
45. Injury	4551/39905	415/2747	1.42*	1.28-1.58	1.27*	1.14-1.41
46. Falls	2068/31770	118/1418	1.31*	1.07-1.59	1.22	1.00-1.50
47. Overall mortality	1709/39905	136/2747	1.26	1.02-1.55	1.04	0.84-1.29
48. Death, cancer	888/39905	52/2747	0.81	0.56-1.18	0.78	0.54-1.14
49. Death, cardiovascular	218/39905	31/2747	2.32*	1.51-3.58	1.68	1.08-2.61
50. Death, other reason	603/39905	53/2747	1.44	1.04-2.00	1.05	0.75-1.47

Model 1 is unadjusted; Model 2 is adjusted for age, sex, SES, and cohort.
*Statistically significant after adjustment for False Discovery Rate of 5%.
For clarity, significant associations are highlighted.



Worktime	Age	Number of participants at risk	Cum number of cases
Standard	20	55	0
	30	1009	2
	40	2508	16
	50	3472	59
	60	3634	234
	70	927	483
	80	0	573
Long	20	14	0
	30	212	1
	40	493	4
	50	595	16
	60	577	41
	70	92	80
	80	0	87



Worktime	Age	Number of participants at risk	Cum number of cases
Standard	20	114	0
	30	3411	4
	40	9999	24
	50	16205	122
	60	15479	462
	70	4190	953
	80	1	1136
Long	20	4	0
	30	112	0
	40	343	1
	50	573	7
	60	681	14
	70	184	46
	80	0	49

eFigure 2. Crude cumulative hazard of death by age, sex and working hours

eTable 7. Associations between selected diseases* and long working hours (>54 h/wk) **by sex**. Follow-up until 65 years.

		Men			Women			
Disease	**Work hours/week**	**N of events/ Total N**	**HR**	**95% CI**	**N of events/ Total N**	**HR**	**95% CI**	**P for interaction (regular or long hours × sex)**
Bacterial infections	35-40	243/8086	1		806/31819	1		
	≥55	59/1486	1.36	1.02-1.82	43/1261	1.43	1.05-1.95	0.99
Diabetes	35-40	605/7938	1		1537/31567	1		
	≥55	108/1466	1.12	0.91-1.38	71/1249	1.26	0.99-1.59	0.56
Epilepsy	35-40	51/8036	1		164/31594	1		
	≥55	13/1480	1.27	0.68-2.36	12/1253	2.06	1.14-3.71	0.50
Sleep disorders	35-40	349/8086	1		614/31819	1		
	≥55	64/1486	1.23	0.94-1.62	30/1261	1.43	0.99-2.07	0.63
Rheumatoid arthritis and related	35-40	116/8013	1		756/31385	1		
	≥55	25/1475	1.34	0.86-2.08	44/1243	1.61	1.18-2.18	0.39
Sciatica	35-40	169/8086	1		549/31819	1		
	≥55	41/1486	1.35	0.96-1.92	40/1261	1.97	1.42-2.72	0.09
Circulatory and respiratory symptoms	35-40	245/8086	1		633/31819	1		
	≥55	60/1486	1.33	1.00-1.77	43/1261	1.65	1.20-2.26	0.39
Falls	35-40	365/5033	1		1428/26737	1		
	≥55	49/550	1.27	0.94-1.72	53/868	1.15	0.88-1.52	0.64
All-cause death	35-40	366/8086	1		727/31819	1		
	≥55	61/1486	0.96	0.73-1.26	34/1261	1.19	0.84-1.69	0.38
Cardiovascular death	35-40	71/8086	1		73/31819	1		
	≥55	21/1486	1.84	1.12-3.04	4/1261	1.34	0.49-3.69	0.68

* Diseases with statistically significant ($p<0.05$) association with working ≥55 h/week. Disease chapters were omitted, if specific disease(s) within the chapter had statistically significant association(s). Models adjusted for age and SES.

eTable 8. Associations between selected diseases* and long working hours (>54 h/wk) **by SES**. Follow-up until 65 years.

		Low SES (manual work)			**High SES (non-manual work)**			
Disease	**Work hours/ week**	**N of events/ Total N**	**HR**	**95% CI**	**N of events/ Total N**	**HR**	**95% CI**	**P for interaction (regular or long hours × SES)**
Bacterial infections	35-40	274/8388	1		773/31479	1		
	≥55	42/651	2.09	1.49-2.93	60/2089	1.12	0.86-1.46	0.03
Diabetes	35-40	673/8253	1		1468/31214	1		
	≥55	55/638	1.02	0.77-1.36	124/2070	1.18	0.97-1.42	0.19
Epilepsy	35-40	45/8311	1		170/31281	1		
	≥55	3/645	0.76	0.23-2.49	22/2081	1.85	1.17-2.93	0.18
Sleep disorders	35-40	291/8388	1		672/31479	1		
	≥55	26/651	1.06	0.70-1.59	67/2089	1.37	1.06-1.78	0.29
Rheumatoid arthritis and related	35-40	198/8293	1		674/31067	1		
	≥55	17/642	1.30	0.78-2.16	52/2069	1.54	1.16-2.06	0.68
Sciatica	35-40	162/8388	1		554/31479	1		
	≥55	19/651	1.30	0.79-2.12	62/2089	1.65	1.26-2.16	0.50
Circulatory and respiratory symptoms	35-40	251/8388	1		627/31479	1		
	≥55	36/651	1.61	1.12-2.31	66/2089	1.37	1.06-1.77	0.51

Falls	35-40	437/6451	1		1356/25319	1		
	≥55	30/304	1.36	0.93-1.97	72/1114	1.13	0.89-1.44	0.48
Cardiovascular death	35-40	57/8388	1		87/31479	1		
	≥55	11/651	1.85	0.95-3.61	14/2089	1.41	0.79-2.53	0.86

* Diseases with statistically significant ($p<0.05$) association with working >54 h/week. Disease chapters were omitted, if specific disease(s) within the chapter had statistically significant association(s). Models adjusted for age and sex.

eTable 9. Associations between selected diseases* and long working hours (≥55 h/wk) **by age**. Follow-up until 65 years.

		Age <=50			**Age>50**			
Disease	**Work hours/ week**	**N of events/ Total N**	**HR**	**95% CI**	**N of events/ Total N**	**HR**	**95% CI**	**P for interaction (regular or long hours × age)**
Bacterial infections	35-40	736/27984	1		313/11921	1		
	≥55	68/1889	1.36	1.11-1.85	34/858	1.35	0.99-2.04	0.94
Diabetes	35-40	1369/27779	1		773/11726	1		
	≥55	108/1872	1.11	0.99-1.48	71/843	1.08	0.91-1.50	0.99
Epilepsy	35-40	145/27770	1		70/11860	1		
	≥55	17/1878	1.74	1.07-3.02	8/855	1.30	0.65-2.95	0.70
Sleep disorders	35-40	748/27984	1		215/11921	1		
	≥55	69/1889	1.28	1.02-1.70	25/858	1.29	0.86-2.02	0.59
Rheumatoid arthritis and related	35-40	652/27687	1		220/11711	1		
	≥55	51/1872	1.58	1.26-2.25	18/846	1.26	0.78-2.08	0.53
Sciatica	35-40	579/27984	1		139/11921	1		
	≥55	61/1889	1.48	1.182.04	20/858	1.84	1.18-3.11	0.46
Circulatory and respiratory symptoms	35-40	538/27984	1		340/11921	1		
	≥55	68/1889	1.60	1.282.17	35/858	1.20	0.88-1.79	0.17
Falls	35-40	1239/21883	1		554/9887	1		
	≥55	66/926	1.09	0.89-1.46	36/492	1.34	0.97-1.92	0.58
Cardiovascular death	35-40	74/27984	1		70/11921	1		
	≥55	11/1889	1.49	0.77-2.87	14/858	1.88	1.04-3.43	0.59

* Diseases with statistically significant ($p<0.05$) association with working ≥55 h/week. Disease chapters were omitted, if specific disease(s) within the chapter had statistically significant association(s). Models adjusted for sex and SES**.**

eTable 10. Associations between selected diseases* and long working hours (>54 h/wk). Models adjusted for sex, age, ses **and lifestyle factors** (alcohol, smoking, physical inactivity, and BMI). Follow-up until 65 years.

Disease	**Work hours/week**	**N of events/ Total N**	**HR**	**95% CI**
Bacterial infections	35-40	1049/39905	1	
	≥55	102/2747	1.33	1.07-1.65
Diabetes	35-40	2142/39505	1	
	≥55	179/2715	1.02	0.86-1.20
Epilepsy	35-40	215/39630	1	
	≥55	25/2733	1.45	0.92-2.28
Sleep disorders	35-40	963/39905	1	
	≥55	94/2747	1.26	1.01-1.57
Rheumatoid arthritis and related	35-40	872/39398	1	
	≥55	69/2718	1.49	1.14-1.93
Sciatica	35-40	718/39905	1	
	≥55	81/2747	1.63	1.27-2.07
Circulatory and respiratory symptoms	35-40	878/39905	1	
	≥55	103/2747	1.52	1.23-1.88
Falls	35-40	1793/31770	1	
	≥55	102/1418	1.21	0.98-1.50
Cardiovascular death	35-40	144/39905	1	
	≥55	25/2747	1.50	0.95-2.38

* Diseases with statistically significant ($p<0.05$) association with working >54 h/week. Disease chapter was not shown, if specific disease(s) within the chapter had statistically significant association(s)

eTable 11. Associations between long working hours and multimorbidity (=having at least two of bacterial infections, diabetes, diseases of the musculoskeletal system, injury, or early cardiovascular death). Effect estimates are adjusted for sex, age, SES, and cohort.

Work hours/week	**N (total)**	**N (event)**	**HR**	**95% CI**
<35	5140	240	0.95	0.83-1.09
35-40	39505	2426	1	
41-48	9022	647	1.23	1.13-1.35
49-54	2613	164	1.06	0.90-1.25
≥55	218	2715	1.27	1.11-1.47

eTable 12. Associations between time-dependent long working hours and selected health outcomes (FPS 2000 and 2004; HeSSup 1998 and 2003). Effect estimates are adjusted for sex, age, SES, and cohort. Follow-up is until 65 years. Results from the main analysis (working hours measured at baseline) are provided for comparison.

		Time-dependent longitudinally measured working hours		**Working hours measured at baseline**	
Disease	**Work hours/week**	**HR**	**95% CI**	**HR**	**95% CI**
Bacterial infections	35-40	1		1	
	≥55	1.28	1.03-1.60	1.41	1.03-1.74
Diabetes	35-40	1		1	
	≥55	1.11	0.95-1.30	1.18	1.01-1.38
Diseases of the musculoskeletal system	35-40	1		1	
	≥55	1.23	1.13-1.34	1.15	1.06-1.26
Injury	35-40	1		1	
	≥55	1.23	1.11-1.37	1.22	1.00-1.50
Death	35-40	1		1	
	≥55	1.07	0.86-1.33	1.05	0.75-1.47
Cardiovascular death	35-40	1		1	
	≥55	1.71	1.10-2.67	1.68	1.08-2.61

eTable 13. Non-response* among employees working long hours compared to those working standard hours? Data are from FPS surveys 2000 and 2004 and HeSSup surveys 1998 and 2003.

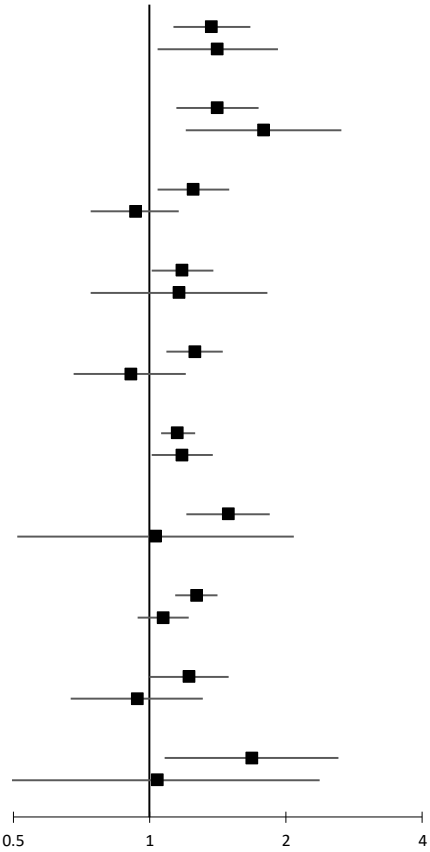
Survey 1	**Survey 2**		**HR**	**95% CI**
Work hours/wk	**Respondents/ Total**	**%**		
<35	946/4115	23	1.26	1.18-1.34
35-40	5953/32714	18	1	
41-48	1545/7646	20	1.11	1.06-1.48
49-54	555/2231	25	1.37	1.27-1.48
≥55	585/2362	25	1.36	1.26-1.47

eTable 14. Risk of disease* among non-responders compared to respondents. Results are from the FPS study. Effect estimates are adjusted for sex, age, and SES.

Disease	Response	N (total)	N (disease cases)	HR	95% CI
Bacterial infections	No	23048	697	1.05	0.96-1.16
Bacterial infections	Yes	47982	1334	1	
Diabetes	No	22770	1490	1.10	1.03-1.17
Diabetes	Yes	47467	2651	1	
Diseases of the musculoskeletal system	No	21198	4207	1.01	0.97-1.05
Diseases of the musculoskeletal system	Yes	44127	8757	1	
Injury	No	23048	2848	1.06	1.01-1.11
Injury	Yes	47982	5162	1	
Death from cardiovascular disease	No	23048	143	1.42	1.13-1.79
Death from cardiovascular disease	Yes	47982	167	1	
Death	No	23048	909	1.34	1.23-1.46
Death	Yes	47982	1295	1	

*Replicated outcomes only

Health outcome Study cohort	Long working hours N (total)	 N (cases)	Hazard ratio for long (ref=standard) working hours (95% confidence interval)
All infectious diseases			
Primary analysis	2729	117	1.37 (1.13-1.67)
Replication analysis	1455	53	1.41 (1.04-1.92)
Bacterial infections			
Primary analysis	2747	102	1.41 (1.15-1.74)
Replication analysis	1462	34	1.79 (1.20-2.65)
Endocrine diseases			
Primary analysis	2714	139	1.25 (1.04-1.50)
Replication analysis	1433	92	0.93 (0.74-1.16)
Diabetes			
Primary analysis	2715	179	1.18 (1.01-1.38)
Replication analysis	1036	23	1.16 (0.74-1.82)
Diseases of the nervous system			
Primary analysis	2706	209	1.26 (1.09-1.45)
Replication analysis	1453	58	0.91 (0.68-1.20)
Diseases of the musculoskeletal system			
Primary analysis	2604	561	1.15 (1.06-1.26)
Replication analysis	1405	195	1.18 (1.01-1.38)
Circulatory and respiratory symptoms			
Primary analysis	2747	103	1.49 (1.21-1.84)
Replication analysis	1036	9	1.03 (0.51-2.08)
Injuries			
Primary analysis	2747	393	1.27 (1.14-1.41)
Replication analysis	1477	259	1.07 (0.94-1.22)
Falls			
Primary analysis	1418	102	1.22 (1.00-1.50)
Replication analysis	1957	44	0.94 (0.67-1.31)
Early cardiovascular death			
Primary analysis	2747	25	1.68 (1.08-2.61)
Replication analysis (Whitehall II only)	748	7	1.04 (0.45-2.37)



eFigure 3. Association between long working hours versus standard hours per week and selected* diseases. Replication cohorts with response rate less than 70% are excluded. Replication cohorts included: Whitehall II, WOLF, DWECS00, PUMA.

*Selected diseases were those with statistically significant ($p<0.05$) association with long working hours. ICD-10 disease chapters instead of specific diseases are shown if the replication cohorts had less than 20 events per specific disease among participants working long hours. Models adjusted for age, sex, socioeconomic status and cohort.

eTable 15. Association between onset of disease related to long working hours and reduction in subsequent working hours among participants with long working hours at baseline. Effect estimates are adjusted for sex, age, SES and cohort. *P for interaction 'sex × disease onset' = 0.0316*

	Onset of a disease between surveys at Time1 and Time2	Participants who worked long hours both at Time1 and Time2 % (N of events/N total)	RR	95% CI
All	No	31% (380/1225)	1	
	Yes	29% (53/183)	1.15	0.90-1.47
Men	No	36% (239/667)	1	
	Yes	38% (43/114)	0.98	0.76-1.27
Women	No	25% (141/558)	1	
	Yes	14% (10/69)	2.00	1.10-3.57

Web appendix 7: Sensitivity analysis with maximum follow-up

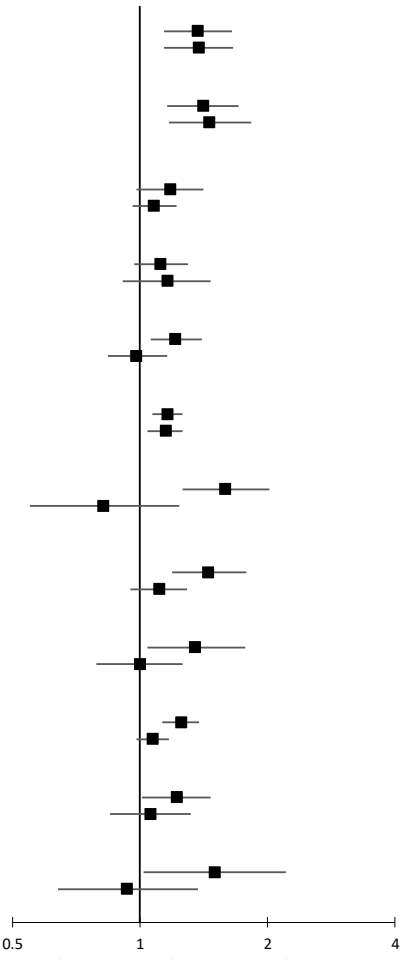
eTable 16. Age-, sex-, socioeconomic status- and cohort-adjusted hazard ratios for long (>55 h/wk) versus regular (35-40 h/wk) working hours at baseline in relation to risk of disease or death in sensitivity analysis with maximum follow-up

ICD-10 disease chapter (in bold) and disease endpoint	N (total)†	N (cases)	HR	95% CI
1. Infections	59154	2216	1.37*	1.14-1.65
2. Bacterial infections	59599	1959	1.41*	1.16-1.71
3. Cancer	59065	4408	1.02	0.88-1.19
4. Melanoma	59552	881	0.95	0.67-1.35
5. Breast cancer	43761	1889	1.21	0.95-1.53
6. Prostate cancer	15504	419	1.52	1.10-2.09
7. Leukaemia, lymphoma	59538	453	1.23	0.81-1.87
8. Endocrine diseases	59089	2073	1.18	0.98-1.41
9. Diabetes	58995	3859	1.12	0.97-1.30
10. Mental and behavioural disorders	59268	1369	0.84	0.65-1.10
11. Disorders due to substance abuse	59599	406	0.89	0.58-1.37
12. Mood disorders	59439	689	0.92	0.63-1.34
13. Diseases of the nervous system	58618	4269	1.21*	1.06-1.40
14. Epilepsy	59205	410	1.48	0.99-2.23
15. TIA	59570	564	1.15	0.78-1.70
16. Sleep disorders	59599	1740	1.28	1.40-1.58
17. Diseases of the eye	59205	3965	0.85	0.72-1.01
18. Diseases of the ear	59306	812	1.17	0.85-1.62
19. Diseases of the circulatory system	57444	7178	1.09	0.98-1.22
20. Hypertension	55800	4768	1.06	0.92-1.21
21. Ischemic heart diseases	59222	1993	1.11	0.91-1.34
22. Angina pectoris	59304	874	1.35	1.04-1.77
23. Myocardial infarction	59542	660	1.08	0.77-1.50
24. Arrhythmias	59335	2689	1.14	0.70-2.02
25. Cerebrovascular diseases	59521	1005	1.17	0.89-1.54
26. Stroke	59540	853	1.19	0.88-1.59
27. Cerebral infarction	59571	569	1.30	0.92-1.83
28. Diseases of the respiratory system	57683	4572	0.95	0.83-1.10
29. Influenza and pneumonia	59599	1570	0.99	0.78-1.27
30. Asthma	57522	2359	1.08	0.88-1.33
31. Diseases of the digestive system	57466	7894	1.04	0.94-1.15
32. Appendicitis	59599	896	0.99	0.72-1.36
33. Diseases of liver	59599	533	1.28	0.87-1.89
34. Diseases of the skin	59334	807	1.10	0.80-1.51
35. Diseases of the musculoskeletal system	55669	10969	1.16*	1.07-1.26
36. Rheumatoid arthritis and related disorders	58825	1483	1.47*	1.16-1.86
37. Osteoarthritis	59599	4282	1.11	0.96-1.29
38. Sciatica	59599	1159	1.59*	1.26-2.02
39. Back pain	59599	520	1.31	0.89-1.91
40. Soft tissue disorders	59599	4032	1.10	0.95-1.27

41. Diseases of the genitourinary system	56470	8046	1.03	0.92-1.16
42. Pregnancy complications	43116	109	1.01	0.72-1.41
43. Circulatory and respiratory symptoms	59599	1565	1.45*	1.19-1.78
44. Digestive and abdominal symptoms	59599	1615	1.18	0.93-1.50
45. Injury	59599	7186	1.25*	1.13-1.38
46. Falls	44635	3019	1.22	1.01-1.47
47. Overall mortality	59599	2567	1.01	0.84-1.20
48. Death, cancer	59599	1296	0.85	0.64-1.13
49. Death, cardiovascular	59599	357	1.50	1.02-2.21
50. Death, other reason	59599	914	0.99	0.75-1.13

*Statistically significant after adjustment for False Discovery Rate of 5%.
For clarity, significant associations are highlighted.

Health outcome Study cohort	Long working hours N (total)	 N (cases)	Hazard ratio for long (ref=standard) working hours (95% confidence interval)
All infectious diseases			
Primary analysis	2729	133	1.37 (1.14-1.65)
Replication analysis	2737	174	1.38 (1.14-1.66)
Bacterial infections			
Primary analysis	2747	117	1.41 (1.16-1.71)
Replication analysis	2403	115	1.46 (1.17-1.83)
Endocrine diseases			
Primary analysis	2714	139	1.18 (0.98-1.41)
Replication analysis	2853	331	1.08 (0.96-1.22)
Diabetes			
Primary analysis	2715	202	1.12 (0.97-1.30)
Replication analysis	2335	88	1.16 (0.91-1.47)
Diseases of the nervous system			
Primary analysis	2706	223	1.21 (1.06-1.40)
Replication analysis	2966	182	0.98 (0.84-1.16)
Diseases of the musculoskeletal system			
Primary analysis	2604	597	1.16 (1.07-1.26)
Replication analysis	2825	513	1.15 (1.04-1.26)
Sciatica			
Primary analysis	2747	82	1.59 (1.26-2.02)
Replication analysis	2385	28	0.82 (0.55-1.24)
Circulatory and respiratory symptoms			
Primary analysis	2747	110	1.45 (1.19-1.78)
Replication analysis	3023	220	1.11 (0.95-1.29)
Angina pectoris			
Primary analysis	2747	415	1.25 (1.13-1.38)
Replication analysis	2105	553	1.07 (0.98-1.17)
Injuries			
Primary analysis	1418	118	1.22 (1.01-1.47)
Replication analysis	1968	104	1.06 (0.85-1.32)
Falls			
Primary analysis	2747	31	1.50 (1.02-2.21)
Replication analysis	1971	33	0.93 (0.64-1.37)
Cardiovascular death			
Primary analysis	2733	63	1.35 (1.04-1.77)
Replication analysis	2379	91	1.00 (0.79-1.26)



eFigure 4. Association between long working hours versus standard hours per week and selected* diseases with maximum follow-up in primary and replication analyses.

*Selected diseases were those with statistically significant ($p<0.05$) association with long working hours. ICD-10 disease chapters instead of specific diseases are shown if the replication cohorts had less than 20 events per specific disease among participants working long hours. Models adjusted for age, sex, socioeconomic status and cohort.