Long working hours and risk of coronary heart disease and stroke: a systematic review and meta-analysis of published and unpublished data for 603 838 individuals

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Summary

Background Long working hours might increase the risk of cardiovascular disease, but prospective evidence is scarce, imprecise, and mostly limited to coronary heart disease. We aimed to assess long working hours as a risk factor for incident coronary heart disease and stroke.

Methods We identified published studies through a systematic review of PubMed and Embase from inception to Aug 20, 2014. We obtained unpublished data for 20 cohort studies from the Individual-Participant-Data Meta-analysis in Working Populations (IPD-Work) Consortium and open-access data archives. We used cumulative random-effects meta-analysis to combine effect estimates from published and unpublished data.

Findings We included 25 studies from 24 cohorts in Europe, the USA, and Australia. The meta-analysis of coronary heart disease comprised data for 603 838 men and women who were free from coronary heart disease at baseline; the meta-analysis of stroke comprised data for 528 908 men and women who were free from stroke at baseline. Follow-up for coronary heart disease was 5·1 million person-years (mean 8·5 years), in which 4768 events were recorded, and for stroke was 3·8 million person-years (mean 7·2 years), in which 1722 events were recorded. In cumulative meta-analysis adjusted for age, sex, and socioeconomic status, compared with standard hours (35–40 h per week), working long hours (≥55 h per week) was associated with an increase in risk of incident coronary heart disease (relative risk [RR] 1·13, 95% CI 1·02–1·26; p=0·02) and incident stroke (1·33, 1·11–1·61; p=0·002). The excess risk of stroke remained unchanged in analyses that addressed reverse causation, multivariable adjustments for other risk factors, and different methods of stroke ascertainment (range of RR estimates 1·30–1·42). We recorded a dose–response association for stroke, with RR estimates of 1·10 (95% CI 0·94–1·28; p=0·24) for 41–48 working hours, 1·27 (1·03–1·56; p=0·03) for 49–54 working hours, and 1·33 (1·11–1·61; p=0·002) for 55 working hours or more per week compared with standard working hours (p_{trend}<0·0001).

Interpretation Employees who work long hours have a higher risk of stroke than those working standard hours; the association with coronary heart disease is weaker. These findings suggest that more attention should be paid to the management of vascular risk factors in individuals who work long hours.

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Introduction

Long working hours have been implicated in the cause of cardiovascular disease.[1–4] In two meta-analyses of published cohort studies,[1,2] the risk of coronary heart disease was raised in employees working long hours compared with those working standard hours.[1,2] The relative risk was about 1·4, which, if substantiated, is substantial, because long working hours are fairly common.[5] However, several limitations in these studies could have biased the estimates.

First, publication bias (the increased likelihood that studies with significant findings will be published) might have distorted the evidence. Second, reverse causation might have changed effect estimates if employees with advanced underlying cardiovascular disease reduced their working hours in the years before the cardiovascular

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event.[3] Third, the association might be confounded; working long hours is more common in high socioeconomic status (SES) occupations,[6] but the incidence of cardiovascular diseases is higher in low SES occupations.[7] Fourth, few studies have examined long working hours as a risk factor for stroke, a major cardiovascular endpoint,[8,9] although stress and extensive sitting, both of which are associated with long working hours, could increase the risk of stroke.[10,11]

We did this meta-analysis of prospective cohort studies assessing long working hours and cardiovascular disease to overcome these limitations. We supplement published studies identified by systematic review with unpublished individual-participant data to examine the effect of publication bias and increase the precision of the estimates. Additionally, we address bias due to reverse causation by excluding disease events that took place in the first years of follow-up, control for confounding by stratifying analyses by SES, and examine associations with incident stroke and coronary heart disease.

Methods

Search strategy and selection criteria

In accordance with the PRISMA guidelines,[12] we identified published studies through a systematic review of PubMed and Embase from inception to Aug 20, 2014, with the following search terms without restrictions: ("work hours", "working hours", "overtime work") and ("coronary heart disease", "ischemic heart disease", "acute myocardial infarction", "angina pectoris", "chest pain", "stroke", "cerebrovascular", "cerebrovascular disease"). We also scrutinised the reference lists of all relevant major reviews,[1,2,13–15] and those of the eligible publications, and did a cited reference search using the Institute of Scientific Information Web of Science.

After exclusion of duplicate studies, two investigators (MKi and MV) independently reviewed titles and abstracts of the remaining articles to establish their eligibility on the basis of predefined inclusion criteria. We included studies that were published in English; had a prospective cohort study design with individual level exposure and outcome data; examined the effect of working hours; reported incident coronary heart disease or stroke as an outcome; and reported either estimates of relative risk (RR), odds ratios (ORs), or hazard ratios (HRs) with 95% CIs, or provided sufficient results to calculate these estimates.

Data extraction

We extracted the following information from each eligible article: name of the first author, start of the follow-up for coronary heart disease or stroke (year), study location (country), number of participants, number of coronary heart disease or stroke events, mean follow-up time, mean age of participants, proportion of women, method of coronary heart disease or stroke ascertainment, and covariates included in the adjusted models.

Unpublished individual-participant data

We supplemented data from the published studies with unpublished individual-level data from 13 European prospective cohort studies participating in the Individual-Participant-Data Meta-analysis in Working Populations (IPD-Work) Consortium (appendix).[16–29]

We located additional individual-level data by searching the Inter-University Consortium for Political and Social Research and the UK Data Service to identify eligible large-scale cohort studies for which data were publicly available. Seven cohort studies were identified (appendix).[30–36] All the studies with unpublished data

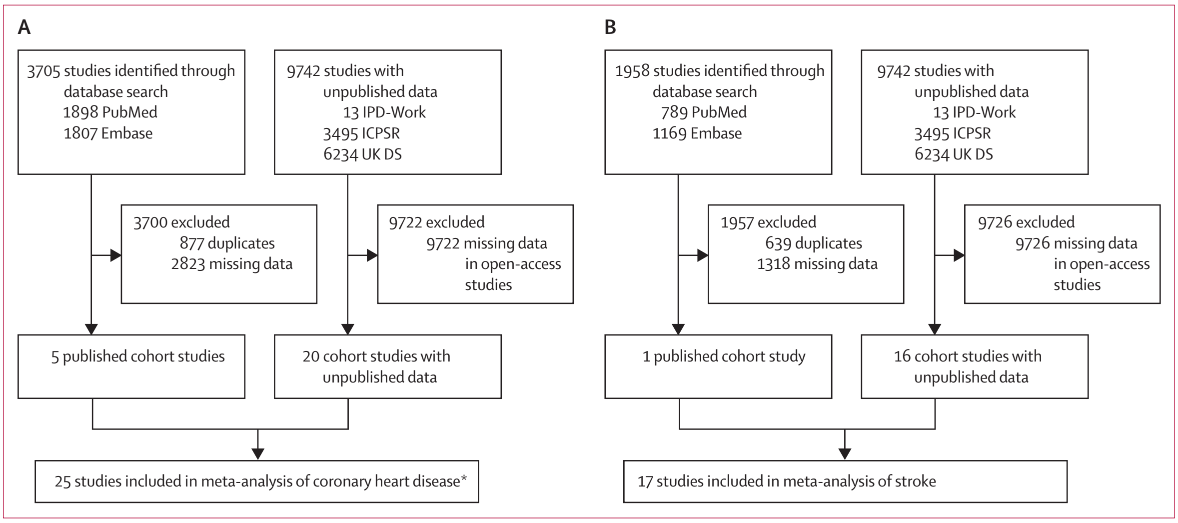


Figure 1: **Study selection**

(A) Long working hours and coronary heart disease. (B) Long working hours and stroke. *In one study published data[41] were used in the main analysis, but unpublished data from the IPD-Work Consortium[17] were used in subgroup and sensitivity analyses. IPD-Work=Individual-Participant-Data Meta-analysis in Working Populations Consortium. ICPSR=Inter-University Consortium for Political and Social Research. UK DS=UK Data Service.

were approved by the relevant local or national ethics committee and all participants gave informed consent to participate.

Harmonised covariates, including potential confounding and mediating factors, were age, sex, SES,[16] smoking,[37] body-mass index (BMI),[38] physical activity,[39] and alcohol consumption.[40] Additional covariates not available for all the studies were total cholesterol or hypercholesterolaemia, systolic blood pressure or hypertension, and diabetes.[41]

Quality assessment

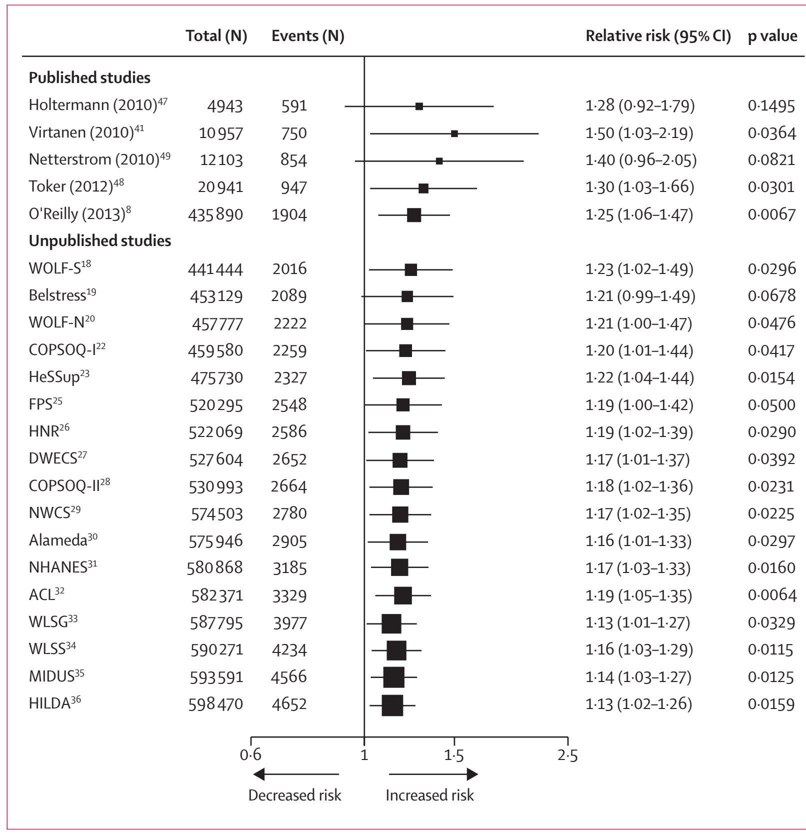
To assess the quality of included studies, we used the Cochrane Risk of Bias Tool for cohort studies.[42] We analysed selection of exposed and non-exposed groups, assessment of exposure, exclusion of the outcome of interest at study baseline, adjustment for confounding variables, assessment of confounding variables, assessment of outcome, and adequacy of the follow-up. The quality of the study was regarded as high if all domains were assessed favourably.

Statistical analysis

Because the proportional hazards assumption was not violated in the unpublished IPD-Work data (all p>0·20), we used Cox proportional hazards models to generate HRs and 95% CIs for the association between working hours and coronary heart disease or stroke in each of the IPD-Work studies. In the open-access studies, incident coronary heart disease and stroke events were self-reported and had no precise date of event. For these studies, we used logistic regression to calculate study specific ORs and 95% CIs for the association between working hours and coronary heart disease or stroke.

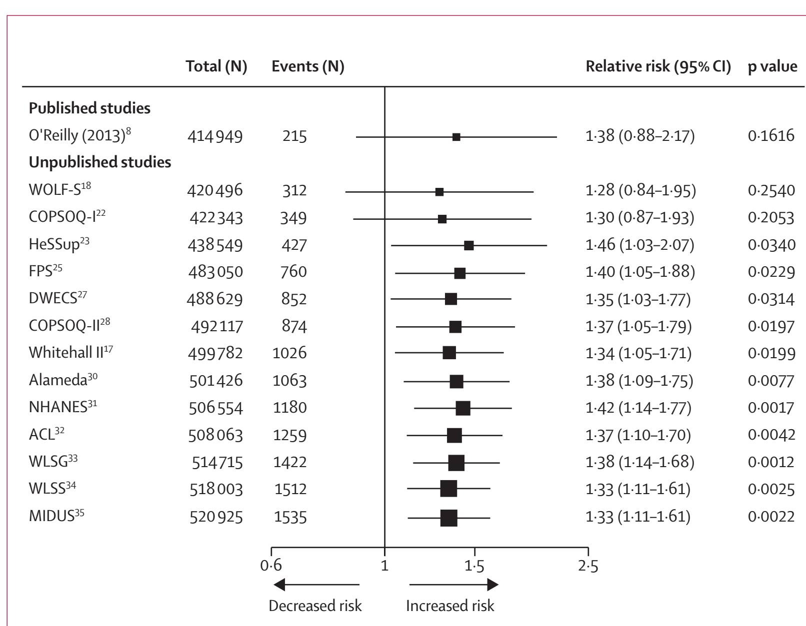
We used meta-analysis to combine the results from the analyses of the unpublished data and the estimates from the published studies reported as HRs or ORs. Because disease incidence was low in the cohort studies, we regarded ORs as close approximations of RR and combined them with HRs, resulting in a common estimate of RR.[43] In accordance with the Meta-Analysis of Observational Studies guidelines,[44] we used all available data in the main analysis and did a sensitivity analysis including only high-quality studies according to the assessment of bias.

We analysed associations of long working hours with incident coronary heart disease and stroke separately. The basic model included age, sex, and SES as covariates. For the unpublished individual-participant data, multivariable adjusted models were additionally adjusted for smoking, alcohol consumption, BMI and physical activity, total cholesterol or hypercholesterolaemia, systolic blood pressure or hypertension, and diabetes; the number of covariates depended on the availability of data. For published studies, we used the most comprehensively adjusted estimates in multivariable adjusted models.



	Total (N)	Events (N)	Relative risk (95% CI)	p value
Published studies				
Holtermann (2010)[47]	4943	591	1·28 (0·92–1·79)	0·1495
Virtanen (2010)[41]	10 957	750	1·50 (1·03–2·19)	0·0364
Netterstrom (2010)[49]	12 103	854	1·40 (0·96–2·05)	0·0821
Toker (2012)[48]	20 941	947	1·30 (1·03–1·66)	0·0301
O'Reilly (2013)[8]	435 890	1904	1·25 (1·06–1·47)	0·0067
Unpublished studies				
WOLF-S[18]	441 444	2016	1·23 (1·02–1·49)	0·0296
Belstress[19]	453 129	2089	1·21 (0·99–1·49)	0·0678
WOLF-N[20]	457 777	2222	1·21 (1·00–1·47)	0·0476
COPSOQ-I[22]	459 580	2259	1·20 (1·01–1·44)	0·0417
HeSSup[23]	475 730	2327	1·22 (1·04–1·44)	0·0154
FPS[25]	520 295	2548	1·19 (1·00–1·42)	0·0500
HNR[26]	522 069	2586	1·19 (1·02–1·39)	0·0290
DWECS[27]	527 604	2652	1·17 (1·01–1·37)	0·0392
COPSOQ-II[28]	530 993	2664	1·18 (1·02–1·36)	0·0231
NWCS[29]	574 503	2780	1·17 (1·02–1·35)	0·0225
Alameda[30]	575 946	2905	1·16 (1·01–1·33)	0·0297
NHANES[31]	580 868	3185	1·17 (1·03–1·33)	0·0160
ACL[32]	582 371	3329	1·19 (1·05–1·35)	0·0064
WLSG[33]	587 795	3977	1·13 (1·01–1·27)	0·0329
WLSS[34]	590 271	4234	1·16 (1·03–1·29)	0·0115
MIDUS[35]	593 591	4566	1·14 (1·03–1·27)	0·0125
HILDA[36]	598 470	4652	1·13 (1·02–1·26)	0·0159

Figure 2: **Cumulative meta-analysis of published and unpublished data of the association between long working hours and incident coronary heart disease**
Estimates adjusted for age, sex, and socioeconomic status.



	Total (N)	Events (N)	Relative risk (95% CI)	p value
Published studies				
O'Reilly (2013)[8]	414 949	215	1·38 (0·88–2·17)	0·1616
Unpublished studies				
WOLF-S[18]	420 496	312	1·28 (0·84–1·95)	0·2540
COPSOQ-I[22]	422 343	349	1·30 (0·87–1·93)	0·2053
HeSSup[23]	438 549	427	1·46 (1·03–2·07)	0·0340
FPS[25]	483 050	760	1·40 (1·05–1·88)	0·0229
DWECS[27]	488 629	852	1·35 (1·03–1·77)	0·0314
COPSOQ-II[28]	492 117	874	1·37 (1·05–1·79)	0·0197
Whitehall II[17]	499 782	1026	1·34 (1·05–1·71)	0·0199
Alameda[30]	501 426	1063	1·38 (1·09–1·75)	0·0077
NHANES[31]	506 554	1180	1·42 (1·14–1·77)	0·0017
ACL[32]	508 063	1259	1·37 (1·10–1·70)	0·0042
WLSG[33]	514 715	1422	1·38 (1·14–1·68)	0·0012
WLSS[34]	518 003	1512	1·33 (1·11–1·61)	0·0025
MIDUS[35]	520 925	1535	1·33 (1·11–1·61)	0·0022

Figure 3: **Cumulative meta-analysis of published and unpublished data of the association between long working hours and incident stroke**
Estimates adjusted for age, sex, and socioeconomic status.

	Events (N)	Total (N)	Relative risk (95% CI)	p value	Dose–response p value*
Coronary heart disease					
<35 h	478	16 022	1·08 (0·92–1·27)	0·3628	
35–40 h	1393	88 115	1·00 (reference)		
41–48 h	460	21 521	1·02 (0·91–1·15)	0·6980	0·18
49–54 h	281	8302	1·07 (0·92–1·24)	0·3946	
≥55 h	347	11 363	1·08 (0·94–1·23)	0·2738	
Stroke					
<35 h	243	14 189	1·20 (0·98–1·46)	0·0783	
36–40 h	774	67 102	1·00 (reference)		
41–48 h	241	18 768	1·10 (0·94–1·28)	0·2401	<0·0001
49–54 h	117	7206	1·27 (1·03–1·56)	0·0265	
≥55 h	132	7170	1·33 (1·11–1·61)	0·0022	

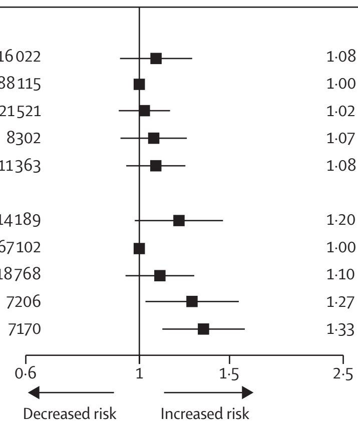


Figure 4: **Association of categories of weekly working hours with incident coronary heart disease and stroke**
Estimates adjusted for age, sex, and socioeconomic status. *For trend from standard to long working hours.

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See **Online** for appendix

For the **Inter-University Consortium for Political and Social Research** see http://www.icpsr.umich.edu/icpsrweb/ICPSR/

For the **UK Data Service** see http://ukdataservice.ac.uk/

We examined heterogeneity of the study-specific estimates with the I^2 statistic (higher values denote greater heterogeneity) and present the summary estimates of the random-effects analysis.[45] To describe the development of evidence over time, we did a cumulative meta-analysis of the association of working hours with coronary heart disease and stroke, based on date of publication and, for the IPD-Work and open-access unpublished data, year of baseline examination.[46] We estimated dose–response associations with generalised least-squares analysis of trend based on numbers of events and participants, effect estimates, and standard errors for the working hours categories (35–40 h, 41–48 h, 49–54 h, and ≥55 h per week).

We examined reverse causation by left-censoring—ie, exclusion from the analysis of coronary heart disease and stroke events that took place in the first 3 years of follow-up.[6,16] Only studies in which definite event times were known were used in this analysis. Prespecified subgroup analyses were done by sex, age group (<50 *vs* ≥50 years), SES (high, intermediate, low), region (Europe [including Israel] *vs* USA), method of outcome ascertainment (medical records *vs* self-report), and publication status (published *vs* unpublished), and assessed group differences with meta-regression. We examined publication bias in published studies with funnel plots.

We did statistical analyses with SAS (version 9.2) or Stata (MP version 11.2) to analyse study specific data, with the exception of data from the Netherlands Working Conditions Survey (NWCS)[29] for which we used SPSS (version 19). We used Stata (MP version 11.2) to compute the meta-analyses.

Role of the funding source

The funders of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. MKi, STN, IEHM, and WEH had full access to the IPD-Work consortium data and MJ had full access to the open-access datasets. MKi had final responsibility for the decision to submit for publication.

Results

Figure 1 shows a flow diagram for the study selection process. We identified 3705 studies of working hours and coronary heart disease and 1958 studies of working hours and stroke (figure 1). Six studies were eligible for inclusion: five about coronary heart disease[8,41,47–49] and one about stroke (figure 1).[8] We did not include two studies[50–52] that were included in previous meta-analyses[1,2] because they did not meet the inclusion criteria (the outcome was a cerebro–cardiovascular composite rather than either coronary heart disease or stroke). In combination, the published and unpublished data included in this meta-analysis comprised 25 studies from the USA,[30–35] Australia,[36] Finland,[23,25] Denmark,[21,22,24,27,28,47,49] Sweden,[18,20] the Netherlands,[29] Belgium,[19] Germany,[26] the UK,[17,41] Northern Ireland,[8] and Israel.[48] The definition of long working hours varied across published studies from 45 h or more[47] to 55 h or more per week.[8,41] In the studies with unpublished data,[17–36] 55 h or more per week are defined as long working hours and the reference category is 35–40 h. The appendix details characteristics of the study populations and quality assessment of the studies included. 17 (68%) of the 25 studies were assessed as being of high quality.[17–29,41,47,48,49]

603 838 men and women free from coronary heart disease at baseline contributed to the analysis of long working hours and incident coronary heart disease. 4768 of these individuals had an event during the mean follow-up of 8·5 years. Four of the five published studies and all the IPD-Work studies had a uniform definition of incident coronary heart disease, with non-fatal myocardial infarction (I21–I22 in International Classification of Diseases [ICD]-10; 410 in ICD-9; or in line with WHO MONICA definitions)[53] or coronary death (I21–I25 in ICD-10; 410–414 in ICD-9) recorded as the main cause of hospital admission or death.[17–29,41,47–49] In one published study, the outcome was fatal ischaemic heart disease from a national mortality register.[8] In studies from the open-access archives, incident coronary heart disease was assessed by self-report.

Figure 2 shows results of the cumulative meta-analysis adjusted for age, sex, and socioeconomic status. We excluded three IPD-Work studies from this analysis: Whitehall II[41] to avoid overlap with published data, and IPAW[21] and PUMA[24] because of no events in the exposure group. Working long hours was associated with a modest overall increase in risk of incident coronary heart disease compared with working standard hours (RR 1·13, 95% CI 1·02–1·26; p=0·02; figure 2). There was no significant heterogeneity in the study-specific estimates (I^2=0%, p=0·49; appendix).

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528 908 men and women free from stroke at baseline contributed to the analysis of long working hours and incident stroke. 1722 of these individuals had an event during mean follow-up of 7·2 years. The only published study available assessed fatal, but not non-fatal, stroke.[8] Incident stroke in the IPD-Work studies was defined with hospital and mortality records (I60, I61, I63, I64 in ICD-10; 430, 431, 433, 434, 436 in ICD-9). Incident stroke was based on self-reported data in the open-access datasets.

We excluded three IPD-Work studies from the cumulative meta-analysis of incident stroke (WOLF-N,[20] IPAW[21], and PUMA[24]) because of no events in the exposure group. Working long hours was associated with an increased risk of incident stroke (RR 1·33, 95% CI 1·11–1·61; p=0·002; figure 3). Again, there was no significant heterogeneity in the study-specific estimates (I^2=0%, p=0·67; appendix).

None of the published studies reported numbers of participants and events and RR for all categories of working hours. Thus, only IPD-Work and the open-access studies (20 for coronary heart disease[17–36] and 16 for stroke[17,18,20–25,27,28,30–35]) contributed to the dose–response analyses. No linear trend from standard to long working hours was shown for coronary heart disease; by contrast, we recorded a dose–response association for stroke (figure 4), for which the RR per one category increase in working hours was 1·11 (95% CI 1·05–1·17).

We recorded no evidence of significant bias arising from reverse causation, confounding, outcome ascertainment, publication status, geographical region, loss to follow-up, or study quality in the associations of long working hours with coronary heart disease and stroke (figure 5, appendix). Any subgroup differences were small with one exception: an analysis limited to high-quality studies showed an SES-dependent association between long working hours and coronary heart disease, with an RR of 2·18 (95% CI 1·25–3·81; p=0·006) in the low SES group, 1·22 (0·77–1·95; p=0·40) in the intermediate SES group, and 0·87 (0·55–1·38; p=0·56) in the high SES group (p=0·001 for difference between groups; appendix).

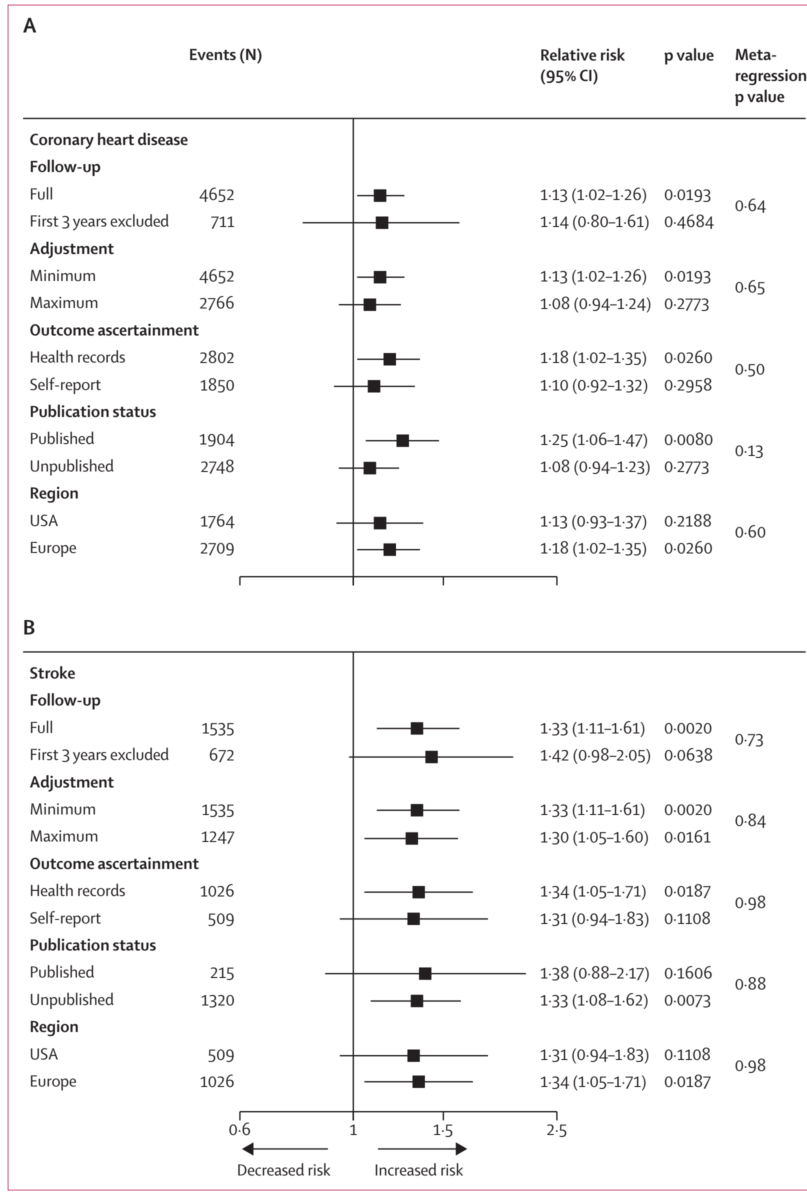

Figure 5: **Association of long working hours with incident coronary heart disease and stroke in relation to study follow-up, adjustments, outcome ascertainment, publication status, and region**
(A) Coronary heart disease. (B) Stroke. Estimates adjusted, when appropriate, for age, sex, and socioeconomic status.

Discussion

Our findings show that individuals who work 55 h or more per week have a 1·3-times higher risk of incident stroke than those working standard hours. There was no evidence of between-study heterogeneity, reverse causation bias, or confounding. Furthermore, the association did not vary between men and women or by geographical region, and was independent of the method of stroke ascertainment, suggesting that the finding is robust. Long working hours were also associated with incident coronary heart disease, but this association was weaker than that for stroke.

Combining estimates from published studies and unpublished data allowed us to examine the status of long working hours as a risk factor for coronary heart disease and stroke with greater precision and a more comprehensive evidence base than has previously been possible. Our findings are consistent with two previous meta-analyses[1,2] of long working hours and coronary heart disease reviewing prospective data from less than 15 000 participants—a substantially smaller evidence base than that in the present meta-analysis. Socioeconomic differences in the association between long working hours and coronary heart disease have been reported for mortality from ischaemic heart disease in Northern Ireland.[8] Our meta-analysis of high-quality cohort studies confirms a stronger association for fatal and non-fatal incident coronary heart disease in individuals with low SES occupations than in those with high SES occupations.

We are not aware of previous prospective cohort studies of the association between long working hours and incident stroke, although this association is biologically plausible. Sudden death from overwork is often caused by stroke and is believed to result from a repetitive triggering of the stress response.[4,54] Behavioural mechanisms, such as physical inactivity, might also link long working hours and stroke; a hypothesis supported by evidence of an increased risk of incident stroke in individuals who sit for long periods at work.[11] Physical inactivity can increase the risk of stroke through various biological mechanisms,[55–58] and heavy alcohol consumption—a risk factor for all types of stroke[59–61]—might be a contributing factor because employees working long hours seem to be slightly more prone to risky drinking than are those who work standard hours.[62] Some, albeit inconsistent, evidence suggests that individuals who work long hours are more likely to ignore symptoms of disease and have greater prehospital delays in relation to acute cardiovascular events than do those who work standard hours.[63]

Our meta-analysis has some limitations. A large proportion of the unpublished individual-participant data was from the IPD-Work Consortium, which is based on a convenience sample potentially contributing to availability bias. Exposure to long working hours was based on self-report and was measured only once. Because the tendency to work long hours is not necessarily stable over time, further research on prolonged exposure to long working hours, preferably with objective measures, is needed to establish whether our findings are underestimated because of misclassification of the exposure. In two studies,[30,36] high loss to follow-up could also have contributed to an underestimation of associations, although this bias seemed to be small or absent in the total data. We had harmonised data for multivariable adjustments for age, sex, SES, smoking, BMI, physical activity, and alcohol consumption, but not for salt intake and blood-based risk factors. Ascertainment of coronary heart disease and stroke varied, ranging from medical records of brain imaging and autopsy to repeated self-report questionnaires; therefore, some outcome misclassification is possible. However, the absence of heterogeneity in the study-specific estimates, and the uniform findings in the analyses stratified by method of ascertainment, suggest that this misclassification is not a major source of bias.

In conclusion, our meta-analysis shows that employees who work long hours have a higher risk of stroke than those working standard hours. However, the evidence for coronary heart disease is less persuasive. Our findings suggest that more attention should be paid to the management of vascular risk factors in individuals who work long hours.

Declaration of interests

We declare no competing interests.

Contributors

All authors designed the study, generated hypotheses, interpreted the data, and wrote and critically reviewed the report. MKi wrote the first draft of the report. MKi and MV did the literature search. MJ and STN analysed the data. MJ, STN, and MKi had full access to anonymised individual-participant data from all constituent studies, with the exception of data from NWCS, COPSOQ-I, COPSOQ-II, DWECS, IPAW, and PUMA. WEH had full access to NWCS data and IEHM had full access to the individual-participant data from COPSOQ-I, COPSOQ-II, DWECS, IPAW, and PUMA.

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Long working hours: an avoidable cause of stroke?

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William Osler, in an article about atherosclerosis published 100 years ago, wrote that the main cause of myocardial infarction was "wear and tear of life".[1] Although we now have more detailed theories regarding the causal mechanisms, there is still some kinship between modern studies of work-related determinants of cardiovascular diseases and Osler's broad approach to the cause of disease.[2]

One important aspect of work environment is working time. Long working hours correlate with increased incidence of cardiovascular diseases and their risk factors.[3,4] However, contradictory results show that long working hours are not associated with increased risk of metabolic syndrome.[5] In a working paper from 2003, White and Beswick reviewed 66 studies from 1920 to 2002 with a guarded conclusion that there are "...potentially negative effects of working long hours on physical health. The strongest evidence probably concerns the links with cardiovascular disorder...".[6]

In *The Lancet,* Miki Kivimäki and colleagues[7] present findings from a meta-analysis of long working hours and risk of cardiovascular disease, based on both published and unpublished data, for up to 603 838 men and women from 24 cohorts in Europe, the USA, and Australia. The investigators conclude that, compared with standard working hours of 35–40 h per week, long working hours (defined as working ≥55 h per week) are a risk factor mainly for stroke (relative risk [RR] 1·33, 95% CI 1·11–1·61), with estimates showing a dose–response association (RR 1·10 [95% CI 0·94–1·28] for 41–48 h, 1·27 [1·03–1·56] for 49–54 h, and 1·33 [1·11–1·61] for ≥55 h per week). The study is a pioneering one because of its large scale, comprising more than 5 million person-years of follow-up, including not only myocardial infarction but also stroke as endpoints. So far, Kivimäki and colleagues' results provide the strongest indication of a causal association between long working hours and an aspect of cardiovascular disease—namely, stroke. On the other hand, the authors report a less convincing association between long working hours and coronary heart disease (RR 1·13, 95% CI 1·02–1·26). Because coronary heart disease is more prevalent than stroke in people of working age,[8] this finding is an interesting one that has probably been missed because of the smaller populations studied previously.

In the present study, the investigators were able to adjust for various confounding factors (ie, age, sex, socioeconomic status, smoking, body-mass index, physical activity, and alcohol consumption). But, as in many epidemiological studies, outcome is measured with better accuracy than exposure—working time is self-assessed and measured just once. And, as in all observational studies, there could be selection effects (eg, work involvement—the degree to which an employee is engaged in and enthusiastic about doing his or her work) and confounding factors (eg, workload or sleeping hours) that are not controlled for.

Prevention of cardiovascular diseases almost exclusively focuses on medical and individual preventive measures.[9] Findings from other studies have shown that this approach is not always simple and tends to increase inequities in health, because individuals with the most favourable socioeconomic situation are often the most successful in implementing these preventive activities.[10]

Working conditions are important determinants of people's health. Some of these conditions might be difficult to change because of the nature of the work (eg, underground work, climate conditions, or toxic exposures), but the length of a working day is a human decision. Essentially, if long working hours present a danger to health, it should be possible to change them, which is not always the case with other work environmental factors.

Philippe Psaila/Science Photo Library

As Kivimäki and colleagues point out,[7] the increase in risk is substantial. Long working hours are not a negligible occurrence. Among member countries of the Organisation for Economic Cooperation and Development (OECD), Turkey has the highest proportion of individuals working more than 50 h per week (43%), and the Netherlands the lowest (<1%). For all OECD countries, a mean of 12% of employed men and 5% of employed women work more than 50 h per week.[11] Although some countries have legislation for working hours—eg, the EU Working Time Directive (2003/88/EC) gives people the right to limit their average working time to 48 h per week[12]—it is not always implemented. Therefore, that the length of a working day is an important determinant mainly for stroke, but perhaps also for coronary heart disease, is an important finding.

Kivimäki and colleagues could now test their results in a more experimental way—eg, by randomly allocating some individuals working long hours to reduced working hours and measuring the consequences for health. In such a way, intermediate mechanisms that are currently only mentioned in the discussion of the present report[7] could be assessed (eg, stress response, blood pressure, salt intake, long exposure to sedentary positions, and sleeping time). Such investigations would be beneficial because the consequences of long working hours, rather than long working hours alone, are likely to be the underlying causes of Kivimäki and colleagues' findings.[13] For now, we have a risk factor that could and should be the subject of general policy decisions.

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