Review. Scand J Work Environ Health – online first. doi:10.5271/sjweh.3712

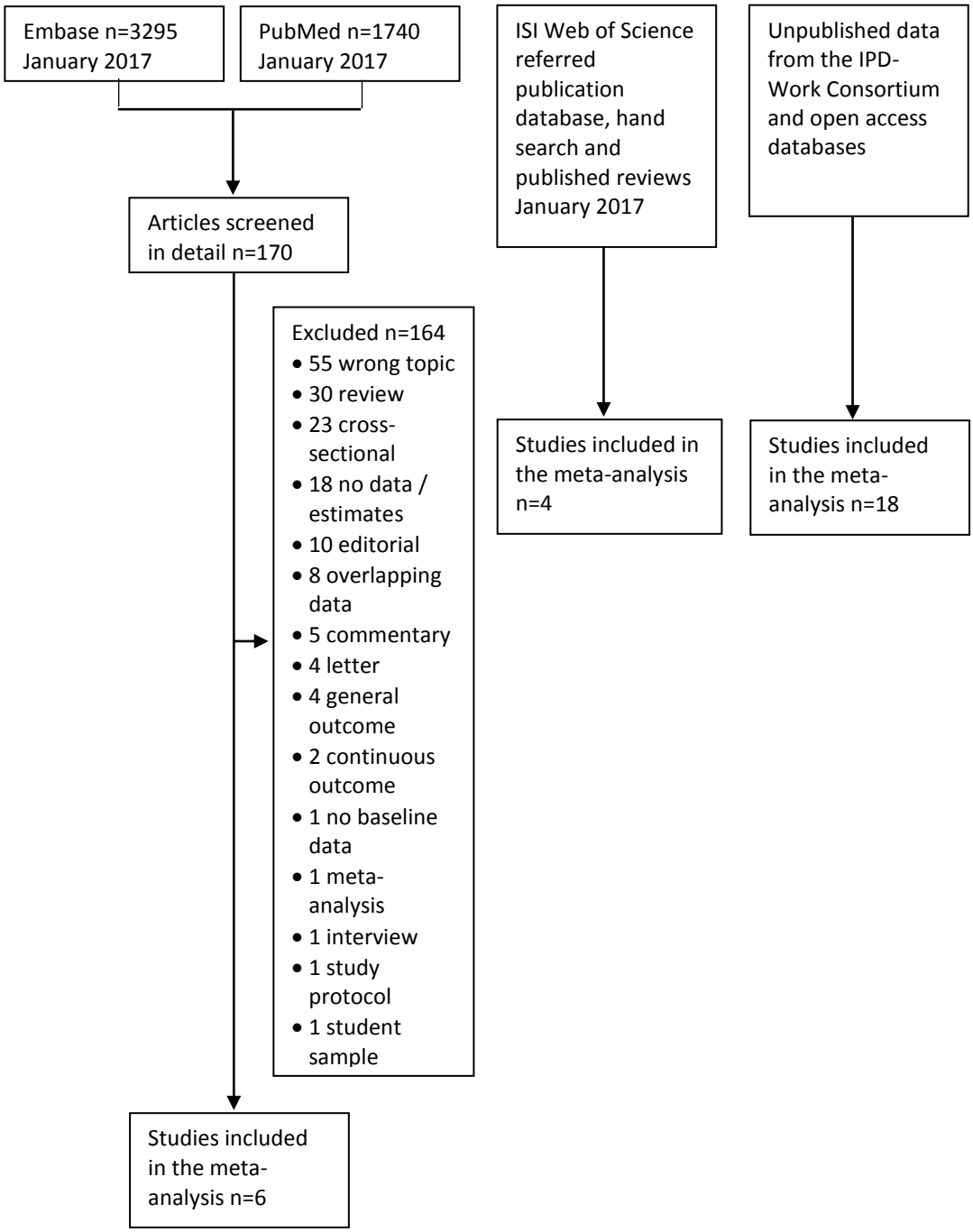
Long working hours and depressive symptoms: systematic review and meta-analysis of published studies and unpublished individual participant data[1]

by Marianna Virtanen, PhD, 2 Markus Jokela, PhD, Ida EH Madsen, PhD, Linda L Magnusson Hanson, PhD, Tea Lallukka, PhD, Solja T Nyberg, PhD, Lars Alfredsson, PhD, G David Batty, DSc, Jakob B Bjorner, MD, PhD, Marianne Borritz, PhD, Hermann Burr, PhD, Nico Dragano, PhD, Raimund Erbel, MD, PhD, Jane E Ferrie, PhD, Katriina Heikkilä, PhD, Anders Knutsson, PhD, Markku Koskenvuo, MD, PhD, Eero Lahelma, PhD, Martin L Nielsen, PhD, Tuula Oksanen, PhD, Jan H Pejtersen, PhD, Jaana Pentti, PhD, Ossi Rahkonen, PhD, Reiner Rugulies, PhD, Paula Salo, PhD, Jürgen Schupp, PhD, Martin J Shipley, PhD, Johannes Siegrist, PhD, Archana Singh-Manoux, PhD, Sakari B Suominen, PhD, Töres Theorell, MD, PhD, Jussi Vahtera, MD, PhD, Gert G Wagner, PhD, Jian Li Wang, PhD, Vasoontara Yiengprugsawan, PhD, Hugo Westerlund, PhD, Mika Kivimäki, PhD

1 *Supplementary materials*

2 *Correspondence to: Marianna Virtanen, Finnish Institute of Occupational Health, PO Box 40, 00032 Työterveyslaitos, Finland. [E-mail: marianna.virtanen@ttl.fi]*

Supplementary figure A. Selection of studies in the meta-analysis



Supplementary table A. Assessment of seven domains of study quality and the overall quality score. Symbols ++ = definitely yes; + = probably/mostly yes; - = probably/mostly no; - - = definitely no

Study	Confidence in exposure (predictor) assessment[a]	Exposed and unexposed from the same population	Confidence in exclusion of prevalent cases	Comprehensive adjustments	Confidence in confounders assessment[b]	Confidence in outcome assessment[c]	Adequate follow-up[d]	Overall score	HIGH /ACCEPTABLE QUALITY
Suwazono	+	++	++	- -	- -	+	+	7	no
Bildt	-	++	++	- -	- -	+	++	7	no
Shields	+	++	++	+	+	++	++	11	yes
Virtanen	+	++	++	+	+	+	+	9	yes
Tokuyama	+	++	++	- -	- -	+	+	7	no
Amagasa	+	++	++	+	+	+	+	9	yes
Niedhammer	+	++	++	+	+	++	++	11	yes
Wang	+	++	++	+	+	++	+	10	yes
Kato	+	++	++	+	+	+	+	9	yes
Kim	+	++	++	+	+	+	+	9	yes
ACL	+	++	++	+	+	+	++	10	yes
BHPS	+	++	++	+	+	+	++	10	yes
NLSY	+	++	++	+	+	+	++	10	yes
HRS	+	++	++	+	+	+	++	10	yes
HESSUP	+	++	++	+	+	+	+	9	yes
BCS	+	++	++	+	+	+	++	10	yes
PUMA	+	++	++	+	+	+	+	9	yes
FPS	+	++	++	+	+	+	++	10	yes

DWECS 2000	+	++	++	+	+	+	+	9	yes
ELSA	+	++	++	+	+	+	++	10	yes
SHARE	+	++	++	+	+	+	++	10	yes
HILDA	+	++	++	+	+	+	++	10	yes
SOEP	+	++	++	+	+	+	++	10	yes
HHS	+	++	++	+	+	+	+	9	yes
SLOSH	+	++	++	+	+	+	++	10	yes
PAIRFAM	+	++	++	+	+	+	+	9	yes
TCS	+	++	++	+	+	+	++	10	yes
UKHLS	+	++	++	+	+	+	+	9	yes

[a]Recorded working hours (++); self-reported working hours (+).
[b]Confounders' data from several sources (++); data mainly self-reported (+).
[c]Structured interview data of clinically significant depressive disorder (++); self-reported data on depressive symptoms or psychological distress (+).
[d]Follow-up of 2 to 4 years (++); 1 or 5 years (+).

Supplementary table B. Overview of prospective studies excluded from the meta-analysis, investigating the association between long working hours and depressive symptoms

First author	Year of study entry	Study site	Population	No of participants	Proportion (%) of women	Mean age / age range at entry	Mean follow-up time	Assessment of depressive symptoms	Findings	Summary of findings
Sugisawa (52)	<1994	Japan	Various occupations and firms	11 121	0	30-59	1.5	Medical treatment for mental disorders	RR=1.45 (0.64-3.31) for ≥80 hours; RR=1.38 (0.70-2.71) for 71-80 hours versus 50-60	0
Marchand (47)	1994	Canada	General population	6611	46	37	8	Within-subject repeated assessments of psychological distress	Linear regression coefficient b=0.001 (n.s.)	0
Tarumi (53)	1997	Japan	White-collar employees	867	21-25	38-42	3	Medical records of incident mental disorder (F00-F99)	RR=1.36 (0.46-4.06) for ≥50 hours versus ≤44 hours	0
Steptoe (49)	<1998	UK	Department store employees	71	62	33/36	0,5	Within-subject analysis of working-hours change and psychological distress	Variation in working hours was not associated with change in psychological distress	0
D'Errico (50)	1999	Italy	Members of a workers' union	2046	23	62% aged 25-44	6	Antidepressant prescriptions	RR=1.00 (0.63-1.60) for >4h/week overtime versus none	0
Allen (46)	2001	USA	Manual workers	2746	20	46	1	Self-reported mental health, continuous outcome	b=0.12 (n.s.) for ≥60 hours/ week versus 41-48	0
Ogasawara (48)	2006	Japan	Office workers	2740	9	36	1	DSM-IV-TR major depressive disorder	RR=1.03 (0.97-1.08) for a	0

									continuous working hours measure	
Varma (51)	2008	Denmark	Senior medical consultants	2790	29	54.5	1.5	Antidepressant prescriptions	HR=0.67 (0.15-2.94) for 55-59 hours; HR 0.48 (0.06-3.68) for ≥60 hours versus 37-40	0

Supplementary table C. Overview of prospective studies investigating the association between long working hours and depression

First author / Study (acronym)	Year of study entry	Study site	Population	No of participants	Proportion (%) of women	Mean age / age range at entry	Mean follow-up time	Assessment of depression	Covariates in the multivariable adjusted model
Published data									
Suwazono (54)	1992	Japan	Workers of a telecommunication enterprise	23 837	20	20-59	1	Psychological distress	Sex-stratified, adjusted for time period
Bildt (55)	1993	Sweden	General (younger) population from Stockholm county	352	53	46-63	4	Subclinical depression (Nottingham Life Quality Questionnaire)	Sex-stratified
Shields (56)	1994	Canada	General population	3783	43	25-54	2	DSM-III major depressive episode (MDE)	Sex-stratified; adjusted for age, SES, work characteristics and family situation
Virtanen (57)	1997	UK	London-based civil service employees	2960	24	52	5	Psychological distress (General Health Questionnaire, GHQ-30)	Age, sex, socioeconomic status, marital status, employment status at follow-up
Tokuyama (58)	1997	Japan	White-collar employees of an insurance company	1365	53	34	1	Zung self-rating depression scale (SDS)	None.
Amagasa (59)	1999	Japan	Clerical workers	194	18	42	1	Depression subscale of the General Well-being scale	Age, sex, job control

Niedhammer (60)	2006	France	General population	4717	49	≥20	4	Major depressive disorder interview (MINI)	Age, sex, occupation, family situation, social support, stressful life events
Wang (61)	2008	Canada	General population	2752	44	43	1	DSM-IV Major depressive disorder (MDD)	Age, sex, marital status, education
Kato (62)	2008	Japan	Employees of a manufacturing company	1194	0	39	1	Depressive symptoms (CES-D)	Age, tenure, job grade, shift work, site of work
Kim (63)	2010	South Korea	General population	6805 observations from 2733 participants	37	20-59	1	Depressive symptoms (CES-D)	Age, sex, education, income, marital status
Unpublished data									
Americans' Changing Lives (ACL) (64)	1986	USA	General population	1291	51	45	3	Depressive symptoms (CES-D)	Age, sex, socioeconomic status, marital status
British Household Panel Survey (BHPS) (65)	1991	UK	General population	10548	50	35	2	Psychological distress (General Health Questionnaire, GHQ-12)	Age, sex, socioeconomic status, marital status
National Longitudinal Survey of Youth (NLSY) (66)	1992	USA	General population	5169	43	30.9	2	Depressive symptoms (CES-D)	Age, sex, socioeconomic status, marital status
Health and Retirement Study (HRS) (67)	1992	USA	General (older) population	7055	53	54	2	Depressive symptoms	Age, sex, socioeconomic status, marital status

Health and Social Support (HeSSup) (68)	1998	Finland	General population, age-stratified	9963	56	40	5	Depressive symptoms (Beck Depression Inventory, BDI)	Age, sex, socioeconomic status, marital status
British Birth Cohort 1970 (BCS) (69)	1999	UK	National birth cohort	5092	45	29.0	4	Psychological distress (General Health Questionnaire, GHQ-12)	Age, sex, socioeconomic status, marital status
Burnout, Motivation and Job Satisfaction (PUMA) (70)	1999	Denmark	Employees in the human service sector	901	85	45	5	Depressive symptoms (Mental Health Inventory, MHI-5);	Age, sex, socioeconomic status, marital status
Finnish Public Sector Study (FPS) (71)	2000	Finland	Public sector employees (10 towns, 21 hospitals)	20241	81	45	3	Psychological distress (General Health Questionnaire, GHQ-12)	Age, sex, socioeconomic status, marital status
Danish Work Environment Cohort (DWECS 2000) (72)	2000	Denmark	General population	3620	49	43	5	Depressive symptoms (Mental Health Inventory, MHI-5)	Age, sex, socioeconomic status, marital status
English Longitudinal Study of Aging (ELSA) (73)	2002	UK	General (older) population	3220	51	55.8	2	Depressive symptoms (CES-D)	Age, sex, socioeconomic status, marital status
Helsinki Health Study (HHS) (74)	2002	Finland	Public sector employees (City of Helsinki)	1768	81	50	5	Psychological distress (General Health Questionnaire, GHQ-12)	Age, sex, socioeconomic status, marital status
Survey of Health, Ageing and Retirement in Europe (SHARE) (75)	2004	Europe	General (older) population	5302	45	56.4	2	Depressive symptoms (EURO-D)	Age, sex, socioeconomic status, marital status
Household, Income, and Labour Dynamics in Australia (HILDA) (76)	2005	Australia	General population	5315	46	39.5	2	Depressive symptoms (Mental Health Inventory, MHI)	Age, sex, socioeconomic status, marital status

German Socioeconomic Panel Survey (SOEP) (77)	2006	Germany	General population	10678	45	40.6	2	Depressive symptoms (Mental Component Summary Scale MCS)	Age, sex, socioeconomic status, marital status
Swedish Longitudinal Occupational Survey of Health (SLOSH) (78)	2008	Sweden	General population	5083	53	49	4	Depressive symptoms (Symptom Check List, SCL)	Age, sex, socioeconomic status, marital status
Panel Analysis of Intimate Relationships and Family Dynamics (PAIRFAM) (79)	2008	Germany	General (younger) population	3064	47	30.5	1	Depressive symptoms (State-Trait Depression Scale)	Age, sex, socioeconomic status, marital status
Thai Cohort Study (TCS) (80)	2009	Thailand	Employed population enrolled in open university	32256	55	43% (men) 58% (women) <40 years	4	K6 psychological distress	Age, sex, marital status, income
UK Household Longitudinal Study (UKHLS) (81)	2009	UK	General population	11204	53	43	1	Psychological distress	Age, sex, socioeconomic status, marital status

Supplementary table D. Response rate, loss to follow-up, and prevalence and onset of depressive symptoms in study cohorts

Study	Response rate (%) at baseline	Loss to follow-up (%)	Prevalence (%) of depressive symptoms at baseline	Onset (%) of depressive symptoms at follow-up
Suwazono	100	0	n.a.	16/20
Bildt	n.a.	15	10/12	10/9
Shields	96	6	n.a.	3/5
Virtanen	76	16	14	19
Tokuyama	49-68	34-40	3-7	7
Amagasa	97	9	n.a.	n.a.
Niedhammer	76	19	n.a.	4
Wang	44	23	16	4
Kato	85	36	24	11
Kim	n.a.	25	7	5
ACL	68	17	17	8
BHPS	74	23	23	19
NLSY	87	4	14	9
HRS	82	14	19	15
HESSUP	40	21	17	11
BCS	92	18	28	16
PUMA	80	42	10	6
FPS	68	38	26	18
DWECS 2000	75	32	2	4
ELSA	67	19	10	8
SHARE	85	31	18	14
HILDA	66	17	19	10
SOEP	63	18	16	12
HHS	76	7	20	11
SLOSH	61	25	21	8
PAIRFAM	49	21	14	10
TCS	45	53	12	4
UKHLS	72	37	21	16