

Psychosocial work characteristics and sleep quality: a systematic review of longitudinal and intervention research ¹

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¹ Appendix - Supplementary tables A-C

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Table A. Complete list of all search terms.		
Work Characteristics		
Job	Occupation*	Role
Skill	Task	Work*
In combination with:		
Ambiguity	Downsizing	Psychosocial
Autonomy	Effort	Resources
Bullying	Feedback	Reward*
Boredom	Identity	Satisfaction
Characteristics	Insecurity	Security
Conflict	Load	Social network
Control	Overload	Strain
Coping	Organizational justice	Stress*
Decision latitude	Organizational change	Support
Demands	Pressure	Variation
Discretion	Procedural justice	Variety
Sleep		
Insomnia	Sleep	
Longitudinal Design		
Cohort	Long-term	RTC
Intervention	Prospective	Temporal
Longitudinal	Randomized controlled trial	

Table B. Detailed information on longitudinal studies. [Ref. = reference, # = participants from same cohort, FP = full-panel design, IP = incomplete panel design, TL = time lag, rr = response rate, n.r. = not reported, n.s. = non-significant, NC = normal causation, NoC = no causation, RC = reversed causation, ReC = reciprocal causation, BNSQ = Basic Nordic Sleep Questionnaire, CES-D = Center for Epidemiologic Studies Depression Scale, DCQ = Demand Control Questionnaire, ERI-Q = Effort-Reward Imbalance Questionnaire, JCQ = Job Content Questionnaire, JSQ = Jenkins Sleep Questionnaire, KSQ = Karolinska Sleep Questionnaire, NHP = Nottingham Health Profile, QPSNordic = General Nordic Questionnaire for Psychological and Social factors at Work, USI = Uppsala Sleep Inventory, 1 = logistic regression, 2 = Structural Equation Modelling, 3 = linear regression, 4 = ANOVA/ANCOVA, 5 = oneway analysis of variance and multiple range tests using LSD procedure, A = demographic information, B = lifestyle factors, C = work factors, D = health variables, E = T1 dependent variables, F = potential change of independent variables, G = other factors, + = positive association, - = negative association, 0 = no association.]

[illegible]

Edme et al., 2011 (41) IP, 1 TL: 4.2 years	1154 mixed occupation, France, rr T1: 88% rr T2: 52%	5 items NHP (Martini & McDowell, 1975), α not indicated	Job demands 9 items JCQ (Karasek et al, 1998), α = .63 Decision latitude 8 items JCQ (Karasek et al, 1998), α = .80 Job strain job demands/ job control Social support 8 items JCQ (Karasek et al, 1998), α = .81 Iso-strain job demands/ job control/ social support Reward 11 items ERI-Q (Siegrist & Peter, 1996), α = .82 Effort-reward imbalance Effort constructed with JCQ	1	A, C, E	Job demands <u>Men</u> OR = 2.05 (CI 1.33 - 3.16) <u>Women</u> OR = 1.10 (CI .57 - 2.14) Decision latitude <u>Men</u> OR = 1.21 (CI .80 - 1.86) <u>Women</u> OR = .77 (CI .38 - 1.55) Job strain <u>Men</u> OR = 1.88 (CI 1.15 - 3.07) <u>Women</u> OR = 0.56 (CI .25 - 1.25) Social support <u>Men</u> OR = 1.12 (CI .73 - 1.72) <u>Women</u> OR = 0.84 (CI 0.40–1.75) Iso-strain <u>Men</u> OR = 2.40 (CI 1.31 - 4.41) <u>Women</u> OR = .26 (CI .07 - .93) Reward <u>Men</u> OR = 1.60 (CI 1.05 - 2.44) <u>Women</u> OR = .54 (CI .26 - 1.12) Effort-reward imbalance <u>Men</u> OR = 2.02 (CI 1.29 - 3.15) <u>Women</u> OR = 0.70 (CI .32 - 1.53)	- 0 0 0 - 0 0 - + + 0 - 0
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Elovainio et al., 2003 (49) IP, 1 TL: 2 years	3773 mixed occupation, predominantly female, Finland, rr T1: 77% rr T2: n.r.	4 items JSQ (Jenkins et al., 1988), $\alpha = .82$	Procedural justice 8 items Procedural Justice Scale (Moorman, 1991), $\alpha = .80$ Relational justice 7 items Relational Justice Scale (Moorman, 1991), $\alpha = .90$	1	A, B	Procedural justice OR = 1.25 (CI 1.17 - 1.33) Relational justice OR = 1.18 (CI 1.10 - 1.26)	+ +
Elovainio et al., 2009 (55) IP, on average 1 TL: 12 - 19 years	5209 office employees, England, rr T1: 73% rr T2: n.r.	Baseline 2 items from a longer symptoms checklist Follow-up 4 items JSQ (Jenkins et al., 1988), $\alpha = .63 - .78$	Organizational justice 5 self-constructed items, $\alpha = .62 - .72$	3	A, B, C, D, E	<u>Overall sleeping problems</u> <u>Men</u> $\beta = -.06$ <u>Women</u> $\beta = -.06$ <u>Sleep onset problems</u> <u>Men</u> $\beta = -.04$ <u>Women</u> $\beta = -.03$ <u>Sleep maintenance problems</u> <u>Men</u> $\beta = -.05$ <u>Women</u> $\beta = -.05$ <u>Non-refreshing sleep</u> <u>Men</u> $\beta = -.07$ <u>Women</u> $\beta = -.06$	+ + + 0 + 0 + +

Eriksen et al., 2008 (54) IP, 1 TL: 3 months	4771 assistant nurses, predominantly female, Norway, rr T1: 62% rr T2: 87%	1 item from BNSQ	Job demands 4 items QPSNordic (Dallner et al, 2000) Positive challenges 3 items QPSNordic (Dallner et al, 2000) Role conflicts 3 items QPSNordic (Dallner et al, 2000) Control of work pace 3 items QPSNordic (Dallner et al, 2000) Control of decisions in own work situation 3 items QPSNordic (Dallner et al, 2000) Social support (from superior) 3 items QPSNordic (Dallner et al, 2000) Fairness (superior) 3 items QPSNordic (Dallner et al, 2000) Rewards 1 item QPSNordic (Dallner et al, 2000) Feedback 1 item QPSNordic (Dallner et al, 2000) Social climate 3 items QPSNordic (Dallner et al, 2000) Exposure to threats 1 item QPSNordic (Dallner et al, 2000) Exposure to bullying 1 item QPSNordic (Dallner et al, 2000) α of indices = .57 - .88	1	A, B, D, E	Job demands OR = 1.54 (CI 1.10 - 2.17) Positive challenges OR = .81 (CI .58 - 1.12) Role conflicts OR = 1.47 (CI 1.03 - 2.11) Control of work pace OR = .81 (CI .57 - 1.17) Control of decisions in own work situation OR = .95 (CI .68 - 1.31) Social support (from superior) OR = .67 (CI .46 - 1.00) Fairness (from superior) OR = 1.25 (CI .90 - 1.73) Rewards OR (rather much) = .74 (CI .54 - 1.00) OR (very much) = .75 (CI .41 - 1.36) Feedback OR = 1.27 (CI .80 - 2.04) Social climate OR = 1.09 (CI .80 - 1.48) Exposure to threats OR (rather often) = 1.77 (CI 1.27 - 2.46) OR (very often) = 1.60 (CI .86 - 2.98) Exposure to bullying OR = .65 (CI .43 - .98)	- 0 - 0 0 + 0 + 0 0 - 0 +
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Jansson & Linton, 2006 (33) IP, 1 TL: 1 year	1530 mixed occupation, Sweden, rr T1: n.r. rr T2: n.r.	4 items from BNSQ (Partinen & Gislason, 1995) and USI (Liljenberg et al., 1988), α not indicated	Job demands 6 items questionnaire by Haynes et al. (1999), $\alpha = .77$ Autonomy and control 6 items questionnaire by Haynes et al. (1999), $\alpha = .84$ Influence over decisions 4 items questionnaire by Haynes et al. (1999), $\alpha = .78$ Peer support 4 items questionnaire by Haynes et al. (1999), $\alpha = .84$ Leader support 6 items questionnaire by Haynes et al. (1999), $\alpha = .86$ Professional compromise 4 items questionnaire by Haynes et al. (1999), $\alpha = .75$ Role conflict 4 items questionnaire by Haynes et al. (1999), $\alpha = .74$ Role clarity 5 items questionnaire by Haynes et al. (1999), $\alpha = .71$ Feedback 4 items questionnaire by Haynes et al. (1999), $\alpha = .81$	1	A, C, E	Job demands <u>Development</u> OR = 1.38 (CI 1.11 - 1.71) <u>Maintenance</u> OR = 1.27 (CI 1.02 - 1.58) Autonomy and control <u>Development</u> OR = n.r. <u>Maintenance</u> OR = n.r. Influence over decisions <u>Development</u> OR = n.r. <u>Maintenance</u> OR = 1.30 (CI 1.05 - 1.62) Peer support <u>Development</u> OR = n.r. <u>Maintenance</u> OR = n.r. Leader support <u>Development</u> OR = .69 (CI .51 - .94) <u>Maintenance</u> OR = n.r. Professional compromise <u>Development</u> OR = n.r. <u>Maintenance</u> OR = n.r. Role conflict <u>Development</u> OR = n.r. <u>Maintenance</u> OR = n.r. Role clarity <u>Development</u> OR = n.r. <u>Maintenance</u>	- - 0 0 0 + 0 0 + 0 0 0 0 0 0
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						OR = n.r. Feedback <u>Development</u> OR = n.r. <u>Maintenance</u> OR = n.r.	0 0 0
#Jansson-Frojmark et al., 2007 (34) IP, 1 TL: 1 year	1873 mixed occupation (age: 50 - 60), Sweden, rr T1: n.r. rr T2: n.r.	4 items from BNSQ (Partinen & Gislason, 1995) and USI (Liljenberg et al., 1988), α not indicated	Job demands 6 items questionnaire by Haynes et al. (1999), α not indicated Autonomy and control 6 items questionnaire by Haynes et al. (1999), α not indicated Influence over decisions 4 items questionnaire by Haynes et al. (1999), α not indicated Peer support 4 items questionnaire by Haynes et al. (1999), α not indicated Leader support 6 items questionnaire by Haynes et al. (1999), α not indicated Professional compromise 4 items questionnaire by Haynes et al. (1999), α not indicated Role conflict 4 items questionnaire by Haynes et al. (1999), α not indicated	1	A, C, E	Job demands <u>Development</u> OR = 1.28 (CI 1.05 - 1.55) <u>Maintenance</u> OR = 1.24 (CI 1.03 - 1.50) Autonomy and control <u>Development</u> OR = n.r. <u>Maintenance</u> OR = n.r. Influence over decisions <u>Development</u> OR = n.r. <u>Maintenance</u> OR = 1.38 (CI 1.16 - 1.63) Peer support <u>Development</u> OR = n.r. <u>Maintenance</u> OR = n.r. Leader support <u>Development</u> OR = n.r. <u>Maintenance</u> OR = n.r. Professional compromise <u>Development</u> OR = n.r. <u>Maintenance</u>	- - 0 0 0 + 0 0 0 0 0

			Role clarity 5 items questionnaire by Haynes et al. (1999), α not indicated Feedback 4 items questionnaire by Haynes et al. (1999), α not indicated			OR = 1.21 (CI 1.01 - 1.47) Role conflict <u>Development</u> OR = n.r. <u>Maintenance</u> OR = n.r. Role clarity <u>Development</u> OR = n.r. <u>Maintenance</u> OR = n.r. Feedback <u>Development</u> OR = n.r. <u>Maintenance</u> OR = n.r.	- 0 0 0 0 0 0
Lallukka et al., 2011 (42) IP, 1 TL: 5 - 7 years	6646 mixed occupation, predominantly female, Finland, rr T1: 67% rr T2: 83%	4 items JSQ (Jenkins et al., 1988), α = .84	Being bullied at work 1 item from Lehto (1991) Observed bullying at work 1 item from Lehto (1991)	1	A, C, D, E	Being bullied at work <u>Men</u> OR = 1.81 (CI .94 - 3.48) <u>Women</u> OR = .99 (CI .74 - 1.33) Observed bullying at work <u>Men</u> OR = 1.05 (CI .57 - 1.94) <u>Women</u> OR = 1.23 (CI .96 - 1.56)	0 0 0 0
Linton, 2004 (50) IP, 1 TL: 1 year	816 mixed occupation, Sweden, rr T1: n.r. rr T2: 79%	Items from BNSQ (Partinen & Gislason, 1995) and USI (Liljenberg et al., 1988), α not indicated	Job demands Questionnaire by Hane et al. (1984), α not indicated Job content (decision latitude) Questionnaire by Hane et al. (1984), α not indicated Social support	1	A, C, D, E	Job demands OR = 1.42 (CI .93 - 2.17) Job content (decision latitude) OR = 1.49 (CI .96 - 2.33) Social support OR = 1.64 (CI 1.06 - 2.54)	0 0 +

			Questionnaire by Hane et al. (1984), α not indicated				
Magnusson Hanson et al., 2011 (45) FP, 1 TL: 2 years	3041 mixed occupation, Sweden, rr T1: 65% rr T2: 78%	7 items KSQ (Kecklund & Åkerstedt, 1992), $\alpha = .80 - .85$	Job demands 5 items DCQ (Theorell, 1988), $\alpha = .72 - .75$ Decision authority 2 items DCQ (Theorell, 1988), $\alpha = .73 - .77$ Social support 6 items DCQ (Theorell, 1988), $\alpha = .85$	2	A, B, C, D, E, F	Job demands <u>Sleep disturbances</u> <u>SEM model</u> χ^2 (NC) = 1255.33 β (NC) = .03 β (RC) = .01 <u>Awakening problems</u> <u>SEM model</u> χ^2 (ReC) = 1137.92 β (NC) = .02 β (RC) = .03 Decision authority <u>Sleep disturbances</u> <u>SEM model</u> χ^2 (NoC) = n.s. β (NC) = -.01 β (RC) = -.02 <u>Awakening problems</u> <u>SEM model</u> χ^2 (ReC) = 255.47 β (NC) = -.04 β (RC) = -.04 Social support <u>Sleep disturbances</u> <u>SEM model</u> χ^2 (RC) = 1285.46 β (NC) = -.03 β (RC) = -.08 <u>Awakening problems</u> <u>SEM model</u> χ^2 (ReC) = 1123.33 β (NC) = -.04 β (RC) = -.06	0 0 0 0 0 0 + + 0 + + +

Ota et al., 2009 (53) IP, 1 TL: 2 years	1022 employees at an electrical products corporation (age: ≤ 39 years), predominantly male, Japan, rr T1: 92% rr T2: n.r.	4 self-constructed items, α not indicated	Job strain (job demands/ job control) <i>Job demands</i> 5 items JCQ (Karasek, 1985), α = .80 <i>Job control</i> 9 items JCQ (Karasek, 1985), α = .67 Social support 8 items JCQ (Karasek, 1985), α = .83 Effort-reward imbalance <i>Effort</i> 6 items ERI-Q (Siegrist & Peter, 1996), α = .83 <i>Reward</i> 11 items ERI-Q (Siegrist & Peter, 1996), α = .86 Overcommitment 6 items ERI-Q (Siegrist & Peter, 1996), α = .76	1	A, B, C, D, E	Job strain (job demands/ job control) <i>Development</i> OR = 1.72 (CI 1.06 - 2.79) <i>Maintenance</i> OR = 1.32 (CI .75 - 2.34) Social support <i>Development</i> OR = .95 (CI .63 - 1.45) <i>Maintenance</i> OR = 2.00 (CI 1.18 - 3.40) Effort-reward imbalance <i>Development</i> OR = 1.38 (CI .65 - 2.94) <i>Maintenance</i> OR = 2.40 (CI 1.13 - 5.10) Overcommitment <i>Development</i> OR = 1.75 (CI 1.16 - 2.66) <i>Maintenance</i> OR = 1.39 (CI .83 - 2.34)	- 0 0 + 0 - - 0
Ribet & Derriennic, 1999 (51) IP, 1 TL: 5 years	18695 mixed occupation (age: only birth years 1938, 1943, 1948, and 1953), France, rr T1: 88% rr T2: 87%	5 items NHP (Martini & McDowell, 1975), α not indicated	Job demands (Having to hurry) 1 self-constructed item Job control 1 self-constructed item Doing several things at the same time 1 self-constructed item Opportunity for learning 1 self-constructed item Job diversity 1 self-constructed item Interruptions 1 self-constructed item	1	A, D, G	Job demands (Having to hurry) OR = 1.50 (CI 1.30 - 1.60) Job control OR = 1.40 (CI 1.20 - 1.50) Doing several things at the same time OR = 1.10 (CI 1.00 - 1.30) Opportunity for learning OR = 1.30 (CI 1.20 - 1.40) Job diversity OR = 1.40 (1.20 - 1.50) Interruptions OR = 1.00 (CI .9 - 1.10)	- + 0 + + 0

Rugulies et al., 2009 (52) IP, 1 TL: 5 years	2351 mixed occupation, Denmark, rr T1: 75% rr T2: 69%	2 self-constructed items	Effort-reward imbalance <i>Effort</i> 4 proxy items of ERI-Q, $\alpha = 0.63$ <i>Reward</i> 7 proxy items of ERI-Q, $\alpha = 0.53$	1	A, B, C, D, E, G	<u>Men</u> OR = 2.06 (CI 1.14 - 3.74) <u>Women</u> OR = .98 (CI .59 - 1.63)	- 0
Virtanen et al., 2011 (43) FP, 1 TL: 12 years	1013 mixed occupation (approximately same age and from same area), Sweden, rr T1: n.r. rr T2: 94%	1 self-constructed item	Job insecurity 1 self-constructed item	1	A, E	<u>Moderate job insecurity, no temporary employment</u> OR = 1.43 (CI 1.01 - 2.05) <u>Heavy job insecurity, no temporary employment</u> OR = 2.93 (CI 1.60 - 5.35) <u>Moderate job insecurity, moderate temporary employment</u> OR = 1.13 (CI .64 - 2.03) <u>Heavy job insecurity, moderate temporary employment</u> OR = 1.68 (CI .74 - 3.83) <u>Moderate job insecurity, heavy temporary employment</u> OR = 1.04 (CI .60 - 1.82) <u>Heavy job insecurity, heavy temporary employment</u> OR = 1.61 (CI .79 - 3.28)	- - 0 0 0 0

Table C. Detailed information on intervention studies. [Ref. = reference, TL = time lag, rr = response rate, n.r. = not reported, JCQ = Job Content Questionnaire, NHP = Nottingham Health Profile, 1 = logistic regression, 2 = Structural Equation Modelling, 3 = linear regression, 4 = ANCOVA, if significant interaction general estimating equations, 5 = oneway analysis of variance and multiple range tests using LSD procedure, A = demographic information, B = lifestyle factors, C = work factors, D = health variables, E = T1 dependent variables, F = potential change of independent variables, G = other factors, + = positive association, - = negative association, 0 = no association.]

Reference	Sample	Measurement of variables		Statistical analysis		Outcome	
		<i>Sleep</i>	<i>Work characteristics</i>	<i>Analysis reported</i>	<i>Con-founders</i>		
Bourbonnais et al., 2006 + 2011 (31/32) 1 control group, no randomization, 2 TL: 1 and 3 years, pre + 2 x post	247 (experimental) and 220 (control) care providers, predominantly female, Canada, rr T1 Exp = 73% rr T1 Con = 69% rr T2 Exp = 45% rr T2 Con = 35% rr T3 Exp = 65% rr T3 Con = 56% Intervention designed to enhance job demands, job control, social support, and effort-reward imbalance by means of an intervention team which proposes solutions to enhance these work characteristics	5 items NHP (Martini & McDowell, 1975), $\alpha = .78$	Job demands 9 items JCQ (Karasek, 1985), $\alpha = .76$	4	C, D, E, F	<u>Sleep quality T2</u> p = .21	0
			Job control 9 items JCQ (Karasek, 1985), $\alpha = .71$ Social support 8 items JCQ (Karasek, 1985), $\alpha = .81$ Reward 11 items ERI-Q (Siegrist & Peter, 1996), $\alpha = .77$ Effort-reward imbalance Effort constructed with JCQ			<u>Sleep quality T3</u> p = .17	0
Moen et al., 2011 (56) 1 control group, no randomization, 1 TL: 6 months, pre + post	325 (experimental) and 334 (control) white-collar employees, US, rr T1: 80% rr T2: 92% Intervention designed to enhance job (schedule) control by means of participatory training of work teams to promote adjustment of work processes to enhance job control	1 item from Burgard and Ailshire (2009)	Schedule control 1 modified item (Thomas & Ganster, 1995)	2	A, C, E, F	<u>Sleep quality</u> $\beta = .012$	0

Wahlstedt & Edling, 1997 (44) no control group, no randomization, 2 TL: 8 and 12 months, pre + 2 x post	100 postal sorting terminal employees, Sweden, rr T1: 93% rr T2: 79% Intervention designed to enhance job demands, decision latitude, and social support by means of organizational changes in working conditions	10 items sleep quality index by Theorell (1988), α not indicated	Job demands 5 items from questionnaire by Theorell (1988), $\alpha = .78$ Skill discretion 4 items from questionnaire by Theorell (1988), $\alpha = .68$ Decision authority 2 items from questionnaire by Theorell (1988), $\alpha = .78$ Contact with superiors 5 items from questionnaire by Theorell (1988), $\alpha = .77$ Contact with teammates 4 items from questionnaire by Theorell (1988), $\alpha = .69$ Social support 16 items from questionnaire by Theorell (1988), $\alpha = .79$	5	A, B, E, F	<u>T2</u> <i>Job demands</i> no change, no significant interaction $p = n.r.$ <i>Skill discretion</i> no change, no significant interaction $p = n.r.$ <i>Decision authority</i> no change, no significant interaction $p = n.r.$ <i>Contact with superiors</i> significant change, no significant interaction $p = n.r.$ <i>Contact with team mates</i> no change, but significant interaction, group with less contact, poorer sleep quality $p = n.r.$ <u>T3</u> <i>Job demands</i> no change, no significant interaction $p = n.r.$ <i>Skill discretion</i> significant change, significant interaction, group with less contact, poorer sleep quality $p < .05$ <i>Decision authority</i>
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