Occupational psychosocial exposures and chronic low back pain: a systematic review and meta-analysis

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Content

Appendix A. Literature search

Our literature search consisted of a block search containing four blocks combining them with the Boolean operator “AND” between blocks and “OR” within blocks.

Table S1. Literature search

Block 1. Work.	**Free text search in title and abstract**
Mesh	
”Occupations”[Mesh]	occupation*, employ*, job*, working condition*, work-related work-load*, work-place*, work environment*
”Occupational Health”[Mesh]	
”Occupational Diseases”[Mesh]	
”Occupational Exposure”[Mesh]	
”Occupational Groups”[Mesh]	
”Work”[Mesh]	
”Workplace”[Mesh]	
”Workload”[Mesh]	
”Women, Working”[Mesh]	
”Employment”[Mesh]	

Block 2. Exposure.	**Free text search in title and abstract**
Mesh	
Mechanical stress	
”Stress, Mechanical”[Mesh]	
Organisational and psychosocial factors	
"Stress, Psychological”[Mesh]	
Development of force	lift*, carry*, hold*, pull*, drag*, push*, manual handling, force*, biomechanic*, physical demand*, physically demand*.
”Lifting”[Mesh]	
”Weight-Bearing”[Mesh]	
”Biomechanics”[Mesh]	
”Moving and Lifting Patients”[Mesh]	
”Physical Exertion”[Mesh]	
Working postures	flexion*, extension*, turning*, sitting*, kneeling*, twisting*, bending, sedentary, walking*, reaching, squatting, standing, postural balance, static AND posture, awkward AND posture.
”Torsion, Mechanical”[Mesh]	
”Postural Balance”[Mesh]	
”Walking”[Mesh]	
Working movement	repetitive movement*, monotonous work, dynamic AND posture, relaxation, recovery of function, static work, dynamic load.
”Recovery of Function”[Mesh]	

”Relaxation”[Mesh]	
Influence and demand	decision latitude, work demand*, job demand*, high demand*, low control, work control, job control, work influence*, demand resource*, lack of control, job strain, work strain.
Effort and reward	effort reward*, time pressure*, work overload*, recuperation*, recovery.
Social support and relations in the workplace	support system*, social network*, emotional support, justice*, injustice*, interaction*, interpersonal relation*.
”Social Support”[Mesh]	
”Employee Performance "Appraisal”[Mesh]	
”Organizational Culture”[Mesh]	
"Justice/psychology”[Mesh]	
”Communication/psychology”[Mesh]	
”Interpersonal Relations”[Mesh]	
Job satisfaction	Boredom, job satisfaction, work satisfaction, coping, work ability.
”Job Satisfaction”[Mesh]	
”Employee Grievances”[Mesh]	
Education and learning:	skill discretion*, staff development.
”Staff Development”[Mesh]	
Conflict, violence or harassment	harass*, workplace conflict*, workplace violen*, silent workplace*, victimization*, bullying, role ambiguity, role conflict*, work role*, discrimination.
”Bullying”[Mesh]	
”Prejudice”[Mesh]	
”Social Discrimination”[Mesh]	
Working time	working hour*, working time, shift work*, work shift*, day-time, night-time, temporary work, full-time, part-time, flexible work*, lean production.
”Work Schedule Tolerance”[Mesh]	
Job insecurity	organizational change, job security, job insecurity.
”Personnel Downsizing”[Mesh]	
Chemical and biological substances	pollut*, indoor air*, airborne, passive smok*, solvent*, smok* AND pollute*.
”Air Pollution”[Mesh]	
”Air Pollutants”[Mesh]	
”Solvents”[Mesh]	
”Fluids and Secretions”[Mesh]	
Contact with chemicals	hazardous chemical*, hazardous material*, hazardous substance*, toxic action*, pesticide*, poison*.
”Toxic Actions”[Mesh]	
Noise	noise*

”Noise”[Mesh]	
Vibrations	vibrat*, driving, vehicle*, truck*, lorry/lorries, automobile*, car/cars, buses, hand tool*, hand-held tool*, power tool*.
”Vibration”[Mesh]	
”Automobile Driving”[Mesh]	
”Motor Vehicles”[Mesh]	
Radiation	radiation*
”Radiation”[Mesh]	
”Air Pollution, Radioactive”[Mesh]	
Temperature	climate*, cold temperature*, hot temperature*.
”Hot Temperature”[Mesh]	
”Cold Temperature”[Mesh]	
”Climate”[Mesh]	
Infected materials	contagious* communicable disease*
”Communicable Diseases”[Mesh]	

Block 3. Back problems	**Free text search in title and abstract**
Mesh	
Back problems	
"Back" [Mesh]	back, spine*, spinal*, trunk*, lumbar*, pelvis*, sacrum, lumbo-sacral*, lumbosacral*, intervertebral disk*, intervertebral disc*, thoracic vertebrae, thoracic vertebra.
"Spine” [Mesh]	
"Pelvis" [Mesh]	
"Pain" [Mesh]	pain, ache*, musculoskeletal disease*, musculoskeletal disorder*, cumulative trauma disorder*, nerve entrapment.
"Pain Measurement" [Mesh]	
"Cumulative Trauma Disorders" [Mesh]	
"Musculoskeletal Diseases" [Mesh]	
"Back Pain" [Mesh]	back pain, backache*, back injur*, spinal disease*, spine disease*, spinal injur* OR spine injur*, intervertebral disk degeneration, intervertebral disc degeneration, spinal osteochondros*, spine osteochondros*, Scheuermann*, spinal stenos*, spondylitis, spondylarthritis, spondylosis, lumbago, sciatica, pelvic pain.
"Back Injuries" [Mesh]	
"Spinal Diseases" [Mesh]	
"Pelvic Pain" [Mesh]	
"Sciatica" [Mesh]	

Block 4 Language restrictions and publication date.	
Language restrictions	

English, Danish, Norwegian, or Swedish.	
Publication date	
From 2014/01/01 to 2021/09/21. The updated search was done including articles from 2021 until September 28, 2022, and adding the following to, e.g., Medline: (2021/9/2:2022/10/1[pdat])	

Aggregated search string from Medline:

((("Back"[MeSH Terms] OR "spine"[MeSH Terms] OR "Pelvis"[MeSH Terms] OR ("Back"[Title/Abstract] OR "spine*"[Title/Abstract] OR "spinal*"[Title/Abstract] OR "trunk*"[Title/Abstract] OR "lumbar*"[Title/Abstract] OR "pelvis*"[Title/Abstract] OR "sacrum"[Title/Abstract] OR "lumbo sacral*"[Title/Abstract] OR "lumbosacral*"[Title/Abstract] OR "intervertebral disk*"[Title/Abstract] OR "intervertebral disc*"[Title/Abstract] OR "thoracic vertebrae"[Title/Abstract] OR "thoracic vertebra"[Title/Abstract])) AND ("Pain"[MeSH Terms] OR "Pain Measurement"[MeSH Terms] OR "Cumulative Trauma Disorders"[MeSH Terms] OR "Musculoskeletal Diseases"[MeSH Terms] OR ("Pain"[Title/Abstract] OR "ache*"[Title/Abstract] OR "musculoskeletal disease*"[Title/Abstract] OR "musculoskeletal disorder*"[Title/Abstract] OR "cumulative trauma disorder*"[Title/Abstract] OR "nerve entrapment"[Title/Abstract]))) OR ("Back Pain"[MeSH Terms] OR "Back Injuries"[MeSH Terms] OR "Spinal Diseases"[MeSH Terms] OR "Pelvic Pain"[MeSH Terms] OR "Sciatica"[MeSH Terms] OR ("Back Pain"[Title/Abstract] OR "backache*"[Title/Abstract] OR "back injur*"[Title/Abstract] OR "spinal disease*"[Title/Abstract] OR "spine disease*"[Title/Abstract] OR "spinal injur*"[Title/Abstract] OR "spine injur*"[Title/Abstract] OR "intervertebral disk degeneration"[Title/Abstract] OR "intervertebral disc degeneration"[Title/Abstract] OR "spinal osteochondros*"[Title/Abstract] OR "spine osteochondros*"[Title/Abstract] OR "scheuermann*"[Title/Abstract] OR "spinal stenos*"[Title/Abstract] OR "spondylitis"[Title/Abstract] OR "spondylarthritis"[Title/Abstract] OR "spondylosis"[Title/Abstract] OR "lumbago"[Title/Abstract] OR "Sciatica"[Title/Abstract] OR "Pelvic Pain"[Title/Abstract]))) AND ("Work"[MeSH Terms] OR "Workload"[MeSH Terms] OR "Workplace"[MeSH Terms] OR "Occupations"[MeSH Terms] OR "Occupational Health"[MeSH Terms] OR "Occupational Diseases"[MeSH Terms] OR "Occupational Groups"[MeSH Terms] OR "Occupational Exposure"[MeSH Terms] OR "women, working"[MeSH Terms] OR "Employment"[MeSH Terms:noexp] OR (("work-related"[Title/Abstract] OR "work load*"[Title/Abstract] OR "workload*"[Title/Abstract] OR "workplace*"[Title/Abstract] OR "workplace*"[Title/Abstract] OR "work environment*"[Title/Abstract] OR "working condition*"[Title/Abstract] OR "occupation*"[Title/Abstract] OR "job"[Title/Abstract] OR "employ*"[Title/Abstract]) NOT ("medline"[Filter] OR "oldmedline"[Filter]))) AND ("stress, mechanical"[MeSH Terms] OR "Lifting"[MeSH Terms] OR "Moving and Lifting Patients"[MeSH Terms] OR "Weight-Bearing"[MeSH Terms] OR "Physical Exertion"[MeSH Terms] OR "torsion, mechanical"[MeSH Terms] OR "Postural Balance"[MeSH Terms] OR "Walking"[MeSH Terms] OR "recovery of function"[MeSH Terms] OR "Relaxation"[MeSH Terms] OR ("static"[Title/Abstract] AND ("postural"[All Fields] OR "posturally"[All Fields] OR "posture"[MeSH Terms] OR "posture"[All Fields] OR "postures"[All Fields] OR "postured"[All Fields] OR "posturing"[All Fields])) OR ("awkward"[Title/Abstract] AND ("postural"[All Fields] OR "posturally"[All Fields] OR "posture"[MeSH Terms] OR "posture"[All Fields] OR "postures"[All Fields] OR "postured"[All Fields] OR "posturing"[All Fields])) OR ("dynamic"[Title/Abstract] AND ("postural"[All Fields] OR "posturally"[All Fields] OR "posture"[MeSH Terms] OR "posture"[All Fields] OR "postures"[All Fields] OR "postured"[All Fields] OR "posturing"[All Fields])) OR "static work"[Title/Abstract] OR "dynamic load*"[Title/Abstract] OR "lift*"[Title/Abstract] OR "carry*"[Title/Abstract] OR "hold*"[Title/Abstract] OR "pull*"[Title/Abstract] OR "drag*"[Title/Abstract] OR "push*"[Title/Abstract] OR "manual handling"[Title/Abstract] OR "force*"[Title/Abstract] OR "biomechanic*"[Title/Abstract] OR "walking*"[Title/Abstract] OR "Postural Balance"[Title/Abstract] OR "flexion*"[Title/Abstract] OR "extension*"[Title/Abstract] OR "turning"[Title/Abstract] OR "sitting"[Title/Abstract] OR "kneeling"[Title/Abstract] OR "squatting"[Title/Abstract] OR "twisting"[Title/Abstract] OR "bending"[Title/Abstract] OR "reaching"[Title/Abstract] OR "standing"[Title/Abstract] OR "sedentary"[Title/Abstract] OR "repetitive movement*"[Title/Abstract] OR "monotonous work"[Title/Abstract] OR "Relaxation"[Title/Abstract] OR "recovery of function"[Title/Abstract] OR "physical demand*"[Title/Abstract] OR "physically demand*"[Title/Abstract] OR ("stress, psychological"[MeSH Terms] OR "Social Support"[MeSH Terms] OR "Job Satisfaction"[MeSH Terms] OR "Work Schedule Tolerance"[MeSH Terms] OR "Employee Performance Appraisal"[MeSH Terms] OR "Employee Grievances"[MeSH Terms] OR "social justice/psychology"[MeSH Terms] OR "Personnel Downsizing"[MeSH Terms] OR "Staff Development"[MeSH Terms] OR "Organizational Culture"[MeSH Terms] OR "Bullying"[MeSH Terms] OR "Prejudice"[MeSH Terms] OR "Social Discrimination"[MeSH Terms] OR "Interpersonal Relations"[MeSH Terms] OR "communication/psychology"[MeSH Terms] OR "psychosocial"[Title/Abstract] OR "job strain"[Title/Abstract] OR "work strain"[Title/Abstract] OR "work demand*"[Title/Abstract] OR "job demand*"[Title/Abstract] OR "high demand*"[Title/Abstract] OR "low control"[Title/Abstract] OR "lack of control"[Title/Abstract] OR "work control"[Title/Abstract] OR "job control"[Title/Abstract] OR "decision latitude"[Title/Abstract] OR "work influence*"[Title/Abstract] OR "demand resource*"[Title/Abstract] OR "effort reward*"[Title/Abstract] OR "time pressure*"[Title/Abstract] OR "recuperation*"[Title/Abstract] OR "work overload*"[Title/Abstract] OR "work over load*"[Title/Abstract] OR "recovery"[Title/Abstract] OR "coping"[Title/Abstract] OR "work ability"[Title/Abstract] OR "Social Support"[Title/Abstract] OR "support system*"[Title/Abstract] OR "social network*"[Title/Abstract] OR "emotional support"[Title/Abstract] OR "interpersonal relation*"[Title/Abstract] OR "interaction*"[Title/Abstract] OR "justice*"[Title/Abstract] OR "injustice*"[Title/Abstract] OR "Job Satisfaction"[Title/Abstract] OR "work satisfaction"[Title/Abstract] OR "boredom"[Title/Abstract] OR "skill discretion*"[Title/Abstract] OR "Staff Development"[Title/Abstract] OR "discrimination"[Title/Abstract] OR "harass*"[Title/Abstract] OR (("workplace"[MeSH Terms] OR "workplace"[All Fields] OR ("work"[All Fields] AND "place"[All Fields]) OR "work-place"[All Fields]) AND "conflict*"[Title/Abstract]) OR "workplace violen*"[Title/Abstract] OR "work place violen*"[Title/Abstract] OR "Bullying"[Title/Abstract] OR "victimization*"[Title/Abstract] OR (("silent"[All Fields] OR "silently"[All Fields] OR "silents"[All Fields]) AND "workplace*"[Title/Abstract]) OR "role ambiguity"[Title/Abstract] OR "roleconflict*"[Title/Abstract] OR "work role*"[Title/Abstract] OR "working hour*"[Title/Abstract] OR "working time"[Title/Abstract] OR "daytime"[Title/Abstract] OR "night-time"[Title/Abstract] OR "shift work*"[Title/Abstract] OR "work shift*"[Title/Abstract] OR "temporary work*"[Title/Abstract] OR "full-time"[Title/Abstract] OR "part-time"[Title/Abstract] OR "flexible work*"[Title/Abstract] OR "organizational change"[Title/Abstract] OR "organisational change"[Title/Abstract] OR "lean production"[Title/Abstract] OR "job security"[Title/Abstract] OR "job insecurity"[Title/Abstract]) OR ("Air Pollutants"[MeSH Terms] OR "Air Pollution"[MeSH Terms] OR "Fluids and Secretions"[MeSH Terms] OR "Toxic Actions"[MeSH Terms] OR "Solvents"[MeSH Terms] OR "pollut*"[Title/Abstract] OR "indoor air*"[Title/Abstract] OR "airborne"[Title/Abstract] OR ("smok*"[Title/Abstract] AND "pollut*"[Title/Abstract]) OR "passive smok*"[Title/Abstract] OR "hazardous chemical*"[Title/Abstract] OR "hazardous material*"[Title/Abstract] OR "hazardous substance*"[Title/Abstract] OR "toxic action*"[Title/Abstract] OR "pesticide*"[Title/Abstract] OR "poison*"[Title/Abstract] OR

"solvent*"[Title/Abstract]) OR ("Radiation"[MeSH Terms] OR "air pollution, radioactive"[MeSH Terms] OR "Hot Temperature"[MeSH Terms] OR "Cold Temperature"[MeSH Terms] OR "Climate"[MeSH Terms] OR "radiation*"[Title/Abstract] OR "climate*"[Title/Abstract] OR "cold temperature*"[Title/Abstract] OR "hot temperature*"[Title/Abstract]) OR ("Communicable Diseases"[MeSH Terms] OR "communicable disease*"[Title/Abstract] OR "contagious*"[Title/Abstract]) OR ("Noise"[MeSH Terms] OR "noise*"[Title/Abstract]) OR ("Vibration"[MeSH Terms] OR "Motor Vehicles"[MeSH Terms] OR "Automobile Driving"[MeSH Terms] OR "driving"[Title/Abstract] OR "automobile*"[Title/Abstract] OR "car"[Title/Abstract] OR "cars"[Title/Abstract] OR "vibrat*"[Title/Abstract] OR "vehicle*"[Title/Abstract] OR "truck*"[Title/Abstract] OR "lorry"[Title/Abstract] OR "lorries"[Title/Abstract] OR "buses"[Title/Abstract] OR "hand held tool*"[Title/Abstract] OR "hand tool*"[Title/Abstract] OR "power tool*"[Title/Abstract])) AND ("english"[Language] OR "danish"[Language] OR "norwegian"[Language] OR "swedish"[Language])

Appendix B. PECOS

Table S2. Inclusion and exclusion criteria for the systematic review.

	Inclusion criteria	**Exclusion criteria**
Population	Adults in or above working age.	Adults never in work or students.
Exposure	Occupational psychosocial exposures quantified through self-report, interview, observation, or job-exposure-matrix.	Non-related occupational exposures.
Comparison	A measure of association between occupational exposures and chronic LBP expressed in an appropriate risk estimate, e.g., odds ratio, relative risk, hazard ratio, or prevalence ratio with corresponding 95% confidence interval.	If no appropriate risk estimate is provided or not possible to calculate based on information eligible in the study.
Outcome	Non-specific chronic low back pain lasting ≥3 months. Specific chronic low back pain including lumbago, sciatica, lumbar herniated disc and lumbosacral degenerative changes with or without radiculopathy. Outcome measured with self-report, interview, clinical diagnosis (e.g., ICD code), imaging modalities (e.g., computed tomography, x-ray, or magnetic resonance imaging), or compensation/insurance claim.	Injuries based on accidents, inherent pain, pain caused by other diseases or conditions such as cancer, fractures, or inflammation. Proxy measures to chronic LBP, e.g., sickness absenteeism. Studies not reporting on chronic LBP according to our definition as pain lasting ≥3 months.
Study design	Randomised control trials; non-randomised control trials; prospective cohort; retrospective cohort; case-control; case-cohort; nested case-control. Original study in full text and peer reviewed. In English, Danish, Swedish or Norwegian. Published from January the 10th 2014.	Cross-sectional studies, systematic reviews, in vitro studies, studies on health economics, studies not addressing any risk factors related to work, studies with less than 30 participants, and Studies in other languages than in the inclusion criteria. Animal trials. Conference notes, books, letters to editor, editorial pages, protocols, reports and abstracts.

LBP=low back pain; ICD=International Classification of Diseases.

Appendix C. Risk of bias assessment tool.

Table S3. Risk of bias assessment tool, case-control studies.

Case-Control Study	Yes	No	Unclear
Major domain 1 – study design and selection			
Were the cases recruited in an acceptable way? Consider the following: ● Are the cases representative of a population, clearly defined and differentiated from controls? ● Was there an established reliable system for selecting all the cases? ● Were inclusion and exclusion criteria explicit and applied similarly to all eligible cases?			
Were the controls selected in an acceptable way? Consider the following: ● Are the controls representative of a population and clearly defined? ● Are the same inclusion and exclusion criteria for cases used to select controls (equally applied) and matched appropriately? ● Is it clearly established that controls are non-cases?			
Is the participation rate satisfactory? Consider the following: ● Are there large differences between the two groups? ● Is the participation rate low?			
Major domain 2 – Exposure			
Was the exposure accurately measured to minimise bias? Consider the following: ● Is the exposure clearly defined? ● Do measurements truly reflect what it is supposed to measure (have they been validated?). ● Is the method of assessment reliable?			
Major domain 3 – Outcome			
Was the outcome accurately measured to minimise bias? Consider the following: ● Is the outcome clearly defined? ● Do measurements truly reflect what it is supposed to measure (have they been validated?). ● Is the method of assessment reliable?			
Major domain 4 – Non-participants			
Is comparison made between participants and non-participants? Consider the following: ● Is similarities or differences established?			
Major domain 5 – Analysis method			
Was the analysis method adequate? Consider the following: ● Are the main potential confounders identified and taken into account in the analysis? ● Were adequate statistical models used to reduce bias?			
Minor domain 1 – Funding			
Was the source of funding provided? Consider the following: ● Was the study affected by sponsors? ● Did sponsoring organisation participate in the analysis?			
Minor domain 2 – Chronology			
Could chronology be established? Consider the following: ● Was the timeframe sufficient to see an association between the exposure and outcome?			
Minor domain 3 – Conflict of interest			
Was the study without any conflict of interest? Consider the following: ● Was the study affected by the authors affiliations or interests?			

Table S4. Risk of bias assessment tool, cohort studies.

Cohort Study	Yes	No	Unclear
Major domain 1 – study design and selection			
Was the cohort recruited in an acceptable way? Consider the following: ● Is it representative of a defined population and clearly specified? ● Are groups comparable in all respects other than the factor under investigation? ● Was everybody included who should have been?			
Was the follow-up of subjects acceptable? Consider the following: ● Conventionally, a 20% drop out rate is acceptable, but observational studies conducted over longer periods, a higher drop-out rate is to be expected. ● Were losses to follow-up taken into account in the analysis (sensitivity analysis, described etc.)?			
Major domain 2 – Exposure			
Was the exposure accurately measured to minimise bias? Consider the following: ● Is the exposure clearly defined? ● Do measurements truly reflect what it is supposed to measure (have they been validated?). ● Is the method of assessment reliable? ● Were all the subjects classified into exposure groups using the same procedure?			
Major domain 3 – Outcome			
Was the outcome accurately measured to minimise bias? Consider the following: ● Is the outcome clearly defined? ● Do measurements truly reflect what it is supposed to measure (have they been validated?). ● Is the method of assessment reliable? ● Were the measurement methods similar in the different groups? ● If blinding is not possible, is there some recognition that knowledge of exposure status could influence the assessment of the outcome?			
Major domain 4 – Enrolment			
Was the outcome taken into account at enrolment? Consider the following: ● Some participants might have the outcome at the time of enrolment. Is it assessed at baseline in the analysis?			
Major domain 5 – Analysis method			
Was the analysis method adequate? Consider the following: ● Are the main potential confounders identified and taken into account in the analysis? ● Were adequate statistical models used to reduce bias?			
Minor domain 1 – Funding			
Was the source of funding provided? Consider the following: ● Was the study affected by sponsors? ● Did sponsoring organization participate in the analysis?			
Minor domain 2 – Chronology			
Could chronology be established? Consider the following: ● Was the timeframe sufficient to see an association between the exposure and outcome? ● Was the follow-up long enough for the outcome to occur?			
Minor domain 3 – Conflict of interest			
Was the study without any conflict of interest? Consider the following: ● Was the study affected by the authors affiliations or interests?			

Appendix D. Grading the evidence of an association

The quality of evidence was evaluated in accordance with the GRADE guidelines, complying with guidelines stated by the Navigation Guide. Therefore, the evidence starts at moderate quality when evaluating observational studies.

The criteria and definitions stated in our instructions has been adopted from the Navigation Guide (Woodruff and Sutton 2014) (1) and Hulshof 2019 (2).

Table S5. Quality level - four levels of evidence.

Quality level	**Definition**
High ++++	We are confident that the true effect lies close to that of the estimate of the effect.
Moderate +++	We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low ++	Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect.
Very low +	We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect.

Table S6. Evaluating the quality of evidence - down- and upgrading factors.

Downgrading factors	**Criteria for downgrading.** (0= no change; -1 (serious) or -2 (very serious) = downgrading 1 or 2 levels).
Risk of bias	Criteria: Judicious considerations regarding each study's contribution towards the measure of association is warranted. One should be confident that there is a substantial risk of bias across most studies included and not downgrade based on an average count.
Inconsistency	Criteria: Consider if: * Effect estimates of the included studies vary widely * Confidence intervals show minimal or no overlap * Heterogeneity (I-squared) is high Inconsistency is important when it reduces the confidence in results. Even if inconsistency is large, estimates that, overall, points towards an increased risk would not be downgraded. For instance, if a protective or harmful effect cannot be determined, GRADE suggests downgrading.
Indirectness	Criteria: * Do differences occur between populations of interest? * Do differences occur between outcome measures of interest? * Do differences occur between exposure measures of interest?

	* Are differences substantial so that it decreases our confidence in comparisons or make difference in the outcome likely?
Imprecision	Criteria: * Do studies have few participants or few events? * Are the confidence intervals wide? * Are few studies included in the pooled estimate? * Confidence interval includes OR/RR of 1.0
Publication bias	Criteria: * Consider Funnel plot and Egger's test * Are there sufficient studies included to interpret the funnel plot accordingly? * In environmental research, consider the likelihood of publishing studies who finds no associations (underestimations might occur).
Upgrading factors	**Criteria for upgrading.** (0= no change; +1 or +2 = upgrading 1 or 2 levels).
Magnitude of effect	Criteria: * Upgrade if a large magnitude of effect exists (GRADE defines it as OR/RR of >2.0) * Assessments should be based on the knowledge of occupational health and expert judgement.
Dose response	Criteria: *Do one or more studies show or test and dose(exposure)-response relation?
Residual confounding	Criteria: * Upgrade if consideration of all plausible residual confounders, biases, or effect modifications would underestimate the effect when results show no effect.

(1) Woodruff TJ, Sutton P. The Navigation Guide systematic review methodology: a rigorous and transparent method for translating environmental health science into better health outcomes. Environ Health Perspect. 2014;122(10):1007-14.

(2) Hulshof CTJ, Colosio C, Daams JG, Ivanov ID, Prakash KC, Kuijer PPFM, Leppink N, Mandic-Rajcevic S, Masci F, van der Molen HF, Neupane S, Nygård CH, Oakman J, Pega F, Proper K, Prüss-Üstün AM, Ujita Y, Frings-Dresen MHW. WHO/ILO work-related burden of disease and injury: Protocol for systematic reviews of exposure to occupational ergonomic risk factors and of the effect of exposure to occupational ergonomic risk factors on osteoarthritis of hip or knee and selected other musculoskeletal diseases. Environ Int. 2019 Apr;125:554-566. doi: 10.1016/j.envint.2018.09.053. Epub 2018 Dec 22. PMID: 30583853; PMCID: PMC7794864.

Table S7. Results of GRADE.

No of studies*	Certainty assessment					Other considerations	Effect estimate (95% CI)	Certainty
	Study design	Risk of Bias	Inconsistency	Indirectness	Imprecision			
Job control								
7	Observational studies	Serious (-1)	Not serious (0)	Not serious (0)	Serious (-1)	- Indication of publication bias (0) - Plausible confounding (0) - Dose-response gradient (0) - Magnitude of effect (0)	OR 1.0 (0.9 to 1.1)	⊕◯◯◯ Very low
Job demand								
4	Observational studies	Serious (-1)	Not serious (0)	Not serious (0)	Serious (-1)	- Indication of publication bias (0) - Plausible confounding (0) - Dose-response gradient (0) - Magnitude of effect (0)	OR 1.1 (1.0 to 1.2)	⊕◯◯◯ Very low
Job strain								
2	Observational studies	Serious (-1)	Not serious (0)	Not serious (0)	Very serious (-2)	- Indication of publication bias (0) - Plausible confounding (0) - Dose-response gradient (0) - Magnitude of effect (0)	OR 1.0 (0.7 to 1.6)	⊕◯◯◯ Very low
Job support								
6	Observational studies	Serious (-1)	Not serious (0)	Not serious (0)	Serious (-1)	- Indication of publication bias (0) - Plausible confounding (0) - Dose-response gradient (0) - Magnitude of effect (0)	OR 0.8 (0.5 to 1.1)	⊕◯◯◯ Very low
Job stress								
5	Observational studies	Serious (-1)	Serious (-1)	Not serious (0)	Serious (-1)	- Indication of publication bias (0) - Plausible confounding (0) - Dose-response gradient (0) - Magnitude of effect (0)	OR 1.1 (0.6 to 1.8)	⊕◯◯◯ Very low
Job satisfaction								
6	Observational studies	Serious (-1)	Serious (-1)	Not serious (0)	Serious (-1)	- Indication of publication bias (0) - Plausible confounding (0) - Dose-response gradient (0) - Magnitude of effect (0)	OR 0.9 (0.6 to 1.2)	⊕◯◯◯ Very low

*Number of studies included in the meta-analysis after removal of double-counting data.

Appendix E. Excluded articles.

Table S8. Excluded articles based on full-text read and reason for exclusion.

References: Studies published before January 10, 2014		**Explanation for exclusion**
1	Albert HB, Godskesen M, Korsholm L, Westergaard JG. Risk factors in developing pregnancy-related pelvic girdle pain. Acta Obstet Gynecol Scand. 2006;85(5):539-44.	Outcome criteria not fulfilled.
2	Andersen JH, Haahr JP, Frost P. Risk factors for more severe regional musculoskeletal symptoms: a two-year prospective study of a general working population. Arthritis Rheum 2007;56:1355-64.	Outcome criteria not fulfilled.
3	Battie MC, Videman T, Gibbons LE, Fisher LD, Manninen H, Gill K. 1995 Volvo Award in clinical sciences. Determinants of lumbar disc degeneration. A study relating lifetime exposures and magnetic resonance imaging findings in identical twins. Spine (Phila Pa 1976) 1995;20:2601-12.	Outcome criteria not fulfilled.
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120	Mikkonen P, Viikari-Juntura E, Remes J, Pienimäki T, Solovieva S, Taimela S, et al. Physical workload and risk of low back pain in adolescence. Occup Environ Med 2012;69:284-90.	Outcome criteria not fulfilled.
121	Milosavljevic S, Bagheri N, Vasiljev RM, McBride DI, Rehn B. Does daily exposure to whole-body vibration and mechanical shock relate to the prevalence of low back and neck pain in a rural workforce? Ann Occup Hyg. 2012;56(1):10-7.	Outcome criteria not fulfilled.
122	Miranda H, Viikari-Juntura E, Martikainen R, Takala EP, Riihimaki H. Individual factors, occupational loading, and physical exercise as pre-dictors of sciatic pain. Spine (Phila Pa 1976) 2002;27:1102-9.	Outcome criteria not fulfilled.
123	Miranda H, Viikari-Juntura E, Punnett L, Riihimaki H. Occupational loading, health behavior and sleep disturbance as predictors of low-back pain. Scand J Work Environ Health 2008;34:411-9.	Outcome criteria not fulfilled.
124	Miwa S, Yokogawa A, Kobayashi T, Nishimura T, Igarashi K, Inatani H, et al. Risk factors of recurrent lumbar disc herniation: A single center study and review of the literature. Journal of Spinal Disorders and Techniques. 2012;14.	Outcome criteria not fulfilled.
125	Myers AH, Baker SP, Li G, Smith GS, Wiker S, Liang KY, et al. Back injury in municipal workers: a case-control study. Am J Public Health 1999;89: 1036-41.	Outcome criteria not fulfilled.
126	Nahit ES, Hunt IM, Lunt M, Dunn G, Silman AJ, Macfarlane GJ. Effects of psychosocial and individual psychological factors on the onset of musculoskeletal pain: common and site-specific effects. Ann Rheum Dis 2003;62:755-60.	Outcome criteria not fulfilled.
127	Neumann WP, Wells RP, Norman RW, Frank J, Shannon H, Kerr MS. A posture and load sampling approach to determining low-back pain risk in occupational settings. International Journal of Industrial Ergonomics 2001;27:65-77.	Outcome criteria not fulfilled.
128	Nuwayhid IA, Stewart W, Johnson JV. Work activities and the onset of first-time low back pain among New York City fire fighters. Am J Epidemiol. 1993;137(5):539-48.	Outcome criteria not fulfilled.
129	Nyman T, Mulder M, Iliadou A, Svartengren M, Wiktorin C. Physical workload, low back pain and neck-shoulder pain: a Swedish twin study. Occupational and Environmental Medicine [Internet]. 2009; (6):[395-401 pp.].	No measure of an association.

130	Oleske DM, Lavender SA, Andersson GB, Morrissey MJ, Zold-Kilbourn P, Allen C, et al. Risk factors for recurrent episodes of work-related low back dis-orders in an industrial population. Spine (Phila Pa 1976) 2006;31:789-98.	Outcome criteria not fulfilled.
131	Palmer KT, Griffin M, Ntani G, Shambrook J, McNee P, Sampson M, et al. Professional driving and prolapsed lumbar intervertebral disc diagnosed by magnetic resonance imaging: a case-control study. Scand J Work Environ Health. 2012;38(6):577-81.	Outcome criteria not fulfilled.
132	Palmer KT, Harris CE, Griffin MJ, Bennett J, Reading I, Sampson M, et al. Casecontrol study of low-back pain referred for magnetic resonance imaging, with special focus on whole-body vibration. Scand J Work Environ Health. 2008;34(5):364-73.	Outcome criteria not fulfilled.
133	Papageorgiou AC, Croft PR, Thomas E, Silman AJ, Macfarlane GJ. Psychosocial risks for low back pain: are these related to work? Ann Rheum Dis. 1998;57(8):500-2.	Outcome criteria not fulfilled.
134	Papageorgiou AC, Macfarlane GJ, Thomas E, Croft PR, Jayson MI, Silman AJ. Psychosocial factors in the workplace – do they predict new episodes of low back pain? Evidence from the South Manchester Back Pain Study. Spine (Phila Pa 1976) 1997;22:1137-42.	Outcome criteria not fulfilled.
135	Pietri F, Leclerc A, Boitel L, Chastang JF, Morcet JF, Blondet M. Low-back pain in commercial travelers. Scand J Work Environ Health 1992;18:52-8.	Outcome criteria not fulfilled.
136	Piterman L, Dunt D. Occupational lower-back injuries in a primary medical care setting: a five-year follow-up study. Med J Aust. 1987;147(6):276-9.	Outcome criteria not fulfilled.
137	Plouvier S, Leclerc A, Chastang JF, Bonenfant S, Goldberg M. Socioeconomic position and low-back pain--the role of biomechanical strains and psychosocial work factors in the GAZEL cohort. Scand J Work Environ Health. 2009;35(6):429-36.	Outcome criteria not fulfilled.
138	Plouvier S, Renahy E, Chastang JF, Bonenfant S, Leclerc A. Biomechanical strains and low back disorders: quantifying the effects of the number of years of exposure on various types of pain. Occup Environ Med. 2008;65(4):268-74.	Outcome criteria not fulfilled.
139	Power C, Frank J, Hertzman C, Schierhout G, Li L. Predictors of low back pain onset in a prospective British study. Am J Public Health. 2001;91(10):1671-8.	Outcome criteria not fulfilled.
140	Punnett L, Fine LJ, Keyserling WM, Herrin GD, Chaffin DB. Back dis-orders and nonneutral trunk postures of automobile assembly workers. Scand J Work Environ Health 1991;17:337-46.	Outcome criteria not fulfilled.
141	Ramond-Roquin A, Bodin J, Serazin C, Parot-Schinkel E, Ha C, Richard I, et al. Biomechanical constraints remain major risk factors for low back pain. Results from a prospective cohort study in French male employees. Spine J 2013 Jul 12 [Epub ahead of print].	Outcome criteria not fulfilled.
142	Reigo T, Tropp H, Timpka T. Absence of back disorders in adults and work-related predictive factors in a 5-year perspective. Eur Spine J. 2001;10(3):215-20; discussion 21.	Outcome criteria not fulfilled.
143	Reme SE, Shaw WS, Steenstra IA, Woiszwillo MJ, Pransky G, Linton SJ. Distressed, immobilized, or lacking employer support? A sub-classification of acute work-related low back pain. J Occup Rehabil 2012;22:541-52.	Outcome criteria not fulfilled.
144	Riihimaki H, Viikari-Juntura E, Moneta G, Kuha J, Videman T, Tola S. Incidence of sciatic pain among men in machine operating, dynamic physical work, and sedentary work. A three-year follow-up. Spine (Phila Pa 1976). 1994;19(2):138-42.	Exposure criteria not fulfilled.
145	Riihimaki H, Wickstrom G, Hanninen K, Luopajarvi T. Predictors of sciatic pain among concrete reinforcement workers and house painters--a five-year follow-up. Scand J Work Environ Health. 1989;15(6):415-23.	Outcome criteria not fulfilled.
146	Riyazi N, Rosendaal FR, Slagboom E, Kroon HM, Breedveld FC, Kloppenburg M. Risk factors in familial osteoarthritis: the GARP sibling study. Osteoarthritis Cartilage. 2008;16(6):654-9.	Outcome criteria not fulfilled.
147	Rohrer MH, Santos-Eggimann B, Paccaud F, Haller-Maslov E. Epidemiologic study of low back pain in 1398 Swiss conscripts between 1985 and 1992. Eur Spine J. 1994;3(1):2-7.	No measure of an association.
148	Roy TC, Lopez HP, Piva SR. Loads Worn by Soldiers Predict Episodes of Low Back Pain during Deployment to Afghanistan. Spine (Phila Pa 1976). 2013.	Outcome criteria not fulfilled.
149	Rugulies R, Krause N. Effort-reward imbalance and incidence of low back and neck injuries in San Francisco transit operators. Occup Environ Med. 2008;65(8):525-33.	Exposure criteria not fulfilled.
150	Rugulies R, Krause N. Job strain, iso-strain, and the incidence of low back and neck injuries. A 7.5-year prospective study of San Francisco transit operators. Soc Sci Med 2005;61:27-39.	Outcome criteria not fulfilled.
151	Seidler A, Bergmann A, Jager M, Ellegast R, Ditchen D, Elsner G et al. Cumulative occupational lumbar load and lumbar disc disease--results of a German multi-center case-control study (EPILIFT). BMC Musculoskelet Disord 2009 Vol. 10 Pages 48	Exposure criteria not fulfilled.
152	Seidler A, Euler U, Bolm-Audorff U, Ellegast R, Grifka J, Haerting J et al. Physical workload and accelerated occurrence of lumbar spine diseases: risk and rate advancement periods in a German multicenter case-control study. Scand J Work Environ Health 2011 Vol. 37 Issue 1 Pages 30-6	Exposure criteria not fulfilled.
153	Shannon HS, Woodward CA, Cunningham CE, McIntosh J, Lendrum B, Brown J, et al. Changes in general health and musculoskeletal outcomes in the workforce of a hospital undergoing rapid change: a longitudinal study. J Occup Health Psychol 2001;6:3-14.	Outcome criteria not fulfilled.
154	Shaw WS, Pransky G, Winters T. The Back Disability Risk Questionnaire for work-related, acute back pain: prediction of unresolved problems at 3-month follow-up. J Occup Environ Med 2009;51:185-94.	Outcome criteria not fulfilled.
155	Smedley J, Egger P, Cooper C, Coggon D. Prospective cohort study of predictors of incident low back pain in nurses. BMJ 1997;314:1225-8.	Outcome criteria not fulfilled.

156	Sterud T, Tynes T. Work-related psychosocial and mechanical risk factors for low back pain: a 3-year follow-up study of the general working population in Norway. Occup Environ Med 2013;70:296-302.	Outcome criteria not fulfilled.
157	Stevenson JM, Weber CL, Smith JT, Dumas GA, Albert WJ. A longitudinal study of the development of low back pain in an industrial population. Spine (Phila Pa 1976). 2001;26(12):1370-7.	Exposure criteria not fulfilled.
158	Stobbe TJ, Plummer RW, Jensen RC, Attfield MD. Incidence of low back injuries among nursing personnel as a function of patient lifting frequency. Journal of Safety Research 1988;19:21-8.	Study design criteria not fulfilled.
159	Stomp-van den Berg SG, Hendriksen IJ, Bruinvels DJ, Twisk JW, van Mechelen W, van Poppel MN. Predictors for post-partum pelvic girdle pain in working women: the Mom@Work cohort study. Pain 2012;153:2370-9.	Outcome criteria not fulfilled.
160	Studnek JR, Crawford JM. Factors associated with back problems among emergency medical technicians. Am J Ind Med 2007;50:464-9.	Outcome criteria not fulfilled.
161	Thorbjornsson CB, Alfredsson L, Fredriksson K, Michelsen H, Punnett L, Vingard E, et al. Physical and psycho-social factors related to low back pain during a 24-year period. A nested case-control analysis. Spine (Phila Pa 1976) 2000;25:369-74; discussion 375.	Outcome criteria not fulfilled.
162	Tiemessen IJ, Hulshof CT, Frings-Dresen MH. Low back pain in drivers exposed to whole body vibration: ana-lysis of a dose-response pattern. Occup Environ Med 2008;65:667-75.	Outcome criteria not fulfilled.
163	Torp S, Riise T, Moen BE. The impact of psychosocial work factors on musculo-skeletal pain: a prospective study. J Occup Environ Med 2001;43:120-6.	Outcome criteria not fulfilled.
164	Trinkoff AM, Le R, Geiger-Brown J, Lipscomb J, Lang G. Longitudinal relationship of work hours, mandatory overtime, and on-call to musculoskeletal problems in nurses. Am J Ind Med 2006;49:964-71.	Outcome criteria not fulfilled.
165	Tubach F, Leclerc A, Landre MF, Pietri- Taleb F. Risk factors for sick leave due to low back pain: a prospective study. J Occup Environ Med 2002;44:451-8.	Outcome criteria not fulfilled.
166	van den Heuvel SG, Ariens GA, Boshuizen HC, Hoogendoorn WE, Bongers PM. Prognostic factors related to recurrent low-back pain and sickness absence. Scand J Work Environ Health 2004;30:459-67.	Outcome criteria not fulfilled.
167	Van Nieuwenhuyse A, Somville PR, Crombez G, Burdorf A, Verbeke G, Johannik K, et al. The role of physical workload and pain related fear in the development of low back pain in young workers: evidence from the BelCoBack Study; results after one year of follow up. Occup Environ Med 2006;63:45-52.	Outcome criteria not fulfilled.
168	van Poppel MN, Koes BW, Deville W, Smid T, Bouter LM. Risk factors for back pain incidence in industry: a pro-spective study. Pain 1998;77:81-6.	Outcome criteria not fulfilled.
169	Vandergrift JL, Gold JE, Hanlon A, Punnett L. Physical and psychosocial ergonomic risk factors for low back pain in automobile manufacturing workers. Occup Environ Med 2012; 69:29-34. Epub 2011 May 17.	Outcome criteria not fulfilled.
170	Ward MM, Reveille JD, Learch TJ, Davis JC, Jr., Weisman MH. Occupational physical activities and long-term functional and radiographic outcomes in patients with ankylosing spondylitis. Arthritis Rheum 2008;59:822-32.	Outcome criteria not fulfilled.
171	Venning PJ, Walter SD, Stitt LW. Personal and job-related factors as determinants of incidence of back injuries among nursing personnel. J Occup Med 1987;29:820-5.	Outcome criteria not fulfilled.
172	Verbeek JH, van der Beek AJ. Psychosocial factors at work and back pain: a prospective study in office workers. Int J Occup Med Environ Health 1999;12:29-39.	Outcome criteria not fulfilled.
173	Wergeland EL, Veiersted B, Ingre M, Olsson B, Akerstedt T, Bjornskau T, et al. A shorter workday as a means of reducing the occurrence of musculo-skeletal disorders. Scand J Work Environ Health 2003;29:27-34.	Outcome criteria not fulfilled.
174	Wickstrom GJ, Pentti J. Occupational factors affecting sick leave attributed to low-back pain. Scand J Work Environ Health 1998;24:145-52.	Outcome criteria not fulfilled.
175	Videman T, Battie MC, Parent E, Gibbons LE, Vainio P, Kaprio J. Progression and determinants of quantitative magnetic resonance imaging measures of lumbar disc degeneration: a five-year follow-up of adult male monozygotic twins. Spine (Phila Pa 1976) 2008;33:1484-90.	Outcome criteria not fulfilled.
176	Videman T, Ojajarvi A, Riihimaki H, Troup JD. Low back pain among nurses: a follow-up beginning at entry to the nursing school. Spine (Phila Pa 1976) 2005;30:2334-41.	Outcome criteria not fulfilled.
177	Wiktorin C, Vingard E, Mortimer M, Pernold G, Wigaeus-Hjelm E, Kilbom A, et al. Interview versus questionnaire for assessing physical loads in the population-based MUSIC-Norrtalje Study. Am J Ind Med 1999;35:441-55.	Outcome criteria not fulfilled.
178	Williams RA, Pruitt SD, Doctor JN, Epping-Jordan JE, Wahlgren DR, Grant I, et al. The contribution of job satisfaction to the transition from acute to chronic low back pain. Arch Phys Med Rehabil 1998;79:366-74.	Outcome criteria not fulfilled.
179	Vingard E, Alfredsson L, Hagberg M, Kilbom A, Theorell T, Waldenstrom M, et al. To what extent do current and past physical and psychosocial occupational factors explain care-seeking for low back pain in a working population? Results from the Musculo-skeletal Intervention Center-Norrtalje Study. Spine (Phila Pa 1976) 2000;25:493-500.	Outcome criteria not fulfilled.
180	Yang LQ, Spector PE, Chang CH, Gallant-Roman M, Powell J. Psychosocial precursors and physical consequences of workplace violence towards nurses: a longitudinal examination with naturally occurring groups in hospital settings. Int J Nurs Stud 2012;49:1091-102.	Outcome criteria not fulfilled.
181	Yassi A, Khokhar J, Tate R, Cooper J, Snow C, Vallentyne S. The epidemiology of back injuries in nurses at a large Canadian tertiary care hospital: implications for prevention. Occup Med (Lond). 1995;45(4):215-20.	Outcome criteria not fulfilled.
182	Zhao I, Bogossian F, Turner C. The effects of shift work and interaction between shift work and overweight/obesity on low back pain in nurses: results from a longitudinal study. J Occup Environ Med 2012;54:820-5.	Outcome criteria not fulfilled.

183	Zochling J, Bohl-Buhler MH, Baraliakos X, Feldtkeller E, Braun J. Infection and work stress are potential triggers of ankylosing spondylitis. Clin Rheumatol 2006;25:660-6.	Outcome criteria not fulfilled.
184	Zwerling C, Ryan J, Schootman M. A case-control study of risk factors for industrial low back injury. The utility of preplacement screening in defining high-risk groups. Spine (Phila Pa 1976). 1993;18(9):1242-7.	Outcome criteria not fulfilled.

Table S9. Excluded articles based on full-text read and reason for exclusion.

Reference: studies published after January 10, 2014		**Reason for exclusion**
1	M. Abid, H. U. Khan, M. H. Abid, A. Ijaz, M. Ahmad, M. T. Naeem, (2021). "Association of occupational risk factors with the level of lumbar disc nucleus pulposus herniation." Pakistan Journal of Medical and Health Sciences **15**(10): 2863-2864.	Study design criteria not fulfilled.
2	Ahlholm, V. H., Ronkko, V., Ala-Mursula, L., Karppinen, J., & Oura, P. (2021). Modeling the Multidimensional Predictors of Multisite Musculoskeletal Pain Across Adulthood-A Generalized Estimating Equations Approach. *Front Public Health*, *9*, 709778.	Outcome criteria not fulfilled.
3	Alghadir, A., Zafar, H., & Iqbal, Z. A. (2015). Work-related musculoskeletal disorders among dental professionals in Saudi Arabia. *J Phys Ther Sci*, *27*(4), 1107-1112.	Study design criteria not fulfilled.
4	Alghadir, A., Zafar, H., Iqbal, Z. A., & Al-Eisa, E. (2017). Work-Related Low Back Pain Among Physical Therapists in Riyadh, Saudi Arabia. *Workplace Health Saf*, *65*(8), 337-345.	Study design criteria not fulfilled.
5	Alhalabi MS, Alhaleeb H, Madani S. Risk factors associated with chronic low back pain in Syria. Avicenna J Med 2015 Vol. 5 Issue 4 Pages 110-6	Exposure criteria not fulfilled.
6	Alrowayeh, H. N., Alnaser, M. Z., Alshatti, T. A., Saeed, R. S. (2021). Prevalence and Risk Factors of Work-Related Lower Back Pain among Radiographers in the State of Kuwait. Radiol Res Pract 2021 Vol. 2021 Pages 5365260.	Study design criteria not fulfilled.
7	Alziyadi, R. H., Elgezery, M. H., & Alziyadi, R. H. (2021). Prevalence of Low Back Pain and Its Associated Risk Factors among Female Nurses Working in a tertiary hospital in Dhahran, Eastern Province, Saudi Arabia. *World Family Medicine*, *19*(1), 173-182.	Study design criteria not fulfilled.
8	Amin, R., Safdar, B., & Masood, M. H. (2019). PSYCHOSOCIAL DETERMINANTS OF BACKACHE IN FEMALES. *Indo American Journal of Pharmaceutical Sciences*, *6*(6), 12915-12921.	Outcome criteria not fulfilled.
9	Andersen, L. L., Vinstrup, J., Sundstrup, E., Skovlund, S. V., Villadsen, E., & Thorsen, S. V. (2021). Combined ergonomic exposures and development of musculoskeletal pain in the general working population: A prospective cohort study. *Scand J Work Environ Health*, *47*(4), 287-295.	Outcome criteria not fulfilled.
10	Andersen, L. L., Vinstrup, J., Villadsen, E., Jay, K., & Jakobsen, M. D. (2019). Physical and Psychosocial Work Environmental Risk Factors for Back Injury among Healthcare Workers: Prospective Cohort Study. *Int J Environ Res Public Health*, *16*(22).	Outcome criteria not fulfilled.
11	Arcury, T. A., Chen, H., Mora, D. C., Walker, F. O., Cartwright, M. S., & Quandt, S. A. (2016). The effects of work organization on the health of immigrant manual workers: A longitudinal analysis. *Arch Environ Occup Health*, *71*(2), 66-73.	Outcome criteria not fulfilled.
12	Arvidsson, I., Gremark Simonsen, J., Lindegard-Andersson, A., Bjork, J., & Nordander, C. (2020). The impact of occupational and personal factors on musculoskeletal pain - a cohort study of female nurses, sonographers and teachers. *BMC Musculoskelet Disord*, *21*(1), 621.	Outcome criteria not fulfilled.
13	Assadi, S. (2022). "Carrying load and related health disorders and disability." Indian Journal of Occupational and Environmental Medicine **26**(2): 129-132.	Study design criteria not fulfilled.
14	Badarin, K., Hemmingsson, T., Hillert, L., & Kjellberg, K. (2021). Physical workload and increased frequency of musculoskeletal pain: a cohort study of employed men and women with baseline occasional pain. *Occup Environ Med*, *78*(8), 558-566.	Outcome criteria not fulfilled.
15	Bazazan, A., Dianat, I., Bahrampour, S., Talebian, A., Zandi, H., Sharafkhaneh, A., & Maleki-Ghahfarokhi, A. (2019). Association of musculoskeletal disorders and workload with work schedule and job satisfaction among emergency nurses. *Int Emerg Nurs*, *44*, 8-13.	Study design criteria not fulfilled.
16	Bergmann A, Bolm-Audorff U, Ditchen D, Ellegast R, Grifka J, Haerting J et al. Do Occupational Risks for Low Back Pain Differ From Risks for Specific Lumbar Disc Diseases?: Results of the German Lumbar Spine Study (EPILIFT). Spine (Phila Pa 1976) 2017 Vol. 42 Issue 20 Pages E1204-E1211.	Exposure criteria not fulfilled.
17	Bontrup, C., Taylor, W. R., Fliesser, M., Visscher, R., Green, T., Wippert, P. M., & Zemp, R. (2019). Low back pain and its relationship with sitting behaviour among sedentary office workers. *Appl Ergon*, *81*, 102894.	Study design criteria not fulfilled.
18	Bonzini, M., Bertù, L., Conti, M., D'Amato, A., Veronesi, G., Coggon, D. N., & Ferrario, M. M. (2014). 0168 Somatising tendency, occupational strain and musculoskeletal symptoms: results from a longitudinal study among Italian nurses. *Occupational and Environmental Medicine*, *71*(Suppl 1), A21.22-A21.	Other reasons (e.g., abstract, books).
19	Bonzini, M., Bertu, L., Veronesi, G., Conti, M., Coggon, D., & Ferrario, M. M. (2015). Is musculoskeletal pain a consequence or a cause of occupational stress? A longitudinal study. *Int Arch Occup Environ Health*, *88*(5), 607-612.	Outcome criteria not fulfilled.
20	A. Boutellier, C. Nuesch, P. Suter, G. Perrot and A. Mundermann (2022). Trunk muscle function and its association with functional limitations in sedentary occupation workers with and without chronic nonspecific low back pain. Journal of Back and Musculoskeletal Rehabilitation 2022 Vol. 35 Issue 4 Pages 783-791	Outcome criteria not fulfilled.

21	Bovenzi, M., & Schust, M. (2021). A prospective cohort study of low-back outcomes and alternative measures of cumulative external and internal vibration load on the lumbar spine of professional drivers. *Scand J Work Environ Health*, *47*(4), 277-286.	Outcome criteria not fulfilled.
22	Bovenzi, M., Schust, M., Menzel, G., Hofmann, J., & Hinz, B. (2015). A cohort study of sciatic pain and measures of internal spinal load in professional drivers. *Ergonomics*, *58*(7), 1088-1102.	Outcome criteria not fulfilled.
23	Bovenzi, M., Schust, M., Menzel, G., Prodi, A., & Mauro, M. (2015). Relationships of low back outcomes to internal spinal load: a prospective cohort study of professional drivers. *Int Arch Occup Environ Health*, *88*(4), 487-499.	Outcome criteria not fulfilled.
24	Brauer, C., Mikkelsen, S., Pedersen, E. B., Moller, K. L., Simonsen, E. B., Koblauch, H., Alkjaer, T., Helweg-Larsen, K., & Thygesen, L. C. (2020). Occupational lifting predicts hospital admission due to low back pain in a cohort of airport baggage handlers. *Int Arch Occup Environ Health*, *93*(1), 111-122.	Exposure criteria not fulfilled.
25	Bugajska, J., Zolnierczyk-Zreda, D., Jedryka-Goral, A., Gasik, R., Hildt-Ciupinska, K., Malinska, M., & Bedynska, S. (2013). Psychological factors at work and musculoskeletal disorders: a one year prospective study. *Rheumatol Int*, *33*(12), 2975-2983.	Outcome criteria not fulfilled.
26	Caputo E.L., M. R. Domingues, A. D. Bertoldi, P. H. Ferreira, M. L. Ferreira, D. Shirley, et al. (2021). Are leisure-time and work-related activities associated with low back pain during pregnancy? BMC Musculoskeletal Disorders 2021 Vol. 22 Issue 1 Pages 1-8.	Outcome criteria not fulfilled.
27	Chaiklieng, S., & Suggaravetsiri, P. (2020). Low Back Pain (LBP) Incidence, Ergonomics Risk and Workers' Characteristics in Relations to LBP in Electronics Assembly Manufacturing. *Indian J Occup Environ Med*, *24*(3), 183-187.	Outcome criteria not fulfilled.
28	Chakrabarty, S., Sarkar, K., Dev, S., Das, T., Mitra, K., Sahu, S., & Gangopadhyay, S. (2016). Impact of rest breaks on musculoskeletal discomfort of Chikan embroiderers of West Bengal, India: a follow up field study. *J Occup Health*, *58*(4), 365-372.	Outcome criteria not fulfilled.
29	Chan, E. W. M., Hamid, M. S. A., Din, F. H. M., Ahmad, R., Nadzalan, A. M., & Hafiz, E. (2019). Prevalence and factors associated with low back pain among Malaysian army personnel stationed in Klang Valley. *Biomedical Human Kinetics*, *11*(1), 9-18.	Study design criteria not fulfilled.
30	Chand, R. K., Roomi, M. A., Begum, S., & Mudassar, A. (2020). Prevalence of musculoskeletal disorders, associated risk factors and coping strategies among secondary school teachers in fiji. *Rawal Medical Journal*, *45*(2), 377-381.	Study design criteria not fulfilled.
31	Chang, K. C., Lee, H. C., Yen, C. L., Liao, Y. H., Hung, J. W., & Wu, C. Y. (2021). Low back pain-associated factors in female hospital-based personal care attendants. *Work*, *69*(1), 315-322.	Study design criteria not fulfilled.
32	Chaudhary, D. K., Palei, S. K., Kumar, V., Karmakar, N. C. (2022). Whole-body vibration exposure of heavy earthmoving machinery operators in surface coal mines: a comparative assessment of transport and non-transport earthmoving equipment operators. Int J Occup Saf Ergon 2022 Vol. 28 Issue 1 Pages 174-183.	Study design criteria not fulfilled.
33	Choochouy N, Saita S, Sirithian D. Prevalence of and factors associated with occupational health problems among hill farmers in Thailand. Southeast Asian J Trop Med Public Health. 2022;53(4):368-86.	Study design criteria not fulfilled.
34	Christensen, J. O., Johansen, S., & Knardahl, S. (2017). Psychological predictors of change in the number of musculoskeletal pain sites among Norwegian employees: a prospective study. *BMC Musculoskelet Disord*, *18*(1), 140.	Outcome criteria not fulfilled.
35	Christensen, J. O., Nielsen, M. B., Finne, L. B., & Knardahl, S. (2018). Comprehensive profiles of psychological and social work factors as predictors of site-specific and multi-site pain. *Scand J Work Environ Health*, *44*(3), 291-302.	Outcome criteria not fulfilled.
36	Clausen, T., Andersen, L. L., Holtermann, A., Jorgensen, A. F., Aust, B., & Rugulies, R. (2013). Do self-reported psychosocial working conditions predict low back pain after adjustment for both physical work load and depressive symptoms? A prospective study among female eldercare workers. *Occup Environ Med*, *70*(8), 538-544.	Outcome criteria not fulfilled.
37	Clays, E., Ketels, M., & Oakman, J. (2021). Low back and neck-shoulder pain: What is the role of objective and subjective measures in determining physical and psychosocial workplace hazards in non-sedentary jobs? *International Journal of Behavioral Medicine*, *28*(SUPPL 1), S134-S135.	Study design criteria not fulfilled.
38	Coenen, P., Douwes, M., van den Heuvel, S., & Bosch, T. (2016). Towards exposure limits for working postures and musculoskeletal symptoms - a prospective cohort study. *Ergonomics*, *59*(9), 1182-1192.	Outcome criteria not fulfilled.
39	Coenen, P., Kingma, I., Boot, C. R., Bongers, P. M., & van Dieen, J. H. (2014). Cumulative mechanical low-back load at work is a determinant of low-back pain. *Occup Environ Med*, *71*(5), 332-337.	Outcome criteria not fulfilled.
40	Coenen, P., Kingma, I., Boot, C. R., Twisk, J. W., Bongers, P. M., & van Dieen, J. H. (2013). Cumulative low back load at work as a risk factor of low back pain: a prospective cohort study. *J Occup Rehabil*, *23*(1), 11-18.	Other reasons (e.g., abstract, books).
41	Coenen, P., Mathiassen, S. E., Kingma, I., Boot, C. R., Bongers, P. M., & van Dieen, J. H. (2015). The effect of the presence and characteristics of an outlying group on exposure-outcome associations. *Scand J Work Environ Health*, *41*(1), 65-74.	Outcome criteria not fulfilled.
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136	Piranveyseh, P., Motamedzade, M., Osatuke, K., Mohammadfam, I., Moghimbeigi, A., Soltanzadeh, A., & Mohammadi, H. (2016). Association between psychosocial, organizational and personal factors and prevalence of musculoskeletal disorders in office workers. *Int J Occup Saf Ergon*, *22*(2), 267-273.	Study design criteria not fulfilled.
137	Plouvier, S., Chastang, J. F., Cyr, D., Bonenfant, S., Descatha, A., Goldberg, M., & Leclerc, A. (2015). Occupational biomechanical exposure predicts low back pain in older age among men in the Gazel Cohort. *Int Arch Occup Environ Health*, *88*(4), 501-510.	Outcome criteria not fulfilled.
138	Prado-León LR. Push/Pull Risk Factors at Workstations: A Case-Control Study of Mexican Industrial Workers. Human Factors and Ergonomics in Manufacturing & Service Industries 2014;24(3):328-35. doi: https://doi.org/10.1002/hfm.20380	Exposure criteria not fulfilled.
139	Prakash, K. C., Neupane, S., Leino-Arjas, P., von Bonsdorff, M. B., Rantanen, T., von Bonsdorff, M. E., Seitsamo, J., Ilmarinen, J., & Nygard, C. H. (2017). Work-Related Biomechanical Exposure and Job Strain as Separate and Joint Predictors of Musculoskeletal Diseases: A 28-Year Prospective Follow-up Study. *Am J Epidemiol*, *186*(11), 1256-1267.	Outcome criteria not fulfilled.
140	Puschmann, A. K., Driesslein, D., Beck, H., Arampatzis, A., Moreno Catala, M., Schiltenwolf, M., Mayer, F., & Wippert, P. M. (2020). Stress and Self-Efficacy as Long-Term Predictors for Chronic Low Back Pain: A Prospective Longitudinal Study. *J Pain Res*, *13*, 613-621.	Outcome criteria not fulfilled.
141	Ramond-Roquin, A., Bodin, J., Serazin, C., Parot-Schinkel, E., Ha, C., Richard, I., Petit Le Manach, A., Fouquet, N., & Roquelaure, Y. (2015). Biomechanical constraints remain major risk factors for low back pain. Results from a prospective cohort study in French male employees. *Spine J*, *15*(4), 559-569.	Outcome criteria not fulfilled.

142	Rasmussen, C. D. N., Holtermann, A., & Jorgensen, M. B. (2018). Recall Bias in Low Back Pain Among Workers: Effects of Recall Period and Individual and Work-Related Factors. *Spine (Phila Pa 1976)*, *43*(12), E727-E733.	No measure of an association.
143	Rasmussen-Barr, E., Grooten, W. J. A., Hallqvist, J., Holm, L. W., & Skillgate, E. (2017). Are job strain and sleep disturbances prognostic factors for low-back pain? A cohort study of a general population of working age in Sweden. *J Rehabil Med*, *49*(7), 591-597.	Outcome criteria not fulfilled.
144	Reme, S. E., Shaw, W. S., Boden, L. I., Tveito, T. H., O'Day, E. T., Dennerlein, J. T., & Sorensen, G. (2014). Worker assessments of organizational practices and psychosocial work environment are associated with musculoskeletal injuries in hospital patient care workers. *Am J Ind Med*, *57*(7), 810-818.	Study design criteria not fulfilled.
145	Ricco, M., Pezzetti, F., & Signorelli, C. (2017). Back and neck pain disability and upper limb symptoms of home healthcare workers: A case-control study from Northern Italy. *Int J Occup Med Environ Health*, *30*(2), 291-304.	Outcome criteria not fulfilled.
146	Ropponen, A., Narusyte, J., Silventoinen, K., & Svedberg, P. (2020). Health behaviours and psychosocial working conditions as predictors of disability pension due to different diagnoses: a population-based study. *BMC Public Health*, *20*(1), 1507.	Outcome criteria not fulfilled.
147	Ropponen, A., Samuelsson, A., Alexanderson, K., & Svedberg, P. (2013). Register-based data of psychosocial working conditions and occupational groups as predictors of disability pension due to musculoskeletal diagnoses: a prospective cohort study of 24,543 Swedish twins. *BMC Musculoskelet Disord*, *14*, 268.	Outcome criteria not fulfilled.
148	Roy, T. C., Lopez, H. P., & Adams. (2013). A comparison of deployed occupational tasks performed by different types of military battalions and resulting low back pain. *Mil Med*, *178*(8), e937-943.	Outcome criteria not fulfilled.
149	Roy, T. C., Lopez, H. P., & Piva, S. R. (2013). Loads worn by soldiers predict episodes of low back pain during deployment to Afghanistan. *Spine (Phila Pa 1976)*, *38*(15), 1310-1317.	Outcome criteria not fulfilled.
150	Roy, T. C., Piva, S. R., Christiansen, B. C., Lesher, J. D., Doyle, P. M., Waring, R. M., Irrgang, J. J., Moore, C. G., Brininger, T. L., & Sharp, M. A. (2016). Heavy Loads and Lifting are Risk Factors for Musculoskeletal Injuries in Deployed Female Soldiers. *Mil Med*, *181*(11), e1476-e1483.	Outcome criteria not fulfilled.
151	Rufa'i, A. A., Sa'idu, I. A., Ahmad, R. Y., Elmi, O. S., Aliyu, S. U., Jajere, A. M., & Digil, A. A. (2015). Prevalence and Risk Factors for Low Back Pain Among Professional Drivers in Kano, Nigeria. *Arch Environ Occup Health*, *70*(5), 251-255.	Study design criteria not fulfilled.
152	Runeson-Broberg, R., Lindgren, T., & Norback, D. (2014). Musculoskeletal symptoms and psychosocial work environment, among Swedish commercial pilots. *Int Arch Occup Environ Health*, *87*(7), 685-693.	Study design criteria not fulfilled.
143	Sadeghi-Yarandi M, Ghasemi M, Ghanjal A, Sepandi M, Soltanzadeh A. The Prediction of Chronicity in Patients With Acute and Subacute Nonspecific Low Back Pain and Associated Risk Factors: A Case-Control Study. Pain Manag Nurs. 2022.	No measure of an association.
154	Sadeghian, F., Coggon, D., Ntani, G., & Hosseinzadeh, S. (2015). Predictors of low back pain in a longitudinal study of Iranian nurses and office workers. *Work*, *51*(2), 239-244.	Outcome criteria not fulfilled.
155	Sain, M. K., & Meena, M. (2019). Identifying musculoskeletal issues and associated risk factors among clay brick kiln workers. *Ind Health*, *57*(3), 381-391.	Study design criteria not fulfilled.
156	Sain, M. K., & Meena, M. L. (2018). Exploring the musculoskeletal problems and associated risk-factors among brick kiln workers. *International Journal of Workplace Health Management*, *11*(6), 395-410.	Study design criteria not fulfilled.
157	Salve, U. R. (2015). Prevalence of musculoskeletal discomfort among the workers engaged in jewelry manufacturing. *Indian J Occup Environ Med*, *19*(1), 44-55.	Other reasons (e.g., abstract, books).
158	Salo S, Hurri H, Rikkonen T, Sund R, Kroger H, Sirola J. Association between severe lumbar disc degeneration and self-reported occupational physical loading. J Occup Health. 2022;64(1):14.	Study design criteria not fulfilled.
159	Samaei, S. E., Mostafaee, M., Jafarpoor, H., & Hosseinabadi, M. B. (2017). Effects of patient-handling and individual factors on the prevalence of low back pain among nursing personnel. *Work*, *56*(4), 551-561.	Study design criteria not fulfilled.
160	Sauter M, Barthelme J, Müller C, Liebers F. Manual handling of heavy loads and low back pain among different occupational groups: results of the 2018 BIBB/BAuA employment survey. BMC Musculoskeletal Disorders. 2021;22(1):1-14.	Study design criteria not fulfilled.
161	Schlussel, A. T., & Maykel, J. A. (2019). Ergonomics and Musculoskeletal Health of the Surgeon. *Clin Colon Rectal Surg*, *32*(6), 424-434.	Other reasons (e.g., abstract, books).
162	Serranheira, F., Sousa-Uva, M., Heranz, F., Kovacs, F., & Sousa-Uva, A. (2020). Low Back Pain (LBP), work and absenteeism. *Work*, *65*(2), 463-469.	Study design criteria not fulfilled.
163	Shankar, S., Naveen Kumar, R., Mohankumar, P., & Jayaraman, S. (2017). Prevalence of work-related musculoskeletal injuries among South Indian hand screen-printing workers. *Work*, *58*(2), 163-172.	Study design criteria not fulfilled.
164	Shankar, S., Shanmugam, M., & Srinivasan, J. (2015). Workplace factors and prevalence of low back pain among male commercial kitchen workers. *J Back Musculoskelet Rehabil*, *28*(3), 481-488.	Study design criteria not fulfilled.
165	Shiri, R., Falah-Hassani, K., Heliovaara, M., Solovieva, S., Amiri, S., Lallukka, T., Burdorf, A., Husgafvel-Pursiainen, K., & Viikari-Juntura, E. (2019). Risk Factors for Low Back Pain: A Population-Based Longitudinal Study. *Arthritis Care Res (Hoboken)*, *71*(2), 290-299.	Outcome criteria not fulfilled.
166	Silva, C., Barros, C., Cunha, L., Carnide, F., & Santos, M. (2016). Prevalence of back pain problems in relation to occupational group. *International Journal of Industrial Ergonomics*, *52*, 52-58.	Study design criteria not fulfilled.

167	Skillgate E, Isacson Hjortzberg M, Strömwall P, Hallqvist J, Onell C, Holm LW, et al. Non-Preferred Work and the Incidence of Spinal Pain and Psychological Distress-A Prospective Cohort Study. Int J Environ Res Public Health. 2021;18(19).	Outcome criteria not fulfilled.
168	Solecki, L. (2014). Complaints of low back pain among private farmers exposed to whole body vibration. *Med Pr*, *65*(1), 55-64.	Other reasons (e.g., abstract, books).
169	Solovev, A., Watanabe, Y., Kitamura, K., Takahashi, A., Kobayashi, R., Saito, T., Takachi, R., Kabasawa, K., Oshiki, R., Platonova, K., Tsugane, S., Iki, M., Sasaki, A., Yamazaki, O., Watanabe, K., & Nakamura, K. (2020). Total physical activity and risk of chronic low back and knee pain in middle-aged and elderly Japanese people: The Murakami cohort study. *Eur J Pain*, *24*(4), 863-872.	Exposure criteria not fulfilled.
170	Sterud, T., Johannessen, H. A., & Tynes, T. (2016). Do Work-Related Mechanical and Psychosocial Factors Contribute to the Social Gradient in Low Back Pain?: A 3-Year Follow-Up Study of the General Working Population in Norway. *Spine (Phila Pa 1976)*, *41*(13), 1089-1095.	Outcome criteria not fulfilled.
171	Sterud, T., & Tynes, T. (2013). Work-related psychosocial and mechanical risk factors for low back pain: a 3-year follow-up study of the general working population in Norway. *Occup Environ Med*, *70*(5), 296-302.	Outcome criteria not fulfilled.
172	Stevens, M. L., Boyle, E., Hartvigsen, J., Mansell, G., Sogaard, K., Jorgensen, M. B., Holtermann, A., & Rasmussen, C. D. N. (2019). Mechanisms for reducing low back pain: a mediation analysis of a multifaceted intervention in workers in elderly care. *Int Arch Occup Environ Health*, *92*(1), 49-58.	Outcome criteria not fulfilled.
173	Sundstrup, E., & Andersen, L. L. (2017). Hard Physical Work Intensifies the Occupational Consequence of Physician-Diagnosed Back Disorder: Prospective Cohort Study with Register Follow-Up among 10,000 Workers. *Int J Rheumatol*, *2017*, 1037051.	Outcome criteria not fulfilled.
174	Tang, R., Kapellusch, J. M., Hegmann, K. T., Thiese, M. S., Wang, I., & Merryweather, A. S. (2020). Evaluating Different Measures of Low Back Pain Among U.S. Manual Materials Handling Workers: Comparisons of Demographic, Psychosocial, and Job Physical Exposure. *Hum Factors*, 18720820971101.	Outcome criteria not fulfilled.
175	Telaprolu, N., & Anne, S. D. (2014). Physical and psychological work demands as potential risk factors for musculoskeletal disorders among workers in weaving operations. *Indian JOccup Environ Med*, *18*(3), 129-134.	Study design criteria not fulfilled.
176	Thiede, M., Liebers, F., Seidler, A., Gravemeyer, S., & Latza, U. (2014). Gender specific analysis of occupational diseases of the low back caused by carrying, lifting or extreme trunk flexion--use of a prevention index to identify occupations with high prevention needs. *Am J Ind Med*, *57*(2), 233-244.	Study design criteria not fulfilled.
177	Thiese, M. S., Lu, M. L., Merryweather, A., Tang, R., Ferguson, S. A., Malloy, E. J., Marras, W. S., Hegmann, K. T., & Kapellusch, J. (2020). Psychosocial Factors and Low Back Pain Outcomes in a Pooled Analysis of Low Back Pain Studies. *J Occup Environ Med*, *62*(10), 810-815.	Study design criteria not fulfilled.
178	Udom, C., Kanlayanaphotporn, R., & Janwantanakul, P. (2019). Predictors for Nonspecific Low Back Pain in Rubber Farmers: A 1-Year Prospective Cohort Study. *Asia Pac J Public Health*, *31*(1), 7-17.	Outcome criteria not fulfilled.
179	Upadhyay R, Bhattacherjee A, Patra AK, Chau N. Association between Whole-Body Vibration exposure and musculoskeletal disorders among dumper operators: A case-control study in Indian iron ore mines. Work. 2022;71(1):235-47.	Outcome criteria not fulfilled.
180	Urquhart, D. M., Kelsall, H. L., Hoe, V. C., Cicuttini, F. M., Forbes, A. B., Sim, M. R., & Burton. (2013). Are psychosocial factors associated with low back pain and work absence for low back pain in an occupational cohort? *Clin J Pain*, *29*(12), 1015-1020.	Study design criteria not fulfilled.
181	Vargas-Prada, S., Serra, C., Martinez, J. M., Ntani, G., Delclos, G. L., Palmer, K. T., Coggon, D., & Benavides, F. G. (2013). Psychological and culturally-influenced risk factors for the incidence and persistence of low back pain and associated disability in Spanish workers: findings from the CUPID study. *Occup Environ Med*, *70*(1), 57-62.	Outcome criteria not fulfilled.
182	Vieira LA, Dos Santos AA, Peluso C, et al. Influence of lifestyle characteristics and VDR polymorphisms as risk factors for intervertebral disc degeneration: a case-control study. Eur J Med Res 2018;23(1):11. doi: 10.1186/s40001-018-0309-x.	Exposure criteria not fulfilled.
183	Vinstrup, J., Jakobsen, M. D., & Andersen, L. L. (2020). Perceived Stress and Low-Back Pain Among Healthcare Workers: A Multi-Center Prospective Cohort Study. *Front Public Health*, *8*, 297.	Outcome criteria not fulfilled.
184	Vinstrup, J., Jakobsen, M. D., Madeleine, P., & Andersen, L. L. (2020). Physical exposure during patient transfer and risk of back injury & low-back pain: prospective cohort study. *BMC Musculoskelet Disord*, *21*(1), 715.	Outcome criteria not fulfilled.
185	Wahlstrom J, Burstrom L, Johnson PW, et al. Exposure to whole-body vibration and hospitalization due to lumbar disc herniation. Int Arch Occup Environ Health 2018;91(6):689- 94. doi: 10.1007/s00420-018-1316-5.	Exposure criteria not fulfilled.
186	Wang F, Chen K, Lin QS, Ma YG, Huang H, Wang CAF, et al. Earlier or heavier spinal loading is more likely to lead to recurrent lumbar disc herniation after percutaneous endoscopic lumbar discectomy. J Orthop Surg Res. 2022;17(1):7.	Outcome criteria not fulfilled.
187	Wippert PM, Valencia LP, Driesslein D. Stress and Pain. Predictive (Neuro)Pattern Identification for Chronic Back Pain: A Longitudinal Observational Study. Front Med. 2022;9:14.	Outcome criteria not fulfilled.
188	Wixted, F., & O'Sullivan, L. (2019). Task engagement as a mediator between the cognitive demands of sustained attention and musculoskeletal complaints: A structural equation modelling approach. *Work*, *64*(3), 623-634.	Study design criteria not fulfilled.
189	Wurzelbacher, S. J., Lampl, M. P., Bertke, S. J., & Tseng, C. Y. (2020). The effectiveness of ergonomic interventions in material handling operations. *Appl Ergon*, *87*, 103139.	Outcome criteria not fulfilled.
190	Xiao, H., McCurdy, S. A., Stoecklin-Marois, M. T., Li, C. S., & Schenker, M. B. (2013). Agricultural work and chronic musculoskeletal pain among Latino farm workers: the MICASA study. *Am J Ind Med*, *56*(2), 216-225.	Study design criteria not fulfilled.

191	Yang, S. T., Park, M. H., & Jeong, B. Y. (2020). Types of manual materials handling (MMH) and occupational incidents and musculoskeletal disorders (MSDs) in motor vehicle parts manufacturing (MVPM) industry. *International Journal of Industrial Ergonomics*, *77*, 9.	Study design criteria not fulfilled.
192	Yazgan E, Ozkan NF, Ulutas BH. A questionnaire-based musculoskeletal disorder assessment for aircraft maintenance technicians. Aircr Eng Aerosp Technol. 2022;94(2):240-7.	Outcome criteria not fulfilled.
193	Yovi, E. Y., & Prajawati, W. (2015). High Risk Posture on Motor-Manual Short Wood Logging System in Acacia mangium Plantation. *Jurnal Manajemen Hutan Tropika (Journal of Tropical Forest Management)*, *21*(1), 11-18.	Study design criteria not fulfilled.
194	Yovi, E. Y., & Yamada, Y. (2019). Addressing Occupational Ergonomics Issues in Indonesian Forestry. *Croatian Journal of Forest Engineering*, *40*(2), 351-363.	Study design criteria not fulfilled.
195	Yue, P., Xu, G., Li, L., & Wang, S. (2014). Prevalence of musculoskeletal symptoms in relation to psychosocial factors. *Occup Med (Lond)*, *64*(3), 211-216.	Study design criteria not fulfilled.
196	Zamri, E. N., Hoe, V. C. W., & Moy, F. M. (2020). Predictors of low back pain among secondary school teachers in Malaysia: a longitudinal study. *Ind Health*, *58*(3), 254-264.	Outcome criteria not fulfilled.
197	Zarra, T., & Lambrianidis, T. (2014). Musculoskeletal disorders amongst Greek endodontists: a national questionnaire survey. *Int Endod J*, *47*(8), 791-801.	Study design criteria not fulfilled.
198	Zhang, D., & Huang, H. (2017). Prevalence of work-related musculoskeletal disorders among sonographers in China: results from a national web-based survey. *J Occup Health*, *59*(6), 529-541.	Study design criteria not fulfilled.
199	Zhang, M. Y., Bai, Z. Z., Zhao, X. F., Ieee, Ieee, & Dalian Univ Technol, F. I. E. D. C. M. D. P. R. C. (2017). Real-time Risk Assessment for Construction Workers' Trunk Posture Using Mobile Sensor. *International Conference on Robotics and Automation Sciences (ICRAS)*, 153-157.	Study design criteria not fulfilled.

Appendix F. Study characteristics

Table S10. Description of each included study

Author	Design	Population	Outcome		Exposure	
			Definition	**Assessment**	**Definition**	**Assessment**
Aghilinejad 2015 (27)	Cohort	The cohort consisted of male workers in one of the biggest metal-industry factories in Iran followed from 2012 to 2013. In total, 218 workers received a questionnaire and 33 were excluded. Therefore, 185 workers were eligible for the analysis (49 chronic participants and 136 cured for acute LBP) with a mean age of 35.96 (SD=7.33).	LBP: Self-reported chronic pain ≥3 months. Participants are followed up until 3 months after onset during monthly phone calls. If the pain had ended before the 3 months, they were categorised in the acute group.	Interview.	Psychosocial exposures were defined as: job demand, job control, job satisfaction, social support, and job strain. All exposures were dichotomised.	Questionnaire (MUSIC)*.
Ahsan 2013 (28)	Case-control	240 cases with LDH were recruited by their physicians from a spinal surgery unit in Dhaka, Bangladesh (2007-2010). 200 cases (124 males and 76 females) were eligible, and 200 controls were matched on age, sex, and area of residence from a non-spinal related orthopaedic department. The overall mean age was 39.42 years (SD=NS).	LDH: With low back pain with or without sciatica collected from radiological and physicians' examinations. Diagnostic criteria: - Dominant leg pain than back pain. - Restricted Straight Leg Raise. - Neurological deficit. - Positive MRI findings.	Physical examination, radiological examination, and MRI.	Psychosocial exposures comprised job satisfaction and stress at work.	Interview.
Esquirol 2017 (29)	Cohort	3,237 male and female employed and retired workers from south of France were followed with a 5-year follow-up period with age ranging from 32 to 52 years. For the analysis, 804 males and 756 females were eligible and divided in: - 231 participants reported "persistent chronic LBP" (they were compared with a non-persistent chronic LBP group containing 199 participants) - 255 participants reported "incidence of chronic LBP" (they were compared with a non-chronic LBP group containing 875 participants).	LBP: Participants were considered as suffering from chronic LBP if they reported LBP or a specific treatment for such pain for at least 6 months at both measurements' points. Participants are divided in three outcome groups: 1. Answering "no" to CLBP at both measurements. 2. Incidence CLBP – answering "no" at baseline but "yes" at follow-up. 3. Persistence CLBP – answering "yes" at both measurements.	Questionnaire.	Psychosocial exposures were defined using the Karasek model to categories levels of decision latitude and demands. Furthermore, three items were dichotomised: job recognition, occupational support, and difficulty communicating.	Questionnaire.
Gold 2017 (30)	Cohort	The study consisted of workers from multiple facilities within a single company in USA; with the vast majority being clinically staff, specifically nurses and nursing aids with a mean age of 41.1 years (SD=13.1). 1291 responded to the survey after 2 years with 1154 participants being eligible for the analyses (>90 % females), and after 6 years, 228 participants were left after attrition.	LBP: Was defined as pain in the low back region the past 3 months with at least mild severity during the prior week.	Questionnaire.	Psychosocial exposures comprised work-family imbalance.	Questionnaire (JCQ)*.

Halonen 2018 (31)	Cohort	A representative Swedish working population consisting of 9,756 individuals. Of these, 4,079 participants were included based on answers to at least 3 out of 4 survey rounds. For the analyses, 1,845 had onset of LBP with (932 males and 913 females) with age NS.	LBP: Self-reported pain in the last 3 months defined as either "pain that affects my life a little" or "pain that affects my life a lot". LBP was dichotomised into: - No affecting pain (no pain or pain that does not affect life). - Affecting pain (pain affecting life a little or a lot).	Questionnaire.	Psychosocial exposures comprised the effort-reward imbalance. It consisted of 10 effort-reward items: three related to efforts at work and seven related to rewards. An effort-reward ratio was calculated and values below 1 indicated no effort-reward imbalance and ≥1 indicated perception of effort-reward imbalance.	Questionnaire.
Herin 2014 (32)	Cohort	Representative sample of subjects randomly selected from 7 French regions using exhaustive lists under the supervision of 400 volunteering occupational physicians. A total of 21,378 participants were included at baseline, 18,695 responded at follow-up, and 12,591 was eligible both at baseline and follow-up. For the analyses, 1206 participants (787 males and 419 females) were presented with LBP who came from 4 years of birth (1938, 1943, 1948 and 1953).	LBP: Self-reported musculoskeletal pain in combination with physicians' examination. Chronic musculoskeletal pain was defined as subjects who, on the day of examination, declared low back pain for at least 6 months who also presented with positive clinical signs.	Interview and physical examination.	Psychosocial exposures comprised psychological demands and decision latitude, both proxies of the two fundamental psychosocial factors of the Karasek model.	Questionnaire.
Jansen 2004 (33)	Cohort	The cohort consisted of workers from 7 Dutch nursing homes and homes for elderly with various professions such as nurses, care givers, kitchen workers, transportation etc. 1208 subjects were invited to participate in 1998-1999 and 769 agreed to participate. After 1 year, 523 were observed again with a mean age of 40.7 years of age (SD=9.7). Information on sex was not provided.	LBP: Low back pain with disability was defined by Von Korff's disability score >50 points which indicated "high disability".	Questionnaire.	Psychosocial exposures comprised decision authority, skill discretion, and work demands included in the Karasek model.	Questionnaire
Jørgensen 2013 (34)	Cohort	The cohort consisted of Danish participants employed in 14 private and public companies. 5,249 men took part in the baseline examination. 3,833 were without LBP at baseline and was then included for the analyses aged between 40 and 59 years.	LDH: Hospitalisation due to herniated lumbar disc disease was identified in the National Hospital Register between 1977 and 2003 using the ICD-8 code 725.11 and ICD-10 code M51.1.	Register information.	Psychosocial exposures comprised mental stress at work - seldom or regularly.	Questionnaire
Latza 2002 (35)	Cohort	The cohort consisted of 571 male construction workers (age 17-59 years) from Hamburg, Germany. After 3 years, all workers were approached for a follow-up survey and 488 were willing to participate with a mean age of 33.1 years (SD=10.0).	Chronic LBP: ≥90 days of low back pain during the last 12 months.	Interview.	Psychosocial exposures comprised monotonous work, time pressure, low job control, poor social support, and satisfaction with own achievements, all measured on a 5-point Likert scale.	Interview
Matsudaira 2014 (36)	Cohort	Employees were recruited from 16 local offices (e.g., office workers, nurses, salesmen and manufacturing engineers) in/near Tokyo, Japan.	Persistent LBP: LBP interfering with work (grade 2 or 3) with disability lasting longer than 3 months during a 1-year follow-up period.	Questionnaire.	Psychosocial exposures comprised mental workload, interpersonal stress at work, workplace environment stress, job control, utilization of skills and expertise, and	Questionnaire (BJSQ)*.

		Baseline questionnaire was distributed to 6,140 participants and 5,310 responded. After 1 year, 3,811 participants completed the follow-up questionnaire. Among the 3,811 participants, 1,675 reported mild LBP during the past year at baseline with a mean age of 43.1 years (SD=10.1) and 78.6% males. Of these, 43 participants reported persistent LBP within the 1-year follow-up period.	Grades: - Grade: No LBP. - Grade 1: LBP that does not interfere with work. - Grade 2: LBP that interferes with work but no absence from work. - Grade 3: LBP that interferes with work, leading to sick leave.		reward to work. Each exposure was assessed on a five-point scale.	
Matsudaira 2015 (37)	Cohort	Employees were recruited from 16 local offices (e.g., office workers, nurses, salesmen and manufacturing engineers) in/near Tokyo, Japan. Baseline questionnaire was distributed to 6140 participants and 5,310 responded. After 1 year, 3,811 participants completed the follow-up questionnaire. Among the 3,811 employees, 171 reported LBP and experiencing work interferences with or without sick leave during a month prior to baseline with a mean age of 42.9 years (SD=10.1) (71.4% males). Of these, 29 developed chronic disabling LBP during a year prior to the follow-up period.	Chronic disabling LBP: LBP that interfered with work for ≥3 months, regardless of sick leave (grade 2 and 3) during a 1-year follow-up period. Grades: - Grade: No LBP. - Grade 1: LBP that does not interfere with work. - Grade 2: LBP that interferes with work but no absence from work. - Grade 3: LBP that interferes with work, leading to sick leave.	Questionnaire.	Psychosocial exposures comprised mental workload, interpersonal stress at work, workplace environment stress, job control, utilization of skills and expertise, and reward to work. Each exposure was assessed on a five-point scale.	Questionnaire (BJSQ)*.
Matsudaira 2019 (38)	Cohort	Participants were recruited from different occupational groups in/near Tokyo. Occupational groups varied from nurses, office workers, sales/marketing to transportation. Baseline questionnaire was distributed to 3,187 employees and 2651 returned the questionnaire. Of these, 1809 participants returned the completed follow-up questionnaire. Among the 1809 participant, only 198 participants with disabling LBP during the month before baseline were included. The mean age was 36.0 (SD=9.1) where 69% were males. Of these 198, 35 had chronic disabling LBP during the 1-year follow-up period.	Chronic disabling LBP: LBP that interfered with work for ≥3 months regardless of sick leave (grade 2 and 3) during the 1-year follow-up period. Grades: - Grade 0: No LBP. - Grade 1: LBP that does not interfere with work. - Grade 2: LBP that interferes with work but no absence from work. - Grade 3: LBP that interferes with work, leading to sick-leave.	Questionnaire.	Psychosocial exposures comprised interpersonal stress at work, inadequate breaks at work, lack of control over how to work, lack of control over what to do at work, lack of workplace support, and dissatisfied with job	Questionnaire (CUPID).
Melloh 2013 (39)	Cohort	315 patients were recruited from 14 health practitioners across New Zealand due to their first episode of acute to subacute LBP or for recurrent LBP. 147 patients were lost to follow-up resulting in 168 patients participating over the six-months period (62% females) with a mean age of 36 (SD=13.1).	To determine persistent LBP, follow-up questionnaires were sent after 3, 6, and 12 weeks and at 6 month collecting information on pain intensity (VAS-scale) in the low back during the last week. Patients with persistent LBP were then compared to patients with non-persistent LBP – no information was given on how the groups were categorised.	Questionnaire.	Psychosocial exposures comprised job satisfaction, job control and social support at work based on the Multinational Musculoskeletal Inception Cohort Study statements.	Questionnaire (items from JCQ).

Melloh 2013 (40)	Cohort	315 patients were recruited from 14 health practitioners in New Zealand due to their first episode of acute to subacute LBP or for recurrent LBP. 168 participants (62 % females) completed the follow-up with a mean age of 36.0 (SD=13.1).	Persistent low back pain was defined by Oswestry Disability Index scorer of >10 points at baseline and 6 months and an ODI change score of ≤10 points between baseline and 6-month follow-up.	Questionnaire.	Psychosocial exposures comprised job satisfaction, job control and social support at work based on the Multinational Musculoskeletal Inception Cohort Study statements.	Questionnaire (items from JCQ).
Melloh 2013 (41)	Cohort	315 patients were recruited from 14 health practitioners in New Zealand due to their first episode of acute to subacute LBP or for recurrent LBP. 195 participants (62 % females) completed the follow-up with a mean age of 36.0 (SD=13.1).	Persistent low back pain was defined by Oswestry Disability Index scorer of >10 points, measured at baseline and 3, 6, and 12 weeks. An ODI score of >10 points and under a 10-point change score at 12-week follow-up was considered as persistent LBP.	Questionnaire.	Psychosocial exposures comprised job satisfaction based on a combined score (4-28 points) and social support at work based on a combined score (6-30 points).	Questionnaire (items from JCQ).
Seidler 2003 (42)	Case-control	437 male patients recruited at neurological clinics in Germany aged between 25 and 65 years. After exclusion, 225 cases were eligible and divided into: - LDH with osteochondrosis/spondylosis = 131, mean age 43.7 - "Pure" LDH = 94, mean age of 40.0. 107 controls (males) were from a random population group (mean age of 43) and 90 patients (males) admitted to hospital for urolithiasis who had no radiographically confirmed osteochondrosis or spondylosis (mean age of 40).	Herniation of the lumbar discs or osteochondrosis/spondylosis of the lumbar spine associated with chronic complaints (low back pain, sciatica). The diagnosis of lumbar disc herniation had to have been confirmed by computed tomography or magnetic resonance imaging. The radiographs were reassessed by reference radiologist.	MRI and CT.	Psychosocial exposures comprised monotonous work, opportunities to use knowledge and skills, satisfaction with supervisor, satisfaction with workmates, psychic strain, time pressure, and to much responsibility. The psychosocial exposures were assessed on a scale from 1 to 6.	Interview.
Seyedmehdi 2016 (43)	Cohort	All industrial workers from a large Iranian rubber factory with acute non-specific LBP in the past 2 weeks were included (2011-2912). Diagnosis of acute non-specific LBP at baseline was made by two occupational medicine specialists. The cohort consisted of 542 participants and 511 completed the 1-year follow-up (500 males and 11 females) with a mean age of 37.6 years (SD=5.8).	LBP was assessed 3, 6, 9 months and at 1 year after baseline asking the question: "Have you recovered from your LBP". If the answer was "yes" The question would follow: "How long did it last?" Participants with LBP were divided in 2 groups: 1. LBP lasting <3 months. 2. LBP lasting ≥3 months.	Face-to-face or telephone interview.	Psychosocial exposures comprised job stress, evaluated by the factors decision making, psychological demands, social support, and occupational and physical needs, and dichotomised into high/low stress.	Questionnaire (JCQ).
Sihawong 2016 (44)	Cohort	The cohort consisted of a sample of office workers recruited from nine-scale enterprises in Thailand. 3,446 office workers responded to the questionnaire and 2,483 were excluded. 669 agreed to participate in the physical examination and 615 were followed up after 1 year. Due to incomplete data, 609 were included in the analysis with a mean age of 35.7 (SD=8.3) including 168 males and 501 females.	Incidence of chronic low back pain was defined as ongoing pain greater than 3 months over the past 6 months. Participants received a self-administered diary to record low back pain, and researchers would collect the diaries every month over the course of 12 months.	Diaries.	Psychosocial exposures comprised psychological job demands measured by factors of decision latitude, support, demands, and security.	Questionnaire (JCQ).
Sørensen 2011 (45)	Cohort	Participants were employed at 14 different private and public companies in Copenhagen, Denmark, including railway, insurance, fire brigade etc., aged between 40 to 59 years. 5249	Hospitalisation due to herniated lumbar disc disease was identified in the National Hospital Register between 1977 and 2003 using the ICD-8 code 725.11 and ICD-10 code M51.1.	Register information.	Psychosocial exposures comprised mental stress at work measured by "seldom" or "regularly".	Questionnaire.

		males were invited at baseline and 3833 without LBP at baseline were entered in the study.				
Tubach 2004 (46)	Cohort	At baseline, the cohort included 20,624 subjects who were employees at a French electricity and gas company. Of these, a random sample of 4,018 subjects received a questionnaire about LBP. 3,240 completed the questionnaire whereas 475 were included in the analyses (405 males and 70 females) aged between 35 to 50 years.	LBP: Assessed by the question regarding suffering from sciatica the last year and if the subjects had visited a physician regarding their symptoms.	Questionnaire.	Psychosocial exposures comprised job satisfaction measured with an analogic visual scale divided into tertiles.	Questionnaire.

Abbreviations: CT = computed tomography; ICD = International Classification of Diseases; kg = kilogram; LBP = low back pain; LDH = lumbar disc herniation; LDN = lumbar disc narrowing; MRI = magnetic resonance imaging; MS = milliseconds; NS = not specified; SD = standard deviation. *BJSQ = Brief Job Stress Questionnaire; CUPID = Cultural and Psychosocial Influences on Disability; JCQ = Job Content Questionnaire; MUSIC = Musculoskeletal intervention Center-Norrtälje Study.

Appendix G. Measure of associations

Table S11. Measures of associations of each included study

Author	Exposure	Confounders	Categories of exposure	Results					
				Men		Women		All	
				Measure of association	95% CI	Measure of association	95% CI	Measure of association	95% CI
Job control									
Aghilinejad 2015	*Job control*: Was assessed using Karasek model and measured by 6 questions on a four-point scale and dichotomised (N=185, 126 cases and 59 controls).	None.	- No - Yes	1.00 OR 0.84 OR	- 0.42 – 1.68	- -	- -	- -	- -
Herin 2014	*Decision latitude*: Was assessed using Karasek model and considered "low" when answering "no" to two out of three questions regarding room for learning, variety of work, and choosing how to do one's work (N=1,206, 787 males and 419 females).	Age, sports participation, BMI, and social class.	Men - Low - High Women - Low - High	1.00 OR 1.06 OR	- 0.90 – 1.26	1.00 OR 0.91 OR	- 0.71 – 1.16	- -	- -
Jansen 2004	*Decision authority*: was assessed using Karasek's model with 11 questions reflecting planning, influence on pace, pauses etc. and based on the centile of distribution (N=523).	Age, trunk flexion between 20 to 45º, trunk flexion >45º, and lifting/carrying loads >10 kg, skill discretion, work demands, and years in service	- 10th centile - 25th centile - 50th centile - 75th centile - 90th centile	- - - - -	- - - - -	- - - - -	- - - - -	1.00 RR 1.07 RR 1.13 RR 1.50 RR 0.76 RR	- 0.64 – 1.78 0.42 – 3.04 0.55 – 4.14 0.21 – 2.72
	Skill discretion: was assessed using Karasek's model with 6 questions reflecting skills, task variety, learning etc. and based on the centile of distribution (N=523).	Age, trunk flexion between 20 to 45º, trunk flexion >45º, lifting/carrying loads >10 kg, decision authority, work demands, and years in service	- 10th centile - 25th centile - 50th centile - 75th centile - 90th centile	- - - - -	- - - - -	- - - - -	- - - - -	1.00 RR 1.10 RR 1.22 RR 1.44 RR 1.09 RR	- 0.63 – 1.89 0.45 – 3.31 0.53 – 3.91 0.38 – 3.16
Latza 2002	*Job control*: Was measured by the question "Regulations and instructions hinder my performance very much" using a 5-point Likert scale (without chronic LBP N=404 at baseline and all workers N= 488).	Age.	Without chronic LBP at baseline - High - Medium - Low All workers - High - Medium - Low	1.00 PR 1.48 PR 1.13 PR 1.00 PR 1.45 PR 1.39 PR	- 0.53 – 4.12 0.40 – 3.20 - 0.71 – 2.96 0.69 – 2.83	- - - - - -	- - - - - -	- - - - - -	- - - - - -
Matsudaira 2015	*Control*: Job control was assessed with the BJSQ on a five-point Likert scale and dichotomised (N=119, 4 controlled and 115 not controlled)	None.	- Controlled - Not controlled		- -	- -	- -	1.00 OR 1.81 OR	- 0.69 – 4.79

Matsudaira 2019	*Control*: Lack of control over how to work was assessed with the CUPID-Questionnaire on a five-point scale and dichotomised (N=198).	None.	- No - Yes	- -	- -	- -	- -	1.00 OR 1.03 OR	- 0.50 – 2.14
	Control: Lack of control over what to do at work was assessed with the CUPID-Questionnaire on a five-point scale and dichotomised (N=198).	None.	- No - Yes	- -	- -	- -	- -	1.00 OR 1.08 OR	- 0.51 – 2.25
Melloh 2013	*Job control*: Was assessed using the JCQ and measured on a seven-point scale (N=168, 38 with persistent LBP and 130 with non-persistent LBP).	Age, sex, and BMI.	- No/low job control - Job control	- -	- -	- -	- -	1.00 OR 0.90 OR	- 0.55 – 1.50
Job demand									
Aghilinejad 2015	*Job demand*: Was assessed using Karasek model and measured by 5 questions on a four-point scale and dichotomised (N=185, 150 cases and 35 controls).	None.	- No - Yes	1.00 OR 1.94 OR	- 0.75 – 5.00	- -	- -	- -	- -
Herin 2014	*Demand*: Was assessed using Karasek model and psychological demand was measured by pace at work, interruption at work, and number of job tasks dichotomised (N=1,206, 787 males and 419 females).	Age, sports participation, BMI, and social class.	Men - Low - High Women - Low - High	1.00 OR 1.00 OR	- 0.87 – 1.15	 1.00 OR 1.11 OR	 - 0.92 – 1.34	 - -	 - -
Jansen 2004	*Work demand:* was assessed using Karasek's model with 11 questions reflecting working fast, hard, excessive work etc. and based on the centile of distribution (N=523).	Trunk flexion between 20 to 45º, trunk flexion >45º, lifting/carrying loads >10 kg, decision authority, and skill discretion.	- 10th centile - 25th centile - 50th centile - 75th centile - 90th centile	- - - - -	- - - - -	- - - - -	- - - - -	1.00 RR 0.86 RR 0.75 RR 1.41 RR 1.45 RR	- 0.61 – 1.21 0.33 – 1.73 0.63 – 3.18 0.60 – 3.53
Sihawong 2016	*Job demand*: Was assessed using the JCQ and measured by a seven-scale (N=609).	History of LBP, frequency of rest breaks, and frequency of exercise.	- Rate of chronic LBP	-	-	-	-	1.12 OR	0.99 – 1.26
Job strain									
Aghilinejad 2015	*Job strain*: Domains of job demands, job control and social support, and job satisfaction were summed, cut in the mid-point and divided into low and high (N=185, 45 cases and 140 controls).	None.	- No - Yes	1.000 OR 1.174 OR	- 0.56 – 2.48	- -	- -	- -	- -
Esquirol 2017	*Job strain*: Was assessed using Karasek model by combining levels of four dimensions based on psychological demands and decision latitude with low=low psych. and high decision, passive=low psych. and low decision, active=high psych. and	None.	Incidence chronic LBP: - Low - Passive - Active - High	 - - - -	 - - - -	 - - - -	 - - - -	 1.00 OR 1.05 OR 1.69 OR 0.95 OR	 - 0.59 – 1.88 0.81 – 3.55 0.55 – 1.63

	high decision, and high=high psych. and low decision (N=1,130 for incidence and 430 for persistence).		Persistence chronic LBP: - Low - Passive - Active - High	 - - - -	 - - - -	 - - - -	 - - - -	 1.00 OR 0.77 OR 1.30 OR 0.67 OR	 - 0.36 – 1.64 0.49 – 3.45 0.34 – 1.35

Job support

Aghilinejad 2015	*Social support*: Was assessed using the MUSIC-questionnaire and measured by 6 questions on a four-point scale and dichotomised (N=185, 49 cases and 136 controls).	Age, BMI, smoking, LBP history, family LBP history, education, shift working, job type, other physical and psychosocial factors.	- Low - High	1.000 OR 0.432 OR	- 0.16 – 1.17	- -	- -	- -	- -
Esquirol 2017	*Support*: Occupational support was dichotomised (N=1,130 for incidence and 430 for persistence).	None.	Incidence chronic LBP: - No - Yes Persistence chronic LBP: - No - Yes	 - - - -	 - - - -	 - - - -	 - - - -	 1.00 OR 1.25 OR 1.00 OR 1.15 OR	 - 0.87 – 1.79 - 0.74 – 1.81
Latza 2002	*Social support*: Was measured by the question "Colleagues impede my work" using a 5-point Likert scale (without chronic LBP N=404 at baseline and all workers N= 488).	Age.	Without chronic LBP at baseline - Low - Medium - High All workers - Low - Medium - High	 1.00 PR 1.39 PR 1.40 PR 1.00 PR 1.46 PR 1.50 PR	 - 0.58 – 3.36 0.59 – 3.31 - 0.82 – 2.60 0.86 – 2.62	 - - - - - -	 - - - - - -	 - - - - - -	 - - - - - -
Matsudaira 2015	*Support by supervisors*: Was assessed with the BJSQ on a five-point scale and dichotomised (N=167).	None.	- Supported - Not supported	- -	- -	- -	- -	1.00 OR 2.00 OR	- 0.88 – 4.55
	Support by co-workers: Was assessed with the BJSQ on a five-point scale and dichotomised (N=168).	None.	- Supported - Not supported	- -	- -	- -	- -	1.00 OR 0.97 OR	- 0.43 – 2.18
Matsudaira 2014	*Support by supervisors*: Was assessed with the BJSQ on a five-point scale and dichotomised (N=1,675).	Age, sex, obesity, smoking, education, and manual materials handling at work.	- Support - No support	- -	- -	- -	- -	1.00 OR 2.01 OR	- 1.05 – 3.85
Matsudaira 2019	*Lack of workplace support*: Was assessed with the CUPID-Questionnaire (N=194).	None.	- Support - No support	- -	- -	- -	- -	1.00 OR 1.74 OR	- 0.67 – 4.50
Melloh 2013	*Support*: Social support at work was assessed with the JCQ on a seven-point scale (N=168, 38 with persistent LBP and 130 with non-persistent LBP).	Age, sex, BMI, and somatization.	- No/low support - Social support	- -	- -	- -	- -	1.00 OR 0.67 OR	- 0.45 – 0.99
Melloh 2013	*Social support*: Were assessed by questionnaires based on the recommendations of a multinational musculoskeletal cohort study addressing occupational, psychological risk factors (N=169).	Age, sex, and BMI.	- No/low support - Social support	- -	- -	- -	- -	1.00 OR 0.54 OR	- 0.32 – 0.90

Melloh 2013	*Social support*: Social support was assessed with Caplan, Cobb, French, et al.'s scale combining score of 6–30 points with higher scores expressing higher social support on a 5-point scale (N=195).	Age, sex, and BMI	- No/low support - Social support	- -	- -	- -	- -	1.00 OR 1.78 OR	- 1.20 – 2.66
Job stress									
Jørgensen 2013	*Mental stress at work*: Was measured by the question: "do you feel under mental stress when performing your job/during leisure time?" (N=3,823).	Age.	- Seldom - Regularly	1.00 HR 0.64 HR	- 0.32 – 1.26	- -	- -	- -	- -
Matsudaira 2015	*Interpersonal stress*: Was assessed with the BJSQ on a five-point scale and dichotomised (N=171).	None.	- Not stressed - Stressed	- -	- -	- -	- -	1.00 OR 1.15 OR	- 0.49 – 2.68
Matsudaira 2014	*Interpersonal stress*: Was assessed with the BJSQ on a five-point scale and dichotomised (N=1,675).	Age, sex, obesity, smoking, education, and manual materials handling at work.	- No stress - Stress	- -	- -	- -	- -	1.00 OR 1.96 OR	- 1.00 – 3.82
Matsudaira 2019	*Interpersonal stress*: Was assessed with the CUPID-Questionnaire (N=197).	None.	- No stress - Stressed	- -	- -	- -	- -	1.00 OR 0.55 OR	- 0.26 – 1.15
Melloh 2013	*Stress*: Single-sided physical stress was assessed using the JCQ and measured on a seven-point scale (N=168, 38 with persistent LBP and 130 with non-persistent LBP).	Age, sex, and BMI.	- No/low stress - Stressed	- -	- -	- -	- -	1.00 OR 1.03 OR	- 0.43 – 2.51
Seyedmehdi 2016	*Stress*: Job stress was assessed with the JCQ on a four-point scale and dichotomised (N=511).	Age, Job experience, smoking, educational level, BMI, heavy physical load, and general health.	- Low - High	- -	- -	- -	- -	1.00 OR 1.67 OR	- 1.13 – 2.46
Sørensen 2011	*Mental stress at work*: Was measured by the question: "do you feel under mental stress when performing your job/during leisure time?" (N=3,823).	Age	- Seldom - Regularly	1.00 HR 0.64 HR	- 0.32 – 1.26	- -	- -	- -	- -
Satisfaction									
Aghilinejad 2015	*Satisfaction*: Was assessed using the MUSIC-questionnaire and measured by 4 questions on a five-point scale and dichotomised (N=185, 49 cases and 136 controls).	Age, BMI, smoking, LBP history, family LBP history, education, shift working, job type, other physical and psychosocial factors.	- Low - High	1.000 OR 0.501 OR	- 0.22 – 1.16	- -	- -	- -	- -

Latza 2002	*Satisfaction with own achievements at work*: Was measured by the question "I am satisfied with my achievements at work" using a 5-point Likert scale (without chronic LBP N=404 at baseline and all workers N= 488).	Age.	Without chronic LBP at baseline - Low - Medium - High All workers - Low - Medium - High	 1.00 PR 1.53 PR 1.85 PR 1.00 PR 1.67 PR 2.07 PR	 - 0.55 – 4.23 0.67 – 5.01 - 0.88 – 3.13 1.10 – 3.88	 - - - - - -	 - - - - - -	 - - - - - -	 - - - - - -
Matsudaira 2014	*Job satisfaction*: Was assessed with the BJSQ on a five-point scale and dichotomised (N=1,675).	Age, sex, obesity, smoking, education, manual materials handling at work, somatic symptoms, and family history of LBP with disability.	- Satisfied - Not satisfied	- -	- -	- -	- -	1.00 OR 2.03 OR	- 1.01 – 4.07
Melloh 2013	*Satisfaction*: Job satisfaction was assessed with the JCQ on a seven-point scale (N=168, 38 with persistent LBP and 130 with non-persistent LBP).	Age, sex, and BMI.	- Persistent group	-	-	-	-	1.15 OR	0.75 – 1.78
Seidler 2003	*Satisfaction with supervisors*: Was measured from 1 = very satisfied to 6 = very dissatisfied and classified by number of working years as 5 or 6 (N=175 controls and 128 cases).	Age, region, nationality, other diseases of the lumbar spine, and lifting/carrying combined with extreme forward bending.	- 0 years - >0 - <10 years - ≥10	1.0 OR 1.1 OR 1.1 OR	- 0.6 – 2.1 0.3 – 4.0	- - -	- - -	- - -	- - -
	Satisfaction with workmates: Was measured from 1 = very satisfied to 6 = very dissatisfied and classified by number of working years as 5 or 6 (N=175 controls and 125 cases).	Age, region, nationality, other diseases of the lumbar spine, and lifting/carrying combined with extreme forward bending.	- 0 years - >0 - <10 years - ≥10	1.0 OR 2.7 OR -	- 0.8 – 9.3 -	- - -	- - -	- - -	- - -
Tubach 2004	*Job satisfaction*: Was measured with an analogic visual scale and divided into tertiles (N=475).	Sex, carrying loads, driving, home repair and renovation activity, visit to a medical practitioner for low back pain, sick leave, psychosomatic score, depression, long lasting LBP in 1991, and sciatica in 1990.	- High - Intermediate - Low	- - -	- - -	- - -	- - -	1.00 OR 1.52 OR 1.13 OR	- 0.90 – 2.58 0.71 – 1.78
Other									
Ahsan 2013	Less job satisfaction or stress at work.	Matched on age, sex, and area of residence.	- No - Yes	- -	- -	- -	- -	1.00 OR 2.45 OR	- NS
Esquirol 2017	*Repetitive work:* Repetitive work under time pressure were categorised into three classes according to exposure (N=1,130 for incidence and 430 for persistence).	None.	Incidence chronic LBP: - Never - Former - Current Persistence chronic LBP: - Never	 - - - -	 - - - -	 - - - -	 - - - -	 1.00 OR 1.39 OR 1.25 OR 1.00 OR	 - 0.87 – 2.20 0.78 – 2.01 -

			- Former	-	-	-	-	1.09 OR	0.60 – 1.99
			- Current	-	-	-	-	0.86 OR	0.44 – 1.68
	Communicating: Difficulty communicating with colleagues (N=430 for persistence).	Age, sex, history of rheumatologically events, history of depression, leisure time physical activity (sport), leisure time activity (gardening), and job changes between instances of data collection.	Persistence chronic LBP:						
			- No	-	-	-	-	1.00 OR	-
			- Yes	-	-	-	-	1.45 OR	0.87 – 2.42
	Recognition: Work recognition was dichotomised (N=1,130 for incidence).	Sex, age, history of rheumatologically events., BMI, number of different jobs held, job changes, productivity-related income, and work recognition	Incidence chronic LBP:						
			- Yes	-	-	-	-	1.00 OR	-
			- No	-	-	-	-	1.76 OR	1.21 – 2.56
Gold 2017	*Work-family imbalance:* Was assessed with the sum of three items regarding tiredness after work, so much work it takes away personal interests, and preoccupation with work while being home (N=228).	No information is given.	- Yes	-	-	-	-	1.82 OR	1.12 – 2.98
Halonen 2018	*Effort-reward*: Effort-reward imbalance (ERI) perception was assessed using the ERI-Questionnaire and measured by an Effort-reward ratio and dichotomised (N=1,845).	Age, sex, number of pseudo-trials, marital status, socioeconomic status, and physically strenuous work.	LBP after onset of ERI:						
			- Affecting	-	-	-	-	1.21 RR	0.97 – 1.50
			- Any	-	-	-	-	1.05 RR	0.85 – 1.29
Latza 2002	*Monotonous work*: Was measured by the question "Altogether, my work is uniform" using a 5-point Likert scale (without chronic LBP N=404 at baseline and all workers N= 488).	Age.	Without chronic LBP at baseline						
			- Low	1.00 PR	-	-	-	-	-
			- Medium	1.39 PR	0.58 – 3.36	-	-	-	-
			- High	1.40 PR	0.59 – 3.31	-	-	-	-
			All workers						
			- Low	1.00 PR	-	-	-	-	-
			- Medium	1.46 PR	0.82 – 2.60	-	-	-	-
			- High	1.50 PR	0.86 – 2.62	-	-	-	-
	Time pressure: Was measured by the question "I am under time pressure" using a 5-point Likert scale (without chronic LBP N=404 at baseline and all workers N= 488).	Age.	Without chronic LBP at baseline						
			- Low	1.00 PR	-	-	-	-	-
			- Medium	7.43 PR	1.70 – 32.6	-	-	-	-
			- High	6.30 PR	1.41 – 28.2	-	-	-	-
			All workers						
			- Low	1.00 PR	-	-	-	-	-
			- Medium	1.63 PR	0.87 – 3.06	-	-	-	-
			- High	1.70 PR	0.92 – 3.15	-	-	-	-
Matsudaira 2019	*Inadequate breaks at work:* Assessed using the JCQ (N=197).		- Yes	-	-	-	-	0.71 OR	0.30 – 1.67

	Dissatisfied with job: Was assessed with the CUPID-Questionnaire (N=198).	None.	- Not dissatisfied - Dissatisfied	- -	- -	- -	- -	1.00 OR 1.14 OR	- 0.52 – 2.50
Matsudaira 2015	*Utilization of skills and expertise:* Assessed using the JCQ (N=140).	None.	- Utilization of skills and expertise - No utilization of skills and expertise	- -	- -	- -	- -	1.00 OR 1.59 OR	- 0.66 – 3.85
	Job Fitness: Feeling fit for the job (N=121).	None.	- Feeling fit - Not feeling fit	- -	- -	- -	- -	1.00 OR 2.04 OR	- 0.91 – 4.60
	Reward: Reward to work was assessed with the BJSQ on a five-point scale and dichotomised (N=171).	Anxiety and daily-life satisfaction.	- Feel rewarded - Not feeling rewarded	- -	- -	- -	- -	1.00 OR 3.59 OR	- 1.57 – 8.20
	Mental workload: The quantitative aspect was assessed with the BJSQ on a five-point scale and dichotomised (N=170).	None.	- Not stressed - Stressed	- -	- -	- -	- -	1.00 OR 1.08 OR	- 0.47 – 2.46
	Mental workload: The qualitative aspect was assessed with the BJSQ on a five-point scale and dichotomised (N=170).	None.	- Not stressed - Stressed	- -	- -	- -	- -	1.00 OR 0.63 OR	- 0.28 – 1.42
	Physical workload: Was assessed with the BJSQ on a five-point scale and dichotomised (N=171).	None.	- Not stressed - Stressed	- -	- -	- -	- -	1.00 OR 1.62 OR	- 0.70 – 3.73
	Environment stress: Was assessed with the BJSQ on a five-point scale and dichotomised (N=171).	None.	- Not stressed - Stressed	- -	- -	- -	- -	1.00 OR 1.95 OR	- 0.87 – 4.38
Matsudaira 2014	*Physical workload*: Was assessed with the BJSQ on a five-point scale and dichotomised (N=1,675).	Age, sex, obesity, smoking, education, and manual materials handling at work.	- No stress - Stress	- -	- -	- -	- -	1.00 OR 1.53 OR	- 0.70 – 3.33
Melloh 2013	*Work absenteeism:* Assessed using the JCQ (N=168, 38 with persistent LBP and 130 with non-persistent LBP).	Age, sex, and BMI.	- Yes	-	-	-	-	1.00 OR	0.99 – 1.01
	Resigned attitude towards the job: Assessed using the JCQ (N=168, 38 with persistent LBP and 130 with non-persistent LBP).	Age, sex, and BMI.	- Yes	-	-	-	-	1.48 OR	0.99 – 2.20
	Uncertainty: Assessed using the JCQ (N=168, 38 with persistent LBP and 130 with non-persistent LBP).	Age, sex, and BMI.	- Yes	-	-	-	-	0.92 OR	0.47 – 1.83
	Work organisational problems: Assessed using the JCQ	Age, sex, and BMI.	- Yes	-	-	-	-	0.63 OR	0.30 – 1.34
	Work interruptions: Assessed using the JCQ (N=168, 38 with persistent LBP and 130 with non-persistent LBP).	Age, sex, and BMI.	- Yes	-	-	-	-	0.87 OR	0.47 – 1.58

	Concentration requirements: Assessed using the JCQ (N=168, 38 with persistent LBP and 130 with non-persistent LBP).	Age, sex, and BMI.	- Yes	-	-	-	-	1.84 OR	0.95 – 3.77
	Time pressure: Assessed using the JCQ (N=168, 38 with persistent LBP and 130 with non-persistent LBP).	Age, sex, and BMI.	- Yes	-	-	-	-	0.76 OR	0.40 – 1.47
	Emotional suppression: Assessed using the JCQ (N=168, 38 with persistent LBP and 130 with non-persistent LBP).	Age, sex, and BMI.	- Yes	-	-	-	-	1.09 OR	0.67 – 1.75
Melloh 2013	*Resigned attitude towards the job*: Were assessed by questionnaires based on the recommendations of a multinational musculoske-letal cohort study addressing occupational, psychological risk factors (N=169).	Age, sex, BMI, and social support.	Resigned attitude towards the job	-	-	-	-	1.83 OR	1.23 – 2.72
	Job satisfaction: Were assessed by questionnaires based on the recommendations of a multinational musculoskeletal cohort study addressing occupational, psychological risk factors (N=169).	Age, sex, and BMI.	Job satisfaction	-	-	-	-	0.74 OR	0.57 – 0.96
	Time pressure: Were assessed by questionnaires based on the recommendations of a multinational musculoskeletal cohort study addressing occupational, psychological risk factors (N=169).	Age, sex, and BMI.	Time pressure	-	-	-	-	1.20 OR	0.83 – 1.75
	Uncertainty: Were assessed by questionnaires based on the recommendations of a multinational musculoskeletal cohort study addressing occupational, psychological risk factors (N=169).	Age, sex, and BMI.	Uncertainty	-	-	-	-	1.22 OR	0.81 – 1.83
	Physically demanding work activities: Were assessed by questionnaires based on the recommendations of a multinational musculoske-letal cohort study addressing occupational, psychological risk factors (N=169).	Age, sex, and BMI.	Physically demanding work activities	-	-	-	-	0.90 OR	0.39 – 2.04
	Ergonomics: Were assessed by questionnaires based on the recommendations of a multinational musculoskeletal cohort study addressing occupational, psychological risk factors (N=169).	Age, sex, and BMI.	Ergonomics	-	-	-	-	0.80 OR	0.46 – 1.42
Seidler 2003	*Opportunities to use knowledge and skills*: Was measured from 1 = very often to 6 = very seldom and classified by number of working years as 5 or 6 (N=176 controls and 127 cases).	Age, region, nationality, other diseases of the lumbar spine, and lifting/carrying combined with extreme forward bending.	- 0 years - >0 - <10 years - ≥10	1.0 OR 1.6 OR 0.5 OR	- 0.9 – 2.9 0.1 – 2.2	- - -	- - -	- - -	- - -
	Psychic strain through contact with clients: Was measured from 1 = very little to 6 = very much	Age, region, nationality, other diseases of the lumbar spine,	- 0 years - >0 - <10 years	1.0 OR 6.9 OR	- 1.2 – 40.1	- -	- -	- -	- -

and classified by number of working years with high degree of psychic strain as 5 or 6 (N=184 controls and 130 cases).	and lifting/carrying combined with extreme forward bending.	- ≥10	-	-	-	-	-	-
Time pressure: Was measured from 1 = very little to 6 = very much and classified by number of working years under high degree of time pressure as 5 or 6 (N=176 controls and 128 cases).	Age, region, nationality, other diseases of the lumbar spine, and lifting/carrying combined with extreme forward bending.	- 0 years - >0 - <10 years - ≥10	1.0 OR 1.3 OR 2.3 OR	- 0.7 – 2.8 1.1 – 4.8	- - -	- - -	- - -	- - -

Abbreviations: BJSQ = Brief Job Stress Questionnaire; BMI = body mass index; CUPID = Cultural and Psychosocial Influences on Disability; HR = Hazard Ratio; JCQ = Job Content Questionnaire; kg = kilogram; LDH = lumbar disc herniation; LDN = lumbar disc narrowing; Musculoskeletal Intervention Centre; NS = Not stated; OR = Odds Ratio; PR = Prevalence Ratio; RR = Relative Risk.

Appendix H. Funnel plots

Figure S1. Job control

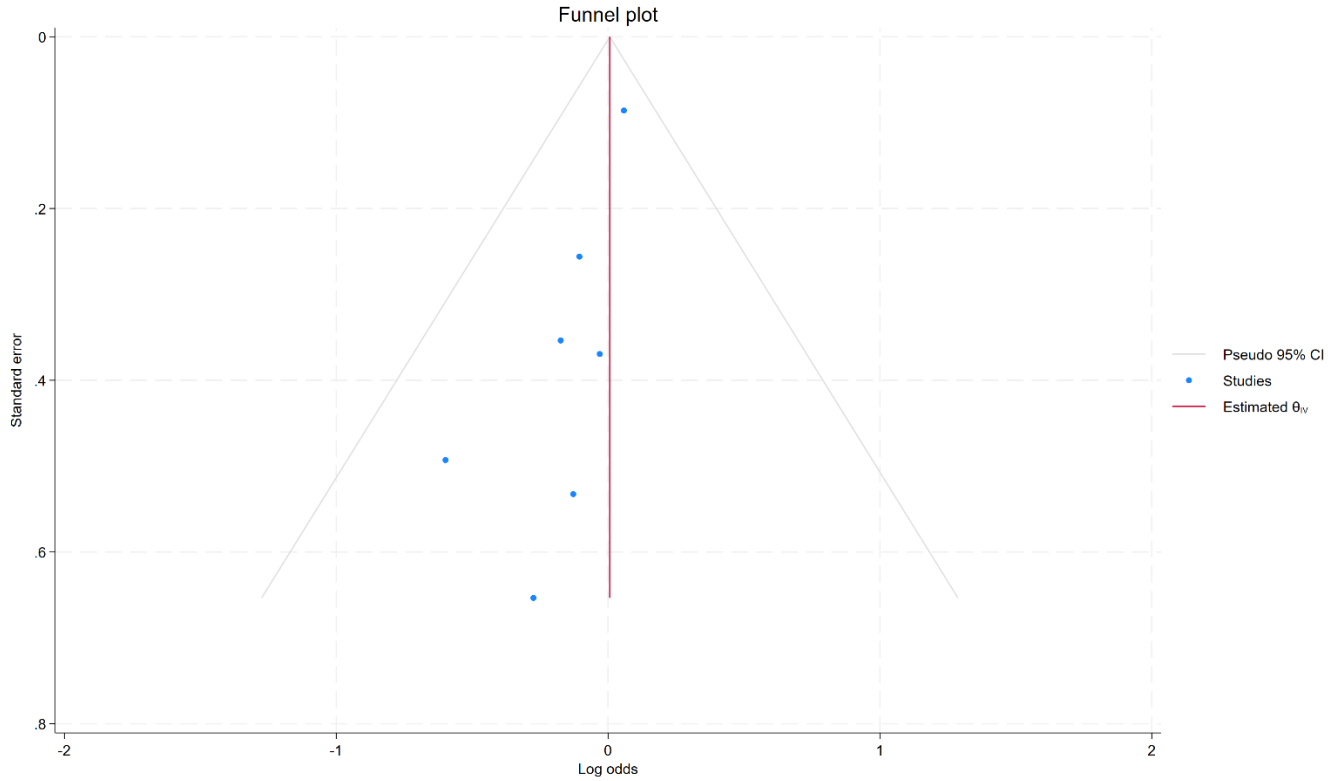

Figure S2. Job demand

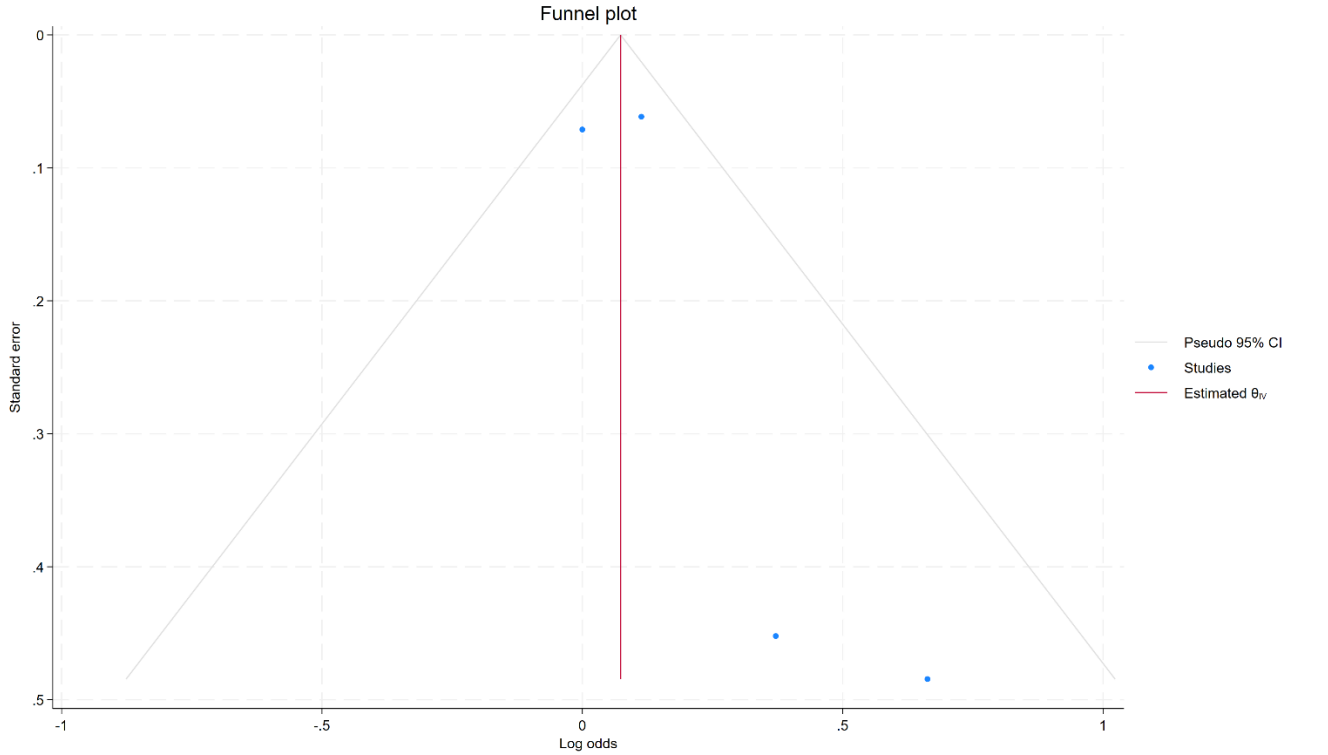

Figure S3. Job support

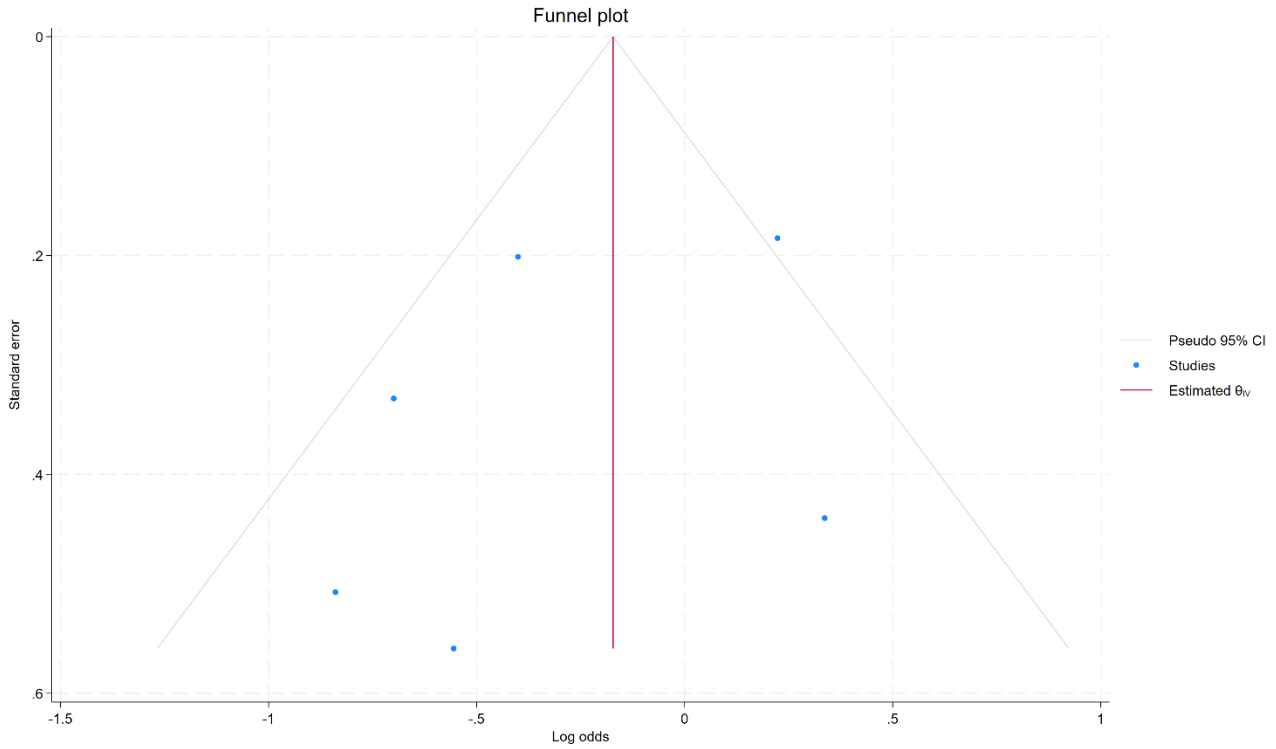

Figure S4. Job stress

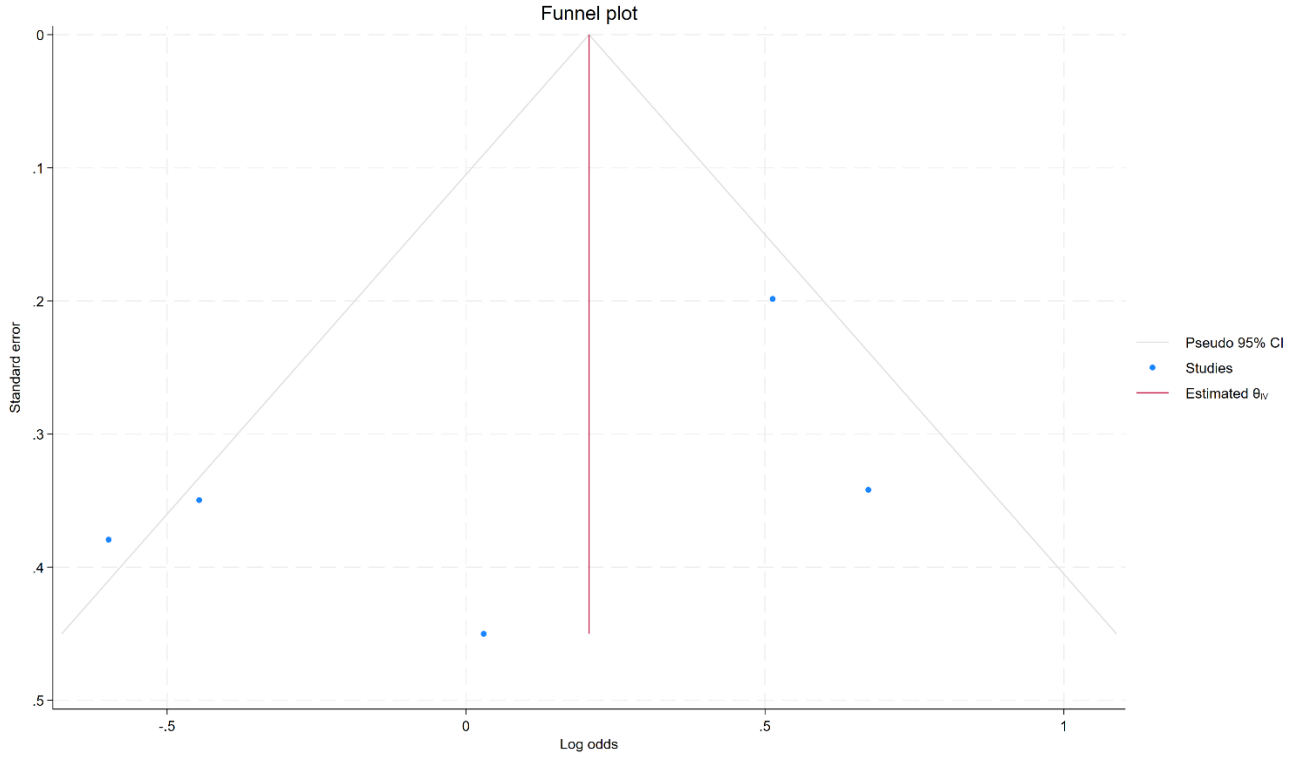

Figure S5. Job satisfaction