

Appendix 1 Search of Medline and Embase 2009 to 24 March 2016

Three Concepts

- (i) Shoulder disorders (1-2)
- (ii) Work-related (4-5)
- (iii) Risk factors (7-10)

Search strategy

Medline (1459 hits)

1. shoulder joint/ or rotator cuff/ or shoulder pain/ or shoulder impingement syndrome/ or hand arm vibration syndrome/ or exp cumulative trauma disorders/
2. (((arm? or shoulder? or upper limb? or upper extremit*) adj3 (vibration or repetitive)) or shoulder pain or (shoulder? adj5 (complaint? or disorder? or exertion or flexion or repetitive)) or shoulder impingement or rotator cuff syndrome or cumulative trauma disorder?).ab,kf,ti
3. or/1-2
4. exp Occupations/ or Workload/ or exp Work/ or Workplace/ or exp Occupational Diseases/ or Rehabilitation, Vocational/ or Occupational Health/ or Sick Leave/ or Absenteeism/ or Retirement/ or workers' compensation/ or exp Employment/ or exp Occupational Exposure/ or Volunteers/ or exp industry/
5. (worka* or worke* or workg* or worki* or workl* or workp* or work capacity or work disabilit* or work abilit* or at work or work exposure or work related or workers or job* or employee or staff or personnel or occupation or occupations or occupational or outdoor work* or day shift* or night shift* or shift work* or vocational rehabilitation or sick leave or absenteeism or sickness absen* or absente* or presente* or "return to work" or vocational reintegration or retirement or pension or employment or unemployed or unemployment or work status or industries or industry or volunteer* or voluntary worker* or repetitive work).ab,kf,ti.
6. or/4-5
7. posture/ or evaluation studies as topic/ or exp causality/ or risk assessment/ or time factors/ or lifting/ or vibration/ or weight bearing/ or exp age factors/
8. (lift* or carry* or elevate? or work above or risk? or course? or etiolog* or causality or exposure?).ab,kf,ti
9. evaluation studies.pt
10. etiology.fs
11. or/7-10
12. 3 and 6 and 11
13. animals/ not humans/

14. 12 not 13

15. limit 14 to yr="2009-Current"

Shoulder disorders (1-2)

Work-related (4-6)

Risk factors (8-10)

Embase (1993 hits)

1. *shoulder/ or exp *rotator cuff/ or *shoulder pain/ or *shoulder impingement syndrome/ or *hand arm vibration/ or exp *cumulative trauma disorder/

2. (((arm? or shoulder? or upper limb? or upper extremit*) adj3 (vibration or repetitive)) or shoulder pain or (shoulder? adj5 (complaint? or disorder? or exertion or flexion or repetitive)) or shoulder impingement or rotator cuff syndrome or cumulative trauma disorder?).ab,kw,ti

3. or/1-2

4. exp Occupation/ or exp Work/ or exp Occupational Disease/ or exp Occupational exposure/ or workman compensation/ or Volunteer/ or industry/

5. (worka* or worke* or workg* or worki* or workl* or workp* or work capacity or work disabilit* or work abilit* or at work or work exposure or work related or workers or job* or employee or staff or personnel or occupation or occupations or occupational or outdoor work* or day shift* or night shift* or shift work* or vocational rehabilitation or sick leave or absenteeism or sickness absen* or absente* or presente* or "return to work" or vocational reintegration or retirement or pension or employment or unemployed or unemployment or work status or industries or industry or volunteer* or voluntary worker* or repetitive work).ab,kw,ti.

6. "Occupational Health and Industrial Medicine ".ec.

7. or/4-6

8. body posture/ or evaluation study/ or risk assessment/ or time/ or biomechanics/ or vibration/ or weight bearing/ or etiology/

9. (lift* or carry* or elevate? or work above or risk? or course? or etiolog* or causality or exposure?).ab,kw,ti

10. et.fs

11. or/8-10

12. 3 and 7 and 11

13. (animal/ or animal experiment/ or animal model/ or nonhuman/ or rat/ or mouse/ or (rat or rats or mouse or mice).ti.) not human/

14. 12 not 13

15. limit 14 to yr="2009-Current"

Appendix 2 Methodological quality assessment

Study population		
1	Study groups defined	Positive if at least 2 of the following 3 items in both groups were reported at baseline: age, sex; sport/leisure time exposure
2	Participation $\geq 70\%$	Positive if the participation of both the exposed and unexposed groups was $\geq 70\%$
3	Number case ≥ 50	Positive if the total number of cases was ≥ 50
Assessment of exposure		
4	Exposure measurement	Positive if the exposure was clearly defined and measured for at least two of the three aspects, i.e. duration, frequency, and intensity
5	Dose-response	Positive if the assessment of exposure was described and assessed at minimal three exposure categories (dose-response)
6	Blind for outcome status	Positive if the exposure was assessed by an independent person, not based on self-report and not aware of outcome
Assessment outcome		
7	Outcome definition	Positive if the outcome was clearly defined (case definition provided)
8	Assessment method	Positive if the method of assessment was suitable (clinically defined disorder)
9	Blind for exposure status	Positive if the outcome was measured without knowledge of the exposure status by an independent person
Study design		
10	Longitudinal	Positive if the study design was prospective or retrospective cohort
11	Inclusion and exclusion criteria	Positive if inclusion and exclusion criteria for participants were described
12	Follow-up period ≥ 1 year	Positive if the follow-up period was ≥ 1 year
13	Info completers versus withdrawals	Positive if demographic information was given for completers and withdrawals
Data analysis		
14	Data presentation	Positive if risk estimates were presented or when raw data were given that allow the calculation of risk estimates with confidence intervals
15	Consideration of confounders	Positive if the confounders that were considered were described and analysed
16	Control for confounding	Positive if the method used to control for confounding was described

Appendix 3 Studies reporting on the occurrence of specific shoulder disorders across occupations in exposed versus reference population

Author (reference)	Study design	Exposed population	Reference population	Disease (diagnosis*)	OR	95%CI
Luopajarvi 1979 (13)	CS	Female assembly line workers in a food production factory (N=152)	Female shop assistants (N=133)	BT/ST	2.45	0.86-6.98
Park 1992 (14)	CC	Frame/body assembly work (N=13) Trim/chassis assembly work (N=36) Sewing work (N=23) Pressing stamping work (N=39) Assembly stamping work (N=19)	Controls with one or more insurance claims for other causes (N=?)	RCS	2.0 1.7 2.5 3.3 2.1	1.1-3.8 1.1-2.6 1.4-4.5 2.1-5.1 1.2-3.7
Nordander 1999 (15)	CS	Fish processing workers (N=322)	Employees in municipal workplaces (N=337)	ST IT BT	3.14 4.19 2.18	1.56-6.32 1.80-9.72 1.08-4.41
Frost 1999 (16)	CS	Slaughterhouse workers (N=576)	Repairmen or chemical workers with light manual or supervisory in chemical plant (N=398)	SIS	5.27	2.09-13.26
Kaergaard 2000 (17)	CS	Sewing machine operators (N=238)	Workers with supervisory jobs, service jobs, office workers and other workers with varied non-repetitive work (N=357)	RCT	2.63	1.08-6.35
Wang 2005 (18)	CS	Female betel pepper leaf cullers (N=20)	Female non-cullers (N=47)	SIS	3.02	0.99-9.24
Melchior 2006 (19)	CS	Manual occupation (N=1,160)	Non-manual occupation (N=1,496)	RCS	1.76	1.32-2.34
Kaerlev 2008 (20)	Cohort	Fishermen (N=8,040) Non-officers (N=11, 037)	Officers (N=10,436)	RCS	2.53 1.31	1.50-4.29 0.74-2.29
Seidler 2011 (21)	CC	Construction or interior workers (>10 years; N=487)	Service workers N=?	ST (lesion)	11.5	2.5-52.5
		Metal workers (>10 years; N=482)	Service workers N=?	ST (lesion)	2.5	1.3-4.9
Grzywacz, 2012 (22)	CS	Poultry processing workers (N=?)	Non-poultry manual labour workers (N=?)	RCS	0.95	0.62-1.45
Rosenbaum 2013 (23)	CS	Poultry processing workers (N=289)	Non-poultry manual labour workers (N=227)	RCS	1.51	0.91-2.51
Chung 2013 (24)	Cohort	Nurses (N=3914, primary female)	Individuals whose occupation was not nursing and included both working and non-working (N=?) subjects (N=11.774; primary female)	RCS	4.33	2.51-7.47

Hsiao 2015 (25)	CS	Army (N=4,897,019)	Navy (N=3,587,430)	SIS	1.42	1.39-1.46
		Air Force (N=3,513,408)			1.46	1.42-1.50
		Marines (N=1,770,677)			1.31	1.26-1.36
Sansone 2015 (26)	CS	Female cashiers (N=199)	Female supermarket customers (N=304)	RCS (calcifications)	0.84	0.53-1.33

* Diagnoses

RCS(T): rotator cuff syndrome (tendinitis)

IT : infraspinatus tendinitis

ST : shoulder tendinitis; supraspinatus tendinitis

SIS : subacromial impingement syndrome

BT : biceps tendinitis

Appendix 4 Associations between risk factors at work and the occurrence of specific disorders of the shoulder

Author (reference)	Design (quality score)	Study population	Disease*	Risk factor High versus No or Low exposure**	OR	95%CI
FORCE						
				FORCE LEVEL		
Frost 2002 (32)	CS (11/16)	Workers in food processing companies, textile plants, electronic plants, cardboard industries, postal sorting centres, a bank, and supermarkets (N=3123)	ST	Force and micro-pauses No repetitive work Low force and no pauses ≤80% of cycle time Low force and no pauses >80% of cycle time High force and no pauses ≤80% of cycle time High force and no pauses >80% of cycle time	1.0 2.29 2.10 3.45 4.48	0.82–6.36 0.74–5.97 0.90–13.23 1.73–11.61
Frost 2002 (32)	CS (11/16)	Workers in food processing companies, textile plants, electronic plants, cardboard industries, postal sorting centres, a bank, and supermarkets (N=3123)	ST	Force requirements No repetitive work Low force (<10% of MVC) <i>High force (≥10% of MVC)</i>	1.00 2.17 4.21	0.84–5.59 1.71–10.40
Svendsen 2004 (33)	CS (13/16)	Male machinists, car mechanics, and house painters (N=136)	ST	Lifetime shoulder force requirements Low Medium <i>High</i>	1.0 a 1.24 0.71	0.48–3.18 0.30–1.65
Grzywacz, 2012 (22)	CS (9/16)	Poultry processing and other manual workers (N=513)	RCS	Heavy load Seldom, never (1 on 4-point scale) Almost always (4 on 4-point scale)	1.0 1.23	0.34–4.25
Svendsen 2013 (31)	Cohort (14/16)	1131 occupational titles from musculoskeletal research database (N=37,402; 15,845 male and 21,557 female)	SIS	Force score 5-point force scale; 0=light and 4=near maximal Force score <1.5 [46 cases in 64,266 person years] Force-score ≥1.5-<2.5 Force-score >2.5 [57 cases in 28,840 person years] For the period 1996-2002 in the meta-analyses: Force-score ≥1.5-<2.5 <i>Force-score >2.5</i>	HR 1.0 1.45 2.01 1.40 1.59	0.93–2.28 1.15–3.53 0.90–2.17 0.99–2.56
Bodin 2012 (28)	Cohort (13/16)	Workers attending health examinations (N=1456; 839 male and 617 female)	RCS male	High perceived physical exertion RPE Borg scale <15 [35 cases in 662 workers (5.3%)]	1.0	

				<i>RPE Borg scale</i> ≥ 15 [16 cases in 163 workers (9.8%)]	1.6	0.8-3.2
Frost 2002 (32)	CS (11/16)	Workers in food processing companies, textile plants, electronic plants, cardboard industries, postal sorting centres, a bank, and supermarkets (N=3123)	ST	Frequency and force No repetitive work Low frequency and low force High frequency and low force Low frequency and high force High frequency and high force	1.0 2.49 1.73 2.89 4.82	0.94-6.64 0.56-5.33 0.77-10.77 1.86-12.51
Herin 2012 (29)	Cohort (11/16)	Executives, artisans, clerks and blue collar workers (N=12,714; 8231 males and 4483 females)	SP	Considerable physical effort No [965 cases in 9726 workers (9.9%)] Yes [390 cases in 2988 workers (13%)]	1.0 1.24	1.04-1.47
Herin 2012 (29)	Cohort (11/16)	Executives, artisans, clerks and blue collar workers (N=12,714; 8231 males and 4483 females)	SP	Physical effort with tools No Yes	1.0 0.95	0.76-1.20
Herin 2012 (29)	Cohort (11/16)	Executives, artisans, clerks and blue collar workers (N=12,714; 8231 males and 4483 females)	SP	Carrying heavy loads No Yes	1.0 1.07	0.90-1.28
				FORCE-YEARS		
Dalbøge 2014 (2)	Cohort (16/16)	Study cohort of least 5 years of full time employment between 1993 and 2007 (N=2,374,403; 1.216.772 male, 1.157.631 female)	SIS	Force-years Force-year: 1 year force score of 2 on 5-point scale <5 years [2982 cases in 3,550,343 person years] 5 years >5-7.5 years >7.5-10 years >10-20 years [2790 cases in 1,789,158 person years]	1.0 0.7 1.2 1.5 1.7	0.6-0.7 1.1-1.2 1.4-1.6 1.6-1.8
Seidler 2011 (21)	CC (11/16)	Male cases with radiographically confirmed supraspinatus tears associated with shoulder pain (N=483) Male resident controls from same regions (N=300)	ST	Lifting /carrying ≥ 20 kg No lifting/carrying of loads ≥ 20 kg >0-<9.6 h 9.6-<77 h 77-9.038 h [29% in cases / 12% in controls]	1.0 0.9 1.2 1.8	0.5-1.7 0.6-2.1 1.0-3.2
Miranda 2005 (6)	CS (11/16)	A sample of general population restricted to subjects aged 30-64 years who had held a job during the preceding 12 months	RCT	Lifting, ≥ 5 kg >2 times/min >2 hours/day None 1-3 year versus none 4-13 year versus none	1.0 1.4 1.5	0.5-3.7 0.7-3.3

		(N=8028)		14–23 year versus none >23 year versus none Lifting, >20 kg >10 times/day None 1–3 year versus none 4–13 year versus none 14–23 year versus none >23 year versus none Work requiring high hand force, ≥1 hours/day None 1–3 year versus none 4–13 year versus none 14–23 year versus none >23 year versus none	1.9 2.0 1.0 1.5 3.0 2.8 1.8 1.0 2.3 2.8 3.7 1.8	0.9–3.9 0.9–4.3 0.6–4.1 1.6–5.8 1.4–5.7 0.8–4.2 0.9–6.3 1.4–6.0 1.9–7.1 0.8–4.1
				TRAPEZIUS ACTIVITY		
Nordander 2016 (37)	CS, pooled (10/16)	33 occupational groups consisting of office, industrial and non -office / non-industrial workers based on databases of previous studies (N=3141; 817 male and 2324 female)	ST	Trapezius act. p10	0.0	0.0-0.45
Nordander 2016 (37)	CS, pooled (10/16)	33 occupational groups consisting of office, industrial and non -office / non-industrial workers based on databases of previous studies (N=3141; 817 male and 2324 female)	IT	Trapezius act. p10	4.06	2.23-8.17
Nordander 2016 (37)	CS, pooled (10/16)	33 occupational groups consisting of office, industrial and non -office / non-industrial workers based on databases of previous studies (N=3141; 817 male and 2324 female)	FS	Trapezius act. p10	0.82	0.61-1.0

POSTURE						
				ARM ELEVATION		
Frost 2002 (32)	CS (11/16)	Workers in food processing companies, textile plants, electronic plants, cardboard industries, postal sorting centres, a bank, and supermarkets (N=3123)	ST	Micro pauses in shoulder flexion No repetitive work ≤80% of cycle time without pauses >80% of cycle time without pauses	1.0 2.82 3.33	1.10–7.28 1.37–8.13
Svendsen 2004 (34)	CS (14/16)	Male machinists, car mechanics, and house painters (N=1627; 3067 shoulders)	ST	Upper-arm elevation >90° 0% of working h 3–6% versus 0–3% 6–9% versus 0–3%	1.0 0.94 4.70	0.37–2.39 2.07–10.68
Svendsen 2013 (31)	Cohort (14/16)	1131 occupational titles from musculoskeletal research database (N=37,402; 15,845 male and 21,557 female)	SIS	Arm elevation >90° 0h/day [63 cases in 75,563 person years] >90° >0-<1 h/day >90° ≥1 h/day [61 cases in 31,034 person years] For the period 1996-2002 in the meta-analyses: >90° >0-<1 h/day >90° ≥1 h/day	HR 1.0 1.41 2.15 1.19 1.20	0.90-2.20 1.23-3.74 0.77-1.82 0.80-1.78
Silverstein 2008 (35)	CS (13/16)	Workers were recruited from manufacturing and healthcare and health research areas excluding direct patient care) sectors (N=733)	RCS	Upper-arm flexion and duty cycle of forceful exertion (% time) Flexion <15% and duty cycle <9% Flexion ≥15% or duty cycle ≥9% versus <i>Flexion ≥15% and duty cycle ≥9%</i> Upper arm flexion and pinch grip force (% time) Flexion <15% and no pinch Flexion ≥15% or pinch >0% Flexion ≥15% and pinch >0%	1.0 2.02 2.43 1.0 1.01 2.66	0.88-4.62 1.04-5.68 0.49-2.11 1.26-5.59
Bodin 2012 (28)	Cohort (13/16)	Workers attending health examinations (N=1456; 839 male and 617 female)	RCS male	Repeated and sustained posture with arms above shoulder level (≥2h/day) No [39 cases in 732 workers (5.3%)] Yes (12 cases in 93 workers (12.9%))	1.0 2.2	1.0-4.7
Bodin 2012 (28)	Cohort (13/16)	Workers attending health examinations (N=1456; 839 male and 617 female)	RCS female	Repeated and sustained arm abduction 60-90° No [25 cases in 457 workers (5.5%)] Yes [20 cases in 157 workers (12.7%)]	1.0 2.6	1.4-5.0
Bodin 2012	Cohort	Workers attending health examinations	RCS male	High perceived physical load and repeated, sustained		

(28)	(13/16)	(N=1456; 839 male and 617 female)		arms above shoulder level (≥ 2h/day) No factor One factor Both factors	1.0 2.0 3.3	1.0-3.8 1.3-8.4
				ARM ELEVATION YEARS		
Svensden 2004 (33)	CS (13/16)	Male machinists, car mechanics, and house painters (N=136)	ST	Lifetime upper-arm elevation $>90^\circ$ 0- <10 months 10- <20 months ≥ 20 versus 0- <10 months	1.0 0.95 2.33	0.41-2.20 0.93-5.84
Dalbøge 2014 (2)	Cohort (16/16)	Study cohort of least 5 years of full time employment between 1993 and 2007 (N=2,374,403; 1.216.772 male, 1.157.631 female)	SIS	Arm-elevation ($>90^\circ$) years Arm-elevation $>90^\circ$ for 0.5h/day for 1 year 0 years [3294 cases in 4,268,935 person years] $>0-2$ years $>2-5$ years $>5-10$ years $>10-56$ years [3121 cases in 2,127,588 person years]	1.0 1.4 1.5 1.8 2.1	1.4-1.5 1.5-1.6 1.7-1.9 2.0-2.2
Seidler 2011 (21)	CC (11/16)	Male cases with radiographically confirmed supraspinatus tears associated with shoulder pain (N=483) Male resident controls from same regions (N=300)	ST	Work above shoulder level No work above shoulder level $>0-<610 h610-<3,195 h3,195-64,057 h [36% in cases / 12% in controls]$	1.0 1.0 1.4 2.0	0.6-1.8 0.8-2.4 1.1-3.5
Miranda 2005 (6)	CS (11/16)	A sample of general population restricted to subjects aged 30-64 years who had held a job during the preceding 12 months (N=8028)	RCT	Working with hand above shoulder, ≥ 1 hour/day None 1-3 years 4-13 years 14-23 years >23 years	1.0 2.3 3.2 4.5 2.3	0.9-5.4 1.6-6.5 2.3-8.6 1.1-4.8
				OTHER		
Nordander 2016 (37)	CS pooled (10/16)	33 occupational groups consisting of office, industrial and non-office / non-industrial workers based on databases of previous studies (N=3141; 817 male and 2324 female)	FS	Wrist flexion p90	1.03	1.01-1.05
Herin 2012	Cohort	Executives, artisans, clerks and blue collar	SP	Long, difficult working positions and awkward posture		

(29)	(11/16)	workers (N=12,714; 8231 males and 4483 females)		No Yes	1.0 1.37	1.19–1.58
MOVEMENT						
ARM-HAND REPETITION YEARS						
Miranda 2005 (6)	CS (11/16)	A sample of general population restricted to subjects aged 30–64 years who had held a job during the preceding 12 months (N=8028)	RCT	Work requiring repetitive motion hand/wrist, ≥2 hours/day None 1–3 year versus none 4–13 year versus none 14–23 year versus none >23 year versus none	1.0 1.6 0.8 2.4 2.6	0.5–5.2 0.3–2.1 1.3–4.3 1.4–4.9
Dalbøge 2014 (2)	Cohort (16/16)	Study cohort of least 5 years of full time employment between 1993 and 2007 (N=2,374,403; 1.216.772 male, 1.157.631 female)	SIS	Repetition-years Moderate (≥4-15 movements per min) repetitive work for 4h/day for 1 year or highly (≥ movements per min) repetitive work for 1 h/day for 1 year 0 years [6001 cases in 6,760,618 person years] >0-1 years >1-2 years >2-10 years >10-68 years[2465 cases in 1,496,248 person years]	1.0 1.2 1.5 1.6 1.9	1.1-1.3 1.5-1.6 1.5-1.6 1.8-2.0
ARM-HAND REPETITION						
Frost 2002 (32)	CS (11/16)	Workers in food processing companies, textile plants, electronic plants, cardboard industries, postal sorting centres, a bank, and supermarkets (N=3123)	ST	Repetitive hand–arm movements No Yes	1.0 3.12	1.33–7.34
Frost 2002 (32)	CS (11/16)	Workers in food processing companies, textile plants, electronic plants, cardboard industries, postal sorting centres, a bank, and supermarkets (N=3123)	ST	Frequency and micro-pauses No repetitive work Low frequency and no pauses ≤80% of cycle time Low frequency and no pauses >80% of cycle time High frequency and no pauses >80% of cycle time	1.0 3.08 2.33 3.53	1.20–7.93 0.68–8.02 1.43–8.70
Frost 2002 (32)	CS (11/16)	Workers in food processing companies, textile plants, electronic plants, cardboard industries, postal sorting centres, a bank,	ST	Frequency of shoulder movements No repetitive work Low (1-14 movements/min) High versus reference (15-36 movements/min)	1.0 2.93 3.29	1.17–7.36 1.34–8.11

		and supermarkets (N=3123)				
Svendsen 2013 (31)	Cohort (14/16)	1131 occupational titles from musculoskeletal research database (N=37,402; 15,845 male and 21,557 female)	SIS	Repetitive work Moderate repetitive work (≥ 4 to < 15 movements per min) < 2 h/day [92 cases in 100,554 person years] Moderate repetitive work ≥ 2 h/day Highly repetitive work (≥ 15 movement per min) ≥ 0.5 h (mostly 6 h) [42 cases in 18,303 person years] For the period 1996-2002 in the meta-analyses: Moderate repetitive work ≥ 2 h/day <i>Highly repetitive work</i>	HR 1.0 1.31 3.03 1.07 1.40	0.79-2.17 1.53-6.03 0.43-2.64 0.95-2.07
Grzywacz, 2012 (22)	CS (9/16)	Poultry processing and other manual workers (N=513)	RCS	Awkward posture and repeated movements Seldom, never Almost always	1.0 2.57	1.00-6.54
Nordander 2009 (36)	CS (7/16)	23 occupational groups consisting of office, industrial and non -office / non-industrial workers based on databases of previous studies (N=2677; 915 male and 1762 female)	SS female	Repetitive / constrained work No (varied, mobile work) Yes	1.0 2.5	1.4-4.2
Nordander 2009 (36)	CS (7/16)	23 occupational groups consisting of office, industrial and non -office / non-industrial workers based on databases of previous studies (N=2677; 915 male and 1762 female)	SS male	Repetitive / constrained work No (varied, mobile work) Yes	1.0 2.7	1.3-5.4
Nordander 2009 (36)	CS (7/16)	23 occupational groups consisting of office, industrial and non -office / non-industrial workers based on databases of previous studies (N=2677; 915 male and 1762 female)	IS female	Repetitive / constrained work No (varied, mobile work) Yes	1.0 3.1	1.6-6.4
Nordander 2009 (36)	CS (7/16)	23 occupational groups consisting of office, industrial and non -office / non-industrial workers based on databases of previous studies (N=2677; 915 male and 1762 female)	IS male	Repetitive / constrained work No (varied, mobile work) Yes	1.0 4.0	1.6-9.9
Herin 2012 (29)	Cohort (11/16)	Executives, artisans, clerks and blue collar workers (N=12,714; 8231 males and 4483	SP	Precise movements and repetitive work No [943 cases in 9114 workers (10.3%)]	1.0	

		females)		Yes [412 cases in 3600 workers (11.4%)]	1.06	0.90–1.28
Nordander 2009 (36)	CS (7/16)	23 occupational groups consisting of office, industrial and non -office / non-industrial workers based on databases of previous studies (N=2677; 915 male and 1762 female)	FS female	Repetitive / constrained posture No (varied, mobile work) Yes	1.0 2.4	0.5-11
Nordander 2009 (36)	CS (7/16)	23 occupational groups consisting of office, industrial and non -office / non-industrial workers based on databases of previous studies (N=2677; 915 male and 1762 female)	FS male	Repetitive / constrained posture No (varied, mobile work) Yes	0	-
Nordander 2009 (36)	CS (7/16)	23 occupational groups consisting of office, industrial and non -office / non-industrial workers based on databases of previous studies (N=2677; 915 male and 1762 female)	BT female	Repetitive / constrained posture No (varied, mobile work) Yes	1.0 2.4	1.4-4.1
Nordander 2009 (36)	CS (7/16)	23 occupational groups consisting of office, industrial and non -office / non-industrial workers based on databases of previous studies (N=2677; 915 male and 1762 female)	BT male	Repetitive / constrained posture No (varied, mobile work) Yes	1.0 3.3	1.3-8.5
				Wrist velocity		
Nordander 2016 (36)	CS, pooled (10/16)	33 occupational groups consisting of office, industrial and non -office / non-industrial workers based on databases of previous studies (N=3141; 817 male and 2324 female)	BT	Wrist angular vel. p50	1.02	1.01-1.02
SHOULDER LOAD						
Dalbøge 2014 (2)	Cohort (16/16)	Study cohort of least 5 years of full time employment between 1993 and 2007 (N=2,374,403; 1.216.772 male, 1.157.631 female)	SIS	Shoulder-load years Shoulder load of 1 (on a scale of 0-3) for 1 year 0 years [5893 cases in 3,722,658 person years] >0-5 years >5-10 years >10-15 years >15-20 years [1766 cases in 2,422,922 person years]	1.0 1.4 1.7 1.8 2.0	1.3-1.5 1.6-1.7 1.7-2.0 1.9-2.1

Svendsen 2013 (31)	Cohort (14/16)	1131 occupational titles from musculoskeletal research database (N=37,402; 15,845 male and 21,557 female) On request adapted by authors for the period 1996-2002 to prevent duplicates with Dalbøge 2014 in the meta-analyses: Medium shoulder load: 1.63 (1.01-2.62), High shoulder load: 1.67 (1.02-2.71)	SIS	Shoulder load Low shoulder load [36 cases in 58,716 person years] (force score ≤ 1.5 , arm elevation $>90^\circ < 0.5$ h/day, ≥ 4 - < 15 movements of upper arm per min < 2 h/day) Medium shoulder load (≥ 15 movements of upper arm per min < 0.5 h/day and at least one of the following criteria: force score $> 1.5 < 3$, arm elevation $> 90^\circ > 0.5$ - < 1 h/day, moderately repetitive work ≥ 2 - < 4 h/day) High shoulder load [74 cases in 41,811 person years] (at least one of the following criteria: force score ≥ 3 , arm elevation $> 90^\circ \geq 1$ h/day, highly repetitive work (≥ 15 movements of upper arm per min) ≥ 0.5 h/day) For the period 1996-2002 in the meta-analyses: Medium shoulder load <i>High shoulder load</i>	HR 1.0 1.58 2.55 1.63 1.67	 0.99-2.51 1.01-2.62 1.02-2.71
HAND-ARM VIBRATION						
Hand-arm vibration years						
Seidler 2011 (21)	CC (11/16)	Male cases with radiographically confirmed supraspinatus tears associated with shoulder pain (N=483) Male resident controls from same regions (N=300)	SS	Hand-arm vibration No handheld vibration > 0 -4.4 years 4.4- < 16 years <i>16-51.6 years [25% in cases / 6% controls]</i>	1.0 2.7 3.1 3.2	 1.3-5.6 1.5-6.1 1.7-5.9
Miranda 2005 (6)	CS (11/16)	A sample of general population restricted to subjects aged 30-64 years who had held a job during the preceding 12 months (N=8028)	RCT	Hand-arm vibration Working with a vibrating tool, ≥ 2 hours/day None 1-3 year versus none 4-13 year versus none 14-23 year versus none <i>> 23 year versus none</i>	1.0 0.6 2.5 3.5 1.4	 0.1-4.6 1.0-5.9 1.5-7.8 0.5-4.4
Sutinen 2006 (27)	Cohort (11/16)	Professional forestry workers using a chainsaw (N=52)	RCS	Lifelong vibration energy [(m ² /s ⁴) hd] <i>$> 1,500$ h chain sawing [17 cases among 52 workers]</i>	1.04 ^a	1.00-1.07

Dalbøge 2014 (2)	Cohort (16/16)	Study cohort of least 5 years of full time employment between 1993 and 2007 (N=2,374,403; 1.216.772 male, 1.157.631 female)	SIS	Hand–arm vibration-years Working with hand-held vibrating tool with low acceleration (<3m/s ²) for 1h/day for 1 year or with moderate (≥3-10m/s ²) acceleration for 0.5h/day for 1 year 0 years >0-5 years >5-58 years	1.0 1.3 1.5	1.2-1.3 1.5-1.6
Herin 2012 (29)	Cohort (11/16)	Executives, artisans, clerks and blue collar workers (N=12,714; 8231 males and 4483 females)	SP	Considerable vibrations and exposure to jolts (1 study) No [1174 cases in 11,050 workers (10.6%)] Yes [181 cases in 1664 workers (10.9%)]	1.0 1.05	0.87-1.27
PSYCHOSOCIAL				SOCIAL SUPPORT		
Svendsen 2004 (34)	CS (14/16)	Male machinists, car mechanics, and house painters (N=1627; 3067 shoulders)	ST	Social support High Low	1.0 0.91	0.46–1.77
Bodin 2012 (28)	Cohort (13/16)	Workers attending health examinations (N=1456; 839 male and 617 female)	RCS male	Low Co-worker support No [36 cases in 681 workers (5.3%)] Yes[15 cases in 144 workers (10.4%)]	1.0 2.0	1.1-3.9
Bugajska, 2013 (30)	Cohort (11/16)	Office workers, toolmakers, welders, seamstresses, TV assembly workers, electric elements assembly workers, packers in cosmetic industry, drivers, driving instructors and nurses (N=725)	RCT	Social support Yes No [84 cases among 725 exposed and non-exposed]	1.00 1.00	0.91-1.10
Svendsen 2013 (31)	Cohort (14/16)	1131 occupational titles from musculoskeletal research database (N=37,402; 15,845 male and 21,557 female)	SIS	Social support Support from leaders and colleagues [196 cases in 111,332 person years] No social support [167 cases in 76,662 person years] Support from leaders Support from colleagues	1.0 0.91 0.70 1.02	0.71-1.17 0.49-0.99 0.80-1.29

				ABUSIVE SUPERVISION		
Grzywacz 2012 (22)	CS (9/16)	Poultry processing and other manual workers (N=513)	RCS	Abusive supervision Strongly disagree Strongly agree	1.0 0.49	0.20-1.26
				TEMPORARY WORKERS AS COLLEAGUES		
Bodin 2012 (28)	Cohort (13/16)	Workers attending health examinations (N=1456; 839 male and 617 female)	RCS female	Working with colleagues in temporary employment No [26 cases in 448 workers (5.8%)] Yes [19 cases in 166 workers (11.5%)]	1.0 2.2	1.2-4.2
				SAFETY COMMITMENT		
Grzywacz 2012 (22)	CS (9/16)	Poultry processing and other manual workers (N=513)	RCS	Poor safety commitment Yes No	1.0 1.35	0.90-2.03
				JOB CONTROL		
Svendsen 2004 (34)	CS (14/16)	Male machinists, car mechanics, and house painters (N=1627; 3067 shoulders)	ST	Job control High Low	1.0 1.83	0.93-3.60
Nordander 2016 (37)	CS pooled (10/16)	33 occupational groups consisting of office, industrial and non-office / non-industrial workers based on databases of previous studies (N=3141; 817 male and 2324 female)	ST	Low job control High Low	1.0 1.0	0.96-1.05
Grzywacz, 2012 (22)	CS (9/16)	Poultry processing workers (N=403; 230 male and 173 female)	RCS	Job control Almost always	1.0	

				Seldom, never	1.89	0.84-4.17
Svendsen 2013 (31)	Cohort (14/16)	1131 occupational titles from musculoskeletal research database	SIS	Job control High [170 cases in 115,516 person years] Low [355 cases in 153,986 person years]	1.0 1.22	1.00-1.50
				DECISION LATITUDE		
Silverstein 2008 (35)	CS (13/16)	Workers were recruited from manufacturing and healthcare and health research areas excluding direct patient care) sectors (N=733)	RCS	Decision latitude Low High	1.0 0.55	0.31-1.0
Bugajska 2013 (30)	Cohort (11/16)	Office workers, toolmakers, welders, seamstresses, TV assembly workers, electric elements assembly workers, packers in cosmetic industry, drivers, driving instructors and nurses (N=725)	RCT	Decision latitude Yes No [84 cases among 725 exposed and non-exposed]	1.0 1.01	0.98-1.05
Herin 2012 (29)	Cohort (11/16)	Executives, artisans, clerks and blue collar workers (N=12,714; 8231 males and 4483 females)	SP	Low decision latitude No [1,078 cases in 10,556 workers (10.2%)] Yes [277 cases in 2,158 workers (12.8%)]	1.0 1.21	1.04-1.41
				JOB DEMANDS		
Svendsen 2004 (34)	CS (14/16)	Male machinists, car mechanics, and house painters (N=1627; 3067 shoulders)	ST	Job demands Low High	1.0 3.19	1.62-6.31
Nordander 2016 (37)	CS pooled (10/16)	33 occupational groups consisting of office, industrial and non-office / non-industrial workers based on databases of previous studies (N=3141; 817 male and 2324 female)	IT	Job strain No Yes	1.0 1.07	1.03-1.12
Miranda 2005	CS	A sample of general population restricted	RCT	Job demands		

(26)	(11/16)	to subjects aged 30-64 years who had held a job during the preceding 12 months (N=8028)		Low High	1.0 1.7	1.0-3.0
Grzywacz, 2012 (22)	CS (9/16)	Poultry processing and other manual workers (N=513)	RCS	Psychological demand Seldom, never Almost always	1.0 1.30	0.61-2.69
Bugajska 2013 (30)	Cohort (11/16)	Office workers, toolmakers, welders, seamstresses, TV assembly workers, electric elements assembly workers, packers in cosmetic industry, drivers, driving instructors and nurses (N=725)	RCT	Mental job demands No Yes [84 cases among 725 exposed and non-exposed]	1.0 1.05	0.99-1.11
Bugajska, 2013 (30)	Cohort (11/16)	Office workers, toolmakers, welders, seamstresses, TV assembly workers, electric elements assembly workers, packers in cosmetic industry, drivers, driving instructors and nurses (N=725)	RCT	Physical job demand No Yes	1.0 1.23	0.89-1.71
Svendson 2013 (31)	Cohort (14/16)	1131 occupational titles from musculoskeletal research database (N=37,402; 15,845 male and 21,557 female)	SIS	Job demands Low [294 cases in 168,550 person years] High [230 cases in 101,379 person years] Job demand * job control	HR 1.0 1.13 1.28	0.94-1.36 0.86-1.89
Herin 2012 (29)	Cohort (11/16)	Executives, artisans, clerks and blue collar workers (N=12,714; 8231 males and 4483 females)	SP	High psychological demand No [535 cases in 5,283 workers (10.1%)] Yes[820 cases in 7,431 workers (11.0%)]	1.0 1.23	1.08-1.39
				JOB SATISFACTION		
Silverstein 2008 (35)	CS (13/16)	Workers were recruited from manufacturing and healthcare and health research areas excluding direct patient care) sectors (N=733)	RCS	Job satisfaction High Low	1.0 1.64	0.93-2.94

				JOB SECURITY		
Silverstein 2008 (35)	CS (13/16)	Workers were recruited from manufacturing and healthcare and health research areas excluding direct patient care) sectors (N=733)	RCS	Job security High <i>Low</i>	1.0 1.79	1.02-3.23
Bugajska 2013 (30)	Cohort (11/16)	Office workers, toolmakers, welders, seamstresses, TV assembly workers, electric elements assembly workers, packers in cosmetic industry, drivers, driving instructors and nurses (N=725)	RCT	Job insecurity No <i>Yes</i> [84 cases among 725 exposed and non-exposed]	1.0 1.12	0.93-1.36

* Diagnoses

RCS(T): rotator cuff syndrome (tendinitis)

IT : infraspinatus tendinitis

ST : shoulder tendinitis; supraspinatus tendinitis

SIS : subacromial impingement syndrome

BT : biceps tendinitis

SP : shoulder pain assessed with clinical test

**Selected risk factors for the formal (cohort and case-control studies in blue and italics) and secondary meta-analyses (in italics)