

Work relatedness of chronic neck pain with physical findings—a systematic review¹

by Keith T Palmer,² Julia Smedley

1 Additional tables (2–6) and appendix 1 on line.

2 Corresponding author [e-mail: ktp@mrc.soton.ac.uk].

Table 2. Features of the studies included in the review.^a [PRIM = Project on Research and Intervention in Monotonous Work, E = exposed, NE = not exposed, TNS = tension neck syndrome, CS = cervical syndrome, TOS = thoracic outlet syndrome; CBFM = cervicobrachial fibromyalgia; NP = neck pain; NSP = neck-shoulder pain; CNSP = chronic neck-shoulder pain; L = low; P = possible; H = high; (c) = cases, (r) = referents]

Study	Study populations	Exposures		Outcomes	Sam- pling meth- ods	Re- spon- se rate	Potential bias		Con- found- ing	Blinding	Outcome		Exposure assessment		Qual- ity rating	
		Categories	Main assessment methods				Infla- tionary	To the null			Clear	Repea- table	Objec- tive	Dose- re- sponse data		
Cohort studies																
Andersen et al, 2003 (18); Denmark	Workers from the PRIM study followed over 4 years	Repetition, force, neck flexion, rest breaks, demands, control, support	Walk-through surveys; videotape analysis of 103 task groups; self-completed questionnaire on physical and psychosocial factors	NP + palpation tenderness	+++	+	L	L	+++	+	+++	+++	+++	+++	++++	
Cassou et al, 2002 (19); France	14 995 workers free of CNSP and 1804 with CNSP followed over 5 years	Repetition, posture, precise work, demands, control	Self-completed questionnaire, checked by physicians	NP + painful neck movement	+++	+++	L	H	-/+	?+	++	-	-	-	+++	
Kaergaard & Andersen, ^b 2000 (38); Denmark	E: 238 sewing machine operators, NE: 357 workers in varied jobs	Static loading, repetition, neck flexion, job strain, social support	Comparison of job titles (including time in the job); self-completed questionnaire on psychosocial factors	Myofascial pain syndrome, neck-shoulder disorder	+++	-/+	L	P	-/+	?+	+++	+++	+	++	++	
Veiersted & Westgaard, 1994 (58); Norway	30 manual workers without NSP at base- line, 1-year follow-up	Posture	Interviewer-administered questionnaire	NSP + palpation tenderness	++	+++	L	P	-	?+	++	-	-	-	+	
Cross-sectional surveys																
Åkesson et al, ^c 1999 (59); Sweden	E: 84 dental personnel, NE: 27 nurses	Static loading, precise work, neck flexion	Comparison of job titles	TNS	++	+++	P	P	+	-	+++	-	+	-	+	
Andersen & Gaardboe, 1993 (35); Denmark	E: 82 sewing machine operators, NE: 25 aux- iliary nurses	Repetition, force, static loading, neck flexion	Comparison of job titles	CBFM, CS, neck-shoulder disorder	++	+++	L	P	-/+	+	+++	+++	+	+	++	
Andersen et al, 2002 (37); Denmark	3123 workers from food processing, textiles and servicing plants (PRIM study baseline)	Repetition, force, neck flexion, rest breaks, demands, control, support	Walk-through surveys; videotape analysis of 103 task groups; self-completed questionnaire on physical and psychosocial factors	NP + palpation tenderness	+++	++	L	L	+++	+	+++	+++	+++	+++	++++	
Anderson, 1992 (60); USA	E: 128 coach drivers, NE: 67 referents	Whole-body vibration, sitting	Comparison of job titles	Radiating NP + pain on neck movement	+++	+++	P	P	-	-	++	-	+	-	+	
Bovenzi et al, 1991 (61); Italy	E: 65 foresters, NE: 31 maintenance workers	Vibratory tools, posture, force	Comparison of job titles; measurement of accelera- tions of tools; questionnaire (to estimate vibration dose)	TNS, CS	?	?	P	P	+	+	+++	-	+++	+++	+++	

(continued)

Table 2. Continued.

Study	Study populations	Exposures		Out-comes	Sampling methods	Response rate	Potential bias		Confounding	Blinding	Outcome		Exposure assessment		Quality rating
		Categories	Main assessment methods				Inflationary	To the null			Clear	Repeatable	Objective	Dose-response data	
Hansson et al, 2000 (62); Sweden	E: 87 laminate workers, NE: 68 office and industrial workers	Static loading, repetition	Comparison of job titles; electromyographic recordings; electrogoniometry; questionnaire	TNS, TOS, neck-shoulder disorder	?	?	P	P	++/+++	–	+++	–	+++	++	+++
Hinnen et al, 1992 (63); Switzerland	E: 46 laser scan cashiers, NE: 106 conventional cashiers	Rest breaks	Comparison of job titles; production records; observation of worktasks; movement analysis	NP + examination findings	+	+++	P	L	–	–	++	++	+	–	+
Kuorinka & Koskinen, 1979 (39); Finland	E: 93 scissor makers, NE: 143 shop assistants, 163 factory workers	Repetition	Comparison of job titles; production records; video-tape analysis; observation of worktasks	TNS	++	++	P	L	–/+	–	+++	++	+	–	+
Luopajarvi et al, 1979 (40); Finland	E: 152 assembly packers, NE: 133 shop assistants	Repetition	Comparison of job titles; expert ergonomic assessment	TNS, CS	++	+++	P	P	–/+	–	+++	–	+/++	–	+
Nordander et al, 1999 (42); Sweden	E: 322 fish processors; NE: 337 other workers	Repetition, neck flexion, lifting	Comparison of job titles; video-tape analysis; observation of worktasks	TNS, CS	+++	+++	P	P	–/+	–	+++	–	+/++	–	++
Ohlsson et al, 1994 (64); Sweden	E: 206 fish processors, NE: 208 other workers	Repetition, posture, demands, control	Comparison of job titles; video-tape analysis; observation of worktasks; questionnaires	TNS, CS, TOS, neck-shoulder disorder	+++	+++	P	P	–	–	+++	–	+/++	–/+	++
Ohlsson et al, 1995 (41); Sweden	E: 82 industrial workers in repetitive jobs, NE: 64 workers in varied jobs	Repetition, neck flexion, arm abduction, rest breaks	Comparison of job titles; video-tape analysis	TNS, TOS, neck-shoulder disorder	++	+++	P	P	+/++	–	+++	–	++	–/+	+++
Silverstein, 1985 (43); USA	574 workers from 6 industrial plants	Repetition, force	Electromyographic recordings; videotape analysis	TNS	+++	+++	L	P	–	+	+++	–	+++	–	++
Toomingas et al, 1991 (44); Sweden	E: 71 platers and 70 assemblers, NE: 45 white-collar workers	Vibratory tools	Comparison of job titles	TNS	?	?	P	P	–	–	+++	–	+	–	+
Viikari-Juntura, 1983 (32); Finland	E: 113 slaughterhouse workers, NE: shop assistants, scissor makers, factory workers (refs 39 & 40)	Repetition, force	Comparison of job titles	TNS	+++	+++	P	P	–	–	+++	–	+	–	+

(continued)

Table 2. Continued.

Study	Study populations	Exposures		Out-comes	Sam- pling meth- ods	Re- spon- se rate	Potential bias		Con- found- ing	Blinding	Outcome		Exposure assessment		Qual- ity rating
		Categories	Main assessment methods				Infla- tionary	To the null			Clear	Repea- table	Objec- tive	Dose- re- sponse data	
Case-control studies															
Ekberg et al, 1994 (65); Sweden	Cases: 109 patients with neck-shoulder disorder from primary care, 327 community referents	Repetition, posture, demands, job satisfaction	Questionnaire	Neck-shoulder disorder	++	? (c) + (r)	H	P	–	?	+	–	–	+	+
Tornqvist et al, 2001 (50); Sweden	Cases: 194 women seeking care for neck-shoulder problems, 623 female referents sampled from a community register (the MUSIC study)	Repetition, vibration, arm elevation, precise work, demands, support, monotony	Self-completed questionnaire; interview	Neck-shoulder disorder	+++	? (c) + (r)	H	P	+	?	+	–	–	–	+

^a The criteria for plus notations are explained in section 4.5, p 13.

Table 3. Diagnostic criteria and methods employed in the reviewed reports. [TNS = tension neck syndrome, CS = cervical syndrome, TOS = thoracic outlet syndrome, NP = neck pain, NSP = neck-shoulder pain, NS = not stated, CBFM = cervicobrachial fibromyalgia, MFPS = myofascial pain syndrome, X = required, (X) = optional)]

Study	Diagnostic label	Source of definition (reference)	Symptoms					Examination findings				Notes
			Pattern of pain	Stiffness/ fatigue	Radiation to head	Radiation to arms	Numbness in hands	Tenderness or hardenings	Limited neck movement	Pain on neck movement	Radiating pain, neck movement	
<i>Neck pain with tenderness</i>												
Åkesson et al, 1999 (59)	TNS	33	NP, Nordic questions	X	X			X				Straightened cervical spine
Bovenzi et al, 1991 (61)	TNS	31, 32	NP on most days of a month in past 2 years and currently	X	X			X				
Hansson et al, 2000 (62)	TNS	33	NP, Nordic questions (last 7 days)	X	X			X				
Kuorinka & Koskinen, 1979 (39)	TNS	31	NS	X	X			X				
Luopajarvi et al, 1979 (40)	TNS	31	NS	X	X			X				
Norander et al, 1999 (42)	TNS	33	NP, Nordic questions	X	X			X				
Ohlsson et al, 1994 (64)	TNS	33	NP, Nordic questions	X	X			X				

(continued)

Table 3. Continued.

Study	Diagnostic label	Source of definition (reference)	Symptoms					Examination findings			Other or notes	
			Pattern of pain	Stiffness/ fatigue	Radiation to head	Radiation to arms	Numbness in hands	Tenderness or hardenings	Limited neck movement	Pain on neck movement		Radiating pain, neck movement
Ohlsson et al, 1995 (41)	TNS	33	NP, Nordic questions	X	X			X				
Silverstein, 1985 (43)	TNS	31	NP or stiffness, > once a week or >20 times in the past year	X				X		X		
Toomingas et al, 1991 (44)	TNS	NS	NS					X		X		
Viikari-Juntura, 1983 (32)	TNS	31, 32	NSP, NS	X	X			X				
Andersen & Gaardboe, 1993 (35)	CBFM	NS	NSP—30 days in past year & lasted a month at some time					X				Tenderness in 6 of 12 defined muscles
Andersen et al, 2002 (37)	NSP + tenderness	25	NSP severity score: average pain & impact in last 3 months, average pain in last 7 days					X				
Andersen et al, 2003 (18)	NSP + tenderness	25, 37	NSP severity score: average pain & impact in last 3 months, average pain in last 7 days					X				
Veiersted & Westgaard, 1994 (58)	NSP + tenderness	NS	NSP for >2 weeks with work limitation					X				
Kaergaard & Andersen, 2000 (38)	MFPS	25	NSP severity score: average pain & impact in last 3 months					X				
<i>Mixed, but mainly neck tenderness</i>												
Andersen & Gaardboe, 1993 (35)	Neck–shoul-der disorder	NS	NSP—30 days in past year and lasted a month at some time					X	X		X	41 cases of CBFM and 14 of CS among 74 neck–shoulder diagnoses; 19 of rotator cuff 47% TNS, 18% CS; also shoul-der tendinitis Predominantly TNS; also shoul-der tendinitis & acromioclavicu-lar syndrome 75% TNS; also, shoulder tendinitis 54% TNS
Ekberg et al, 1994 (65)	Neck–shoul-der disorder	31	NS	X	X			X	X			
Hansson et al, 2000 (62)	Neck–shoul-der disorder	33	NP, Nordic questions (last 7 days)	X	X			X				
Kaergaard & Andersen, 2000 (38)	Neck–shoul-der disorder	25	NSP severity score: average pain & impact in last 3 months, average pain in last 7 days					X				
Ohlsson et al, 1994 (64)	Neck–shoul-der disorder	33	NP, Nordic questions	X	X			X				
Ohlsson et al, 1995 (41)	Neck–shoul-der disorder	33	NP, Nordic questions	X	X			X				80% TNS

(continued)

Table 3. Continued.

Study	Diagnostic label	Source of definition (reference)	Symptoms					Examination findings			Other or notes		
			Pattern of pain	Stiffness/fatigue	Radiation to head	Radiation to arms	Numbness in hands	Tenderness or hardenings	Limited neck movement	Pain on neck movement		Radiating pain, neck movement	
Tornqvist et al, 2001 (50)	Neck–shoulder disorder	65	NS										53% TNS; also cervical branchialgia, shoulder tendinitis
<i>Radiating neck pain with pain on neck movement</i>													
Andersen & Gaardboe, 1993 (35)	CS	NS	30 days in past year + lasted a month at some time						X ^a	X		X ^a	Positive foraminal test
Bovenzi et al, 1991 (61)	CS	31, 32	NP on most days of a month in past 2 years & currently				X	X		X		X	Reduced force, deltoid, triceps, biceps
Luopajarvi et al, 1980 (40)	CS	31	NS				X	(X)		X		X	
Nordander et al, 1999 (42)	CS	33	NP, Nordic questions				X	X		X		X	
Ohlsson et al, 1994 (64)	CS	33	NP, Nordic questions				X	X		X		X	
Anderson, 1992 (60)	Neck disorder	n/s	Intense recurrent or continuous pain				X ^b		X	X	X	X	Moderate-to-severe category
<i>Thoracic outlet syndrome</i>													
Hansson et al, 2000 (62)	TOS	33	NP, Nordic questions (past 7 days)				X ^c	X ^c					Positive Morley & Roo tests
Ohlsson et al, 1994 (64)	TOS	33	NP, Nordic questions				X ^c	X ^c					Positive Morley & Roo tests
Ohlsson et al, 1995 (41)	TOS	33	NP, Nordic questions				X ^c	X ^c					Positive Morley & Roo tests
<i>Other symptoms and signs</i>													
Cassou et al, 2002 (19)	NP + painful movement	NS	Intermittent or persistent, past 6 months and causing functional limitation								X		
Hinnen et al, 1992 (63)	NP + examination findings	NS	Daily or occasional	X					X ^a		X ^a		

^a At least one of these.^b Commonly present.^c In ulnar nerve distribution.

Table 4. Risk estimates by job title and diagnostic category. (OR = odds ratio, PR = prevalence ratio, TNS = tension neck syndrome, CF = cervicobrachial fibromyalgia, MPS = myofascial pain syndrome, NSD = neck-shoulder disorder, CS = cervical syndrome, TOS = thoracic outlet syndrome, NP = neck pain, MSND = moderate-to-severe neck disorder, EF = examination findings)

Study	Diag- nosis	Numbers in analysis	Exposure comparisons	Mea- sure of risk	Point estimate		P-value	Confounders considered	
					OR or PR	95% CI			
Neck pain with tenderness									
Åkesson et al, 1999 (59)	TNS	54	Dentists versus nurses	OR	4.0	0.8–25.6	P<0.03	Age, gender	
		56	Hygienists versus nurses	OR	2.1	0.4–12.2			
		55	Dental assistants versus nurses	OR	2.2	0.4–14.9			
		84	All dental personnel versus nurses	OR	3.2	0.8–18			
Bovenzi et al, 1991 (61)	TNS	96	Forestry versus maintenance workers	OR	2.1	..		P<0.03	Age, gender
Hansson et al, 2000 (62)	TNS	122	Laminate workers versus industrial workers	OR	1.4	0.6–3.8			Gender
		120	Laminate workers versus office work		2.9	1.0–9.4			
		155	Laminate workers versus industrial and office workers		1.9	0.9–4.1			
Kuorinka & Koskinen, 1979 (39)	TNS	236	Scissor makers versus shop workers	OR	4.1	2.3–7.4		Similar mean age, gender	
		256	Scissor makers versus factory workers		2.6	1.5–4.6			
Luopajarvi et al, 1979 (40)	TNS	285	Assembly-line packers versus shop assistants	OR	1.6	0.9–2.7		Similar mean age, gender	
Nordander et al, 1999 (42)	TNS	414	Fish processors versus controls (women)	OR	3.0	1.6–6.1		Similar mean age, gender	
		245	Fish processors versus controls (men)		2.6	0.8–9.8			
		659	Fish processors versus controls (all)		2.9	1.7–5.3			
Ohlsson et al, 1994 (64)	TNS	414	Fish processors versus controls (women)	OR	3.0	1.6–6.1		Similar mean age, gender	
Ohlsson et al, 1995 (41)	TNS	146	Industrial workers versus controls	OR	4.7	1.9–12.8		Similar mean age, gender	
Toomingas et al, 1991 (44)	TNS	186	Platers & assemblers versus controls	OR	4.5	0.6–194.1		Gender	
Viikari-Juntura, 1983 (32)	TNS	265	Slaughterhouse workers versus factory workers	OR	0.1	<0.1–0.2		–	
		206	Slaughterhouse workers versus scissor makers		<0.1	<0.1–0.1			
		256	Slaughterhouse workers versus shop assistants		0.1	<0.1–0.4			
Andersen & Gaardboe, 1993 (35)	CF		Sewing operators versus nursing aides	OR			X² for trend P<0.001	Age, gender	
		46	0–7 versus 0 years		2.7	0.3–32.5			
		50	8–15 versus 0 years		9.0	1.6–91.5			
		61	≥15 versus 0 years		23.0	4.3–220.1			
Kaergaard & Andersen, 2000 (38)	MPS	238	Years as a sewing operator (versus controls)	OR				Similar mean age, gender	
			>10–20 versus >2–10 years		0.6	0.2–1.4			
			>20 versus ≤10 years		3.7	1.8–7.6			
			Sewing operators versus mixed controls	PR	1.7	1.1–2.6			
Mixed, but mainly neck pain with tenderness									
Andersen & Gaardboe, 1993 (35)	NSD	107	Years as a sewing operator (versus controls)	OR				Age, gender, smoking, leisure-time exercise	
			0–7 versus 0 years		3.17	0.62–16.12			
			8–15 versus 0 years		11.16	2.38–52.25			
			>15 versus 0 years		36.74	7.14–189.1			

(continued)

Table 4. Continued.

Study	Diagnosis	Numbers in analysis	Exposure comparisons	Measure of risk	Point estimate		P-value	Confounders considered
					OR or PR	95% CI		
Kaergaard & Andersen, 2000 (38)	NSD	243	Internal comparison, years as a sewing operator ≤2 versus >2–10 years 10–20 versus >2–10 years >20 versus >2–10 years	PR	2.44 1.80 4.44	0.72–8.23 0.62–5.26 1.54–12.78		Age, gender, mental health, smoking, body mass index, other ^a
Ohlsson et al, 1995 (41)	NSD	146	Internal comparison, years as an industrial worker <10 versus 0 years 10–19 versus 0 years ≥20 versus 0 years	OR	9.6 4.4 3.8	2.8–33 1.5–13 1.4–10		Age, gender, mental health
			Mobile workers versus controls		2.3	0.6–9		
			Assembly workers versus controls		6.7	2.7–17		
			Polishers versus controls		4.4	1.5–13		
		A77 106 91						
Ohlsson et al, 1994 (64)	NSD	414	Fish processors versus controls (women)	OR	3.2	2.0–5.3		Similar mean age, gender
<i>Radiating neck pain with pain on neck movement</i>								
Andersen & Gaardboe, 1993 (35)	CS	46 50 61	Internal comparison, years as a sewing operator 0–7 versus 0 years 8–15 versus 0 years >15 versus 0 years		4.8% versus 0% 12.0% versus 0% 27.8% versus 0%		X ² for trend, P<0.001	Gender
Bovenzi et al, 1991 (61)	CS	96	Forestry workers versus maintenance workers	OR	6.8	..	P=0.06	Age, gender
Luopajarvi et al, 1979 (40)	CS	285	Assembly-line packers versus shop assistants	OR	0.3	0–3.6		Similar mean age, gender
Nordander et al, 1999 (42)	CS	414	Fish processors versus controls (women)		5% versus 0%			Similar mean age, gender
		245	Fish processors versus controls (men)		0% versus 1%			
		659	Fish processors versus controls (all)	OR	11.9	1.7–513		
Ohlsson et al, 1994 (64)	CS	414	Fish processors versus controls (women)		5% versus 0%	3.0 ^b	P<0.001	Similar mean age, gender
Anderson, 1992 (60)	MSND	195	Coach drivers versus controls	OR	1.8	0.5–7.8		–
<i>Thoracic outlet syndrome</i>								
Hansson et al, 2000 (62)	TOS	155	Laminate workers versus industrial and office workers		1.1% versus 0%		P=0.38	Gender
Ohlsson et al, 1994 (64)	TOS	414	Fish processors versus controls (women)	OR	2.1	0.4–12.8		Similar mean age, gender
Ohlsson et al, 1995 (41)	TOS	146	Industrial workers versus controls		4.0 % versus 0%		P=0.12	Similar mean age, gender
<i>Other symptoms and signs</i>								
Hinnen et al, 1992 (63)	NP + EF	154	Non versus scanner checkout workers	OR	0.7	0.3–2.0		Gender
	NP + EF		No job rotation versus job rotation, checkout workers		1.1	0.4–3.4		
	NP + EF		No chute versus chute at checkout		1.2	0.5–3.3		

^a Also, past history of neck injury, job strain and social support.^b Lower boundary.

Table 5. Risks by physical occupational activity. (OR = odds ratio, PR = prevalence ratio, HR = hazard ratio, NSP = neck–shoulder pain, TNS = tension neck syndrome, CS = cervical syndrome, TOS = thoracic outlet syndrome, MCV = maximum voluntary contraction, TWA = time-weighted average, MET = metabolic equivalent)

Study	Outcomes	Exposure contrasts	Num- bers in analy- sis	Point estimate		Confounders considered
				OR, PR or HR	95% CI	
Repetition						
Neck pain with tenderness						
Andersen et al, 2002 (37)	Prevalent NSP + palpation tenderness	Versus nonrepetitive reference group Low 1–15 shoulder movements per minute High 16–40 shoulder movements per minute	2725	PR 1.3 PR 1.8	0.8–2.1 1.1–2.9	Age, gender, mental health, body mass index, past injury to neck–shoulder, rheumatic disease, leisure-time physical activity
Andersen et al, 2003 (18)	Incident NSP + palpation tenderness	Versus nonrepetitive reference group Low: 1–15 shoulder movements per minute High: 16–40 shoulder movements per minute	4700	OR 1.3 OR 3.0	0.7–2.6 1.5–5.8	Age, gender, mental health, body mass index, rheumatic disease, leisure-time physical activity, pain pressure threshold
Silverstein, 1985 (43)	TNS	Final exposure classification (women)				Gender
		High repetition–low force versus low repetition–low force	161	OR 0.8	0.2–3.5	
		Initial exposure classification (women)				Gender
		High repetition–low force versus low repetition–low force	169	OR 0.8	0.2–3.1	
Mixed, but mostly neck pain with tenderness						
Ekberg et al, 1994 (65)	Neck–shoulder disorder	Repetitive precision movements (versus low)	436			–
		Medium		OR 2.7	1.1–6.4 ^a	
		High		OR 7.5	2.4–23 ^a	
Hansson et al, 2000 (62)	Neck–shoulder disorder	Wrist movements (versus low)	436			Age, gender
		Medium		OR 5.4	1.3–22	
		High		OR 3.1	0.7–13	
Ohlsson et al, 1995 (41)	Neck–shoulder disorder	Repetitive work versus none	146	OR 4.6	1.9–12	Age, gender, mental health
Tornqvist et al, 2001 (50)	Neck–shoulder disorder	Repetitive hand & finger movements, many times per minute, ≥2 days per week	817	OR 2.2	1.5–3.2	Age, gender, past injury to neck–shoulder
Other symptoms and signs						
Cassou et al, 2002 (19)	Incident chronic neck pain + signs	Repetitive work versus no repetitive work				Age, gender, mental health, smoking, rheumatic disease, leisure-time physical activity
		In 1990 (men)	8952	OR 0.9	0.7–1.2	
		Before 1990 (men)		OR 1.3	1.0–1.7	
		In 1990 (women)	6043	OR 1.3	1.0–1.6	
		Before 1990 (women)		OR 1.2	1.0–1.5	
	Recovery from chronic neck pain	Repetitive work versus no repetitive work	1056			Age, gender, rheumatic disease, leisure-time physical activity
		In 1990 (women)		OR 0.8	0.5–1.3	
		Before 1990 (women)		OR 0.5	0.3–0.7	

(continued)

Table 5. Continued.

Study	Outcomes	Exposure contrasts	Num- bers in analy- sis	Point estimate		Confounders considered
				OR, PR or HR	95% CI	
Forceful work						
<i>Neck pain with tenderness</i>						
Andersen et al, 2002 (37)	Prevalent NSP + palpation tenderness	<i>Versus nonrepetitive reference group</i> Low (<10% of MCV) High (≥10% of MCV)	2756	PR 1.3 PR 2.0	0.8–2.0 1.2–3.3	Age, gender, mental health, body mass index, past injury to neck–shoulder, rheumatic disease, leisure-time physical activity
Andersen et al, 2003 (18)	Incident NSP + palpation tenderness	<i>Versus nonrepetitive reference group</i> Low (<10% of MCV) High (≥10% of MCV)	4706	PR 1.9 PR 2.0	1.0–3.6 1.0–4.2	Age, gender, mental health, body mass index, rheumatic disease, leisure-time physical activity, pain pressure threshold
Silverstein, 1985 (43)	TNS	Final exposure classification (women) <i>Low-repetition-high force versus low repetition–low force</i>	113	OR 1.7	0.4–7.4	Gender
		Initial exposure classification (women) <i>Low-repetition-high force versus low repetition–low force</i>	116	OR 1.9	0.5–7.4	Gender
Posture/static loading						
<i>Neck pain with tenderness</i>						
Andersen et al, 2002 (37)	Prevalent NSP + palpation tenderness	<i>Percentage of cycle time with neck flexed >20°</i> >0–<66% versus reference ≥66% versus reference	2756	PR 1.3 PR 1.7	0.8–2.1 1.1–2.8	Age, gender, mental health, body mass index, past injury to neck–shoulder, rheumatic disease, leisure-time physical activity
Andersen et al, 2003 (18)	Incident NSP + palpation tenderness	<i>Percentage of cycle time with neck flexed >20°</i> >0–<66% versus reference ≥66% versus reference	4704	PR 1.4 PR 2.6	0.7–2.9 1.3–5.1	Age, gender, mental health, body mass index, rheumatic disease, leisure-time physical activity, pain pressure threshold
Veiersted & Westgaard, 1994 (58)	Incident neck pain + palpation tenderness	<i>Postures strenuous to the neck & shoulders (yes versus no)</i>	30	HR 7.2	2.1–25.3	Gender, mental health
<i>Mixed, but mostly neck pain with tenderness</i>						
Ekberg et al, 1994 (65)	Neck–shoulder disorder	<i>Lifted arms</i> Medium High	436	OR 2.4 OR 4.8	0.80–7.1 ^a 1.3–18 ^a	–
		<i>Uncomfortable sitting (high versus low)</i>	436	OR 3.6	1.4–9.3 ^a	
Hansson et al, 2000 (62)	Neck–shoulder disorder	<i>Muscle loading (M trapezius) (versus low)</i> Medium High	84	OR 1.9 OR 1.5	0.6–6.3 0.4–5.2	Age, gender
		<i>Muscle loading (M infraspinatus) (versus low)</i> Medium High	82	OR 0.7 OR 0.9	0.2–2.4 0.2–3.3	Age, gender

(continued)

Table 5. Continued.

Study	Outcomes	Exposure contrasts	Numbers in analysis	Point estimate		Confounders considered
				OR, PR or HR	95% CI	
Tornqvist et al, 2001 (50)	Neck–shoulder disorder	<i>Constrained sitting ≥4 hours per day (yes versus no)</i>	817	OR 1.5	0.7–2.9	Age, gender, past injury to neck–shoulder
		<i>Work with hands above shoulder (>30 minutes per day) (yes versus no)</i>	817	OR 1.6	1.0–2.7	
<i>Other symptoms and signs</i>						
Cassou et al, 2002 (19)	Incident chronic neck pain	<i>Awkward work (versus never exposed)</i>				Gender
		In 1990 (men)	9028	OR 1.4	1.2–1.5	
		Before 1990 (men)		OR 1.4	1.2–1.6	
		In 1990 (women)	6100	OR 1.3	1.1–1.4	
		Before 1990 (women)		OR 1.1	1.0–1.2	
		<i>Recovery from chronic neck pain</i>				Gender
		In 1990 (men)	759	OR 0.8	0.6–1.0	
		Before 1990 (men)		OR 0.6	0.5–0.8	
		In 1990 (women)	1063	OR 0.9	0.8–1.1	
		Before 1990 (women)		OR 0.7	0.6–0.9	
Rest breaks						
<i>Neck pain with tenderness</i>						
Andersen et al, 2002 (37)	Prevalent NSP + palpation tenderness	<i>Percentage of time without micropause rest breaks</i>	2756			Age, gender, mental health, body mass index, past injury to neck–shoulder, rheumatic disease, leisure-time physical activity
		<80% versus reference		PR 1.3	0.8–2.1	
		≥80% versus reference		PR 1.8	1.1–2.9	
Andersen et al, 2003 (18)	Incident NSP + palpation tenderness	<i>Percentage of time without micropause rest breaks</i>	4614			Age, gender, mental health, body mass index, rheumatic disease, leisure-time physical activity, pain pressure threshold
		<80% versus reference		PR 1.0	0.4–2.9	
		≥80% versus reference		PR 2.1	1.1–3.9	
Precision work						
<i>Mixed, but mostly neck pain with tenderness</i>						
Tornqvist et al, 2001 (50)	Neck–shoulder disorder	Visually demanding precision work (≥4 hours versus <4 hours/day)	817	OR 0.5	0.0–7.8	–
<i>Other symptoms and signs</i>						
Cassou et al, 2002 (19)	Incident chronic neck pain	<i>Work with precise movements (yes versus no)</i>				Gender
		Men	9028	OR 1.1	0.9–1.2	
		Women	6100	OR 1.3	1.1–1.4	
	Recovery from neck pain	<i>Work with precise movements (yes versus no)</i>				Gender
		Men	759	OR 0.9	0.7–1.1	
		Women	1063	OR 1.1	1.0–1.4	

(continued)

Table 5. Continued.

Study	Outcomes	Exposure contrasts	Num- bers in analy- sis	Point estimate		Confounders considered
				OR, PR or HR	95% CI	
Repetition and force						
Neck pain with tenderness						
Andersen et al, 2002 (37)	Prevalent NSP + palpation tenderness	Versus reference group	2725			Age, gender, mental health, body mass index, past injury to neck–shoulder, rheumatic disease, leisure-time physical activity
		Low repetition, low force		PR 1.2	0.7–2	
		High repetition, low force		PR 1.4	0.7–2.9	
		Low repetition, high force		PR 1.4	0.8–2.4	
		High repetition, high force		PR 2.3	1.4–4.0	
Andersen et al, 2003 (18)	Incident NSP + palpation tenderness	Versus reference group	4700			Age, gender, mental health, body mass index, rheumatic disease, leisure-time physical activity, pain pressure threshold
		Low repetition, low force		PR 1.3	0.6–2.7	
		High repetition, low force		PR 3.3	1.6–6.9	
		Low repetition, high force		PR 1.3	0.4–3.7	
		High repetition, high force		PR 2.6	1.2–5.9	
Silverstein, 1985 (43)	TNS	Final exposure classification (women)				Gender
		High-repetition(HR)-high force (HF) versus low repetition–low force	135	OR 0.5	0.1–2.6	
		Initial exposure classification (women)				Gender
		High-repetition(HR)-high force (HF) versus low repetition–low force	142	OR 0.3	<0.1–1.8	
Repetition and posture						
Neck pain with tenderness						
Andersen et al, 2002 (37)	Prevalent NSP + palpation tenderness	Versus reference group	2725			Age, gender, mental health, body mass index, past injury to neck–shoulder, rheumatic disease, leisure-time physical activity
		Low repetition, low % time neck flexed		PR 1.2	0.7–2.1	
		High repetition, low % time neck flexed		PR 1.4	0.7–2.9	
		Low repetition, high % time neck flexed		PR 1.4	0.8–2.6	
		High repetition, high % time neck flexed		PR 1.9	1.1–3.1	
Andersen et al, 2003 (18)	Incident NSP + palpation tenderness	Versus reference group	4698			Age, gender, mental health, body mass index, rheumatic disease, leisure-time physical activity, pain pressure threshold
		Low repetition, low % time neck flexed		PR 1.2	0.6–2.5	
		High repetition, low % time neck flexed		PR 2.5	1.0–6.0	
		Low repetition, high % time neck flexed		PR 1.6	0.6–4.1	
		High repetition, high % time neck flexed		PR 3.2	1.6–6.4	
Repetition and rest breaks						
Neck pain with tenderness						
Andersen et al, 2002 (37)	Prevalent NSP + palpation tenderness	Versus reference group	2725			Age, gender, mental health, body mass index, past injury to neck–shoulder, rheumatic disease, leisure-time physical activity
		Low repetition, low % time with micropauses		PR 1.2	0.7–2.1	
		High repetition, low % time with micropauses		PR 1.1	0.5–2.5	
		Low repetition, high % time with micropauses		PR 1.4	0.7–2.6	
		High repetition, high % time with micropauses		PR 1.9	1.2–3.2	

(continued)

Table 5. Continued.

Study	Outcomes	Exposure contrasts	Numbers in analysis	Point estimate		Confounders considered
				OR, PR or HR	95% CI	
Andersen et al, 2003 (18)	Incident NSP + palpation tenderness	<i>Versus reference group</i> Low repetition, low % time with micropauses High repetition, low % time with micropauses Low repetition, high % time with micropauses High repetition, high % time with micropauses	4608	PR 1.0 PR 1.5 PR 1.4 PR 3.1	0.3–3.1 0.2–11.9 0.7–2.9 1.6–6.0	Age, gender, mental health, body mass index, rheumatic disease, leisure-time physical activity, pain pressure threshold
Vibration						
<i>Neck pain with tenderness</i>						
Bovenzi et al, 1991 (61)	TNS	<i>Daily vibration dose</i> >0–7.5 versus 0 m/s ² >7.5 versus 0 m/s ²	96	OR 0.9 ^b OR 3.8 ^c		Age, gender
<i>Mixed, but mostly neck pain with tenderness</i>						
Tornqvist et al, 2001 (50)	Neck–shoulder disorder	Work with vibrating tools (≥60 minutes per day)	817	OR 0.9	0.4–2.2	Age, gender, past injury to neck–shoulder
<i>Neck pain with pain on neck movement</i>						
Bovenzi et al, 1991 (61)	CS	>0–7.5 versus 0 m/s ² >7.5 versus 0 m/s ²	96	OR 2.8 ^b OR 10.7 ^d		Age, gender
Other activity						
<i>Mixed, but mostly neck pain with tenderness</i>						
Ekberg et al, 1994 (65)	Neck–shoulder disorder	Lifting (high and medium versus low)	436	OR 13.6	4.8–39 ^a	–
Tornqvist et al, 2001 (50)	Neck–shoulder disorder	Manual material handling (≥50 N, ≥60 minutes per day)	817	OR 0.8	0.3–2.0	Age, gender, past injury to neck–shoulder
		High energy expenditure (≥3 TWA MET) (yes versus no)	817	OR 1.0	0.6–1.9	

^a 90% CI.^b P-value >0.05.^c P-value <0.03.

Table 6. Neck pain with physical signs and psychosocial factors in the work environment. (OR = odds ratio, 95% CI = 95% confidence interval, NSP = neck-shoulder pain)

Study	Outcome	Exposure contrasts	Num- bers in analysis	Effect mea- sure	Point estimate		Confounders considered
					OR	95% CI	
Job demands							
<i>Neck pain with tenderness</i>							
Andersen et al, 2002 (37)	NSP + palpation tenderness	High versus low job demands	2937	PR	1.8	1.2–2.7	Age, gender, past injury to neck–shoulder, body mass index, leisure-time physical activity, rheumatic disease
Andersen et al, 2003 (18)	Incident NSP + palpation tenderness	High versus low job demands	4685	PR	2.0	1.2–3.3	Age, gender, past injury to neck–shoulder, body mass index, leisure-time physical activity, mental health, other ^b
<i>Mixed, but mostly neck pain with tenderness</i>							
Ekberg et al, 1994 (65)	Neck–shoulder disorder	High versus low demands on attention	436	OR	3.8	1.4–11 ^b	–
Tornqvist et al, 2001 (50)	Neck–shoulder disorder	High demands (yes versus no)	817	RR	1.3	0.9–1.5	
		High time pressure (yes versus no)	817	RR	1.2	0.8–1.9	
		High quantitative demands (yes versus no)	817	RR	0.8	0.4–1.7	
		High demands for competence (yes versus no)	817	RR	0.8	0.5–1.2	
		Low demands for competence (yes versus no)	817	RR	1.1	0.7–1.8	
<i>Other symptoms and signs</i>							
Cassou et al, 2002 (19)	Incident chronic neck pain	High versus low job demands (men)	8952	OR	1.2	1.0–1.4	Age, gender, mental health, smoking, leisure-time physical activity, rheumatic disease, other ^c
		High versus low job demands (women)	6043	OR	1.2	1.0–1.4	
	Recovery from neck pain	High versus low job demands (men)	748	OR	0.7	0.5–0.9	Age, gender, mental health, rheumatic disease, other ^c
		High versus low job demands (women)	1056	OR	0.7	0.6–0.9	
Control over work							
<i>Neck pain with tenderness</i>							
Andersen et al, 2002 (37)	Prevalent NSP + palpation tenderness	Low versus high job control	2940	PR	1.4	1.0–1.9	Age, gender, past injury to neck–shoulder, body mass index, leisure-time physical activity, rheumatic disease
Andersen et al, 2003 (18)	Incident NSP + palpation tenderness	Low versus high job control	4677	PR	1.3	0.8–2.1	Age, gender, past injury to neck–shoulder, body mass index, leisure-time physical activity, mental health, other ^b
Mixed, but mostly neck pain with tenderness							
Ohlsson et al, 1994 (64)	Neck–shoulder disorder	High versus low control	206	OR	0.68	0.27–1.27	Age, gender
Tornqvist et al, 2001 (50)	Neck–shoulder disorder	Low decision latitude	817	OR	1.1	0.8–1.6	Age, gender, past injury to neck–shoulder
		Low participation in planning	817	OR	1.4	0.6–2.9	

(continued)

Table 6. Continued.

Study	Outcome	Exposure contrasts	Num- bers in analy- sis	Effect mea- sure	Point estimate		Confounders considered
					OR	95% CFI	
Other symptoms and signs							
Cassou et al, 2002 (19)	Incident chronic neck pain	Low versus high job control (men)	9028	OR	1.0	0.9–1.2	Gender
		Low versus high job control (women)	6100	OR	0.9	0.8–1.0	
	Recovery from neck pain	Low versus high job control (men)	759	OR	0.9	0.7–1.1	Gender
		Low versus high job control (women)	1063	OR	1.0	0.8–1.2	
Support at work							
Neck pain with tenderness							
Andersen et al, 2002 (37)	Prevalent NSP + palpation tenderness	High versus low social support	2937	PR	1.3	0.9–1.8	Age, gender, past injury to neck–shoulder, body mass index, leisure-time physical activity, rheumatic disease
Andersen et al, 2003 (18)	Incident NSP + palpation tenderness	High versus low social support	4430	PR	1.3	0.8–2.1	Age, gender, past injury to neck–shoulder, body mass index, leisure-time physical activity, mental health, other ^c
Mixed, but mostly neck pain with tenderness							
Kaergaard & Andersen, 2000 (38)	Prevalent neck–shoulder disorder	High versus low social support	238	PR	1.66	0.86–3.23	Age, gender, smoking, body mass index, mental health
	Incident neck–shoulder disorder	High versus low social support	149	PR	3.72	1.22–11.30	Age, gender, mental health, job strain
Tornqvist et al, 2001 (50)	Neck–shoulder disorder	Poor general support at work	817	RR	1.4	1.0–2.0	Age, gender, past injury to neck–shoulder
Job strain							
Mixed, but mostly neck pain with tenderness							
Kaergaard & Andersen, 2000 (38)	Neck–shoulder disorder	High versus low job strain	239	PR	0.88	0.45–1.71	Age, gender, smoking, body mass index, mental health
Ohlsson et al, 1994 (64)	Neck–shoulder disorder	Fish processors	206				
		Medium versus low work strain		OR	2.9	1.1–7.6	Age, gender
		High versus low work strain		OR	6.6	2.6–17	
		Controls	208				
		Medium versus low work strain		OR	1.2	0.45–3.2	Age, gender
		High versus low work strain		OR	3.0	1.1–8.7	
Tornqvist et al, 2001 (50)	Neck–shoulder disorder	Job strain	817	RR	1.6	1.1–2.5	Age, gender, past injury to neck–shoulder
Work content							
Mixed, but mostly neck pain with tenderness							
Ekberg et al, 1994 (65)	Neck–shoulder disorder	Work content (poor versus good)	436	OR	2.6	0.71–9.4 ^{la}	–
Tornqvist et al, 2001 (50)	Neck–shoulder disorder	Job profile–high routine, low creativity	817	OR	1.0	0.6–1.5	Age, gender, past injury to neck–shoulder

^a Other physical and psychosocial risk factors.^b 90% CI.^c Other physical risk factors.

Appendix 1

Search strategy

In this study the search below was performed in Ovid MEDLINE (from 1966 to May week 3, 2006). Owing to small differences in indexing terms between databases, small refinements were made when the search was separately run in BIDS Embase and Psycinfo. References were imported into Refman, and the duplicates were eliminated.

A. Exposure(s)

- 1 computer mouse.mp.
- 2 (control and support and demand).mp.
- 3 (cumulative trauma\$ or cumulative injur\$).mp.
- 4 Karasek.mp.
- 5 exertion of force.mp.
- 6 (neck extension or shoulder extension or arm extension).mp.
- 7 extreme posture\$.mp.
- 8 awkward posture\$.mp.
- 9 (neck flexion or shoulder flexion or arm flexion).mp.
- 10 forceful exertion.mp.
- 11 forceful work.mp.
- 12 (forceful grip or power grip or precision grip).mp.
- 13 job satisfaction.mp. or exp Job Satisfaction/
- 14 job strain.mp.
- 15 (keyboard or keypad).mp.
- 16 exp Lifting/ or lifting.mp.
- 17 exp Occupations/ or occupation\$.mp.
- 18 overuse.mp.
- 19 exp Stress, Psychological/ or perceived psychological stress.mp.
- 20 personality attribute\$.mp.
- 21 personality trait\$.mp.
- 22 personality type\$.mp.
- 23 (physical load\$ or physical workload or paced workload or paced work).mp.
- 24 cumulative strain.mp.
- 25 (neck posture or shoulder posture or arm posture or upper limb posture).mp.
- 26 precis\$ work.mp.
- 27 psychosocial.mp.
- 28 pulling.mp.
- 29 pushing.mp.
- 30 perceived exertion.mp
- 31 constrained posture.mp.
- 32 (repetiti\$ strain\$ or repetiti\$ activit\$ or repetiti\$ action\$ or repetiti\$ task\$ or repetiti\$ work or repetiti\$ job\$).mp.
- 33 (head rotation or neck rotation or shoulder rotation or arm rotation).mp.
- 34 skill discretion.mp. [mp=title, original title, abstract, name of substance word, subject heading word]
- 35 (static posture or static loading or static force or static position or static work).mp.
- 36 typing speed.mp.
- 37 exp Computer Terminals/ or VDU.mp.
- 38 DSE.mp.
- 39 (hand-arm vibration or hand arm vibration or hand transmitted vibration or hand-transmitted vibration or vibrating tool\$ or hand-powered tool\$).mp.
- 40 visual display terminal.mp.
- 41 visual display unit.mp.
- 42 work-related.mp.
- 43 work pace.mp.
- 44 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43
- 45 assembly line packer\$.mp.
- 46 assembly line worker\$.mp.
- 47 automobile assembler\$.mp.
- 48 boarding worker\$.mp.
- 49 bricklayer\$.mp.
- 50 call centre worker\$.mp.
- 51 call centre operator\$.mp.
- 52 car assembler\$.mp.
- 53 carpenter\$.mp.
- 54 cash register operator\$.mp.

- 55 chocolate worker\$.mp.
- 56 clerical worker\$.mp.
- 57 computer user\$.mp.
- 58 construction worker\$.mp.
- 59 data processing.mp.
- 60 data processor\$.mp.
- 61 data entry operator\$.mp.
- 62 dental hygienist\$.mp.
- 63 dentist\$.mp.
- 64 docker\$.mp.
- 65 electrical equipment assembler\$.mp.
- 66 electrician\$.mp.
- 67 electronic worker\$.mp.
- 68 farm worker\$.mp.
- 69 farmers\$.mp.
- 70 film rolling worker\$.mp.
- 71 fish filleter\$.mp.
- 72 fish worker\$.mp.
- 73 folding worker\$.mp.
- 74 folding operat\$.mp.
- 75 food process\$.mp.
- 76 fruit picker\$.mp.
- 77 furniture mover\$.mp.
- 78 garment worker\$.mp.
- 79 grocery checker\$.mp.
- 80 grocery store checker\$.mp.
- 81 home care worker\$.mp.
- 82 keyboard worker\$.mp.
- 83 keyboard operat\$.mp.
- 84 knitting worker\$.mp.
- 85 knitting operat\$.mp.
- 86 laundry operat\$.mp.
- 87 laundry worker\$.mp.
- 88 machine operat\$.mp.
- 89 meat cutter\$.mp.
- 90 meat process\$.mp.
- 91 meat wrapper\$.mp.
- 92 meat operat\$.mp.
- 93 musician\$.mp.
- 94 newspaper employee\$.mp.
- 95 newspaper worker\$.mp.
- 96 newspaper operat\$.mp.
- 97 nurse\$.mp.
- 98 office worker\$.mp.
- 99 orchard worker\$.mp.
- 100 packaging operat\$.mp.
- 101 packer\$.mp.
- 102 plate worker\$.mp.
- 103 postal clerk\$.mp.
- 104 postal sorter\$.mp.
- 105 poultry processor\$.mp.
- 106 poultry worker\$.mp.
- 107 poultry operat\$.mp.
- 108 riveter\$.mp.
- 109 rock blaster\$.mp.
- 110 scissor maker\$.mp.
- 111 secretar\$.mp.
- 112 secretarial worker\$.mp.
- 113 semiconductor worker\$.mp.
- 114 sewing machine operat\$.mp.
- 115 shipyard welder\$.mp.
- 116 sign language interpreter\$.mp.
- 117 slaughterhouse worker\$.mp.
- 118 supermarket cashier\$.mp.
- 119 telecommunication\$ worker\$.mp.
- 120 telephonist\$.mp.
- 121 teleservice operat\$.mp.
- 122 textile worker\$.mp.
- 123 typist\$.mp.
- 124 VDT user\$.mp.
- 125 VDU user\$.mp.
- 126 45 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63 or 64 or 65 or 66 or 67 or 68 or 69 or 70 or 71 or 73 or 74 or 75 or 76 or 77 or 78 or 80 or 81 or 82 or 85 or 86 or 87 or 88 or 89 or 90 or 91 or 92 or 93 or 94 or 95 or 96 or 97 or 98 or 99 or 100 or 101 or 102 or 104 or 105 or 106 or 107 or 108 or 110 or 111 or 112 or 113 or 114 or 115

or 116 or 117 or 118 or 119 or 121 or 122 or 123 or 124 or 125
127 44 or 126

B. Outcome(s)

128 cervical syndrome.mp.
129 cervicobrachial disorder\$.mp.
130 cervicobrachial fibromyalgia.mp.
131 cervicobrachial pain.mp.
132 cumulative trauma disorder\$.mp. or exp Cumulative Trauma Disorders/
133 (musculoskeletal and neck).mp.
134 (musculoskeletal and neck-shoulder).mp.
135 (musculoskeletal and shoulder).mp.
136 neck discomfort.mp.
137 neck myalgia.mp.
138 neck pain.mp. or exp Neck Pain/
139 neck symptom\$.mp.
140 neck tenderness.mp.
141 neck-shoulder myalgia.mp.
142 neck-shoulder pain.mp.
143 neck-shoulder tenderness.mp.
144 shoulder disorder\$.mp.
145 shoulder girdle pain\$.mp.
146 shoulder muscle fatigue.mp.
147 shoulder myalgia.mp.
148 shoulder pain.mp. or exp Shoulder Pain/
149 shoulder tenderness.mp.
150 tension neck syndrome.mp.
151 thoracic outlet syndrome.mp. or exp Thoracic Outlet Syndrome/
152 trapezius myalgia.mp.
153 (upper extremity and neck).mp.
154 (upper extremity and neck-shoulder).mp.
155 (upper extremity and shoulder).mp.
156 (upper limb and neck).mp.
157 (upper limb and neck-shoulder).mp.
158 (upper limb and shoulder).mp.
159 (WRULD and shoulder).mp.
160 (work-related upper limb disorder\$ and shoulder).mp.

161 (WRULD and neck).mp.
162 (work-related upper limb disorder\$ and neck).mp.
163 (WRULD and neck-shoulder).mp.
164 (work-related upper limb disorder\$ and neck-shoulder).mp.
165 128 or 129 or 130 or 131 or 132 or 133 or 134 or 135 or 136 or 137 or 138 or
139 or 141 or 142 or 143 or 144 or 145 or 146 or 147 or 148 or 149 or 150 or
151 or 152 or 153 or 154 or 155 or 156 or 157 or 158 or 159 or 160 or 161
or 162 or 163 or 164

C. Filters for physical examination

166 physical examination.mp. or exp Physical Examination/
167 examination.mp.
168 physical signs.mp.
169 objective assessment.mp.
170 functional assessment.mp.
171 palpation.mp. or exp Palpation/
172 palpatory findings.mp.
173 palpable muscle tightness.mp.
174 tenderness.mp.
175 passive neck movement\$.mp.
176 resisted neck movement\$.mp.
177 range of movement\$.mp.
178 neck angle\$.mp.
179 neck posture\$.mp.
180 neck flexion.mp.
181 neck extension.mp.
182 goniomet\$.mp.
183 foraminal test.mp.
184 nerve root sign\$.mp.
185 neck compression test\$.mp.
186 shoulder abduction test\$.mp.
187 166 or 167 or 168 or 169 or 170 or 171 or 173 or 174 or 176 or 177 or 178
or 179 or 180 or 181 or 183 or 184 or 185 or 186
188 165 and 187

Exposure + outcome

189 127 and 165

Exposure + outcome + physical examination

190 127 and 188

D. Epidemiologic filters

191 risk\$.mp.

192 rate\$.mp.

193 exp Odds Ratio/ or odds.mp.

194 incidence.mp. or Incidence/

195 prevalence.mp. or Prevalence/

196 ratio\$.mp.

197 exp Epidemiology/ or epidemiology.mp.

198 epidemiolo\$.mp.

199 191 or 192 or 193 or 194 or 195 or 196 or 197 or 198

Exposure + outcome + physical examination + epidemiologic filter

200 190 and 199