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Criteria document for evaluating the work-relatedness of upper-extremity musculoskeletal disorders

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Key terms: carpal tunnel syndrome; case definition; criteria document; cupital tunnel syndrome; De Quervain's disease; definition; elbow; evaluation; flexor-extensor peritendinitis; forearm; forearm-wrist region; guyon canal syndrome; hand; hand-arm vibration; lateral epicondylitis; medial epicondylitis; MSD; musculoskeletal disorder; neck; nonspecific upper-extremity musculoskeletal disorder; osteoarthrosis; peripheral neuropathy; radial nerve compression; radial tunnel syndrome; radiating neck complaint; raynaud's phenomenon; rotator cuff syndrome; shoulder; temporal criterion; tenosynovitis; ulnar nerve compression; upper back; upper extremity; upper-extremity joint; work-related musculoskeletal disorder; work-related upper-extremity musculoskeletal disorder; work-relatedness; wrist

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Appendix B

Glossary of acronyms

ADL	activities of daily living
ADM	abductor digiti minimi
APL	abductor pollicis longus
ARC	Arthritis and Rheumatism Council for Research (in the United Kingdom)
Borg CR10	Borg rating scale between 0 and 10
CCT	carpal compression test
CMC	carpal-metacarpal
CTD	cumulative trauma disorder
CTS	carpal tunnel syndrome
DIP joint	distal interphalangeal joint
ECRB	extensor carpi radialis brevis
EPB	extensor pollicis brevis
FDP	flexor digitorum profundus
FSBP	finger systolic blood pressure
G-H	glenohumeral
HAVS	hand-arm vibration syndrome
ICD	International Classification of Diseases
ISO	International Organization for Standardization
MCP	metacarpophalangeal (ie, of the metacarpus and phalanx)
MCV	maximal voluntary contraction
MRC	Medical Research Council (in the United Kingdom)
MSD	musculoskeletal disorder
NIOSH	National Institute for Occupational Safety and Health (in the United States)
NPV	negative predictive value
OA	osteoarthrosis
OCD	occupational cumulative disorder, occupational cervicobrachial disorder
OCRA	concise exposure index
OOS	occupational overuse syndrome
OR	odds ratio
PE	physical examination
PI	palmar interosseous muscle
PIP joint	proximal interphalangeal joint
PINS	posterior interosseous nerve syndrome
PPRI	postural and repetitive risk factor index
PPV	positive predictive value
PR	prevalence ratio
R-L	right-left
ROM	range of motion
RP	Raynaud's phenomenon
RSI	repetitive strain injury
RTS	radial tunnel syndrome
SNQ	standardized Nordic questionnaire
SSIS	short-segment incremental studies (type of electrodiagnostic study)
STIR	short tau inversion recovery sequence (a magnetic resonance imaging technique)
TNS	tension neck syndrome
UE	upper extremity
UEMSD	upper-extremity musculoskeletal disorder
VDT	video display terminal
VWF	vibration white finger
WRUEMSD	work-related upper-extremity musculoskeletal disorder

Appendix C

Tabular summary of evidence for work factors

In this appendix, the significant evidence per physical or nonphysical work factors is listed per body region. Tables for the neck, shoulder, elbow, and wrist-hand region are listed separately. In addition, tables for distal and proximal upper-extremity muscular disorder(s) (UEMSD) and a table with general upper-extremity risk factors are summarized.

When publications included statistical analyses, only the *work factors found to be significant* have been listed.

Contents of tables

The "outcomes of interest" column lists the symptoms or disorders that were included in the study.

In the "work factor" column, physical factors are identified with a closed circle (•) and nonphysical factors are indicated with a diamond (◆). Whenever possible, the significant outcome measure that was used in the study has been listed after each work factor [odds ratio (OR), prevalence ratio (PR), relative risk (RR), expert group consensus] or the authors' ordinal strength of the evidence reviewed in the publication (eg, + = some evidence or evidence, ++ = strong evidence). Other abbreviations used in the tables can be found in appendix B.

The "reference" column shows at least the first author and year of publication and reference number corresponding to the full citation in the reference list of this document (pages 73—78).

Note! The meaning of the "+" symbols is not comparable *between* studies.

Neck region

Outcomes of interest	Work factor	Reference
Cervical region	Expert group consensus • asymmetric head posture • > 25 degrees' neck flexion • neck extension without full head support • maximum holding time compared with head inclination	ISO 1999, (165)
Cervical diagnoses	◆ age (OR 2.7) ◆ use of spectacles (OR 4)	Bergqvist et al, 1995 (162)
Neck region MSD	• static posture • repetitive work with video display unit ◆ lack of social support	Punnett & Bergqvist, 1997 (14)
Neck MSD	• highly repetitive work (++) • neck movements (frequency and duration) (+++) • forceful exertions of arm-hand (++) • static contractions-load (+++) • extreme work postures (+++)	Bernard, 1997 (12)
Symptoms in neck region	◆ high psychological demands (PR 2.0) ◆ low social support (PR1.8) ◆ job strain (PR2.1)	Toomingas et al, 1997 (179)
Neck pain	• neck flexion • arm force • arm posture • duration of fixed sedentary sitting posture • twisting-bending • hand-arm vibration	Ariëns et al, 2000 (173)
Neck symptoms (Nordic questionnaire)	◆ overtime work ◆ high mental load	Fredriksson et al, 1999 (28)

Neck region (continued)

Outcomes of interest	Work factor	Reference
Neck symptoms (Nordic questionnaire, 12 months' prevalence)	♦ hours/week (OR 7)	Finsen et al, 1998 (176)
Neck symptoms (pain, numbness, tingling, aching, stiffness, burning), frequency and duration asked for case definition according to NIOSH	♦ 30-39 hours spent under deadline (OR 2.8) ♦ perceived lack of ergonomic issues by management (OR 2.3)	Bernard, 1997 (12)
Neck-shoulder MSD	• highly repetitive work (++) • neck movements (frequency-duration) (+++) • static contractions-load (+++) • extreme work postures (+++)	Bernard, 1997 (12)
Severe neck symptoms (Nordic questionnaire)	♦ high work demands (OR 1.82)	Lagerström et al, 1995 (180)
Neck-shoulder symptoms	Women ♦ monotonous work ♦ high decision latitude	Barnekow-Bergqvist et al, 1998 (204)
Neck-shoulders	• static contractions • highly repetitive work • forceful work • extreme postures	Devereux, 1997 (178)
Neck-shoulder symptoms	♦ night shift ♦ psychological demands	Holness et al, 1998 (177)
Neck disorders (cervical syndrome and tension neck syndrome) (Waris criteria)	• high repetitive precision movements (OR 16) • medium-high lifting (OR 50) ♦ medium-rushed workpace (OR 8, 11) ♦ high work role ambiguity (OR 23) ♦ low work content (OR 11)	Ekberg et al, 1994 (181)
Tension neck syndrome	• static posture (++) • repetitive movement of neck (+) • exertion of force by hands and arms (+) • combination of above plus tension or stress (+)	Sluiter et al, 1998 (29)
Tension neck syndrome	♦ low social support (PR 2.7)	Toomingas et al, 1997 (179)
Tension neck syndrome	♦ limited rest break opportunity (OR 7.4) ♦ too highly placed keyboard (OR 4.4)	Bergqvist et al, 1995 (162)
Tension neck syndrome	• vibration (OR 3.8)	Bovenzi, 1998 (128)

Shoulder region

Outtcomes of interest	Work factor	Reference
Laboratory study on shoulder movements, generalizable to rotator cuff work factors in industrial work (all movements with straight elbows)	Factors for prolonged static or repetitive working posture • > 30 degrees' arm elevation without load causes accumulated fatigue in infra- or supraspinatus muscles • > 15 degrees elevation with 1-kg load causes accumulated fatigue in infra- or supraspinatus muscles • >50 degrees elevation without load causes impaired muscle blood flow in infra- or supraspinatus muscles • > 35 degrees elevation with 1-kg load causes impaired muscle blood flow in infra- or supraspinatus muscles	Palmerud et al, 2000 (182)

Shoulder region (continued)

Outtcomes of interest	Work factor	Reference
Shoulder region	Expert group consensus • > 60 degrees' upper arm elevation • awkward upper-arm postures (retroflexion, adduction, extreme external rotation) • maximal holding times compared with elevation upper arm	ISO, 1999 (165)
Shoulder posture compared with shoulder load during work (electromyography)	• posture: shoulder abduction of 40 degrees gave 4.4 times higher shoulder moment than abduction of < 30 degrees	Finsen & Christensen, 1998 (175)
Shoulder contraction pain	♦ low social support (PR 6.2) ♦ job strain (PR 4.1)	Toomingas et al, 1997 (179)
Shoulder pain	• prolonged exposure arms elevated (RR 1.4)	Sobti et al, 1997 (186)
Shoulder symptoms (Nordic quesionnaire)	• blue-collar work • night or shift work • overtime work ♦ high mental load	Fredriksson et al, 1999 (28)
Shoulder symptoms (Nordic questionniare; 12 months' prevalence)	♦ duration of breaks/day (OR 1.02)	Finsen et al, 1998 (176)
Severe shoulder symptoms (Nordic questionnaire)	♦ high demands (OR 1.65)	Lagerström et al, 1995 (180)
Shoulder girdle pain	• repetitive work • sustained shoulder postures of >60 degrees • combination of holding tool and working overhead	Devereux, 1997 (178)
Shoulder MSD	• static posture • repetitive work video display unit ♦ lack social support	Punnett & Bergqvist, 1997 (14)
Shoulder WRUEMSD	• duration forearm twisting ♦ low decision latitude	Hughes et al, 1997 (184)
Shoulder MSD Shoulder tendinitis	• highly repetitive work (MSD) (+) • repeated or static postures of >60 degrees (+) (tendinitis and nonspecific complaints) ♦ tendency for stress or worry	Bernard, 1997 (12)
Shoulder MSD	• prolonged exposure, elevated arms • static muscle force	Lindbeck et al, 1997 (185)
Any shoulder diagnosis	♦ limited rest break opportunity (OR 3.3) ♦ low task flexibility (OR3.2)	Bergqvist et al, 1995 (162)
Rotator cuff	• repetition • posture • combination of force, repetition, posture, vibration	Viikari-Juntura, 1998 (183)
Rotator cuff syndrome	• posture arm compared with trunk (+) • repetitive movement neck (+) • exertion force (0)	Sluiter et al, 1998 (29)
Rotator cuff tenderness	♦ low social support (PR 3.2)	Toomingas et al, 1997 (179)
Shoulder: humeral tendinitis (Waris et al criteria)	• high repetitive precision movements (OR 16) • medium or high lifting (OR 50) ♦ medium or rushed workpace (OR 8, 11) ♦ high workrole ambiguity (OR 23) ♦ low work content (OR 11)	Ekberg et al, 1994 (181)

Elbow region

Outcomes of interest	Work factor	Reference
Elbow and forearm	Expert group consensus • extreme elbow flexion or extension • extreme forearm pronation or supination	ISO, 1999 (165)
Elbow-forearm WRUEMSD	• duration (in years) of forearm twisting	Hughes et al, 1997 (184)
Elbow	• repetitive and forceful movement	Devereux, 1997 (178)
Arm-elbow MSD	• static posture • repetitive work with video display unit ♦ lack of social support	Punnett & Bergqvist, 1997 (14)
Lateral epicondylitis	• force • combination of force, repetition, posture, vibration	Viikari-Juntura, 1998 (183)
Lateral epicondylitis	• movement (0) • force forearm muscles (+) • combination force in wrist and repetitive movements of wrist or elbow (+)	Sluiter et al, 1998 (29)
Epicondylitis	• forceful work (+) • combination repetition-force (+++) ♦ duration of employment	Bernard, 1997 (12)
Cubital tunnel syndrome	• prolonged elbow flexion with repetitive movements fingers (+)	Sluiter et al, 1998 (29)
Frohse' arc local tenderness	♦ low social support (PR 3.1) ♦ job strain (PR 2.2)	Toomingas et al, 1997 (179)
Elbow osteoarthrosis	• using tongs for lifting and twisting hot metal rods • vibration	Felson, 1994 (151)

Wrist-hand region

Outcomes of interest	Work factor	Reference
Hand	Expert group consensus • extreme wrist posture (flexion-extension and radial-ulnar abduction)	ISO, 1999 (165)
Hand complaints (Nordic questionnaire)	• duration >30 minutes of continuously pipetting or number of hours/year • awkward wrist postures • fixed posture	David & Buckle, 1997 (188)
Severe hand symptoms (with Nordic questionnaire)	♦ type of ward (geriatric or medical versus other) (OR 2.84)	Lagerström et al, 1995 (180)
Hand-wrist symptoms (with Nordic questionnaire)	• high physical loads • physical demands	Fredriksson et al, 1999 (28)
Hand-wrist complaints	• repetitive and forceful movement or high force and posture • highly repetitive work • vibration	Devereux, 1997 (178)
Hand-wrist MSD	• static posture • repetitive work with visual display unit ♦ lack of social support	Punnett & Bergqvist, 1997 (14)
Hand-wrist WRUEMSD	• duration (in years) of forearm twisting	Hughes et al, 1997 (184)
Nordic symptoms in wrist-hand (now and during past 12 months)	♦ low social support (PR 1.8)	Toomingas et al, 1997 (179)
Hand or wrist symptoms (pain, numbness, tingling, aching, stiffness, burning), frequency and duration asked for, case definition according to NIOSH	♦ 6-8 hours' typing/day (OR 4.4)	Bernard, 1997 (12)

Wrist-hand region (continued)

Outcomes of interest	Work factor	Reference
Nonspecific wrist MSD	• force (+++) • repetitiveness (+) • angles radial-ulnar deviation (++) • velocity (+)	Malchaire et al, 1996 (197)
Arm-hand discomforts (Nordic questionnaire: 12-months' prevalence)	• nonneutral hand position (OR 2.2) ♦ extensive overtime (OR 2.2)	Bergqvist et al, 1995 (162)
Visual analogue scale for assessing repetition in hand tasks	• duration-frequency of pauses • speed of movements	Latko et al, 1997 (195)
Carpal tunnel syndrome	• repetitive movements of hands-fingers (+) • force (+) • duration of exposure (+) • combination repetitive movements and force (++) • vibration (+)	Sluiter et al, 1998 (29)
Carpal tunnel syndrome	• forceful repetitive work • extreme wrist postures • vibration	Viikari-Juntura & Silverstein, 1999 (189)
Carpal tunnel syndrome	• force • repetition • combination of force, repetition, posture, vibration	Viikari-Juntura, 1998 (183)
Carpal tunnel syndrome	• highly repetitive work (+) • force (+) • vibration (+) • combination repetition and force (+++) • force-posture (+++)	Bernard, 1997 (12)
Quervain's disease	• ulnar deviation wrist (++) • repetitive movements (++) • force involving squeezing-grasping (++)	Sluiter et al, 1998 (29)
Tenosynovitis or peritendinitis of wrist and forearm	• force • repetition • combination of force, repetition, posture, vibration	Viikari-Juntura, 1998 (183)
Tendinitis wrist	• repetition (+) • force (+) • posture (+) • combination repetition-force (+++)	Bernard, 1997 (12)
Finger osteoarthrosis	• repetitive work hands	Elsner et al, 1995 (198)
MCP osteoarthrosis DIP and PIP osteoarthrosis	• vibration • repeated finger-hand movements: precision, pincer, and power grip	Felson, 1994 (151)
Rhiz-arthrosis saddle joint of the thumb	• typing • repeated precision grips	Elsner et al, 1995 (198)

Distal UEMSD

Outcomes of interest	Work factor	Reference
UEMSD	Expert group consensus • force (>20% of the maximal voluntary contraction) • high repetitive movements (cycles <30 seconds or >50% of cycle time at same action) • extreme static postures • static force ♦ work-rest ratio (<5:1)	Colombini et al, 1999 (166)

Distal UEMSD (continued)

Outcomes of interest	Work factor	Reference
WMSD: caution zones	• awkward postures for >2 hours/workday • high hand force for >2 hours/workday • high repetitive motions for >2 hours/workday • high to moderate vibration for more than 30 minutes — 2 hours/workday	Silverstein, 1999 (172)
Strain index scores	• intensity of exertion • duration of exertion • efforts/minute • hand-wrist posture (speed of work) (duration/day)	Moore & Garg, 1995 (205)
Grip strength in manual workers (dynamometer)	• decrease in grip strength after 5 weeks (adaptation process), return to baseline after 3 months and increase in grip strength at 12 months	Worrell et al, 1998 (191)
Forearm-hand symptoms in last week	• precision movements hand-fingers • repetitive movements hand-fingers • >4 hours/day	Fransson-Hall et al, 1995 (206)
Hand-arm symptoms: cases = 1—3 days in previous 4 weeks: – numbness in hand-wrist – pain in hand-wrist – night waking from pain in hand – arm pain or numbness	• >6 hours of work with video display terminal/day (OR 1.8) ♦ overall satisfaction (OR 0.49)	Nelson & Silverstein, 1998 (190)
Hand arm vibration	• intensity and duration of exposure to vibrating tools (+++)	Bernard, 1997 (12)
Carpal tunnel syndrome, carpal instability, tendinitis (but analysis for number of symptoms)	• twisting and pushing wrist motions (for carpal tunnel syndrome and carpal instability) • posture (for symptoms) • frequency and duration of scans (for symptoms)	Schoenfeld et al, 1999 (207)

Proximal UEMSD

Outcomes of interest	Work factor	Reference
UEMSD	Expert group consensus • force (>20% of maximal voluntary capacity) • high repetitive movements (cycles <30 seconds or >50% of cycle time at same action) • extreme static postures • static force ♦ work:rest ratio (< 5:1)	Colombini et al, 1999 (166)
WMSD	• awkward postures for >2 hours/workday • high hand force for >2 hours/workday • high repetitive motions for >2 hours/workday	Silverstein, 1999 (172)
Tension neck syndrome	♦ low social support (PR 2.7)	Toomingas et al, 1997 (179)
Neck and shoulder complaints (Nordic questionnaire, 6 months' prevalence)	♦ low work content (low variation and stimulation, low decision authority, low development possible) (OR 1.3)	Ekberg et al, 1995 (208)
Neck and shoulder pain, ache or discomfort in last 12 months	• lifting heavy loads (RR 1.83, 1.54) • twisted postures (RR 1.69, 1.55) • hands above shoulder (RR 1.38, 1.52) • deep forward flexed trunk (RR 1.68, 1.58) • monotonous movements (RR 1.73, 1.47) ♦ stimulus from work (RR 1.52, 1.33) ♦ psychological workload (RR 1.83, 1.54)	Johansson & Rubenowitz, 1994 (209)
Neck and shoulder complaints (symptoms at least once per month)	♦ high decision latitude (OR 3.80) ♦ monotonous work (OR 5.88)	Barnekow-Bergkvist et al, 1998 (174)

Proximal UEMSD (continued)

Outcomes of interest	Work factor	Reference
Disorders in neck (pain, aching, stiffness in the neck and shoulder) (Nordic questionnaire 12 months' prevalence)	Women ♦ overtime work (PR 2.7) (shoulder) Men • blue-collar work (PR 3.6) (shoulder)	Fredriksson et al, 1999 (28)
Neck or shoulder pain	♦ monotonous work ♦ time pressure ♦ poor work content ♦ combined demand-control variable¨ ♦ high perceived work stress ♦ worry-tension, anxiety, nervousness	Bongers et al, 1993 (210)

General UEMSD

Outcomes of interest	Work factor	Reference
Postural and repetitive risk-factor index (PPRI)	• >4 hours' keying per day • >15 degrees' neck flexion • >30 degrees' shoulder forward flexion • >90 degrees' elbow flexion • >20 degrees' wrist flexion-extension • >20 degrees' ulnar-radial deviation	James et al, 1997 (211)
General WMSD	♦ intensified workload ♦ low job control ♦ low social support ♦ low job clarity	Devereaux, 1997 (178)
Model for biomechanical overload	Frequency-repetitiveness of task • cycles <30 seconds or • >50% cycle time on same action • force in repetitive fashion (Borg CR10) • > 60 degrees shoulder movements • shoulder extension • frequency >2/minute • identical repeated body movements for >50% of cycle time • joint movements that >50% of maximum range • posture at risk if no variations of posture present ♦ work:rest ratio 5:1 at minimum	Colombini et al, 1998 (212)
NIOSH WRUEMSD sign interpreters	• wrist deviation from neutral (ulnar deviation, extension) • rapid hand movements (270/minute) • jerky-forceful movement • hitting hands with force ♦ pauses ♦ job pressure ♦ continue working with pain ♦ number of years worked	Feuerstein et al, 1997 (194)
Activity of upper-extremity muscles (electromyography) during meat cutting tasks	• posture (height and distance of handle) • slice grip worse than stable grip	Grant & Habes, 1997 (213)
Blood flow (microcirculation) during static load in trapezius in patients with cervicobrachial syndrome	• impaired microcirculation trapezius in chronic neck pain of patients during static load	Larsson, et al, 1998 (214)
Peripheral sensorineural disorders, wrist osteoarthrosis, elbow osteoarthrosis, vibration white finger	• vibrating tools	Bovenzi, 1998 (128)
Shoulder muscle loads in painting ceilings	• high load levels in individual muscles (up to 45% of maximal muscle force) infra-and supraspinatus muscles and upper part of trapezius	Lindbeck et al, 1997 (185)
Upper-extremity symptoms	♦ night shift ♦ psychological demands	Holness et al, 1998 (177)

Appendix D

Coding of the International Classification of Diseases for disorders in this document

International Classification of Diseases, 10th revision (ICD-10) codes for upper-extremity musculoskeletal disorders by body region

Disorders by body region			ICD-10 code[a]
Neck	1	Radiating neck pain (cervicobrachial syndrome)	M53.1
	12	Nonspecific neck pain (cervicalgia)	M54.2
Shoulder	2	Rotator cuff syndrome	M75.1, 75.2
	12	Nonspecific shoulder pain (soft-tissue disorder, unspecified)	M75.2 [1]– 75.9 [1]
Elbow	3	Lateral epicondylitis	M77.1
	3	Medial epicondylitis	M77.0
	4	Cubital tunnel syndrome (mononeuropathy: ulnar nerve)	G56.2 [2]
	5	Radial tunnel syndrome (mononeuropathy: radial nerve)	G56.3 [2]
	10	Osteoarthrosis: elbow (arthrosis, unspecified)	M 19.9 [2]
	12	Nonspecific elbow pain	M 79.9 [2]
Forearm, wrist, hand	6	Extensor-flexor tendinitis (chronic crepitant synovitis hand-wrist / soft tissue disorders related to use, overuse, and pressure)	M70.0 / M 70.8
	7	De Quervain's disease	M65.4
	8	Carpal tunnel syndrome	G56.0
	9	Guyon canal syndrome (mononeuropathy: ulnar nerve)	G56.2 [4]
	10	Osteoarthrosis: fingers	M15.1 – M 15.2
		CMC I	M 18.9
		wrist	M 19.9 [3]
	12	Nonspecific forearm, wrist or hand pain (soft-tissue disorder, unspecified)	M 79.9 [3] or [4]

[a] The ICD-10 provides the following subclassification to indicate the site of involvement, for optional use with diseases of the musculoskeletal system and connective tissue. If used, they should be placed in an identifiably separate position (eg, in an additional box):

0	multiple sites		
1	shoulder region	clavicle scaplula	acromioclavicular glenohumeral sternoclavicular joints
2	upper arm	humerus	elbow joint
3	forearm	radius ulna	wrist joint
4	hand	carpus fingers metacarpus	joints between these bones

Appendix E

Quick scan to decide what case definitions have to be checked

Disorder to check	Body regions				
	Neck region	Shoulder- upper arm region	Elbow region	Forearm region	Wrist-hand region
Specific UEMSD[a]					
Carpal tunnel syndrome					X (ventral)
Guyon's canal syndrome					X (ulnar)
Quervain's disease				X (radial)	X (radial)
Raynaud's phenomenon and peripheral neuropathy					X
Flexor-extensor peritendinitis or tenosynovitis of forearm-wrist				X	X
Radial tunnel syndrome			X (dorsal)	X (dorsal)	
Lateral-medial epicondylitis			X		
Cubital tunnel syndrome			X (ulnar)	X (ulnar)	X (ulnar)
Rotator cuff syndrome		X			
Radiating neck complaints	X				
Nonspecific UEMSD[a]	X	X	X	X	X

[a] UEMSD = upper-extremity musculoskeletal disorder