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Risk factors for upper-extremity musculoskeletal disorders in the working population.

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Table 1. Potential risk factors for UEMSDs considered in the study and univariate analyses

		Altogether (n = 3,710)					Men (n = 2,162)			Women (n = 1,548)		
		N _{sample}	n _{UMSD}	OR	[95%CI]	p ^γ	OR	[95%CI]	p ^γ	OR	[95%CI]	p ^γ
PERSONAL FACTORS												
1. Personal factors and medical history												
Age	< 30 (ref)	875	39	1			1			1		
	30-34;	572	44	1.8	[1.1 - 2.8]		1.8	[1.0 - 3.3]		1.7	[0.9 - 3.4]	
	35-39;	508	61	2.9	[1.9 - 4.4]		2.5	[1.4 - 4.4]		3.6	[1.9 - 6.6]	
	40-44;	561	73	3.2	[2.1 - 4.8]	<0.001	2.9	[1.7 - 5.1]	<0.001	3.5	[1.9 - 6.4]	<0.001
	45-49;	538	109	5.4	[3.7 - 8.0]		4.9	[2.9 - 8.2]		6.4	[3.4 - 10.8]	
	50-54;	451	103	6.3	[4.3 - 9.4]		5.5	[3.2 - 9.2]		7.6	[4.3 - 13.7]	
	55 yrs	198	42	5.8	[3.6 - 9.2]		5.1	[2.7 - 9.6]		6.7	[3.4 - 13.5]	
Gender	Female vs male	1,548	229	1.4	[1.1-1.7]	0.001						
Body mass index (Kg/m ²)	Normal (BMI=18.5-24.9)	2,157	230	1			1			1		
	Underweight (BMI<18.5)	124	8	0.6	[0.3 - 1.2]	<0.001	-	-	<0.001	0.7	[0.3 - 1.4]	0.006
	Overweight (BMI=25-29.9)	1,078	160	1.5	[1.2 - 1.8]		1.6	[1.2 - 2.1]		1.6	[1.1 - 2.2]	
	Obesity (BMI≥30)	300	59	2.1	[1.5 - 2.8]		2.5	[1.7 - 3.9]		1.7	[1.0 - 2.7]	
Prior history of at least one of the UEMSDs	yes vs no	713	226	5.3	[4.3 - 6.5]	<0.001	4.3	[3.2 - 5.8]	<0.001	6.4	[4.7 - 8.6]	<0.001
Diabetes mellitus	yes vs no	61	17	2.7	[1.5 - 4.8]	<0.001	2.0	[0.9 - 4.4]	0.083	4.5	[1.9 - 10.8]	<0.001
Thyroid disorders	yes vs no	135	24	1.5	[1.0 - 2.4]	0.073	0.8	[0.2 - 2.6]	0.693	1.6	[0.9 - 2.6]	0.086
Upper limb inflammatory arthritis	yes vs no	78	20	2.4	[1.5 - 4.1]	<0.001	1.7	[0.8 - 4.0]	0.187	3.0	[1.5 - 6.0]	0.001
OCCUPATIONAL FACTORS												
2. Current occupational category and length of service												
Current occupational category	Managers, professionals, technicians (ref)	1,133	116	1			1			1		
	Low-grade white-collar	986	114	1.1	[0.9 - 1.5]	<0.001	0.9	[0.5 - 1.7]	0.026	1.0	[0.7 - 1.4]	<0.001
	Skilled blue-collar	943	135	1.5	[1.1 - 1.9]		1.5	[1.1 - 2.1]		1.9	[1.1 - 3.3]	
	Unskilled blue-collar	643	107	1.8	[1.3 - 2.3]		1.4	[1.0 - 2.1]		2.0	[1.3 - 3.0]	
Length of service in the current job (year)	<1(ref)	455	36	1			1			1		
	1-2	591	48	1.0	[0.7 - 1.6]	<0.001	1.7	[0.9 - 3.2]	<0.001	0.6	[0.3 - 1.2]	<0.001
	3-10	1,238	127	1.3	[0.9 - 2.0]		1.9	[1.0 - 3.4]		1.0	[0.6 - 1.7]	
	> 10	1,389	257	2.6	[1.8 - 3.8]		3.6	[2.0 - 6.3]		2.0	[1.3 - 3.3]	
3. Factors related to the work organization												
Paced work	yes vs no	383	59	1.3	[1.0 - 1.8]	0.078	1.3	[0.8 - 1.9]	0.242	1.4	[0.9 - 2.1]	0.147
Work pace dependent on automatic rate	yes vs no	400	70	1.5	[1.2 - 2.0]	0.002	1.5	[1.0 - 2.1]	0.043	1.8	[1.2 - 2.7]	0.009
Work pace dependent on other technical organization	yes vs no	742	100	1.1	[0.9 - 1.4]	0.405	1.1	[0.8 - 1.5]	0.511	1.4	[0.9 - 2.1]	0.113
Work pace dependent on customers' demand	yes vs no	1,643	184	0.8	[0.7 - 1.0]	0.025	0.9	[0.7 - 1.1]	0.299	0.7	[0.5 - 0.9]	0.021
Work pace dependent on the colleagues' work	yes vs no	1,109	146	1.1	[0.9 - 1.4]	0.399	1.4	[1.1 - 1.8]	0.022	0.9	[0.6 - 1.2]	0.353
Work pace dependent on quantified targets	yes vs no	1,729	241	1.2	[1.0 - 1.5]	0.030	1.1	[0.8 - 1.4]	0.506	1.6	[1.2 - 2.1]	0.002
Job/task rotation (≥ 1 job rotation per week)	yes vs no	1,350	199	1.3	[1.1 - 1.6]	0.004	1.4	[1.1 - 1.9]	0.013	1.3	[1.0 - 1.7]	0.086
Work with temporary workers	yes vs no	1,106	165	1.3	[1.1 - 1.6]	0.010	1.3	[1.0 - 1.7]	0.105	1.4	[1.0 - 1.8]	0.042
High visual demand	yes vs no	2,380	331	1.4	[1.1 - 1.7]	0.005	1.2	[0.9 - 1.6]	0.201	1.5	[1.1 - 2.1]	0.008
Overtime hours	yes vs no	2,186	260	0.8	[0.7 - 1.0]	0.055	0.9	[0.7 - 1.2]	0.647	0.8	[0.6 - 1.0]	0.075
Prior knowledge of the workload	yes vs no	366	43	0.9	[0.6 - 1.3]	0.546	1.2	[0.8 - 1.7]	0.469	0.6	[0.3 - 1.2]	0.140
4. Working postures and biomechanical constraints												
High repetitiveness (≥ 4 h per day) [#]	yes vs no	958	183	2.0	[1.6 - 2.5]	<0.001	1.8	[1.4 - 2.5]	<0.001	2.1	[1.6 - 2.8]	<0.001
Too little recovery time (< 10-min. break possible) [#]	yes vs no	205	50	2.4	[1.7 - 3.3]	<0.001	1.9	[1.1 - 3.3]	0.020	2.5	[1.6 - 3.9]	<0.001
High physical demand (RPE Borg scale ≥13)	yes vs no	1,856	309	2.1	[1.7 - 2.6]	<0.001	2.5	[1.8 - 3.3]	<0.001	1.9	[1.5 - 2.6]	<0.001
Arms at or above shoulder level (≥ 2 h/day) [#]	yes vs no	487	104	2.1	[1.7 - 2.7]	<0.001	2.6	[1.9 - 3.6]	<0.001	1.6	[1.1 - 2.4]	0.013
Arms abducted (≥ 2 h/day) [#]	yes vs no	572	108	1.8	[1.4 - 2.2]	<0.001	1.8	[1.3 - 2.4]	<0.001	1.9	[1.3 - 2.7]	<0.001
Holding the hand behind the trunk (≥ 2 h/day)	yes vs no	187	29	1.3	[0.8 - 1.9]	0.242	1.6	[0.9 - 2.7]	0.084	1.0	[0.5 - 1.8]	0.902
Full elbow flexion/extension movements (≥ 2 h/day) [#]	yes vs no	1,214	221	2.0	[1.6 - 2.4]	<0.001	2.4	[1.8 - 3.1]	<0.001	1.7	[1.2 - 2.2]	<0.001
Working with full pronosupination movements (≥ 2 h/day) [#]	yes vs no	534	86	1.4	[1.1 - 1.8]	0.011	1.4	[1.0 - 1.9]	0.027	2.1	[1.3 - 3.4]	0.004
Wrist bending in extreme postures (≥ 2 h/day) [#]	yes vs no	1,236	222	2.0	[1.6 - 2.4]	<0.001	1.8	[1.4 - 2.4]	<0.001	2.2	[1.6 - 2.9]	<0.001
Use of handtools (≥ 2 h/day)	yes vs no	1,711	251	1.4	[1.2 - 1.7]	<0.001	1.3	[1.0 - 1.7]	0.074	1.8	[1.4 - 2.4]	<0.001
Holding tools or objects in a pinch grip (≥ 4 h/day) [#]	yes vs no	297	66	2.1	[1.6 - 2.8]	<0.001	2.1	[1.4 - 3.1]	<0.001	2.1	[1.4 - 3.2]	<0.001
Precise finger movements (≥ 2 h/day)	yes vs no	1,665	263	1.6	[1.4 - 2.0]	<0.001	1.5	[1.1 - 1.9]	0.004	1.9	[1.4 - 2.5]	<0.001
Pressing with the base of the palm (≥ 2 h/day) [#]	yes vs no	294	59	1.8	[1.4 - 2.5]	<0.001	1.9	[1.3 - 2.7]	<0.001	2.4	[1.3 - 4.4]	0.004
Use of vibrating handtools (≥ 2 h/day) [#]	yes vs no	469	73	1.3	[1.0 - 1.7]	0.046	1.3	[1.0 - 1.8]	0.098	2.5	[1.4 - 4.4]	0.002
Exposure to cold temperature (≥ 4 h/day) [#]	yes vs no	220	34	1.3	[0.9 - 1.9]	0.205	1.2	[0.7 - 1.9]	0.529	1.6	[0.9 - 2.8]	0.127
Keying and computer work (≥ 4 h/day) [#]	yes vs no	1,024	96	0.6	[0.5 - 0.8]	<0.001	0.6	[0.4 - 0.9]	0.022	0.5	[0.4 - 0.7]	<0.001
Wearing gloves (≥ 4 h/day)	yes vs no	584	95	1.4	[1.1 - 1.8]	0.005	1.3	[1.0 - 1.8]	0.089	1.7	[1.2 - 2.5]	0.006
5. Psychosocial factors at work												
High psychological demand (score ≥ 22) [#]	yes vs no	1,814	250	1.2	[1.0 - 1.5]	0.050	1.4	[1.1 - 1.9]	0.009	1.0	[0.8 - 1.3]	0.968
Low skill discretion (score ≤ 34)	yes vs no	2,016	297	1.5	[1.2 - 1.8]	<0.001	1.4	[1.1 - 1.8]	0.013	1.5	[1.1 - 2.1]	0.006
Low decision authority (score ≤ 32) [#]	yes vs no	1,276	185	1.3	[1.1 - 1.6]	0.014	0.9	[0.7 - 1.3]	0.711	1.6	[1.2 - 2.2]	<0.001
Low supervisor support (score ≤ 11)	yes vs no	1,427	216	1.4	[1.2 - 1.8]	<0.001	1.4	[1.1 - 1.9]	0.009	1.5	[1.1 - 2.0]	0.007
Low coworker support (score ≤ 11)	yes vs no	708	111	1.4	[1.1 - 1.7]	0.007	1.4	[1.0 - 1.9]	0.039	1.3	[1.0 - 1.9]	0.088

See references ^(10,13) for details; ^γIn bold, p-value<0.20. [#] Risk factors taken into account by the European consensus.

Table 2. Characteristics of workers participating in the French Pays de la Loire study

	MEN		WOMEN		ALTOGETHER	
	N	(%)	N	(%)	N	(%)
Study population	2,162	(58.3)	1,548	(41.7)	3,710	(100)
Age (years) (n = 3,703)						
. < 30	514	(23.8)	361	(23.3)	875	(23.6)
. 30-35	344	(16.0)	228	(14.8)	572	(15.5)
. 35-39	307	(14.2)	201	(13.0)	508	(13.7)
. 40-44	311	(14.4)	250	(16.2)	561	(15.2)
. 45-49	301	(14.0)	237	(15.3)	538	(14.5)
. 50-54	265	(12.3)	186	(12.0)	451	(12.2)
. ≥ 55	114	(5.3)	84	(5.4)	198	(5.3)
Economic sector (n = 3,701)						
. Agriculture	31	(1.4)	25	(1.6)	56	(1.5)
. Industry	859	(39.8)	401	(26.0)	1,260	(34.0)
. Construction	189	(8.8)	25	(1.6)	214	(5.8)
. Services	1,078	(50.0)	1,093	(70.8)	2,171	(58.7)
Occupation (n = 3,705)						
. Farmers (1)	0	(0.0)	0	(0.0)	0	(0.0)
. Craftsmen (1)	13	(0.6)	3	(0.2)	16	(0.4)
. Managers and professionals	210	(9.7)	78	(5.0)	288	(7.8)
. Associate professionals and technicians	540	(25.0)	289	(18.7)	829	(22.4)
. Low-grade white-collar workers	188	(8.7)	798	(51.7)	986	(26.6)
. Skilled and unskilled blue-collar workers	1,209	(56.0)	377	(24.4)	1,586	(42.8)

(1) Farmers and most craftsmen are not surveyed by the occupational physicians in France.

Table 3. Prevalence rates of clinically-diagnosed UE-MSDs of the upper extremities

	MEN			WOMEN			ALTOGETHER		
	N	%	95% CI	N	%	95% CI	N	%	95% CI
Rotator cuff syndrome	142	6.6	[5.5 - 7.6]	132	8.5	[7.1 - 9.9]	274	7.4	[6.5 - 8.2]
Lateral epicondylitis	51	2.5	[1.8 - 3.1]	39	2.7	[1.9 - 3.5]	90	2.6	[2.0 - 3.1]
Ulnar tunnel syndrome	16	0.7	[0.4 - 1.1]	14	0.9	[0.4 - 1.4]	30	0.8	[0.5 - 1.1]
Carpal tunnel syndrome	51	2.4	[1.7 - 3.0]	62	4.0	[3.0 - 5.0]	113	3.1	[2.5 - 3.6]
Wrist tendinitis	19	0.9	[0.5 - 1.3]	10	0.7	[0.3 - 1.1]	29	0.8	[0.5 - 1.1]
De Quervain's Disease	13	0.6	[0.3 - 0.9]	32	2.1	[1.4 - 2.8]	45	1.2	[0.9 - 1.6]
At least one UEMSD	243	11.2	[9.9 - 12.6]	229	14.8	[13.0 - 16.6]	472	12.7	[11.7 - 13.8]
At least two UEMSDs	42	1.9	[1.4 - 2.5]	44	2.8	[2.0 - 3.7]	86	2.3	[1.8 - 2.8]

Table 4. Multivariate models for risk factors of UE-MSDs in the male and female working populations

	Men (n = 2,058)					Women (n = 1,481)				
	N _{sample} *	n _{MSD} *	OR	[95%CI]	p	N _{sample} *	n _{MSD} *	OR	[95%CI]	p
PERSONAL FACTORS										
Age (years)					<0.001					<0.001
< 30	499	22	1			349	17	1		
30-34	333	26	1.8	[1.0 - 3.3]		221	18	1.8	[0.9 - 3.6]	
35-39	291	28	2.4	[1.3 - 4.4]		189	26	2.8	[1.4 - 5.5]	
40-44	296	32	2.4	[1.3 - 4.4]		242	37	3.0	[1.6 - 5.7]	
45-49	284	50	4.5	[2.6 - 7.9]		224	51	4.5	[2.4 - 8.2]	
50-54	250	49	4.9	[2.7 - 8.6]		177	48	5.0	[2.7 - 9.3]	
≥ 55	105	20	4.0	[2.0 - 8.1]		79	20	4.4	[2.1 - 9.4]	
Prior history of UE-MSDs	357	93	3.1	[2.3 - 4.2]	<0.001	321	120	5.0	[3.6 - 7.0]	<0.001
BMI (Kg/m²)					0.014					
Normal (BMI = 18.5 – 24.9)	1,130	98	1							
Underweight (BMI <18.5)	33	0	-	-						
Overweight (BMI = 25 – 29.9)	731	97	1.2	[0.9 - 1.7]						
Obesity (BMI ≥ 30)	164	32	2.2	[1.4 - 3.6]						
Diabetes mellitus						20	9	4.9	[1.8 - 12.9]	0.001
OCCUPATIONAL FACTORS										
High physical demand (RPE-Borg scale ≥ 13)	1,106	166	2.0	[1.4 - 2.8]	<0.001					
High repetitiveness	446	74	1.5	[1.0 - 2.1]	0.027					
Arms at or above shoulder level	283	61	1.7	[1.1 - 2.4]	0.009					
Full elbow flexion/extension movements	690	115	1.6	[1.1 - 2.2]	0.006					
Wrist bending in extreme postures						466	104	2.0	[1.4 - 2.8]	<0.001
Use of vibrating handtools						61	17	2.2	[1.1 - 4.2]	0.025
High psychological demand	1,006	129	1.5	[1.1 - 2.1]	0.005					
Low level of decision authority						600	112	1.4	[1.0 - 1.9]	0.042

Note. (*) Subjects with no missing value for the risk factors in the multivariate model; Number of subjects excluded from analyses because of missing values: 129 men and 112 women; OR, odds ratio; CI, confidence interval; Variables excluded from the model for men (in order of exclusion): current occupational category, work with temporary workers, work pace dependent on the colleagues' work, frequent job/task rotation, low level of skill discretion, low supervisor support; Variables excluded from the model for women: work pace dependent on demand of customers, arms abducted, high visual demand, frequent job/task rotation, current occupational category, work pace dependent on quantified targets, work with temporary workers, length of service in the current job, keying and computer work, low supervisor support, knowledge of the workload, high repetitiveness; Hosmer Lemeshow goodness-of-fit test: $P = 0.016$ for the model for men and $P = 0.319$ for the model for women; area under ROC curve = 0.78 (men) and 0.78 (women).

Table 5. Multivariate model for risk factors of UE-MSDs in the total working population

	Men and women altogether				
	(n = 3,275)				
	N _{sample} *	n _{MSD} *	OR	[95% CI]	p
PERSONAL FACTORS					
Age (years)					<0.001
< 30	792	36	1		
30-34	520	41	1.8	[1.1 - 3.0]	
35-39	439	47	2.6	[1.6 - 4.2]	
40-44	496	63	2.9	[1.9 - 4.5]	
45-49	459	92	4.9	[3.2 - 7.5]	
50-54	401	92	5.6	[3.6 - 8.6]	
≥ 55	168	36	4.5	[2.6 - 7.7]	
Prior history of MSDs	621	188	3.3	[2.6 - 4.2]	<0.001
BMI (Kg/m²)					0.056
Normal (BMI = [18.5 - 25])	1,926	205	1		
Underweight (BMI <18.5)	109	7	0.9	[0.4 - 2.0]	
Overweight (BMI = [25 - 30])	975	143	1.2	[0.9 - 1.5]	
Obesity (BMI ≥ 30)	265	52	1.6	[1.1 - 2.4]	
OCCUPATIONAL FACTORS					
High repetitiveness	858	165	1.6	[1.2 - 2.0]	<0.001
Arms at or above shoulder level	430	93	1.5	[1.1 - 2.0]	0.016
Wrist bending in extreme postures	1,107	198	1.5	[1.2 - 2.0]	0.002
Pressing with the base of the palm	260	52	1.5	[1.0 - 2.1]	0.058 ^δ
Frequent job rotation	1,265	180	1.2	[1.0 - 1.5]	0.079 ^δ
Low supervisor support	1,312	198	1.3	[1.1 - 1.7]	0.015
Interaction terms : Gender x Physical demand					0.037 [#]
Women vs men in low physical demand			1.9	[1.3 - 2.8]	
Women vs men in high physical demand			1.2	[0.9 - 1.6]	
High vs low physical demand in males			1.8	[1.3 - 2.6]	
High vs low physical demand in females			1.1	[0.8 - 1.6]	

Note. (*), subjects with no missing value for the risk factors in the multivariate model; Number of subjects excluded from analyses because of missing values: 435; OR., odds ratio; CI., confidence interval; Variables excluded from the model (in order of elimination): high visual demand, work pace dependent on quantified targets, work pace dependent on customers' demand, current occupational category, full elbow flexion, high psychological demand, work with temporary workers, diabetes mellitus, low level of skill discretion; Hosmer Lemeshow goodness-of-fit test: $P = 0.243$; area under ROC curve = 0.78; δ , $P > 0.05$; #, P-value for multiplicative interaction.