

Applying two general population job exposure matrices to predict incident carpal tunnel syndrome: A cross-national approach to improve estimation of workplace physical exposures ¹

by Marcus Yung, PhD, Bradley A Evanoff, MD,² Skye Buckner-Petty, MPH, Yves Roquelaure, MD, Alexis Descatha, MD, Ann Marie Dale, PhD ¹

1. *Supplementary tables and figure*
2. *Correspondence to: Dr Bradley A Evanoff, Division of General Medical Sciences, Washington University School of Medicine in St Louis, St Louis, MO 63110, USA. [E-mail: bevanoff@wustl.edu]*

O*NET JEM	Consortium Study	Rationale of Match
Static Strength	Peak Hand Force (Worker Rated)	Requires “maximum muscle force” to lift, push, pull, or carry objects
	Peak Hand Force (Analyst Rated)	
	ACGIH TLV (Worker Rated)	
	ACGIH TLV (Analyst Rated)	
Dynamic Strength	Peak Hand Force (Worker Rated)	Requires force to exert repeatedly or continuously over time
	Peak Hand Force (Analyst Rated)	
	ACGIH TLV (Worker Rated)	
	ACGIH TLV (Analyst Rated)	
	Repetition Per Minute for Forceful Exertions	
Performing General Physical Activities	Peak Hand Force (Worker Rated)	Performing general activities involve whole body movement with significant hand force
	Peak Hand Force (Analyst Rated)	
	ACGIH TLV (Worker Rated)	
	ACGIH TLV (Analyst Rated)	
	Repetition Per Minute for Forceful Exertions	
Trunk Strength	Peak Hand Force (Worker Rated)	Carrying and lifting loads requires significant force
	Peak Hand Force (Analyst Rated)	
	ACGIH TLV (Worker Rated)	
	ACGIH TLV (Analyst Rated)	
Handling & Moving Objects	Duty Cycle of Forceful Exertions	Requires hands and arms to move and manipulate objects.
	ACGIH TLV (Worker Rated)	
	ACGIH TLV (Analyst Rated)	
	%Time ≥50 Degrees Wrist Extension	
	%Time ≥30 Degrees Wrist Flexion	

	Repetition Per Minute for Forceful Exertions	
Spend Time Making Repetitive Motions	Duty Cycle of All Exertions	Repetitive motions involve repeated hand exertions
	Hand Activity Level (Analyst Rated)	
	Repetition Per Minute for All Exertions	
	Repetition Per Minute for Forceful Exertions	
	ACGIH TLV (Worker Rated)	
	ACGIH TLV (Analyst Rated)	
Wrist Finger Speed	Duty Cycle of All Exertions	Requires the ability to make repeated movements of fingers, hands, wrists
	Hand Activity Level (Analyst Rated)	
	Repetition Per Minute for All Exertions	
Spend Time Using Your Hands	Duty Cycle of All Exertions	Amount of time using hands to handle, control, or feel objects, tools, or controls.
	Hand Activity Level (Analyst Rated)	
	Repetition Per Minute for All Exertions	
	Repetition Per Minute for Forceful Exertions	
	ACGIH TLV (Worker Rated)	
	ACGIH TLV (Analyst Rated)	
	%Time ≥ 50 Degrees Wrist Extension	
	%Time ≥ 30 Degrees Wrist Flexion	
There are 8 unique O*NET variables and 11 unique Consortium variables. Definition of JEM exposure variable informs the rationale of exposure matches		

Table S2. Matched Exposure Variables between CONSTANCES JEM and Individual-Level Measures.		
CONSTANCES JEM	Consortium Study	Rationale of Match
Physical Intensity	Peak Hand Force (Worker Rated)	CONSTANCES asks participant how they would describe the intensity of the physical efforts of their work. Physical intensity is a combination of force, repetition, and duration.
	Peak Hand Force (Analyst Rated)	
	Duty Cycle of Forceful Exertions	
	Repetition Per Minute for Forceful Exertions	
	ACGIH TLV (Worker Rated)	
	ACGIH TLV (Analyst Rated)	
Handle Objects 1-4 kg	%Time \geq 50 Degrees Wrist Extension	CONSTANCES asks participant to rate the amount of time spent handling or regularly moving a load, part, or object <4 kg or between 1 and 4 kg. Handling objects involve repetitive distal upper extremity activity and duration.
	%Time \geq 30 Degrees Wrist Flexion	
	Duty Cycle of All Exertions	
Handle Objects 1-4 kg, >4 kg	Repetition Per Minute for All Exertions	
	Repetition Per Minute for Forceful Exertions	
	Hand Activity Level (Analyst Rated)	
Handle Objects >4 kg	Peak Hand Force (Worker Rated)	
	Peak Hand Force (Analyst Rated)	
	Duty Cycle of Forceful Exertions	
	ACGIH TLV (Worker Rated)	
	ACGIH TLV (Analyst Rated)	
Carry Loads 10-25 kg, > 25 kg	Peak Hand Force (Worker Rated)	CONSTANCES asks participant to rate the amount of time carrying a load that weighs 10-25kg or >25kg. Carrying loads requires significant force.
	Peak Hand Force (Analyst Rated)	
	Duty Cycle of Forceful Exertions	
	Repetition Per Minute for Forceful Exertions	
	ACGIH TLV (Worker Rated)	
	ACGIH TLV (Analyst Rated)	
Carry Loads <10 kg	No Match	Consortium variables pertaining to carry loads indicate significant force.
Repetition	Repetition Per Minute for All Exertions	CONSTANCES asks participant if they repeat same actions more than 2-4 times per min. Duty cycle is the ratio of duration of effort to duration of total cycle time (i.e., repetition).
	Repetition Per Minute for Forceful Exertions	
	Hand Activity Level (Analyst Rated)	
	Duty Cycle of All Exertions	
Rotate forearm	Peak Hand Force (Worker Rated)	CONSTANCES asks participant to rate the amount of time twisting their forearm as if they were using a screwdriver. Rotating forearm involves handgrip force and flexion/extension.
	Peak Hand Force (Analyst Rated)	
	Duty Cycle of Forceful Exertions	
	Repetition Per Minute for Forceful Exertions	
	ACGIH TLV (Worker Rated)	
	ACGIH TLV (Analyst Rated)	
	%Time \geq 50 Degrees Wrist Extension	
	%Time \geq 30 Degrees Wrist Flexion	
Bend wrist	Repetition Per Minute for All Exertions	CONSTANCES asks participant to rate the amount of time bending their wrist. Bending wrist requires flexion/extension and can be repetitive.
	Hand Activity Level (Analyst Rated)	
	%Time \geq 50 Degrees Wrist Extension	
	%Time \geq 30 Degrees Wrist Flexion	
	Duty Cycle of All Exertions	
Finger pinch	Peak Hand Force (Worker Rated)	CONSTANCES asks participant the amount of time pinching objects with
	Peak Hand Force (Analyst Rated)	

	Duty Cycle of Forceful Exertions	their thumb and forefinger. Pinch force greater than or equal to 9N is required in calculating “significant force.”
	ACGIH TLV (Worker Rated)	
	ACGIH TLV (Analyst Rated)	
Use Vibrating Tools	No Match	CONSTANCES asks participant if they use vibrating tools or place their hands on vibrating machines. No direct measurement of vibration
There are 11 unique CONSTANCES variables and 11 unique Consortium variables. There are two separate questions under “Handle Object” and three questions under “Carry Loads,” representing different weights handled. Consortium variables linked to two weights handled are matched in a separate row. Definition of JEM exposure variable informs the rationale of exposure matches		

Table S3. Worker characteristics for Aim 1 and 2 analyzed cohort (n = 2393 workers) and the Aim 3 analyzed cohort (n = 1073 workers).

Characteristic	Aim 1 & 2 Cohort (n=2393 workers)	Aim 3 Cohort (n=1073 workers)
Mean Age (yrs)	40.83 (SD = 11.12)	42.28 (SD = 10.97)
Mean BMI	28.3 (SD = 6.0)	28.7 (SD = 6.3)
Sex	52.2% Female; 47.8% Male	60.4% Female; 39.6% Male
#CTS Cases	195	162
Total Years of Follow-up Time	5005	3399
Incident Rate of CTS	3.9 per 100 person-years	4.8 per 100 person-years

Table S4. Comparison of Aim 1 and 2 analyzed cohort (n = 2393 workers) and Aim 3 analyzed cohort (n = 1073 workers) by Aim 1's frequency of jobs held (highest to lowest). 130 SOC job codes contained within Aim 1 and 2 cohort. 113 SOC codes contained within Aim 3 cohort. Only SOC codes with more than 20 workers in Aim 1 and 2 cohorts are reported.

SOC Code & Job Title	Aim 1 & 2 Cohort (n=2393 workers)		Aim 3 Cohort (n=1073 workers)		Difference in % of Cohort
	n	% of Cohort	n	% of Cohort	
51-2092.00 Team assemblers	799	33.39	350	32.62	-0.77
51-2022.00 Electrical and electronic equipment assemblers	135	5.64	56	5.22	-0.42
51-9195.07 Molding and casting workers	118	4.93	5	0.47	-4.47
45-2092.01 Nursery workers	90	3.76	3	0.28	-3.48
51-4031.00 Cutting, punching, and press machine setters, operators, and tenders, metal and plastic	85	3.55	36	3.36	-0.20
51-6031.00 Sewing machine operators	84	3.51	69	6.43	2.92
53-7063.00 Machine feeders and offbearers	81	3.38	28	2.61	-0.78
51-2031.00 Engine and other machine assemblers	66	2.76	30	2.80	0.04
53-7064.00 Packers and packagers, hand	43	1.80	8	0.75	-1.05
51-3022.00 Meat, poultry, and fish cutters and trimmers	42	1.76	32	2.98	1.23
51-9061.00 Inspectors, testers, sorters, samplers, and weighers	39	1.63	20	1.86	0.23
51-9123.00 Painting, coating, and decorating workers	33	1.38	6	0.56	-0.82
51-6011.00 Laundry and dry-cleaning workers	30	1.25	22	2.05	0.80
51-7021.00 Furniture finishers	27	1.13	16	1.49	0.36
43-9061.00 Office clerks, general	26	1.09	22	2.05	0.96
51-4121.06 Welders, cutters, and welder fitters	25	1.04	7	0.65	-0.39
51-4081.00 Multiple machine tool setters, operators, and tenders, metal and plastic	22	0.92	6	0.56	-0.36
51-4121.07 Solderers and brazers	22	0.92	0	0.00	-0.92
51-7011.00 Cabinetmakers and bench carpenters	21	0.88	11	1.03	0.15
43-5071.00 Shipping, receiving, and traffic clerks	20	0.84	13	1.21	0.38

Table S5. Comparison of mean (SD) exposure values between Aim 1 and 2 analyzed cohort (n = 2393 workers) and Aim 3 restricted analyzed cohort (n = 1073 workers).

Individual-Level Measures	Definition	Scale	Aim 1 and 2 Cohort (n=2393 workers)		Aim 3 Cohort (n=1073 workers)	
			Mean	SD	Mean	SD
Peak Hand Force (Worker Rated)	Peak hand force in a task estimated by observer using Borg CR10 scale	1 -- 10	3.23	2.08	3.39	2.13
Peak Hand Force (Analyst Rated)	Peak hand force in a task estimated by worker using Borg CR10 scale	1 -- 10	2.98	1.75	2.87	1.82
Hand Activity Level (Analyst Rated)	Analyst HAL rating using the verbal anchor	0 -- 10	4.75	1.67	4.64	1.69
ACGIH TLV (Worker Rated)	ACGIH TLV level using worker estimated hand force and HAL in a task		0.81	0.71	0.78	0.66
ACGIH TLV (Analyst Rated)	ACGIH TLV level using observer estimated hand force and HAL in a task		0.70	0.60	0.64	0.53
Repetition per Min. for All Exertions	Total number of exertions per minute for a task irrespective of exertion level	#/min	23.49	18.87	19.04	12.86
Repetition per Min. for Forceful Exertions	Total number of exertions per minute for a task requiring significant force	#/min	9.77	13.02	6.41	8.49
Duty Cycle of All Exertions	Percentage of duration for all exertions for a task	0 -- 100	65.84	20.10	64.59	20.12
Duty Cycle of Forceful Exertions	Percentage of duration for exertions requiring significant force	0 -- 100	24.07	20.56	20.61	21.06
%Time ³ 50 Degrees Wrist Extension	Percentage of time hand/wrist is in extension greater than 50 degrees	0 -- 100	14.82	22.31	15.92	25.23
%Time ³ 30 Degrees Wrist Flexion	Percentage of time hand/wrist is in flexion greater than 30 degrees	0 -- 100	3.18	6.46	3.84	7.64

Table S6. ORs and 95% CIs for Incident Carpal Tunnel Syndrome for Each Exposure Variable in CONSTANCES JEM, O*NET JEM, and Consortium Individual-Level Measures. N = 1073, Restricted to 2-year follow-up period. Research site as random intercept.

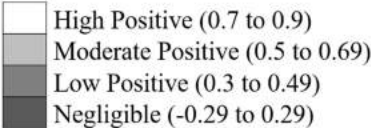
Exposure Variable	Continuous Exposure (Per 1-unit Increase)		Dichotomous Exposure (at Median)	
	OR	95%CI	OR	95%CI
CONSTANCES JEM				
Physical Intensity	1.15	1.00-1.31	1.16	0.75-1.78
Repetition	1.39	0.88-2.20	1.32	0.83-2.10
Handle Objects 1-4kg	1.32	1.02-1.72	1.01	0.65-1.57
Handle Objects >4kg	1.27	0.97-1.68	1.01	0.65-1.58
Carry Loads <10kg	1.39	1.02-1.89	1.09	0.70-1.69
Carry Loads 10-25kg	1.37	0.97-1.92	1.06	0.68-1.66
Carry Loads >25kg	1.41	0.95-2.10	1.58	0.99-2.50
Rotate Forearm	2.31	1.47-3.64	1.96	1.25-3.10
Bend Wrist	1.44	0.84-2.46	0.85	0.54-1.33
Finger Pinch	2.27	1.22-4.24	1.23	0.79-1.91
Use Vibrating Tools	2.94	1.52-5.67	3.21	1.10-9.32
O*NET JEM				
Performing General Physical Activities	1.63	1.24-2.15	1.52	0.98-2.36
Trunk Strength	2.30	1.50-3.52	2.09	1.32-3.32
Static Strength	2.03	1.46-2.81	2.21	1.42-3.45
Dynamic Strength	2.42	1.62-3.62	1.67	1.07-2.61
Handling & Moving Objects	1.68	1.30-2.17	1.72	1.10-2.69
Spend Time Making Repetitive Motions	1.17	0.82-1.69	0.87	0.57-1.34
Wrist Finger Speed	1.50	1.04-2.16	1.39	0.91-2.13
Spend Time Using Your Hands	2.25	1.46-3.47	1.72	1.05-2.82
Consortium (Individual-Level Measures)				
Peak Hand Force (Worker Rated)	1.11	1.01-1.21	2.09	1.32-3.30
Peak Hand Force (Analyst Rated)	1.18	1.05-1.32	1.83	1.15-2.90
Hand Activity Level (Analyst Rated)	1.10	0.97-1.25	1.31	0.84-2.04
ACGIH TLV (Worker Rated)	1.30	0.97-1.73	1.52	0.97-2.37
ACGIH TLV (Analyst Rated)	1.57	1.11-2.22	1.63	1.05-2.53
Repetition per Min. for All Exertions	1.03	1.02-1.05	1.74	1.11-2.72
Repetition per Min. for Forceful Exertions	1.05	1.02-1.07	1.73	1.10-2.70
Duty Cycle of All Exertions	1.01	0.99-1.02	1.17	0.76-1.81
Duty Cycle of Forceful Exertions	1.01	1.00-1.02	1.67	1.09-2.58
%Time ≥50 Degrees Wrist Extension	1.00	0.99-1.01	1.03	0.62-1.72
%Time ≥30 Degrees Wrist Flexion	1.03	1.01-1.05	1.23	0.80-1.90

Bold denotes significance.

Supplement, Figure 1. Heat maps of (A) Spearman's correlations and (B) Cohen's kappa agreement values at the *worker level* between O*NET and Individual-Level Measures. Underlined values denote matched exposure variable pairs. N = 2393 workers.

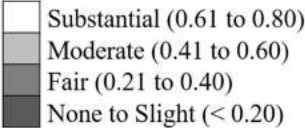
A.

		Individual-Level Measures from Consortium										
		Peak Hand Force (Worker Rated)	Peak Hand Force (Analyst Rated)	Duty Cycle of All Exertions	Duty Cycle of Forceful Exertions	Hand Activity Level (Analyst Rated)	Repetition per Minute for All Exertions	Repetition per Minute for Forceful Exertions	ACGIH TLV (Worker Rated)	ACGIH TLV (Analyst Rated)	%Time >50 Degrees Wrist Extension	%Time >30 Degrees Wrist Flexion
O*NET Exposures	Static Strength	<u>0.23</u>	<u>0.36</u>	0.03	0.31	0.02	-0.07	0.28	0.16	<u>0.29</u>	-0.03	0.08
	Dynamic Strength	<u>0.28</u>	<u>0.36</u>	0.07	0.35	0.09	0.05	<u>0.34</u>	<u>0.22</u>	<u>0.33</u>	-0.01	0.02
	Performing General Physical Activities	<u>0.25</u>	<u>0.32</u>	0.12	0.33	0.06	0.00	<u>0.29</u>	0.18	<u>0.28</u>	0.03	0.02
	Trunk Strength	<u>0.26</u>	<u>0.39</u>	0.07	0.32	0.03	-0.01	0.29	0.18	<u>0.31</u>	-0.05	0.05
	Handling & Moving Objects	0.22	0.30	0.08	<u>0.29</u>	0.09	0.05	<u>0.29</u>	0.17	<u>0.25</u>	0.00	<u>0.08</u>
	Spend Time Making Repetitive Motions	0.18	0.20	<u>0.17</u>	0.26	<u>0.25</u>	<u>0.24</u>	<u>0.31</u>	<u>0.23</u>	<u>0.27</u>	0.19	0.02
	Wrist Finger Speed	0.13	0.09	<u>0.18</u>	0.07	<u>0.21</u>	<u>0.03</u>	0.09	0.17	0.12	0.07	0.08
	Spend Time Using Your Hands	0.27	0.24	<u>0.15</u>	0.31	0.26	0.25	<u>0.36</u>	<u>0.30</u>	<u>0.31</u>	0.19	<u>0.01</u>



B.

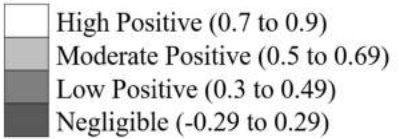
		Individual-Level Measures from Consortium										
		Peak Hand Force (Worker Rated)	Peak Hand Force (Analyst Rated)	Duty Cycle of All Exertions	Duty Cycle of Forceful Exertions	Hand Activity Level (Analyst Rated)	Repetition per Minute for All Exertions	Repetition per Minute for Forceful Exertions	ACGIH TLV (Worker Rated)	ACGIH TLV (Analyst Rated)	%Time >50 Degrees Wrist Extension	%Time >30 Degrees Wrist Flexion
O*NET Exposures	Static Strength	<u>0.12</u>	<u>0.20</u>	0.02	0.19	0.06	0.08	0.21	<u>0.12</u>	<u>0.18</u>	0.05	0.05
	Dynamic Strength	<u>0.15</u>	<u>0.17</u>	0.05	0.19	0.07	0.19	<u>0.22</u>	<u>0.13</u>	<u>0.16</u>	0.04	0.03
	Performing General Physical Activities	<u>0.11</u>	<u>0.22</u>	0.08	0.27	0.11	0.11	<u>0.29</u>	<u>0.13</u>	<u>0.21</u>	0.09	0.04
	Trunk Strength	<u>0.16</u>	<u>0.25</u>	0.09	0.20	0.05	0.17	0.22	<u>0.12</u>	<u>0.21</u>	0.05	0.01
	Handle & Moving Objects	0.11	0.20	0.08	<u>0.23</u>	0.14	0.11	<u>0.24</u>	<u>0.07</u>	<u>0.15</u>	<u>0.06</u>	<u>0.06</u>
	Spend Time Making Repetitive Motions	0.12	0.15	<u>0.19</u>	0.26	<u>0.23</u>	<u>0.24</u>	<u>0.28</u>	<u>0.12</u>	<u>0.19</u>	0.18	0.01
	Wrist Finger Speed	0.09	0.08	<u>0.13</u>	0.11	<u>0.14</u>	<u>0.13</u>	0.16	0.06	0.06	0.13	0.00
	Spend Time Using Your Hands	0.13	0.19	<u>0.17</u>	0.25	<u>0.21</u>	<u>0.21</u>	<u>0.28</u>	<u>0.12</u>	<u>0.19</u>	<u>0.21</u>	<u>-0.03</u>



Supplement, Figure 2. Heat maps of (A) Spearman's correlations and (B) Cohen's kappa agreement values at the worker level between O*NET and CONSTANCES JEM exposure estimates. Underlined values denote matched exposure variable pairs. N = 2393 workers.

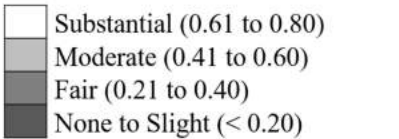
A.

		CONSTANCES Exposures								
		Physical intensity	Handle objects 1-4 kg	Handle objects > 4 kg	Carry loads 10-25 kg	Carry loads >25 kg	Repetition	Rotate forearm	Bend wrist	Finger pinch
O*NET Exposures	Static Strength	0.17	0.21	0.12	0.23	0.22	0.07	0.32	-0.01	0.05
	Dynamic Strength	0.31	0.31	0.07	0.10	0.06	0.13	0.18	0.18	0.00
	Performing General Physical Activities	0.20	0.42	0.19	0.30	0.35	0.01	0.35	0.18	0.03
	Trunk Strength	0.35	0.29	0.07	0.11	0.11	0.18	0.15	0.17	-0.08
	Handling and Moving Objects	0.23	0.48	0.26	0.41	0.45	0.10	0.45	0.25	0.15
	Spend Time Making Repetitive Motions	0.19	0.29	0.18	0.25	0.23	0.25	0.37	0.41	0.50
	Wrist Finger Speed	0.17	0.23	0.10	0.35	0.21	0.16	0.41	0.27	0.39
	Spend Time Using Your Hands	0.24	0.32	0.27	0.35	0.37	0.36	0.50	0.48	0.52



B.

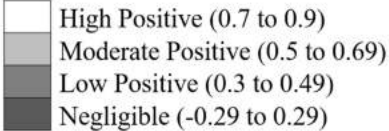
		CONSTANCES Exposures								
		Physical intensity	Handle objects 1-4 kg	Handle objects > 4 kg	Carry loads 10-25 kg	Carry loads >25 kg	Repetition	Rotate forearm	Bend wrist	Finger pinch
O*NET Exposures	Static Strength	0.19	0.23	0.23	0.28	0.37	0.10	0.43	0.09	0.20
	Dynamic Strength	0.40	0.45	0.21	0.10	0.20	0.23	0.36	0.32	0.23
	Performing General Physical Activities	0.38	0.52	0.31	0.35	0.50	0.30	0.54	0.40	0.30
	Trunk Strength	0.41	0.46	0.21	0.26	0.31	0.29	0.36	0.26	0.10
	Handling and Moving Objects	0.46	0.60	0.36	0.45	0.57	0.38	0.55	0.52	0.35
	Spend Time Making Repetitive Motions	0.49	0.60	0.39	0.47	0.47	0.55	0.50	0.67	0.64
	Wrist Finger Speed	0.18	0.15	0.11	0.31	0.24	0.29	0.34	0.25	0.33
	Spend Time Using Your Hands	0.38	0.48	0.30	0.51	0.48	0.59	0.54	0.60	0.56



Supplement, Figure 3. Heat maps of (A) Spearman's correlations and (B) Cohen's kappa agreement values at the *job level* between O*NET and Individual-Level Measures. Underlined values denote matched exposure variable pairs. N = 130 SOC codes.

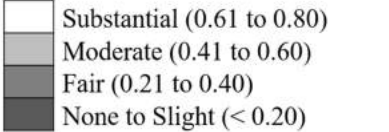
A.

		Individual-Level Measures from Consortium										
		Peak Hand Force (Worker Rated)	Peak Hand Force (Analyst Rated)	Duty Cycle of All Exertions	Duty Cycle of Forceful Exertions	Hand Activity Level (Analyst Rated)	Repetition per Minute for All Exertions	Repetition per Minute for Forceful Exertions	ACGIH TLV (Worker Rated)	ACGIH TLV (Analyst Rated)	%Time >50 Degrees Wrist Extension	%Time >30 Degrees Wrist Flexion
O*NET Exposures	Static Strength	<u>0.49</u>	<u>0.55</u>	-0.03	0.48	0.21	0.14	0.53	<u>0.44</u>	<u>0.50</u>	0.17	0.16
	Dynamic Strength	<u>0.47</u>	<u>0.54</u>	0.00	0.47	0.20	0.17	<u>0.51</u>	<u>0.42</u>	<u>0.49</u>	0.17	0.16
	Performing General Physical Activities	<u>0.46</u>	<u>0.48</u>	-0.02	0.46	0.22	0.09	<u>0.48</u>	<u>0.41</u>	<u>0.45</u>	0.14	0.17
	Trunk Strength	<u>0.49</u>	<u>0.53</u>	0.03	0.48	0.27	0.19	0.53	<u>0.46</u>	<u>0.52</u>	0.18	0.16
	Handling & Moving Objects	0.47	0.52	0.01	<u>0.46</u>	0.26	0.11	<u>0.50</u>	<u>0.45</u>	<u>0.50</u>	<u>0.17</u>	<u>0.23</u>
	Spend Time Making Repetitive Motions	0.15	0.28	<u>0.21</u>	0.16	<u>0.21</u>	<u>0.13</u>	<u>0.19</u>	<u>0.17</u>	<u>0.28</u>	0.26	0.12
	Wrist Finger Speed	<u>0.28</u>	0.34	<u>0.00</u>	0.33	<u>0.19</u>	<u>0.05</u>	0.38	0.26	0.31	0.07	0.20
	Spend Time Using Your Hands	0.43	0.45	<u>0.20</u>	0.41	<u>0.34</u>	<u>0.14</u>	<u>0.43</u>	<u>0.44</u>	<u>0.46</u>	<u>0.21</u>	<u>0.15</u>



B.

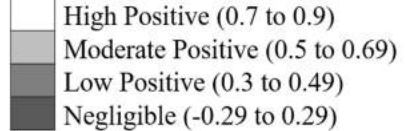
		Individual-Level Measures from Consortium										
		Peak Hand Force (Worker Rated)	Peak Hand Force (Analyst Rated)	Duty Cycle of All Exertions	Duty Cycle of Forceful Exertions	Hand Activity Level (Analyst Rated)	Repetition per Minute for All Exertions	Repetition per Minute for Forceful Exertions	ACGIH TLV (Worker Rated)	ACGIH TLV (Analyst Rated)	%Time >50 Degrees Wrist Extension	%Time >30 Degrees Wrist Flexion
O*NET Exposures	Static Strength	<u>0.40</u>	<u>0.43</u>	0.06	0.46	0.20	0.15	0.52	<u>0.46</u>	<u>0.46</u>	0.03	0.00
	Dynamic Strength	<u>0.35</u>	<u>0.45</u>	0.11	0.42	0.30	0.14	<u>0.45</u>	<u>0.42</u>	<u>0.48</u>	0.08	0.11
	Performing General Physical Activities	<u>0.32</u>	<u>0.38</u>	0.05	0.42	0.18	0.05	<u>0.45</u>	<u>0.38</u>	<u>0.42</u>	0.02	0.02
	Trunk Strength	<u>0.45</u>	<u>0.51</u>	0.14	0.48	0.31	0.14	0.51	<u>0.51</u>	<u>0.51</u>	0.08	0.02
	Handle & Moving Objects	<u>0.38</u>	0.45	0.11	<u>0.42</u>	0.15	0.02	<u>0.42</u>	<u>0.38</u>	<u>0.45</u>	<u>0.17</u>	<u>0.11</u>
	Spend Time Making Repetitive Motions	<u>0.08</u>	0.29	<u>0.20</u>	0.14	<u>0.15</u>	<u>-0.02</u>	<u>0.11</u>	<u>0.11</u>	<u>0.20</u>	0.11	0.01
	Wrist Finger Speed	0.26	0.38	<u>0.11</u>	0.26	<u>0.24</u>	<u>-0.02</u>	0.20	0.17	0.29	0.14	0.08
	Spend Time Using Your Hands	<u>0.32</u>	0.45	<u>0.32</u>	0.35	<u>0.37</u>	<u>0.08</u>	<u>0.32</u>	<u>0.29</u>	<u>0.32</u>	<u>0.17</u>	<u>0.17</u>



Supplement, Figure 4. Heat maps of (A) Spearman's correlations and (B) Cohen's kappa agreement values at the *job level* between O*NET and CONSTANCES JEM exposure estimates. Underlined values denote matched exposure variable pairs. N = 130 SOC codes.

A.

		CONSTANCES Exposures								
		Physical intensity	Handle objects 1-4 kg	Handle objects > 4 kg	Carry loads 10-25 kg	Carry loads >25 kg	Repetition	Rotate forearm	Bend wrist	Finger pinch
O*NET Exposures	Static Strength	<u>0.69</u>	<u>0.65</u>	0.66	<u>0.68</u>	<u>0.69</u>	0.49	0.69	0.70	0.62
	Dynamic Strength	<u>0.70</u>	<u>0.67</u>	<u>0.67</u>	<u>0.69</u>	<u>0.69</u>	0.47	0.73	0.73	0.66
	Performing General Physical Activities	<u>0.69</u>	0.65	0.67	<u>0.69</u>	<u>0.71</u>	0.41	0.68	0.70	0.58
	Trunk Strength	0.73	0.68	0.67	0.67	0.68	0.53	0.72	0.74	0.66
	Handling and Moving Objects	0.70	<u>0.69</u>	<u>0.70</u>	<u>0.73</u>	<u>0.76</u>	<u>0.44</u>	<u>0.72</u>	<u>0.73</u>	0.69
	Spend Time Making Repetitive Motions	0.41	0.38	0.37	0.36	0.38	<u>0.52</u>	0.39	0.48	0.46
	Wrist Finger Speed	0.50	0.47	0.45	0.48	0.50	<u>0.42</u>	0.61	<u>0.56</u>	<u>0.63</u>
	Spend Time Using Your Hands	0.63	<u>0.60</u>	0.60	0.63	0.66	<u>0.52</u>	<u>0.71</u>	<u>0.72</u>	0.76



B.

		CONSTANCES Exposures								
		Physical intensity	Handle objects 1-4 kg	Handle objects > 4 kg	Carry loads 10-25 kg	Carry loads >25 kg	Repetition	Rotate forearm	Bend wrist	Finger pinch
O*NET Exposures	Static Strength	<u>0.62</u>	<u>0.55</u>	0.58	<u>0.48</u>	<u>0.49</u>	0.42	0.54	0.66	<u>0.40</u>
	Dynamic Strength	<u>0.63</u>	<u>0.57</u>	0.60	<u>0.55</u>	<u>0.54</u>	0.40	0.62	0.65	0.45
	Performing General Physical Activities	<u>0.54</u>	0.48	0.51	<u>0.46</u>	<u>0.48</u>	0.34	0.55	0.62	<u>0.35</u>
	Trunk Strength	0.60	0.54	0.57	0.55	0.57	0.43	0.52	0.68	0.48
	Handling and Moving Objects	0.48	<u>0.42</u>	0.48	<u>0.49</u>	<u>0.54</u>	<u>0.31</u>	<u>0.46</u>	<u>0.52</u>	0.51
	Spend Time Making Repetitive Motions	0.23	0.26	0.29	0.25	0.26	<u>0.34</u>	0.22	0.31	0.35
	Wrist Finger Speed	0.29	0.26	0.29	0.40	0.42	<u>0.25</u>	0.46	<u>0.40</u>	<u>0.54</u>
	Spend Time Using Your Hands	0.48	<u>0.48</u>	0.48	0.58	0.60	<u>0.40</u>	<u>0.58</u>	<u>0.55</u>	0.63

