

## Supplementary material

**Supplementary table 1. Weighted Characteristics of Study Participants by Physical Job Demands<sup>a</sup> at Baseline (Wave 1)**

	Total ( <i>n</i> = 2170)		Low PS ( <i>n</i> = 696)		High PS ( <i>n</i> = 1474)		Low LH ( <i>n</i> = 964)		High LH ( <i>n</i> = 1206)		Low BK ( <i>n</i> = 786)		High BK ( <i>n</i> = 1384)	
	Mean (SD)	<i>n</i> (%)	Mean (SD)	<i>n</i> (%)	Mean (SD)	<i>n</i> (%)	Mean (SD)	<i>n</i> (%)	Mean (SD)	<i>n</i> (%)	Mean (SD)	<i>n</i> (%)	Mean (SD)	<i>n</i> (%)
Age	53.2 (6.6)		52.6 (5.8)		53.5 (6.9)		52.6 (5.9)		53.7 (7.1)		52.4 (5.7)		53.7 (7.1)	
Sex (male)		1349 (66.5)		497 (74.1)		852 (62.5)		638 (69.6)		711 (63.7)		557 (74.0)		792 (61.5)
Marital status (married)		1976 (91.0)		643 (92.1)		1333 (90.4)		885 (91.7)		1091 (90.4)		727 (92.0)		1249 (90.3)
Educational attainment														
Elementary school or below		671 (22.6)		95 (9.6)		576 (29.5)		171 (12.7)		500 (31.6)		118 (10.9)		553 (30.4)
Middle school		434 (18.8)		121 (14.2)		313 (21.2)		178 (15.9)		256 (21.5)		130 (14.5)		304 (21.7)
High school		781 (40.8)		285 (41.1)		496 (40.6)		388 (41.3)		393 (40.3)		329 (42.4)		452 (39.7)
College or above		284 (17.8)		195 (35.1)		89 (8.7)		227 (30.1)		57 (6.6)		209 (32.2)		75 (8.2)
Household income (below median)		1243 (51.8)		328 (41.6)		915 (57.2)		459 (42.8)		784 (60.0)		367 (42.5)		876 (57.9)
Residential area														
Metropolis		881 (45.4)		335 (51.6)		546 (42.1)		472 (51.2)		409 (40.0)		380 (51.6)		501 (41.2)

Small town	664 (33.3)	252 (36.5)	412 (31.6)	337 (36.3)	327 (30.6)	288 (36.4)	376 (31.3)
Rural	625 (21.3)	109 (11.9)	516 (26.3)	155 (12.5)	470 (29.4)	118 (12.0)	507 (27.5)
Body mass index (below 25 kg/m <sup>2</sup> )	1662 (75.9)	522 (73.3)	1140 (77.2)	727 (74.9)	935 (76.8)	589 (74.1)	1073 (77.1)
Smoking status							
Non-smoker	1331 (57.9)	414 (59.0)	917 (57.3)	602 (60.8)	729 (55.3)	472 (58.2)	859 (57.7)
Ex-smoker	256 (12.0)	101 (13.8)	155 (11.1)	119 (11.5)	137 (12.5)	102 (12.5)	154 (11.7)
Current smoker	583 (30.1)	181 (27.2)	402 (31.6)	243 (27.7)	340 (32.2)	212 (29.3)	371 (30.6)
Risky drinker <sup>b</sup> (no)	1888 (86.1)	598 (85.1)	1290 (86.6)	847 (87.1)	1041 (85.1)	685 (86.4)	1203 (85.8)
Physical activity <sup>c</sup> (sufficient)	781 (38.7)	367 (53.8)	414 (30.7)	471 (49.9)	310 (28.4)	415 (52.5)	366 (29.5)
Hypertension <sup>d</sup> (no)	1778 (83.2)	560 (81.8)	1218 (84.0)	787 (83.1)	991 (83.3)	641 (83.1)	1137 (83.3)
Diabetes <sup>d</sup> (no)	1995 (93.0)	629 (90.9)	1366 (94.0)	871 (91.6)	1124 (94.2)	716 (92.5)	1279 (93.3)
Depressive symptoms <sup>e</sup> (no)	2085 (96.8)	683 (98.3)	1402 (96.0)	937 (97.6)	1148 (96.1)	769 (97.8)	1316 (96.2)
Weekly work hours	49.9 (16.9)	47.1 (15.3)	51.4 (17.5)	48.3 (15.3)	51.4 (18.2)	48.6 (14.8)	50.8 (18.2)
Employment status							
Permanent worker	675	318	357	444	231	381	294

	(35.6)	(51.7)	(27.1)	(51.7)	(21.0)	(53.3)	(23.8)
Temporary worker	127 (5.9)	35 (4.3)	92 (6.8)	56 (5.1)	71 (6.7)	38 (4.4)	89 (7.0)
Day laborer	179 (8.4)	19 (2.1)	160 (11.6)	45 (3.7)	134 (12.6)	25 (2.6)	154 (12.2)
Self-employed worker	979 (42.9)	281 (36.9)	698 (46.1)	369 (35.5)	610 (49.6)	309 (36.5)	670 (47.1)
Unpaid family worker	210 (7.2)	43 (5.0)	167 (8.4)	50 (4.0)	160 (10.1)	33 (3.2)	177 (9.9)
Occupation <sup>f</sup>							
Managers	85 (4.9)	59 (9.4)	26 (2.5)	77 (9.2)	8 (1.0)	69 (9.2)	16 (2.0)
Professionals and related workers	103 (5.4)	75 (11.7)	28 (2.1)	84 (9.6)	19 (1.6)	79 (10.5)	24 (2.0)
Clerks	170 (9.5)	119 (17.9)	51 (5.1)	134 (15.5)	36 (4.0)	123 (16.8)	47 (4.7)
Service workers	235 (10.2)	52 (6.4)	183 (12.3)	111 (9.9)	124 (10.5)	64 (7.7)	171 (11.9)
Sales workers	263 (12.9)	101 (13.8)	162 (12.4)	103 (9.8)	160 (15.8)	95 (10.7)	168 (14.4)
Skilled agricultural, forestry, and fishery	342 (10.2)	14 (1.3)	328 (14.9)	21 (1.5)	321 (18.2)	9 (0.7)	333 (16.6)
Craft and related trades workers	197 (10.3)	44 (6.0)	153 (12.5)	58 (5.7)	139 (14.4)	38 (5.0)	159 (13.8)
Equipment, machine operating, and assembling	218 (10.3)	66 (8.7)	152 (11.1)	136 (13.4)	82 (7.5)	112 (13.6)	106 (8.1)

Elementary workers	404 (18.2)	90 (10.6)	314 (22.2)	154 (13.7)	250 (22.2)	110 (11.9)	294 (22.3)
Unspecified	153 (8.1)	76 (14.2)	77 (4.9)	86 (11.7)	67 (4.8)	87 (13.9)	66 (4.2)

PS, physical strength; LH, lifting heavy objects; BK, bending, kneeling, or squatting; SD, standard deviation

All values, except the number of participants by category, were weighted estimates considering a complex sampling design.

<sup>a</sup>For simplicity, each physical job demand was dichotomized as low (never and sometimes) and high (often and always).

<sup>b</sup>High-risk drinkers were defined as individuals who consumed alcohol twice or more per week, based on the Korea National Health and Nutrition Examination Survey criteria.

<sup>c</sup>Insufficient physical activity was defined as less than 150 minutes per week based on the World Health Organization guidelines.

<sup>d</sup>Hypertension or diabetes cases were defined as those diagnosed with hypertension or diabetes by a physician.

<sup>e</sup>Depressive symptoms were defined as a score of four or above on the 10-item Center for Epidemiologic Studies Depression Scale.

<sup>f</sup>Based on the Korean Standard Classification of Occupations

**Supplementary table 2. Weighted Prevalence of Cognitive Impairment Among Study Participants by Physical Job Demands During the Study Period**

Physical job demands	Weighted prevalence of cognitive impairment (%)								Overall
	Wave 1 (2006)	Wave 2 (2008)	Wave 3 (2010)	Wave 4 (2012)	Wave 5 (2014)	Wave 6 (2016)	Wave 7 (2018)	Wave 8 (2020)	
Overall	6.9	7.2	8.2	6.6	9.5	8.2	12.5	12.2	8.6
Physical strength									
Never	3.1	4.7	10.4	5.8	6.5	10.9	4.1	5.5	6.4
Sometimes	2.3	7.0	5.7	4.5	6.6	4.2	11.1	12.7	6.4
Often	8.5	6.4	8.1	6.0	10.7	7.7	13.8	12.4	8.9
Always	10.4	10.1	11.1	11.5	13.2	14.8	14.4	13.6	11.9
Lifting heavy objects									
Never	3.0	3.1	6.3	3.2	5.6	3.9	3.1	1.8	3.8
Sometimes	3.9	6.7	4.8	5.2	6.4	4.0	11.4	12.7	6.4
Often	9.2	7.9	9.9	6.8	11.5	9.7	14.3	12.7	10.0
Always	10.7	10.1	12.4	11.1	14.8	16.9	15.3	16.4	12.8
Bending, kneeling, or squatting									
Never	2.9	0.8	6.0	5.2	4.5	5.4	2.1	2.1	3.6
Sometimes	2.4	6.2	5.2	5.0	6.0	2.9	8.1	13.2	5.7

Often	7.6	7.8	8.6	5.8	12.1	8.9	14.6	13.1	9.5
Always	13.2	11.1	14.2	12.6	12.6	17.7	20.1	12.6	13.9

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**Supplementary table 3. Weighted Distribution of Study Participants Across Levels of Each Physical Job Demand by Wave**

Physical job demands	Distribution (weighted %) of respondents								
	Wave 1 ( <i>n</i> = 2170)	Wave 2 ( <i>n</i> = 1971)	Wave 3 ( <i>n</i> = 1844)	Wave 4 ( <i>n</i> = 1686)	Wave 5 ( <i>n</i> = 1588)	Wave 6 ( <i>n</i> = 1444)	Wave 7 ( <i>n</i> = 1112)	Wave 8 ( <i>n</i> = 1114)	Overall ( <i>n</i> = 12929)
Physical strength									
Never	7.5	9.7	9.0	6.9	5.5	7.3	6.7	6.7	7.5
Sometimes	27.0	26.0	26.6	27.9	31.1	29.3	28.3	32.0	28.3
Often	39.5	42.4	45.4	45.9	48.8	45.5	47.2	45.7	44.7
Always	26.0	21.9	19.0	19.3	14.6	17.9	17.8	15.6	19.5
Lifting heavy objects									
Never	11.1	13.9	11.1	8.5	8.8	9.0	9.1	9.4	10.3
Sometimes	36.5	34.1	32.9	35.4	35.9	36.1	32.2	36.0	35.0
Often	31.2	34.3	39.9	39.9	43.4	39.9	42.9	40.1	38.4
Always	21.2	17.7	16.1	16.2	11.9	15.0	15.8	14.5	16.3
Bending, kneeling, or squatting									
Never	8.6	10.0	9.8	6.6	7.6	7.2	7.9	7.4	8.3
Sometimes	31.3	32.2	30.9	32.8	33.5	31.5	30.8	31.8	31.9
Often	36.9	38.9	43.2	43.8	46.4	45.0	45.6	42.7	42.4

Always

23.2

18.9

16.1

16.8

12.5

16.3

15.7

18.1

17.4

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**Supplementary table 4. Results of Models<sup>a</sup> Fitted with an Interaction Term Between Physical Strength and Potential Effect Modifiers**

Subgroup	Physical job demands (physical strength)								p-value for interaction
	Never		Sometimes		Often		Always		
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	
Overall	Ref		0.48	0.27–0.88	0.40	0.21–0.75	0.31	0.14–0.68	
Sex									0.388
Male	Ref		0.47	0.24–0.95	0.44	0.21–0.91	0.31	0.12–0.78	
Female	Ref		0.51	0.20–1.29	0.33	0.13–0.83	0.30	0.12–0.80	
Educational attainment									0.206
Elementary school or below	Ref		0.92	0.34–2.52	0.71	0.27–1.90	0.65	0.23–1.85	
Middle school	Ref		0.49	0.20–1.22	0.29	0.13–0.65	0.21	0.08–0.55	
High school	Ref		0.30	0.12–0.73	0.28	0.11–0.72	0.19	0.05–0.67	
College or above	Ref		0.89	0.13–5.96	1.46	0.22–9.77	0.74	0.07–8.34	
Household income									0.344
Below median	Ref		0.77	0.33–1.80	0.71	0.30–1.66	0.51	0.20–1.31	
Above median	Ref		0.40	0.20–0.80	0.31	0.15–0.63	0.26	0.11–0.62	
Body mass index									0.833
Below 25 kg/m <sup>2</sup>	Ref		0.53	0.27–1.05	0.43	0.21–0.89	0.35	0.15–0.86	



Permanent worker	Ref	1.14	0.47–2.74	0.65	0.27–1.57	0.58	0.22–1.57
Temporary worker	Ref	0.41	0.11–1.49	0.22	0.06–0.77	0.24	0.05–1.12
Day laborer	Ref	0.16	0.04–0.71	0.18	0.04–0.73	0.09	0.02–0.41
Self-employed worker	Ref	0.39	0.15–1.04	0.43	0.17–1.10	0.35	0.12–0.98
Unpaid family worker	Ref	0.33	0.03–4.24	0.34	0.03–4.25	0.32	0.02–4.30

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OR, odds ratio; CI, confidence interval; Ref, reference.

<sup>a</sup>Adjusted for sociodemographic, health-related, occupational characteristics, and other physical job demands.

<sup>b</sup>Insufficient physical activity was defined as less than 150 min per week based on the World Health Organization guidelines.

<sup>c</sup>Hypertension or diabetes cases were defined as those diagnosed with hypertension or diabetes by a physician.

<sup>d</sup>Depressive symptoms were defined as a score of four or above on the 10-item Center for Epidemiologic Studies Depression Scale.



Below 25 kg/m <sup>2</sup>	Ref	2.50	1.31–4.80	2.71	1.39–5.29	3.03	1.41–6.52	
Above 25 kg/m <sup>2</sup>	Ref	1.13	0.49–2.62	1.51	0.65–3.51	2.02	0.75–5.43	
Smoking status								0.460
Non-smoker	Ref	2.16	1.12–4.17	2.40	1.21–4.77	2.53	1.15–5.56	
Ex-smoker	Ref	1.72	0.59–4.96	1.77	0.59–5.27	1.75	0.53–5.86	
Current smoker	Ref	2.12	0.72–6.24	2.96	1.04–8.39	5.00	1.61–15.47	
Physical activity <sup>b</sup>								0.624
Sufficient	Ref	1.49	0.67–3.30	1.97	0.89–4.37	1.80	0.70–4.61	
Insufficient	Ref	2.41	1.21–4.79	2.62	1.32–5.21	3.20	1.45–7.07	
Hypertension <sup>c</sup>								0.459
No	Ref	2.67	1.39–5.13	3.21	1.63–6.35	3.63	1.66–7.93	
Yes	Ref	1.42	0.64–3.17	1.46	0.64–3.32	1.80	0.70–4.61	
Diabetes <sup>c</sup>								0.303
No	Ref	2.17	1.22–3.86	2.29	1.25–4.19	2.79	1.38–5.65	
Yes	Ref	1.34	0.52–3.45	2.40	0.88–6.55	2.16	0.66–7.06	
Depressive symptoms <sup>d</sup>								0.142
No	Ref	1.67	0.99–2.83	1.99	1.14–3.50	2.35	1.19–4.65	
Yes	Ref	9.60	2.10–	7.59	1.74–	8.24	1.75–	

			43.86		33.09		38.86	
Employment status								0.314
Permanent worker	Ref	3.54	1.53–8.16	2.89	1.20–6.98	4.49	1.62–12.47	
Temporary worker	Ref	1.26	0.35–4.60	1.27	0.37–4.39	2.71	0.61–12.13	
Day laborer	Ref	3.50	0.91–13.45	2.52	0.66–9.57	2.20	0.51–9.53	
Self-employed worker	Ref	1.51	0.69–3.30	2.26	1.00–5.14	2.42	0.93–6.26	
Unpaid family worker	Ref	1.16	0.22–6.05	1.85	0.32–10.74	1.80	0.29–11.02	

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OR, odds ratio; CI, confidence interval; Ref, reference.

<sup>a</sup>Adjusted for sociodemographic, health-related, occupational characteristics, and other physical job demands.

<sup>b</sup>Insufficient physical activity was defined as less than 150 min per week based on the World Health Organization guidelines.

<sup>c</sup>Hypertension or diabetes cases were defined as those diagnosed with hypertension or diabetes by a physician.

<sup>d</sup>Depressive symptoms were defined as a score of four or above on the 10-item Center for Epidemiologic Studies Depression Scale.

**Supplementary table 6. Results of Models<sup>a</sup> Fitted with an Interaction Term Between Bending, Kneeling, or Squatting and Potential Effect Modifiers**

Subgroup	Physical job demands (bending, kneeling, or squatting)								p-value for interaction
	Never		Sometimes		Often		Always		
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	
Overall	Ref		1.25	0.68–2.32	1.43	0.75–2.73	1.69	0.82–3.47	
Sex									0.784
Male	Ref		1.19	0.58–2.46	1.52	0.73–3.16	1.79	0.77–4.14	
Female	Ref		1.34	0.51–3.50	1.26	0.47–3.42	1.50	0.53–4.23	
Educational attainment									0.718
Elementary school or below	Ref		1.00	0.36–2.77	1.42	0.50–4.06	1.68	0.55–5.12	
Middle school	Ref		3.78	0.97–14.71	3.50	0.93–13.14	4.70	1.08–20.50	
High school	Ref		0.91	0.39–2.15	0.93	0.38–2.27	1.03	0.37–2.90	
College or above	Ref		1.60	0.31–8.19	2.53	0.48–13.38	1.42	0.13–16.12	
Household income									0.631
Below median	Ref		1.40	0.52–3.73	1.92	0.73–5.06	2.18	0.77–6.14	
Above median	Ref		1.21	0.59–2.46	1.26	0.60–2.62	1.52	0.67–3.48	





No	Ref	1.23	0.65–2.34	1.40	0.72–2.73	1.65	0.79–3.43
Yes	Ref	1.42	0.33–6.11	1.71	0.45–6.44	1.99	0.45–8.79
Employment status							0.459
Permanent worker	Ref	1.30	0.52–3.26	0.93	0.36–2.41	1.69	0.59–4.84
Temporary worker	Ref	0.83	0.19–3.67	1.31	0.32–5.37	2.38	0.48– 11.77
Day laborer	Ref	1.32	0.29–5.98	1.66	0.40–6.96	1.62	0.34–7.87
Self-employed worker	Ref	1.16	0.43–3.08	1.57	0.57–4.32	1.73	0.59–5.06
Unpaid family worker	Ref	2.43	0.48– 12.24	3.43	0.82– 14.45	2.58	0.59– 11.37

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OR, odds ratio; CI, confidence interval; Ref, reference.

<sup>a</sup>Adjusted for sociodemographic, health-related, occupational characteristics, and other physical job demands.

<sup>b</sup>Insufficient physical activity was defined as less than 150 min per week based on the World Health Organization guidelines.

<sup>c</sup>Hypertension or diabetes cases were defined as those diagnosed with hypertension or diabetes by a physician.

<sup>d</sup>Depressive symptoms were defined as a score of four or above on the 10-item Center for Epidemiologic Studies Depression Scale.

**Supplementary table 7. Longitudinal Associations Between Physical Job Demands and Cognitive Impairment: Incorporating Time-Lagged**

**Variables and Changes**

Physical job demands	Total						Male						Female					
	Total		Low EDU <sup>a</sup>		High EDU		Total		Low EDU		High EDU		Total		Low EDU		High EDU	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
<b>Physical strength</b>																		
Never	Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref	
Sometimes	0.67	0.37–1.21	0.55	0.23–1.28	0.81	0.35–1.85	0.55	0.27–1.10	0.35	0.13–0.96	0.75	0.29–1.92	1.10	0.33–3.59	1.29	0.20–8.53	0.55	0.13–2.35
Often	0.57	0.27–1.21	0.34	0.13–0.92	1.04	0.33–3.26	0.48	0.20–1.18	0.21	0.06–0.71	1.02	0.30–3.48	0.90	0.22–3.75	0.95	0.13–6.75	0.55	0.05–6.01
Always	0.39	0.15–1.06	0.22	0.07–0.69	0.99	0.19–5.08	0.35	0.10–1.23	0.11	0.02–0.52	1.28	0.21–7.88	0.64	0.13–3.14	0.82	0.11–5.96	0.18	0.01–2.99
The change in physical strength	0.73	0.56–0.95	0.69	0.53–0.91	0.80	0.49–1.32	0.69	0.49–0.97	0.58	0.40–0.83	0.83	0.47–1.46	0.80	0.56–1.15	0.86	0.58–1.27	0.64	0.25–1.64
<b>Lifting heavy objects</b>																		
Never	Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref	
Sometimes	2.28	1.27–4.11	1.92	0.82–4.51	2.26	1.02–5.00	1.70	0.86–3.37	1.61	0.55–4.69	1.59	0.68–3.76	4.58	1.28–16.43	3.28	0.63–16.99	11.30	2.65–48.17
Often	3.00	1.46–6.14	2.76	1.01–7.56	2.52	0.91–6.93	2.43	1.00–5.90	2.60	0.67–10.14	1.87	0.62–5.67	4.86	1.20–19.68	3.98	0.68–23.49	9.79	1.33–72.03
Always	4.32	1.76–10.58	5.37	1.64–17.56	1.95	0.48–7.88	2.92	0.91–9.37	4.73	0.84–26.58	1.29	0.28–6.03	9.25	1.89–45.13	8.81	1.22–63.52	11.58	0.93–143.67
The change in	1.20	0.96–	1.35	1.01–	0.99	0.71–	1.18	0.87–	1.38	0.87–	0.99	0.68–	1.19	0.87–	1.30	0.91–	0.92	0.46–

lifting heavy objects	1.49	1.80	1.37	1.58	2.16	1.42	1.63	1.86	1.86									
Bending, kneeling, or squatting																		
Never	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref									
Sometimes	0.70	0.35–1.40	1.24	0.46–3.36	0.52	0.21–1.30	0.80	0.36–1.76	0.92	0.28–3.05	0.71	0.26–1.93	0.66	0.13–3.42	5.54	0.61–50.43	0.18	0.02–1.41
Often	0.82	0.38–1.75	1.42	0.49–4.11	0.59	0.21–1.68	1.04	0.42–2.62	1.53	0.39–6.03	0.72	0.22–2.33	0.60	0.11–3.25	3.74	0.37–37.61	0.27	0.02–3.28
Always	0.90	0.36–2.27	1.84	0.56–6.06	0.47	0.10–2.13	1.20	0.38–3.80	2.09	0.43–10.19	0.57	0.09–3.43	0.56	0.09–3.56	3.78	0.33–43.33	0.19	0.01–4.77
The change in bending, kneeling, or squatting	1.09	0.87–1.37	1.10	0.84–1.45	1.08	0.75–1.57	1.25	0.94–1.66	1.34	0.91–1.99	1.14	0.76–1.71	0.83	0.58–1.20	0.81	0.56–1.16	0.85	0.31–2.36

EDU, educational attainment; OR, odds ratio; CI, confidence interval; Ref, reference

Adjusted for sociodemographic, health-related, occupational characteristics, and other physical job demands.

<sup>a</sup>Educational attainment was dichotomized as low EDU (middle school or below) and high EDU (high school or above).