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Unhealthy lifestyle and sleep problems as risk factors for increased direct employers' cost of short-term sickness absence ¹

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1 *Supplementary tables*

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Supplemental table S1. Characteristics of participants who were excluded from analyses due to missing informant consent or who had lifestyle and background variables missing compared to participants with complete information.

	Complete cases	No informant consent	Missing lifestyle and background variables
n	5459	1974	985
% ^a	100.0	100.0	100.0
sex			
men, n	1073	320	126
%	19.7	16.2	12.8
women, n	4386	1654	859
%	80.3	83.8	87.2
Age, years			
mean	49.0	49.0	50.5
sd	6.5	6.5	6.4

Marital status				
Married, n	3233	1049	558	
%	59.2	53.7	58.6	
Co-habiting, n	593	238	120	
%	10.7	12.2	12.6	
Single, n	704	301	96	
%	12.9	15.4	10.1	
Widow, n	109	46	30	
%	2.0	2.4	3.2	
Separated / Divorced, n	820	319	149	
%	15.0	16.3	15.6	
Education, n				
Primary school, n	547	326	165	
%	10.0	16.7	17.6	
Secondary school	416	164	76	
%	7.6	8.4	8.1	
College	1100	459	208	
%	20.2	23.6	22.2	
High school	1861	557	267	
%	34.1	28.6	28.5	
University	1535	441	222	
%	28.1	22.7	23.7	
Income				
< 1260 €, n	407	187	82	

%	7.5	10.0	9.8
1260-1680 €, n	799	363	140
%	14.6	19.4	16.7
1681-2100 €, n	666	229	120
%	12.2	12.2	14.3
2101-2520 €, n	876	308	147
%	16.1	16.4	17.6
2521-3360 €, n	1389	412	165
%	25.4	22.0	19.7
3361-4200 €, n	785	228	96
%	14.4	12.2	11.5
> 4200 €, n	537	146	87
%	14.4	7.8	10.4
Occupational class			
Managers and professionals, n	1797	473	265
%	32.9	26.3	26.9
Semiprofessionals, n	1111	301	156
%	20.4	16.7	15.8
Routine non-manuals, n	1938	725	401
%	35.5	40.3	40.7
Manual workers, n	613	302	163
%	11.2	16.8	16.6
BMI, kg/m ²			
mean	25.5	25.4	25.7

sd	4.3	4.3	4.7
Physical functioning, score			
mean	89.6	88.3	89.2
sd	14.4	15.6	14.9

BMI, body mass index.

^a For total cohort, percentages are calculated by columns whereas for sex-stratified percentages were calculated by rows.

Supplemental table S2. Association between risk factors and direct cost of short-term (1-14 days) sickness absence over 10-year follow-up.

[illegible]

Both daily		ref.			ref.			ref.			ref.	
Either daily	-0.011	0.115	0.93	-0.023	0.116	0.84	-0.039	0.116	0.74	-0.040	0.117	0.736
Neither daily	0.304	0.137	0.026	0.233	0.139	0.09	0.220	0.139	0.11	0.218	0.140	0.119
Sleep ^j												
Good sleep		ref.			ref.			ref.			ref.	
Moderate sleep	0.334	0.114	0.003	0.372	0.114	0.001	0.302	0.116	0.009	0.362	0.116	0.002
Poor sleep	0.443	0.130	0.001	0.441	0.131	0.001	0.313	0.136	0.021	0.408	0.132	0.002
Generalized linear model ^k												
Number of risk factors												
0		ref.			ref.			ref.			ref.	
1	0.124	0.043	0.004	0.114	0.040	0.004	0.097	0.040	0.014	0.098	0.039	0.011
2	0.309	0.050	<0.001	0.274	0.046	<0.001	0.230	0.047	<0.001	0.228	0.046	<0.001
≥3	0.422	0.066	<0.001	0.383	0.062	<0.001	0.321	0.062	<0.001	0.356	0.061	<0.001
Physical activity												
Vigorously active		ref.			ref.			ref.			ref.	
Moderately active	0.090	0.041	0.028	0.078	0.038	0.043	0.048	0.038	0.22	0.030	0.038	0.424
Inactive	0.170	0.048	<0.001	0.106	0.045	0.019	0.106	0.045	0.019	0.083	0.045	0.063
Smoking												
Non-smoker		ref.			ref.			ref.			ref.	
Former smoker	0.169	0.043	<0.001	0.157	0.041	<0.001	0.157	0.041	<0.001	0.140	0.040	<0.001
Current smoker	0.318	0.044	<0.001	0.286	0.042	<0.001	0.283	0.041	<0.001	0.292	0.041	<0.001
Alcohol use												
Non-user		ref.			ref.			ref.			ref.	
Moderate user	-0.077	0.078	0.32	-0.045	0.073	0.54	-0.004	0.073	0.95	-0.006	0.071	0.934

High user	-0.064	0.087	0.46	-0.02	0.082	0.81	0.029	0.082	0.73	0.026	0.080	0.748
F&V consumption												
Both daily		ref.			ref.			ref.			ref.	
Either daily	0.009	0.041	0.82	-0.001	0.039	0.98	-0.003	0.038	0.95	-0.003	0.038	0.927
Neither daily	0.077	0.046	0.10	0.044	0.044	0.31	0.035	0.044	0.42	0.022	0.043	0.608
Sleep												
Good sleep		ref.			ref.			ref.			ref.	
Moderate sleep	0.133	0.040	0.001	0.138	0.037	<0.001	0.100	0.037	0.008	0.125	0.036	0.001
Poor sleep	0.215	0.046	<0.001	0.214	0.043	<0.001	0.140	0.045	0.002	0.192	0.042	<0.001

F, fruits; SE, standard error; V, vegetables.

^a Model 1 was adjusted for age, sex and follow-up time.

^b When analyzing each risk factor independently, the model was also adjusted for other risk factors.

^c Model 2 was adjusted for age, sex, follow-up time, marital status, and occupational class.

^d Model 3 was adjusted for age, sex, follow-up time, marital status, occupational class and physical functioning.

^e Model 4 was adjusted for age, sex, follow-up time, marital status, occupational class, and BMI.

^f In binomial model, the association between the number of risk factors and probability of having sickness absence costs was analyzed among all participants.

^g A sum of the risk factors, ranging from 0 to 5 points, was calculated as follows: Participants received one point for being a smoker; high alcohol user (>7 portions/week for women and >14 portions/week for men, one portion of alcohol contains 12g ethanol); physically inactive

(<14 MET hours/ week); infrequent fruit and vegetable consumption (<1 times/day); or poor sleep (difficulties initiating and maintaining sleep as well as non-restorative sleep >14 nights/month).

^h Vigorous physical activity was defined as ≥ 14 MET hours/week including exercise at the two highest intensity grades. Moderate physical activity was defined as ≥ 14 MET hours/week at moderate at the two lowest intensity grades. Physical inactivity was defined as <14 MET hours/week.

ⁱ Moderate alcohol use was defined as <8 portions / week for women and <15 portions / week for men. High alcohol use was defined as >7 portions / week for women and >14 portions / week for men. One portion of alcohol contains 12g ethanol.

^j Good sleep was defined as 6-8 hours of sleep/night and reporting insomnia symptoms in <4 nights /month. Moderate sleep was defined as <6h or >8 hours of sleep/night or reporting insomnia symptoms in 4-14 nights/month. Poor sleep was defined as reporting insomnia symptoms in >14 nights/ month. Insomnia symptoms were measured by four items asking difficulties initiating and maintaining sleep as well as non-restorative sleep during the previous 4 weeks.

^k In generalized linear model, the association between the number of risk factors and sickness absence costs was analyzed among those who had sickness absence costs.

Supplemental table S3. Association between number of risk factors and direct cost of short-term (1-14 days) sickness absence over 10-years follow-up. Complete case analysis.

	Model 1 ^{a,b}			Model 2 ^{b,c}			Model 3 ^{b,d}			Model 4 ^{b,e}		
	Coef	SE	P	Coef	SE	P	Coef	SE	P	Coef	SE	P
Binomial model ^f												
Number of risk factors ^g												
0	ref.			ref.			ref.			ref.		
1	0.305	0.123	0.013	0.275	0.125	0.028	0.236	0.126	0.062	0.256	0.126	0.041
2	0.773	0.157	<0.001	0.715	0.159	<0.001	0.644	0.162	<0.001	0.679	0.160	<0.001
≥3	0.618	0.205	0.003	0.518	0.209	0.013	0.405	0.214	0.058	0.469	0.210	0.025
Physical activity ^h												
Vigorously active	ref.			ref.			ref.			ref.		
Moderately active	0.343	0.130	0.008	0.285	0.133	0.032	0.264	0.133	0.048	0.240	0.134	0.073
Inactive	0.104	0.145	0.475	0.083	0.147	0.574	0.01	0.151	0.945	-0.005	0.151	0.975
Smoking												
Non-smoker	ref.			ref.			ref.			ref.		
Former smoker	0.242	0.129	0.060	0.170	0.131	0.196	0.178	0.132	0.176	0.149	0.132	0.260
Current smoker	0.905	0.164	<0.001	0.730	0.168	<0.001	0.709	0.168	<0.001	0.729	0.168	<0.001
Alcohol use ⁱ												
Non-user	ref.			ref.			ref.			ref.		
Moderate user	0.281	0.209	0.179	0.367	0.213	0.085	0.403	0.214	0.060	0.363	0.214	0.090
High user	0.304	0.249	0.223	0.528	0.255	0.039	0.575	0.256	0.025	0.530	0.256	0.038
F&V consumption												
Both daily	ref.			ref.			ref.			ref.		

Either daily	-0.029	0.127	0.822	-0.046	0.129	0.721	-0.054	0.129	0.675	-0.055	0.129	0.671
Neither daily	0.245	0.150	0.103	0.159	0.153	0.299	0.149	0.153	0.329	0.162	0.153	0.291
Sleep ^j												
Good sleep		ref.			ref.			ref.			ref.	
Moderate sleep	0.409	0.125	0.001	0.443	0.127	<0.001	0.398	0.129	0.002	0.432	0.127	0.001
Poor sleep	0.512	0.144	<0.001	0.498	0.145	0.001	0.404	0.152	0.008	0.473	0.146	0.001
Generalized linear model ^k												
Number of risk factors												
0		ref.			ref.			ref.			ref.	
1	0.123	0.043	0.004	0.119	0.041	0.004	0.101	0.042	0.016	0.104	0.040	0.010
2	0.345	0.049	<0.001	0.301	0.047	<0.001	0.263	0.049	<0.001	0.266	0.047	<0.001
≥3	0.453	0.065	<0.001	0.414	0.063	<0.001	0.360	0.065	<0.001	0.392	0.062	<0.001
Physical activity												
Vigorously active		ref.			ref.			ref.			ref.	
Moderately active	0.089	0.042	0.033	0.069	0.04	0.089	0.046	0.041	0.260	0.030	0.040	0.450
Inactive	0.158	0.049	0.001	0.109	0.048	0.025	0.109	0.048	0.025	0.084	0.047	0.075
Smoking												
Non-smoker		ref.			ref.			ref.			ref.	
Former smoker	0.130	0.044	0.004	0.111	0.043	0.010	0.117	0.043	0.007	0.099	0.042	0.019
Current smoker	0.335	0.045	<0.001	0.284	0.044	<0.001	0.284	0.045	<0.001	0.300	0.043	<0.001
Alcohol use												
Non-user		ref.			ref.			ref.			ref.	
Moderate user	-0.113	0.081	0.163	-0.070	0.078	0.372	-0.031	0.079	0.693	-0.041	0.076	0.590

High user	-0.064	0.091	0.479	0.004	0.087	0.959	0.047	0.088	0.593	0.025	0.085	0.769
F&V consumption												
Both daily		ref.			ref.			ref.			ref.	
Either daily	0.040	0.042	0.347	0.025	0.041	0.532	0.023	0.041	0.575	0.025	0.040	0.532
Neither daily	0.097	0.048	0.043	0.054	0.046	0.248	0.045	0.047	0.335	0.043	0.045	0.342
Sleep												
Good sleep		ref.			ref.			ref.			ref.	
Moderate sleep	0.111	0.040	0.006	0.123	0.039	0.002	0.092	0.040	0.020	0.110	0.038	0.004
Poor sleep	0.204	0.048	<0.001	0.205	0.046	<0.001	0.136	0.048	0.005	0.182	0.045	<0.001

Abbreviations: F, fruits; SE, standard error; V, vegetables.

^a Model 1 was adjusted for age, sex and follow-up time.

^b When analyzing each risk factor independently, the model was also adjusted for other risk factors.

^c Model 2 was adjusted for age, sex, follow-up time, marital status, and occupational class.

^d Model 3 was adjusted for age, sex, follow-up time, marital status, occupational class and physical functioning.

^e Model 4 was adjusted for age, sex, follow-up time, marital status, occupational class, and BMI.

^f In binomial model, the association between the number of risk factors and probability of having sickness absence costs was analyzed among all participants.

^g A sum of the risk factors, ranging from 0 to 5 points, was calculated as follows: Participants received one point for being a smoker; high alcohol user (>7 portions/week for women and >14 portions/week for men, one portion of alcohol contains 12g ethanol); physically inactive (<14 MET hours/ week); infrequent fruit and vegetable consumption (<1 times/day); or poor sleep (difficulties initiating and maintaining sleep as well as non-restorative sleep >14 nights/month).

^h Vigorous physical activity was defined as ≥ 14 MET hours/week including exercise at the two highest intensity grades. Moderate physical activity was defined as ≥ 14 MET hours/week at moderate at the two lowest intensity grades. Physical inactivity was defined as <14 MET hours/week.

ⁱ Moderate alcohol use was defined as <8 portions / week for women and <15 portions / week for men. High alcohol use was defined as >7 portions / week for women and >14 portions / week for men. One portion of alcohol contains 12g ethanol.

^j Good sleep was defined as 6-8 hours of sleep/night, short sleep as <6h sleep/night and long sleep as >8 hours of sleep/night. Insomnia symptoms were measured by four items asking difficulties initiating and maintaining sleep as well as non-restorative sleep during the previous 4 weeks. No insomnia symptoms was defined as reporting symptoms <4 nights/month; occasional symptoms was defined as symptoms 4-14 nights/month; and frequent symptoms as symptoms >14 nights/month.

^k In generalized linear model, the association between the number of risk factors and sickness absence costs was analyzed among those who had sickness absence costs.

Supplemental table S4. Marginal effects on cost (€) of short-term (1-14 days) sickness absence on employer over 10 years: participants with multiple risk factors compared to those without any risk factors. Complete case analysis.

	Model 1 ^{a,b}			Model 2 ^{b,c}			Model 3 ^{b,d}			Model 4 ^{b,e}		
	dy/dx ^f	95% CI		dy/dx	95% CI		dy/dx	95% CI		dy/dx	95% CI	
Number of risk factors ^g												
0		ref.			ref.			ref.			ref.	
1	958	361	1554	991	340	1482	777	191	1362	802	239	1365
2	2948	2119	3778	2524	1744	3304	2195	1405	2985	2212	1454	2970
≥3	4001	2736	5267	3580	2340	4761	3056	1884	4229	3369	2220	4519
Physical activity ^h												
Vigorously active		ref			ref.			ref			ref.	
Moderately active	755	130	1380	578	-20	1177	404	-206	1014	278	-315	871
Inactive	1260	492	2029	1171	434	1908	843	98	1589	646	-74	1366
Smoking												
Non-smoker		ref			ref.			ref			ref.	
Former smoker	1024	359	1689	859	218	1500	905	258	1551	757	140	1373
Current smoker	2976	2178	3773	2464	1704	3224	2449	1686	3212	2594	1846	3341
Alcohol use ⁱ												
Non-user		ref			ref.			ref			ref.	
Moderate user	-836	-2197	526	-445	-1689	798	-129	-1334	1080	-219	-1395	956
High user	-444	-1953	1066	175	-1231	1582	527	-855	1908	335	-999	1670
F&V consumption												
Both daily		ref			ref.			ref			ref.	

Either daily	296	-341	934	183	-429	796	163	-454	780	176	-419	772
Neither daily	821	62	1581	452	-271	1174	381	-342	1105	366	-331	1063
Sleep ^j												
Good sleep		ref			ref.			ref			ref.	
Moderate sleep	943	332	1555	1027	440	1614	790	189	1391	923	353	1494
Poor sleep	1748	958	2538	1730	978	2481	1148	382	1915	1526	802	2249

Abbreviations: CI, confidence interval; F, fruits; V, vegetables.

^a Model 1 was adjusted for age, sex and follow-up time.

^b When analyzing each risk factor independently, the model was also adjusted for other risk factors.

^c Model 2 was adjusted for age, sex, follow-up time, marital status, and occupational class.

^d Model 3 was adjusted for age, sex, follow-up time, marital status, occupational class and physical functioning.

^e Model 4 was adjusted for age, sex, follow-up time, marital status, occupational class, and BMI.

^f Marginal effects at covariate means are derived from the two-part model, in which the association between risk factors and probability of having costs was first analyzed with logistic model among all participants. Then the association between risk factors and the amount of costs was analyzed with linear model among participants who had any costs.

^g A sum of the risk factors, ranging from 0 to 5 points, was calculated as follows: Participants received one point for being a smoker; high alcohol user (>7 portions/week for women and >14 portions/week for men, one portion of alcohol contains 12g ethanol); physically inactive

(<14 MET hours/ week); infrequent fruit and vegetable consumption (<1 times/day); or poor sleep (difficulties initiating and maintaining sleep as well as non-restorative sleep >14 nights/month).

^h Vigorous physical activity was defined as ≥ 14 MET hours/week including exercise at the two highest intensity grades. Moderate physical activity was defined as ≥ 14 MET hours/week at moderate at the two lowest intensity grades. Physical inactivity was defined as <14 MET hours/week.

ⁱ Moderate alcohol use was defined as <8 portions / week for women and <15 portions / week for men. High alcohol use was defined as >7 portions / week for women and >14 portions / week for men. One portion of alcohol contains 12g ethanol.

^j Good sleep was defined as 6-8 hours of sleep/night, short sleep as <6h sleep/night and long sleep as >8 hours of sleep/night. Insomnia symptoms were measured by four items asking difficulties initiating and maintaining sleep as well as non-restorative sleep during the previous 4 weeks. No insomnia symptoms was defined as reporting symptoms <4 nights/month; occasional symptoms was defined as symptoms 4-14 nights/month; and frequent symptoms as symptoms >14 nights/month.