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

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This study adds to the Literature by providing a calculation of the direct cost of short-term sickness absence due to unhealthy behaviors among Finnish public-sector employees. Employees with unhealthy behaviors have more sickness absence rendering higher costs for the employers. Targeted programs addressing health behaviors are expected to yield substantial savings.

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Key terms: alcohol; cost; employer cost; fruit; Helsinki Health Study; insomnia symptom; lifestyle; physical activity; risk factor; short-term sickness absence; sick leave; sickness absence; sickness absence; sleep; sleep duration; sleep problem; smoking; unhealthy lifestyle; vegetable

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

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Objectives Unhealthy lifestyle (eg, smoking) as well as sleep problems are associated with increased risk of sickness absence, but the financial impact of these associations beyond risk ratios is not well known. We aimed to estimate the additive contribution of lifestyle and sleep problems (risk factors) to direct costs of short-term (<15 days) sickness absence.

Methods The Helsinki Health Study is a longitudinal cohort of employees of the City of Helsinki, Finland (N=8960, response rate 67%). During 2000–2002 the participants were mailed a survey questionnaire that gathered information on their lifestyle and sleep. A sum of the risk factors was calculated: participants received one point for being a smoker; high alcohol user (>7 servings/week for women and >14 servings/week for men); physically inactive [<14 metabolic equivalents (MET) hours/week]; having low fruit and vegetable consumption (<1 times/day); or suffering from frequent insomnia symptoms. Sickness absence, salary, and time of employment were followed through the employer's register between 2002–2016. Individual salary data were used to calculate the direct costs of short-term sickness absence. Data were analyzed using a two-part model.

Results Direct costs of short-term sickness absences were on average €9057 (standard deviation €11 858) per employee over the follow-up. Those with ≥3 risk factors had €3266 [95% confidence interval (95% CI) €2114–4417] higher direct costs for the employer over the follow-up compared to those without any risk factors.

Conclusions Unhealthy lifestyle and sleep problems may increase the costs of short-term sickness absence to the employer by 10–30%. Consequently, programs addressing lifestyle and sleep may deliver significant savings.

Key terms alcohol; fruit; Helsinki Health Study; insomnia symptom; physical activity; sick leave; sleep duration; smoking; vegetable.

Sickness and disability generate considerable burden to societies, healthcare systems, and employers. Causes of sickness absence from work are multifactorial and include occupational injuries and work-related factors, such as physical demands, perceived exertion and psychosocial exposures (1–4). In addition to work-related factors, sickness absence is influenced by an unhealthy lifestyle, such as low physical activity (5), heavy alcohol consumption (6), and smoking (7). Furthermore, other factors that are closely related to an unhealthy lifestyle – eg, overweight and obesity (8) as well as insomnia with short or long sleep (9) – have been associated with higher risk of sickness absence.

Unhealthy lifestyle factors tend to cluster with each other (10, 11) and have additive effects on health (12). A majority of individuals demonstrate 0–1 factors, whereas accumulation of >2 factors is rare (13). Lifestyle factors that have been found to cluster more commonly within an individual are smoking and high alcohol consumption as well as inactivity and poor diet (10, 11, 13). Smoking especially seems to play a central role as a gateway to an unhealthy lifestyle among both men and women (14). Smoking men have also been found to be more consistent in their lifestyle over time compared to non-smoking men (15). Besides sex, there are many other sociodemographic factors that are associated with

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an unhealthy lifestyle. Young age, not being married, having a lower education and belonging to a lower occupational class may predispose individuals to have multiple unhealthy lifestyle factors (16).

Sickness absence comes with a great economical cost. On average, Organization for Economic Co-operation and Development (OECD) countries spend 2.1% of their GDP on disability and sickness benefits (17). For the employers, sickness costs can be divided to presenteeism (at-work) and absenteeism (out-of-work) related costs (18). Absenteeism includes costs such as salary paid during employee's sickness leave, possible sickness benefits, healthcare fees, use of substitute, delays and decreases in production due to absence (from work). Some studies have also attempted to estimate costs of sickness absence that are attributable to an unhealthy lifestyle, overweight and obesity, and sleep problems. Thus far, current and former smoking and lack of exercise have repeatedly been associated with higher medical and productivity costs (19–22). Even though there are number of studies that have shown an association between a single lifestyle factor and sickness absence, we lack studies on the economic impact of an unhealthy lifestyle on sickness-absence-related costs. Furthermore, studies with a prospective design and use of individual rather than group-level data are needed.

We examined the association between the number of unhealthy lifestyle factors (physical inactivity, smoking, alcohol consumption, and poor diet) and the direct employer's costs of short-term (<15 days) sickness absence over ten years of follow-up. In addition to these common lifestyle factors, we included sleep duration and insomnia symptoms as additional risk factors as their importance in relation to the other risk factors and sickness absence has been only recently explored. We used individual sickness absence and salary data obtained from the employer's comprehensive register to estimate the direct costs related to the risk factors among midlife employees of the City of Helsinki, Finland.

Methods

Participants

Helsinki Health Study (HHS) invited employees of the City of Helsinki (N=13 344) to participate in the mail questionnaire survey in 2000–2002 (23). At baseline, the cohort comprised 8960 (67%) employees aged 40–60 years who responded to the questionnaire. The participants were followed through the employer's comprehensive personnel register on sickness absence, salary, and time of employment. Register linkage was done using the unique personal identification number given to each Finnish citizen. Those who did not give their consent for register linkage (N=1974, 22%) were excluded from this study. Of the remaining participants, those who were not in work during the follow-up (N=471) or had either salary, working time, or both missing in the first follow-up year (N=71) were excluded. The final analysis sample comprised 6444 participants (80% women).

The Ethics Committee of the Department of Public Health, University of Helsinki (30 November 1998), and the City of Helsinki health authorities (3 February 2000), Finland, approved the HHS protocol.

Direct employer costs of short-term sickness absence

The short-term sickness absence (<15 days) of the participants were followed in the employer's register. Follow-up began 1 January 2000 and continued until the end of 2016 or until the end of the employment contract. In this study, however, to overcome difficulties in taking into account the change in currency from Finnish markkas to euros, and possible bias that could generate from the changes made to the registration method of sickness absence in 2001, follow-up was considered to begin 1 January 2002. Furthermore, if the participant had either salary, working time, or both missing in some follow-up year, the participant was followed-up until the last year when all information was available.

Individual annual gross salary data were used to calculate the cost of short-term sickness absence. Salaries were first converted to 2016 earnings level using local government wage and salary indices (24). Then, average daily earnings were calculated for every participant for each follow-up year. The individual annual salary was divided by the months the participant was employed and then divided by 21 to give the average daily salary for the specific year.

The cost of sickness absence was calculated for each individual and follow-up year by multiplying the total annual number of short-term sickness absence days with the daily salary of the specific year. Then the figures for each follow-up year were summed to give the total cost of short-term sickness absence during the follow-up years.

Risk factors of short-term sickness absences and other variables

The baseline questionnaire gathered information on participants' sociodemographic (age, sex, marital status, and household income) and health [physical functioning, body mass index (BMI), sleep duration and insomnia symptoms] characteristics as well as lifestyle factors (physical activity, smoking, alcohol use, and diet). Self-perceived physical functioning was assessed, using the Short Form 36 Health Survey's subscale for physical functioning (25). The score ranges from 0–100, with higher scores representing better physical functioning. BMI was calculated as weight (kg) divided by the square of high (m^2), based on participants' self-reported measures. Participants were asked to report their current marital status using the following categories: married, co-habiting, single, widowed, or divorced/separated. Education was assessed by asking the participants to report their highest educational level as primary school, secondary school, vocational school, upper-secondary school or college, or university. Participants' household income was asked using seven categories ranging from <€1260–>4200. Furthermore, socioeconomic status was assessed as occupational class, which was obtained through the employer's register and categorized as follows: managers or professionals, semi-professionals, routine non-manuals, or manual workers.

In the questionnaire, participants were asked whether they currently smoked regularly. Those who answered "yes" were classified as current smokers. Those who reported a former regular smoking habit were classified as former smokers, and those who responded negatively were classified as non-smokers (reference group).

Consumption of different alcohol types (beer/cider/wine/spirits) was reported on seven frequency categories. To calculate total alcohol consumption level, the consumption of different alcohol types was summed together. One portion of alcohol was defined to contain 12g ethanol. Those who reported consuming >7 servings/week for women and >14 servings/week for men, were classified as high alcohol users (26, 27). Those who reported less than these portions/week were classified as moderate alcohol users. Participants who reported no alcohol consumption were classified as non-users (reference group).

The average weekly hours of PA during leisure time or commuting within the previous 12 months was estimated with a question that had four grades of intensity: walking, brisk walking, jogging, and running or their equivalent activities (5). Each intensity grade was divided into 5 response alternatives from 0–4 hours or more. Metabolic equivalents (MET) were used to approximate the amount of physical activity. MET hours/week were calculated by multiplying the time spent in physical activity with the MET value of each intensity grade and adding the four values together. Participants with weekly exercise <14 MET hours were classified as physically inactive. Furthermore, those with ≥14 MET hours on the two lowest intensity grades as moderately active, and ≥14 MET hours including exercise at the two highest intensity grades as vigorously active (reference group) (22).

The consumption of various food items was measured with a 22-item food frequency questionnaire that was included in the baseline questionnaire (28). Participants were asked to estimate how often they had consumed the specific food items during the past four weeks. Average consumption frequency of each food item was reported on seven frequency categories ranging from "not during the past 4 weeks" to "1–2 times/day". Fresh fruits (F) and vegetables (V) consumption was categorized to non-daily F&V consumption (<1 times/day), daily consumption of either F or V, and daily consumption of both F&V (reference group).

Sleep was measured by first asking the respondents about their usual sleep duration during weekdays (29). This was reported in full hours with six response alternatives ranging from ≤5–≥10 hours. Reporting sleeping for ≥9 hours was classified as long sleep. Reporting sleeping for ≤5 hours was classified as short sleep, and mid-range sleep duration was classified as 6–8 hours. Insomnia symptoms were measured by four items asking difficulties initiating and maintaining sleep as well as non-restorative sleep during the previous four weeks (30). Six response alternatives ranged from "never" to "in 22–28 nights/month". The joint sleep variable was created using responses to questions on insomnia symptoms and sleep duration (29). Those who reported mid-range sleep and insomnia symptoms <4 nights/month were classified as good sleepers (reference group). Those who reported short or long sleep or having insomnia symptoms 4–14 nights/month were classified as moderate sleepers, and those reporting insomnia symptoms >14 nights/months (regardless of sleeping hours) were classified as poor sleepers.

Summary score of risk factors

To examine the additive effect of multiple risk factors for short-term sickness absence, a sum of the risk factors for each participant was calculated. The score was selected to include the following risk factors: current smoking habit, high alcohol consumption, physical inactivity, non-daily F&V consumption, and poor sleep (as defined above). From each of these risk factors, participant received 1 point. Otherwise 0 points were given. The points were summed up and the final score ranked from 0–5 points. For analysis purposes, participants were classified as those who had: 0 (reference group), 1, 2, and ≥3 risk factors.

Statistical analysis

The analyses were performed, using R statistical software version 3.3.2 (31) and STATA version 12 (Stata Corp, College Station, TX, USA). Due to the low number of men in the cohort, the analyses were conducted jointly for men and women.

In total, 788 participants had missing information in some of the risk factors (physical activity, smoking, alcohol use, F&V consumption, poor sleep), and 197 participants had missing information on the background variables (age, sex, marital status, occupational class, physical functioning, BMI). Missing information in these variables was imputed, using predictive mean matching ("mice" procedure in package mice in R) (32). All analyses and tables are presented for the imputed dataset (N=6444), unless otherwise mentioned.

Participants' sociodemographic and health characteristics are presented as mean and standard deviation (SD) for continuous variables and as count and percentage for categorical variables. Differences in the background variables by the number of risk factors were tested with linear regression and with χ^2 test for categorical variables.

Association between the number of risk factors and costs of short-term sickness absence were analyzed, using a two-part model. First, the probability of having short-term sickness absence was analyzed among all participants, using generalized linear model with binomial distribution. Then, generalized linear model with gamma distribution and log-link function was used to analyze association between the number of risk factors and costs of short-term sickness absence among participants who had costs during the ten-year follow-up period. To control for confounding, both analyses were first adjusted for age, sex, and follow-up time. The second model was additionally adjusted for marital status and occupational class; the third model for physical functioning; and the fourth model for BMI. From the two-part model, marginal effects were evaluated at covariate means to provide estimated effect of the number of risk factors on employer's costs in monetary terms ("tpm" and "margins" procedure in STATA).

Table 1. Participants' sociodemographic and health characteristics by number of risk factors. [BMI=body mass index; SD=standard deviation].

	Number of risk factors [a]																P-value [b]
	0				1				2				≥3				
	N	%	Mean	SD	N	%	Mean	SD	N	%	Mean	SD	N	%	Mean	SD	
Total	2137	33.2			2393	37.4			1318	20.5			596	9.3			
Sex																	<0.001
Men	328	27.4			436	36.4			289	24.1			146	12.2			
Women	1809	34.5			1957	37.3			1029	19.6			450	8.6			
Age (years)			49.2	6.5			49.4	6.6			49.3	6.5			49.1	6.3	0.91
Marital status																	<0.001
Married	1382	36.3			1441	37.9			721	19.0			260	6.8			
Co-habiting	187	26.1			259	36.1			163	22.8			107	14.9			
Single	256	31.8			284	35.3			174	21.6			90	11.2			
Widow	42	29.8			57	40.4			34	24.1			8	5.7			
Separated/divorced	270	27.6			352	36.0			226	23.1			131	13.4			
Education																	<0.001
Primary school	181	25.2			256	35.6			191	26.6			91	12.7			
Secondary school	138	27.8			162	32.7			135	27.2			61	12.3			
Vocational school	423	32.0			527	39.9			253	19.1			119	9.0			
Upper-secondary/college	765	35.7			787	36.7			392	18.3			199	9.3			
University	630	35.7			661	37.5			437	19.7			126	7.1			
Occupational class																	<0.001
Managers and professionals	733	35.6			767	37.2			394	19.1			168	8.2			
Semi-professionals	469	37.0			483	38.1			206	16.3			109	8.6			
Routine non-manuals	737	31.5			864	36.9			522	22.3			216	9.2			
Manual workers	198	25.5			279	36.0			196	25.3			103	13.3			
Household income (€)																	<0.001
<1260	148	29.8			169	34.0			119	23.9			61	12.3			
1260–1680	286	29.9			332	34.7			220	30.0			119	12.4			
1681–2100	237	29.6			290	36.2			189	23.6			86	10.7			
2101–2520	305	28.9			430	40.8			210	19.9			110	10.4			
2521–3360	544	34.0			619	38.7			309	19.3			128	8.0			
3361–4200	365	40.7			296	33.0			174	19.4			61	6.8			
>4200	252	39.6			257	40.4			97	15.2			31	4.9			
BMI (kg/m^2)			24.9	4.0			25.5	4.3			26.2	4.8			26.5	4.9	<0.001
Physical functioning (score) [c]			92.7	11.3			89.7	14.2			86.2	17.0			84.2	16.9	<0.001

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

[b] Unadjusted P-value for categorical variables was derived from Pearson's chi-square test (using score as categorical variable) and for continuous variable from linear regression (using the sum of risk factors as continuous variable).

[c] Physical functioning score was derived from the SF-36 subscale for physical functioning.

In addition to analyzing the total number of risk factors each factor's association with the costs of short-term sickness absence was analyzed independently, adjusting for the other risk factors. In these analyses, we used the three-category variables for risk factors (described earlier in the methods).

Finally, as a sensitivity test, we also conducted analyses as complete-case analyses.

Results

Participants were 49.3 [standard deviation (SD) 6.5] years on average at baseline. A majority of them were women (N=5245, 81.4%), married (N=3804, 59.0%), and one-third had at least high-school level degree (N=2143, 33.3%). The largest occupational class was routine non-manuals (N=2339, 36.3%) and the largest household income class was those who earned €2521–3360/month (N=1600, 24.8%). Participants were, on average, overweight (mean 25.5 kg/m^2, SD 4.4 kg/m^2) and their physical functioning was 89.5 points (SD 14.5). When participants' sociodemographic and health characteristics were stratified by the number of risk factors, those with ≥3 risk factors were likely to be men, co-habiting, and having lower occupational class compared to those without any risk factors (table 1). Higher BMI and poorer physical functioning score were also associated with having multiple risk factors.

Participants who did not consent to the register linkage and those having missing information on risk factors or sociodemographic and health variables were more likely women compared to participants with all information available (supplementary table S1, www.sjweh.fi/show_abstract.php?abstract_id=3695). Furthermore, they tended to have lower education, occupational class, and household income compared to the participants with all information available. Those who did not consent to the register linkage were also more seldom married.

Mean follow-up time was approximately ten years (table 2). Furthermore, 82.9% of the participants were followed through the registers longer than four years, and 92.8% were followed longer than two years. On average, an employee was absent on a short-term sick leave for 63 days during the ten-year follow-up (6 days/year), at an average cost of €9050 to the employer. In relation to salaries, the costs of short-term sickness absences were on average 2.7% (SD 4.4) of the direct salary costs over the follow-up period. The number of short-term sickness absence days as well as all sickness absence days tended to increase with higher number of risk factors. Consequently, the costs of short sickness absence to the employer also tended to increase along with the number of risk factors.

In the two-part model, having ≥3 risk factors was associated with a higher likelihood of having any costs of short-term sickness absence, as well as a higher amount of these costs (supplementary table S2, www.sjweh.fi/show_abstract.php?abstract_id=3695). When each risk factor was treated as an independent variable in the model, moderately active participants, current smokers, and those with poor sleep were more likely to have short-term sickness absence compared to vigorously active participants, non-smokers, and those with good sleep. Moderate activity and inactivity, current smoking, and poor sleep were also associated with higher costs of short-term sickness absence.

When expressed as monetary terms, the direct cost of short-term sickness absence to employer from participants with ≥3 risk factors were >€3000 higher over the follow-up period compared to those without

Table 2. Individual salaries, and number and costs of short-term (1–14 days) sickness absence over 10-years' follow-up.

	All (N=6444)		Number of risk factors [a] 0 (N=2137)		1 (N=2393)		2 (N=1318)		≥3 (N=596)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Follow-up time (days)	3581	1783	3620	1776	3565	1790	3561	1785	3551	1775
Average salary (€)€€	3301	2407	3332	1728	3303	2325	3329	3590	3119	1300
Number of short (1–14) sickness days	62.5	75.3	53.1	63.3	60.0	71.7	72.2	82.3	85.3	101.5
Total sickness days	162.4	215.2	127.5	170.2	154.3	209.5	196.4	243.7	244.7	275.3
Costs of short (1–14) sickness days to employer during follow-up per employee (€) €	9057	11858	7782	8993	8739	12655	10438	13423	11847	13096
Salary costs to employer over follow-up per employee (€) €	381 133	255 099	393 886	262 229	381 846	257 831	366 540	243 250	364 003	241 337
Proportion of short-term sickness absence costs from salary costs per employee (%)	2.7	4.4	2.2	2.6	2.5	2.7	3.3	7.9	3.7	4.1

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

any risk factors (table 3, models 1 and 2). Of the single risk factors, physically inactive participants and current smokers had >€1000 and >€2000 higher costs, respectively, over the follow-up period compared to vigorously active participants and non-smokers (table 3, models 1 and 2). Furthermore, those with poor sleep had approximately €1700 higher costs during the follow-up compared to those with good sleep. In the additional analyses adjusted for either BMI or physical functioning, the results remained the same except for physical activity (table 3, models 3 and 4).

In sensitivity testing, all analyses were redone as complete-case analysis (N=5459) (supplementary table S3 and S4, www.sjweh.fi/show_abstract.php?abstract_id=3695). The results between complete-case analyses and imputed analyses were similar.

Discussion

Our study among 6444 employees of the City of Helsinki showed that the direct employer's costs for an employee who had ≥3 risk factors (physical inactivity, smoking, alcohol consumption, non-daily F&V consumption, and poor sleep) was >€3000 higher compared to an employee without any risk factors over the follow-up period. Of the single risk factors, current smoking habit and poor sleep (ie, frequent insomnia symptoms) had the highest costs: both of these risk factors increased costs by approximately €2000 compared to non-smokers or participants with good sleep. In relation to total direct costs of short-term sickness absence, 10–30% of costs were attributable to the examined risk factors over the follow-up. Furthermore, for those with ≥3 risk factors

Table 3. Marginal effects on costs (€) of short-term (1–14 days) sickness absence for employer over ten years. Participants with multiple risk factors compared to those without any risk factors. [CI=confidence interval; F&V=fruits and vegetables].

	Model 1 [a]		Model 2 [b]		Model 3 [c]		Model 4 [d]	
	dy/dx [e]	95% CI	dy/dx [e]	95% CI	dy/dx [e]	95% CI	dy/dx [e]	95% CI
Number of risk factors [f]								
0		ref		ref		ref		ref
1	942	344–1540	855	289–1421	730	162–1297	733	188–1279
2	2644	1827–3462	2206	1447–2964	1860	1111–2609	1900	1179–2620
≥3	3722	2470–4974	3266	2114–4417	2690	1578–3802	3043	1948–4138
Physical activity [g]								
Vigorous		ref		ref		ref		ref
Moderate	750	145–1355	586	14–1158	374	-203–952	268	-294–830
Inactive	1349	603–2096	1229	523–1934	818	113–1522	617	-65–1299
Smoking								
Non-smoker		ref		ref		ref		ref
Former	1315	658–1974	1184	561–1807	1184	565–1802	1051	459–1642
Current	2794	2034–3554	2337	1622–3049	2315	1608–3023	2494	1797–3191
Alcohol consumption [h]								
None		ref		ref		ref		ref
Moderate	-534	-1796–728	-152	-1290–985	130	-963–1224	53	-1012–1118
High	-420	-1825–986	168	-1124–1460	494	-761–1748	342	-873–1557
F&V daily consumption								
Both		ref		ref		ref		ref
Either	68	-549–685	-51	-636–534	-57	-638–524	-36	-598–527
Neither	682	-48–1412	292	-392–976	235	-441–912	216	-436–8609
Sleep quality [i]								
Good		ref		ref		ref		ref
Moderate	1095	498–1693	1159	593–1725	869	298–1441	1019	476–1563
Poor	1814	1059–2569	1780	1071–2488	1184	476–1891	1576	901–2252

[a] Adjusted for age, sex and follow-up time. When analyzing each risk factor independently, the model was also adjusted for other risk factors.

[b] Model 1 + marital status and occupational class. When analyzing each risk factor independently, the model was also adjusted for other risk factors.

[c] Model 2 + physical functioning. When analyzing each risk factor independently, the model was also adjusted for other risk factors.

[d] Model 3 + body mass index. When analyzing each risk factor independently, the model was also adjusted for other risk factors.

[e] 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.

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

[g] 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.

[h] Moderate alcohol use was defined as <8 servings / week for women and <15 servings / week for men. High alcohol use was defined as >7 servings / week for women and >14 servings / week for men. One serving of alcohol contains 12g ethanol.

[i] Good sleep was defined as 6–8 hours of sleep/night and reporting insomnia symptoms in <4 nights/month. Moderate sleep was defined as <6 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 four weeks.

the proportion of short-term sickness absence costs from paid salaries was 1.5 percentage points higher compared to those without any risk factors. The magnitude can be compared to, for example, the employers' statutory sickness insurance which is 1.08% of paid salaries.

There are not many other studies that have examined the financial impact of an unhealthy lifestyle, sleep problems and costs of sickness absence. Furthermore, varying methods of recording absence and absence-related costs, as well as differences in legislation of which payments are covered by the employer makes international comparisons difficult. Most of the published studies have focused on defining medical costs using medical and pharmacy claims (19–21) or attempted to estimate productivity losses of presenteeism and absenteeism (20) through standardized questionnaires (18). In these studies, inactivity, former smoking, and larger BMI have also been associated with higher medical costs for the employer. Goetzel et al (20) and O'Donnell et al (21) used a health risk assessment instrument including unhealthy lifestyle factors and biometric measures to measure the association between modifiable risk factors and medical costs. Both studies found that high-risk individuals have approximately three times the cost of risk-free individuals, which is about the same magnitude we observed for the direct cost of short-term sickness absence between participants with no risk factors and with ≥3 risk factors.

Our study demonstrated that the association between the number of risk factors and costs of short-term sickness absence is fairly linear, with the costs getting higher with multiple risk factors. While having ≥3 risk factors is, however, quite rare (9.5% of the participants in our cohort), having 2 risk factors is more common (20.6% of the participants in our cohort). These figures correspond to what has been previously observed in the Finnish adult population (13). It is noteworthy that already having 2 risk factors may cause €2000 higher direct costs of short-term sickness absence in the long run compared to not having any risk factors. For instance, for the City of Helsinki – which has approximately 40 000 employees – this would mean €17.6 million higher direct costs of short-term sickness absence over ten years. Furthermore, being a current smoker generated the highest cost of the risk factors when compared to healthy counterparts. According to our estimates, if 20% of employees were smokers, their sickness absence would cost the City of Helsinki €18.7 million more than non-smokers.

Compared to direct salary costs for the follow-up period (mean €381 133 per employee), the sickness absence costs attributable to the risk factors are obviously a notably smaller expenditure to employers. However, on top of the salary that is paid during sick leave, productivity decreases due to the employee's absence, which is an additional cost to employers. According to our results, this extra cost could be at least partly prevented. It is reasonable to expect that it is in the employer's interest to prevent such costs, especially in large workplaces such as the City of Helsinki where overall costs of sickness absence are a notable issue, and any successful efforts in reducing them result in notable savings. Furthermore, it should be emphasized that our results represent only the direct salary costs. The total costs would also include, for example, reduced productivity at work, delays in production and delivery and cancellations due to absenteeism, as well as need to hire a substitute to cover the absent employee (depending on profession). Thus, €1000–3000 costs for the follow-up period is likely to be an underestimate of the total costs related to risk factors. Regarding sickness absence spells >14 days, the Social Insurance Institution of Finland pays sickness benefit for the employee and, if the employee receives a salary while on longer sickness absence, the sickness benefit is paid to the employer. In other words, the employer is usually compensated salary costs for sickness absence spells that last >14 days. The amount of compensation depends on the type of employment and profession, which hampers the estimation of true direct salary costs. Therefore the focus in this study was only on short-term sickness absence.

Smoking, poor sleep and physical inactivity were found to increase the costs of sickness absence compared to non-smokers, good sleepers and participants who were vigorously active. In a previous study by Tolonen et al (22), the association between leisure-time physical activity and direct costs of short-term sickness absence was analyzed using the same cohort as in the present study but with more recent sickness absence data (2008 onwards) and shorter follow-up (three years). The direct cost of sickness absence of a vigorously active employee was €414 less than that of an inactive employee. This estimate is in line with our current longer term results, which showed that inactivity resulted in approximately €1200 higher direct costs compared to a vigorously active employee.

F&V consumption was not associated with sickness absence costs. Since diet and its effect on health is generated through interplay between several foods and nutrients over many years, including only one (even though important) dietary component may not adequately reflect the total healthiness of individual's diet. Overall, unhealthy diet has been defined in several different ways when the contribution of diet to medical costs or the costs of absenteeism and presenteeism have been evaluated. The results vary respectively. In studies concerning large US employers, employees with an unhealthy diet have had lower medical costs compared to those with healthier diet (19, 20), but higher number of both absenteeism and presenteeism days (20). Furthermore, health risks that are known to be at least partly caused by unhealthy diet, such as blood pressure, high blood glucose and BMI, has been found to predict high medical care costs (19, 22). One possible reason for the inconsistent results is that individuals with diseases such as type 2 diabetes may have improved their eating habits due to their medical condition, as a part of their treatment right before or soon after the collection of baseline data, leaving the direction of causality in our analysis unclear. Future studies attempting to estimate the contribution of unhealthy diet to employers' costs should aim to measure and define healthy diet more specifically, taking into account possible misreporting and changes in dietary habits over time.

In addition to F&V consumption, high alcohol consumption was not associated with higher costs. This may reflect issues in our reference group, which consisted of non-drinkers. In addition to individuals who genuinely have chosen not to drink any alcohol, the group of non-drinkers may include former frequent drinkers or individuals who have an illness that restricts alcohol consumption – both of which would come with higher medical costs. Furthermore, another study also found no difference in absenteeism cost between high and low-risk alcohol consumption, but observed higher presenteeism costs for the high- compared to low-risk drinkers (19). Thus, high-risk drinkers may have more sickness absence days, but the costs attributable to greater consumption of alcohol are perhaps not pronounced in absenteeism but in decreased productivity while working.

We based the selection of confounding variables on preliminary information on the association between the confounders, risk factors and sickness absence. Adjusting for marital status and occupational class did not explain the association between risk factors and short-term sickness absence costs. This implies that especially smoking and sleep may have a strong independent role in sickness absence and its costs. Admittedly, it is also possible that variance in marital status and occupational class between risk factors categories was so small in our cohort that it did not allow us to detect their effect on the main result. We also provided additional models adjusted for self-perceived physical functioning and BMI (table 3). Both physical functioning and BMI can be seen to be at least partly on the causal pathway of the association between lifestyle factors (physical activity and diet) and sickness absence costs. Consequently, adding these factors in the model could be considered as over adjustment. BMI and physical functioning may also be seen as back-door paths from factors, such as depression, injuries or number of children, to sickness absence costs, and therefore adjusting for physical functioning and BMI would be justified. However, even though adjusting for physical functioning and BMI led to attenuation of the results, the interpretation – risk factors are independently associated with sickness absence costs – was unaffected.

Methodological considerations

The strengths of our study are the prospective design with long follow-up time. A majority of our study population was female, which accurately reflects the gender division in our target population – the City of Helsinki and public-sector employees in general – but does not allow our results to be generalized to the private sector directly. Furthermore, we addressed missing data with multiple imputations by fully conditional specification, which is a powerful and statistically valid method for creating imputations in large datasets including both categorical and continuous variables (32).

Using the individual salary and sickness absence data from the employer's comprehensive register allowed more accurate estimation of the direct costs of short-term sickness absence compared to self-reported sickness absence days and average salary data. Individual-level salary information is recommendable as the salary level of employees may systematically differ between risk factors. It should be noted that the gross salary figures used in the study do not include employer's social security costs. Furthermore, the salary costs of short-term sickness absence do not represent the total financial costs of risk factors for the employer. As mentioned earlier, there are also other direct and indirect costs (eg, hiring a substitute, decrement and delays in productions, etc) that should be taken into account to give a complete estimate of the productivity loss.

Using the baseline risk factors as a predictor of short-term sickness absences is a potential limitation of the study as participants may have changed their lifestyle right before or during the follow-up. Generally, smoking in Helsinki area has been decreasing for decades among men and also since the late 1990s among women (33, 34). Self-reported duration of sleep has remained similar after 2000, whereas there is some indication that insomnia symptoms would have increased among working-aged Finns (35). Furthermore, more recent studies from our cohort show that the number of heavy alcohol drinkers and non-drinkers has increased during the follow-up, but most of the participants have remained moderate drinkers (36). In addition, the number of inactive men remained or even slightly decreased during the follow-up (37), whereas the proportion of both men and women consuming F&V daily has increased (28). Overall, taking account the changes in the risk factors, our results may include some over- and underestimation (depending on the exposure) of the costs over the whole follow-up period.

Like all observational epidemiological studies, we cannot rule out the possibility that the effect sizes in our study may be affected by residual or unmeasured confounding. Another limitation of our study is that information on the risk factors was based on questionnaire data and not measurements. The reliance on self-report for the behaviors may have resulted in misclassification of employees. This would especially concern physical activity, F&V, and alcohol consumption as physical activity and F&V consumption is usually overestimated, whereas alcohol consumption is often underestimated. As mentioned earlier, asking only about F&V consumption over rather short period of time (four weeks) does not necessarily represent the true healthiness of individual's diet. However, many previous studies have shown that high F&V consumption is a strong predictor for decreased risk of cardiovascular disease (38, 39), which is known to impose substantial morbidity- and mortality-related productivity loss (40).

Concluding remarks

In our study, direct employer's costs for an employee who had multiple risk factors (inactivity, smoking, high alcohol consumption, non-daily F&V consumption, or poor sleep) was approximately €2000–3000 over ten years compared to an employee without any risk factors. This corresponds 10–30% increment in the costs of short-term sickness absence. Of the single risk factors, smoking and poor sleep had the highest costs. Consequently, designing targeted programs that address these risk factors are supported as our results imply that such programs may yield to a significant reduction in sickness absence-related costs.

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