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The Joint Contributions of Overweight/Obesity and Physical and Mental Working Conditions to Short and Long Sickness Absence among Young and Midlife Finnish Employees: A Register-Linked Follow-Up Study

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Keywords
Body mass index · Cohort study · Disability · Sick leave · Work strain

Abstract

Introduction: Overweight/obesity and strenuous working conditions are associated with work disability, but their joint contributions to sickness absence (SA) are unknown. We aimed to examine their joint contributions to SA periods of 1–7 and ≥8 days. ***Methods:*** Self-reported data on body mass index and working conditions, including perceived physically and mentally strenuous work and hours per day spent in heavy physical work, were linked to the employer's SA register for the City of Helsinki, Finland, employees (n = 4,323, women 78%) who were 19–39 years old at baseline. We calculated rate ratios (RRs) and 95% confidence intervals (CIs) for SA periods using negative binomial regression models among participants with healthy weight and overweight/obesity, with and without exposure to strenuous working conditions. The mean follow-up time was 2.1 years. ***Results:*** Participants with overweight/obesity and exposure to physically strenuous working conditions had the highest age- and gender-adjusted RRs for SA periods of both 1–7 and ≥8 days (physically strenuous work: RR: 1.38, CI: 1.25–1.52, and RR: 1.87, CI: 1.60–2.18, respectively; ≥3 h per day spent in physical work: RR: 1.40, CI: 1.26–1.55 and 2.04, CI: 1.73–2.40, respectively). The interaction between overweight/obesity and physically strenuous working conditions was additive for SA periods of 1–7 days and weakly synergistic for SA periods of ≥8 days. For mentally strenuous work, participants with overweight/obesity and exposure to mentally strenuous work had the highest age-adjusted RRs for SA periods of ≥8 days, and the interaction was additive. ***Conclusion:*** The joint contributions of overweight/obesity and exposure to strenuous working conditions to SA should be considered when aiming to reduce employees' SA. Employers might benefit from providing employees adequate support for weight management and adherence to healthy lifestyles while improving employees' working conditions.

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Introduction

Overweight/obesity and exposure to strenuous working conditions are both known risk factors for ill-health and work disability [1–8]. At a population level, the rates of people living with overweight/obesity have risen sharply in the last 5 decades and is now rising, especially in urban regions in low- and middle-income countries [8–10] and also among younger age groups [3, 9, 10]. Individuals with overweight/obesity are at higher risk for several diseases [7, 8] and have increased rates of sickness absence (SA) [1, 4, 5]. While physically strenuous work has slightly reduced within the past decades in Western countries [11–13], mentally strenuous work has increased, especially among women. However, in Finland, especially manual workers (60%) and those with low education (44%) still reported their job as physically strenuous [13].

Physical working conditions have been associated with SA in previous studies, majority of which are from the Nordic countries [14–21]. However, many previous studies have focused on long-term SA [14, 15, 19, 22] and employees over 40 years old [16–19]. Short-term SA has been shown to be associated with future SA and long-term work disability [23]; thus, short-term SA might provide insights into early intervention points. A recent Finnish study on 19–39-year-old employees found that physical workload, heavy physical work, and hazardous exposures were associated with SA [20]. Exposure to adverse psychosocial working conditions is also a known risk factor for SA [2, 6]. Studies have identified several determinants of psychosocial working conditions, and in particular, low job control has been associated with SA in European countries [18, 24–27]. However, self-reported mental strain was not associated with SA of different durations in a Finnish study [18].

Although overweight/obesity and strenuous working conditions are known risk factors for SA, the relationship is poorly understood. Previous studies have shown that obesity and strenuous physical working conditions were synergistically associated with work disability among male construction workers in the Netherlands and in Sweden [28, 29]. However, in a Finnish study on the association between overweight/obesity and work disability, exposure to physically strenuous work did not result in additional risk of self-rated work disability [30]. To the best of our knowledge, no previous studies have examined the joint association of overweight/obesity and exposure to strenuous physical and mental working conditions with SA. Understanding these individual- and work-related risk factors in young and midlife employees is needed to develop effective risk management strategies to support career longevity.

This study aimed to examine the joint association of overweight/obesity and exposure to strenuous working conditions, including perceived physically and mentally strenuous work and hours per day spent in physical work, with subsequent short and long SA periods among young and early midlife Finnish employees. An additional aim was to study the potential contribution of age, gender, marital status, employment status, alcohol use, smoking, and prior SA to the association.

Materials and Methods

Participants

The Helsinki Health Study is an ongoing cohort study on employees of the City of Helsinki, Finland, who were 19–39 years old at baseline in 2017 [31]. The City of Helsinki is the largest employer in Finland, with around 38,000 employees representing a wide range of occupations and sectors. Data were collected among the target population (n = 11,459) via online and postal questionnaires, targeting employees born in 1978 or later with at least a 50% employment contract for at least 4 months before the start of the data collection. Furthermore, a shorter telephone interview (n = 787) was conducted among those who did not respond to the online or postal questionnaire. In total, 5,898 participants (response rate 51.5%) responded to the questionnaire. The majority (79%) of respondents were women, which reflects the gender distribution of the target population and the municipal sector in Finland [31]. According to the non-response analysis, the respondents represented the target population broadly, although those with a lower socioeconomic position and those with long-term SA were less likely to respond [31].

We excluded participants on a sick leave greater than 6 months and those receiving a disability pension (n = 31). Additional exclusions included those who were pregnant (n = 69), without follow-up data (n = 47), underweight (n = 77), and missing information on their weight (n = 52), working conditions (n = 123), or any of the covariates (n = 142). The final dataset consisted of 3,370 women and 953 men.

Exposures

Working Conditions

We used single-item questions with four response alternatives to measure exposure to physically and mentally strenuous work [18, 32]. Physically strenuous work was dichotomized to strenuous (rather/very strenuous) and intermediate/non-strenuous (very/rather light), and mentally strenuous work to strenuous (very strenuous) and intermediate/non-strenuous (rather/very light and rather strenuous) since employees with physically very strenuous work were few (n = 179) and employees with mentally very (n = 721) or rather (n = 2,650) strenuous work were many. Additionally, we asked how many hours per day the respondents do physically strenuous work such as heavy lifting and climbing stairs [20, 32]. We used the highest quartile to dichotomize the participants into those spending ≥3 h per day and those spending <3 h per day in heavy physical work.

Body Mass Index

Self-reported weight (kg) divided by the square of the height (m) defined the body mass index (BMI) (kg/m^2). We used the World Health Organization's criterion to dichotomize participants into those with healthy weight (18.5–24.9 kg/m^2) and overweight/obesity (≥25 kg/m^2), due to the small proportion of participants recording a BMI ≥30 kg/m^2 (n = 616).

Outcome Measure: SA

We linked the questionnaire data with employer's personnel register data on SA for those respondents who gave their consent to the linkage (82%). We combined overlapping and subsequent SA periods and separately examined SA periods of 1–7 days and ≥8 days. The employee's supervisor can in certain circumstances authorize SA periods shorter than a week without a medical certificate, thus we chose the cut-off based on the maximum length of self-certified SA periods. Medical certificates for short SA periods can in certain cases also be given by nurses and physiotherapists; however, in all other cases and for SA periods lasting more than a week, the employee needs to show a medical certificate of disability from a physician. The SA follow-up started the day after we received the questionnaire from a participant, since September 2017, until March 2020 (the beginning of the COVID-19 pandemic in Finland) or the end of the participant's employment contract, whichever came first. Mean follow-up time was 2.1 years.

Covariates

Age, gender, marital status, alcohol use, and smoking have in previous studies been associated with SA and were therefore included as covariates [33–36]. Baseline age was categorized into three age groups: 18–29, 30–34, and 35–39 years. Gender included women and men. Marital status was dichotomized to married/cohabiting and others. We dichotomized participants according to their employment status to those who worked full-/part-time and those who were temporarily studying, on parental leave or unemployed at baseline. Alcohol use was dichotomized to those consuming alcohol weekly and those using alcohol less often than weekly/not at all. Smoking status included smokers (current daily and occasional) and non-smokers. Prior SA was used as a continuous variable and calculated as the number of SA periods divided by person-years in the year prior to baseline.

Statistical Analyses

First, we used cross-tabulation to describe the distribution of baseline characteristics among the participants according to SA periods of 1–7 and ≥8 days (Table 1). Then, we calculated the incidence and 95% confidence intervals (CIs) for SA periods of 1–7 and ≥8 days per 100 person-years by the exposure groups with negative binomial regression (Fig. 1). The exposure groups were formed based on working conditions (physically and mentally strenuous work and hours per day spent in heavy physical work) and BMI as follows: participants with (1) healthy weight without strenuous working conditions, (2) healthy weight with strenuous working conditions, (3) overweight/obesity without strenuous working conditions, and (4) overweight/obesity with strenuous working conditions. In the additional analyses, we formed the exposure groups by categorizing participants into those with healthy weight/overweight (18.5–29.9 kg/m^2) and those with obesity (≥30 kg/m^2).

We used negative binomial regression models to calculate rate ratios (RRs) and 95% CIs for subsequent SA periods of 1–7 and ≥8 days (Table 2). Participants with healthy weight without strenuous working conditions served as the reference group. Model 1 was adjusted for age, or age and gender, and models 2, 3, and 4 additionally for marital and employment status, health behaviors (alcohol use and smoking), and prior SA, respectively. We included a natural logarithm of the follow-up time as an offset variable in the models to account for different lengths of follow-up time.

We examined whether the associations between the joint groups, and SA differed between women and men and found no significant gender interactions for physically strenuous work (p = 0.073 for SA periods of 1–7 days; p = 0.177 for SA periods of ≥8 days) and hours per day spent in physical work (p = 0.079 for SA periods of 1–7 days; p = 0.098 for SA periods of ≥8 days). However, we found a significant gender interaction for mentally strenuous work (p = 0.021 for SA periods of 1–7 days; p = 0.460 for SA periods of ≥8 days) and therefore examined the association between mentally strenuous work and SA separately among women and men.

Finally, we examined the synergistic interaction between overweight/obesity and working conditions by calculating the synergy index (S) using the following equation: S = (RR participants with overweight/obesity and work exposure − 1)/([RR participants with healthy weight and work exposure − 1] + [RR participants with overweight/obesity without work exposure − 1]) [37]. We calculated the synergy index using RRs from model 1 (adjusted for age, or age and gender) and fully adjusted RRs from model 4. The results were similar, and we chose to present the age- and gender-adjusted results. A synergy index >1 suggests that the interaction is synergistic. We used IBM SPSS Statistics 27 for the analyses.

Results

Table 1 shows the distribution of the baseline characteristics among participants with and without at least one SA period of 1–7 and ≥8 days during the follow-up. Of the participants, 83% had at least one SA period of 1–7 days and 28% at least one SA period of ≥8 days during the mean follow-up time of 2.1 years. In all, 42% of participants were with overweight/obesity, 35% reported physically and 17% mentally strenuous work, and 27% spent ≥3 h per day undertaking heavy physical work.

Figure 1 presents the age- and gender-adjusted incidence of SA periods per 100 person-years according to the exposure groups. Participants with both overweight/obesity and exposure to strenuous working conditions had the highest incidence of SA periods of both 1–7 and ≥8 days. Additionally, participants with overweight/obesity or exposure to strenuous working conditions had a higher incidence of SA periods than participants with a healthy weight and without strenuous working conditions.

Table 1. Baseline characteristics according to subsequent sickness absence (SA) periods of 1–7 and ≥8 days during mean follow-up of 2.1 years

	All	SA period of 1–7 days			SA period of ≥8 days		
		no	yes	*p* value[b]	no	yes	*p* value[b]
Characteristics at baseline	*n* (%)	*n* (%)	*n* (%)		*n* (%)	*n* (%)	
All				0.025			0.034
Women	3,370 (78)	540 (16)	2,830 (84)		2,400 (71)	970 (29)	
Men	953 (22)	182 (19)	771 (81)		712 (75)	241 (25)	
Age				<0.001			0.452
18–29	1,347 (31)	216 (16)	1,131 (84)		954 (71)	393 (29)	
30–34	1,475 (34)	291 (20)	1,184 (80)		1,076 (73)	399 (27)	
35–39	1,501 (35)	215 (14)	1,286 (86)		1,082 (72)	419 (28)	
Marital status				0.603			0.555
Married/cohabiting	2,910 (67)	492 (17)	2,418 (83)		2,103 (72)	807 (28)	
Others	1,413 (33)	230 (16)	1,183 (84)		1,009 (71)	404 (29)	
Employment status				<0.001			<0.001
Working	3,829 (89)	505 (13)	3,324 (87)		2,692 (70)	1,137 (30)	
Temporarily not working	494 (11)	217 (44)	277 (56)		420 (85)	74 (15)	
Smoking				<0.001			<0.001
Current	1,031 (24)	124 (12)	907 (88)		693 (67)	338 (33)	
Former or never-smoker	3,293 (76)	598 (18)	2,694 (82)		2,419 (74)	873 (27)	
Alcohol use				0.020			0.018
Weekly	1,200 (28)	226 (19)	974 (81)		895 (75)	305 (25)	
Occasional or never	3,123 (72)	496 (16)	2,627 (84)		2,217 (71)	906 (29)	
BMI[a]				0.022			<0.001
Healthy weight	2,508 (58)	442 (18)	2,066 (82)		1,884 (75)	624 (25)	
Overweight	1,199 (28)	200 (17)	999 (83)		859 (72)	340 (28)	
Obesity	616 (14)	80 (13)	536 (87)		369 (60)	247 (40)	
Physically strenuous work				0.576			<0.001
Intermediate/non-strenuous	2,823 (65)	478 (17)	2,345 (83)		2,101 (74)	722 (26)	
Strenuous	1,500 (35)	244 (16)	1,256 (84)		1,011 (67)	489 (33)	
Time spent in heavy physical work				0.151			<0.001
<3 h/workday	3,176 (73)	546 (17)	2,630 (83)		2,362 (73)	814 (27)	
≥3 h/workday	1,147 (27)	176 (15)	971 (85)		750 (65)	397 (35)	
Mentally strenuous work				0.005			<0.001
Intermediate/non-strenuous	3,602 (83)	627 (17)	2,975 (83)		2,646 (74)	956 (27)	
Strenuous	721 (17)	95 (13)	626 (87)		466 (65)	255 (35)	
Total	4,323 (100)	722 (17)	3,601 (83)		3,112 (72)	1,211 (28)	

[a]Body mass index (BMI): healthy weight 18.5–24.9 kg/m^2, overweight 25–29.9 kg/m^2, and obesity ≥30 kg/m^2. [b]*p* values from χ^2 tests.

Table 2 presents the adjusted RRs for SA periods of 1–7 and ≥8 days by participants with healthy weight and overweight/obesity with and without exposure to physical working conditions (physically strenuous work and ≥3 h per day heavy physical work). Participants with both overweight/obesity and exposure to physical working conditions had the highest age- and gender-adjusted RRs for SA periods of both 1–7 days (physically strenuous work RR: 1.38, 95% CI: 1.25–1.52; ≥3 h per day heavy physical work RR: 1.40, CI: 1.26–1.55) and ≥8 days (physically strenuous work RR: 1.87, CI: 1.60–2.18; ≥3 h per day heavy physical work RR: 2.04, CI: 1.73–2.40). Additionally, participants with overweight/obesity or exposure to physical working conditions had higher RRs for SA periods than the reference group. Adjustments for marital and employment status (model 2) and additionally for health behaviors (model 3) had minimal effects on the associations. Additional adjustment for prior SA periods (Model 4) somewhat attenuated the associations, but the RRs remained statistically significant and strong, especially for SA periods of ≥8 days. The interaction of overweight/obesity and physical working

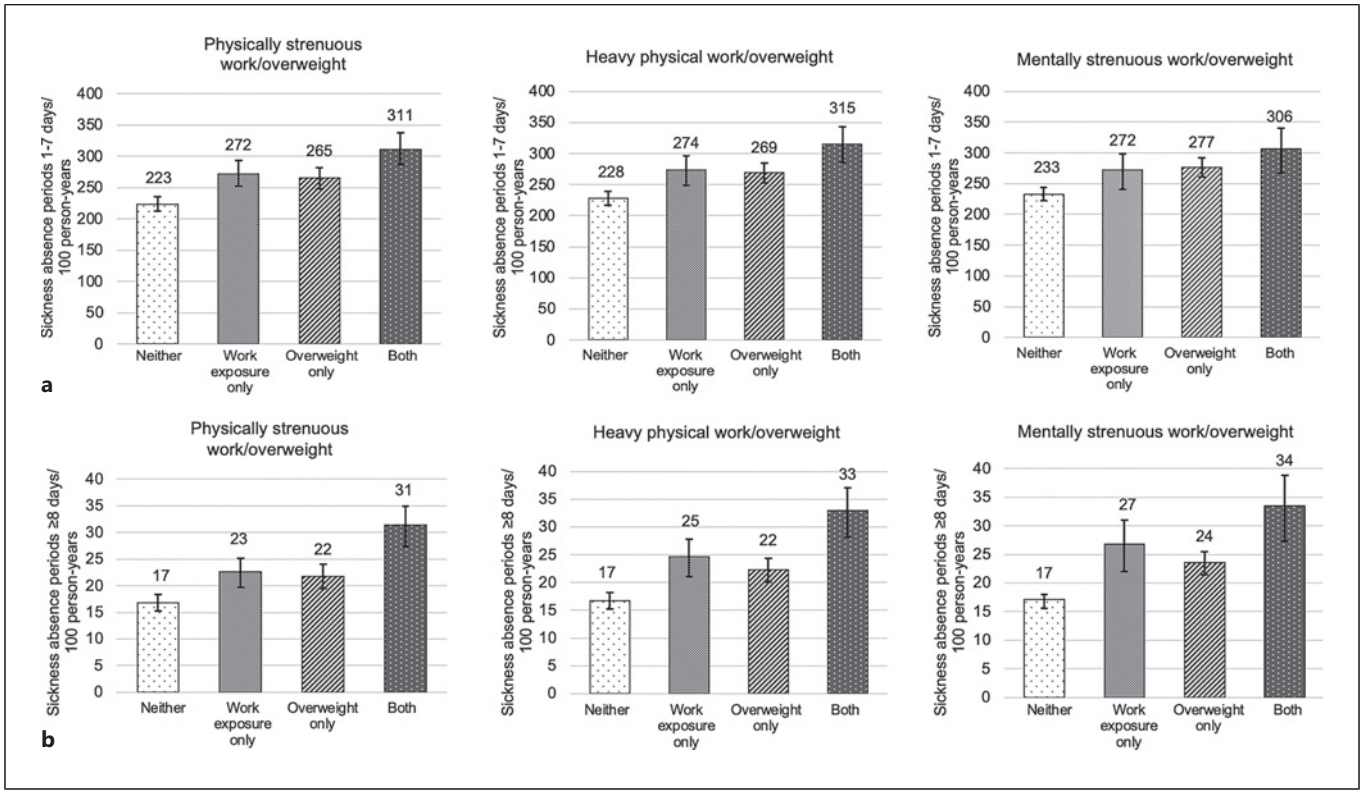

Fig. 1. Incidence of sickness absence (SA) periods during a mean follow-up of 2.1 years with 95% CIs of (**a**) 1–7 days and (**b**) ≥8 days per 100 person-years according to exposure groups (participants with and without overweight [BMI ≥25] and exposure to physically and mentally strenuous working conditions).

conditions for SA periods of 1–7 days was additive with both physically strenuous work (S = 0.97) and with spending ≥3 h per day in heavy physical work (S = 1.03). For SA periods of ≥8 days, the interaction was weakly synergistic with physically strenuous work (S = 1.43) and with spending ≥3 h per day in heavy physical work (S = 1.25).

Table 3 shows the gender-stratified RRs for SA periods of 1–7 and ≥8 days by participants with healthy weight and overweight/obesity and with and without exposure to mentally strenuous work. The RRs were highest for SA periods of ≥8 days among women (RR: 1.93, CI: 1.55–2.41) and men (RR: 2.52, CI: 1.67–3.80) with simultaneous overweight/obesity and exposure to mentally strenuous work. Overweight/obesity and exposure to mentally strenuous work were associated with increased rates of SA periods of both 1–7 and ≥8 days among women, however, among men only with SA periods of ≥8 days. Adjustments for marital and employment status (model 2) and additionally for health behaviors (model 3) had almost no effects on the associations. Additional adjustment for prior SA periods (model 4) attenuated the associations somewhat, but they remained statistically significant. Among women, the interaction between overweight/obesity and mental working conditions was antagonistic for SA periods of 1–7 days (S = 0.78) and additive for SA periods of ≥8 days (S = 1.01). Among men, the interaction for SA periods of ≥8 days was weakly synergistic (S = 1.35).

In the sensitivity analyses, the associations for physical working conditions were stronger when using a higher cut-off for BMI (online suppl. Table S1; for all online suppl. material, see https://doi.org/10.1159/000534525). For mentally strenuous work, the RRs among women with obesity and mentally strenuous work were only somewhat higher when the higher cut-off was used (online suppl. Table S2). We also performed analyses with a commonly used cut-off for SA periods: 1–14 and ≥15 days. The results for both physical and mental working conditions were similar to the main analyses, except for the RRs for SA periods of ≥15 days (RR: 1.93, CI: 1.45–2.56), which were somewhat higher than for SA periods of ≥8 days (RR: 1.56, CI: 1.24–1.96) among women with simultaneous overweight/obesity and

Table 2. Rate ratio (RR) and 95% confidence intervals (CIs) for sickness absence (SA) periods of 1–7 and ≥8 days by participants with and without overweight (BMI ≥25 kg/m^2) and with and without exposure to physically strenuous working conditions (physically strenuous work and ≥3 h per day spent in heavy physical work)

SA periods			Model 1		Model 2		Model 3		Model 4	
	Exposure group	*n* (%)	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
1–7 days	Physically strenuous work/overweight									
	Neither	1,700 (39)	1.00		1.00		1.00		1.00	
	Work exposure only	808 (19)	1.16	1.05–1.27	1.17	1.07–1.29	1.15	1.05–1.27	1.08	0.98–1.18
	Overweight only	1,123 (26)	1.23	1.13–1.34	1.23	1.13–1.34	1.21	1.11–1.32	1.09	1.00–1.18
	Both	692 (16)	1.38	1.25–1.52	1.38	1.25–1.53	1.34	1.22–1.48	1.15	1.04–1.28
	Physical work ≥3 h per day/overweight									
	Neither	1,901 (44)	1.00		1.00		1.00		1.00	
	Work exposure only	607 (14)	1.16	1.05–1.29	1.21	1.09–1.34	1.18	1.06–1.31	1.13	1.01–1.25
	Overweight only	1,275 (29)	1.23	1.13–1.33	1.23	1.13–1.33	1.21	1.11–1.31	1.09	1.00–1.18
	Both	540 (13)	1.40	1.26–1.55	1.42	1.27–1.58	1.38	1.24–1.53	1.19	1.07–1.33
≥8 days	Physically strenuous work/overweight									
	Neither	1,700 (39)	1.00		1.00		1.00		1.00	
	Work exposure only	808 (19)	1.28	1.09–1.50	1.31	1.12–1.54	1.26	1.07–1.48	1.17	0.99–1.37
	Overweight only	1,123 (26)	1.33	1.16–1.54	1.32	1.14–1.52	1.28	1.11–1.48	1.17	1.01–1.35
	Both	692 (16)	1.87	1.60–2.18	1.92	1.64–2.24	1.80	1.54–2.11	1.53	1.30–1.80
	Physical work ≥3 h per day/overweight									
	Neither	1,901 (44)	1.00		1.00		1.00		1.00	
	Work exposure only	607 (14)	1.46	1.23–1.73	1.52	1.28–1.80	1.45	1.22–1.72	1.32	1.11–1.58
	Overweight only	1,275 (29)	1.37	1.20–1.57	1.37	1.20–1.57	1.33	1.16–1.52	1.22	1.06–1.40
	Both	540 (13)	2.04	1.73–2.40	2.09	1.77–2.46	1.97	1.66–2.32	1.64	1.38–1.95

Model 1: adjusted for age and gender. Model 2: adjusted for model 1 + marital and employment status. Model 3: adjusted for model 2 + alcohol use and smoking. Model 4: adjusted for model 3 + prior SA.

exposure to mentally strenuous work (online suppl. Tables S3, S4). Exposure to mentally strenuous work was not associated with SA periods of ≥15 days among men with healthy weight.

Discussion

Our study showed that both overweight/obesity and exposure to strenuous physical and mental working conditions were associated with SA periods among young and early midlife Finnish employees. The associations were strongest for those with simultaneous overweight/obesity and exposure to strenuous working conditions. The associations were stronger for SA periods of ≥8 than of 1–7 days. The interaction between overweight/obesity and exposure to strenuous working conditions was additive for SA periods of 1–7 days. For SA periods of ≥8 days, the association between overweight/obesity and mentally strenuous working conditions was additive, but for physical working conditions weakly synergistic.

Although overweight/obesity and exposure to strenuous working conditions have been associated with SA, only a few studies have examined the joint association of overweight/obesity and exposure to strenuous working conditions with work disability, with inconsistent findings [28–30]. Previous studies have used self-reported measures of work disability [28, 30] and register information on disability pensions [29]. In our study, we found that the association between overweight/obesity and exposure to physically strenuous working conditions was weakly synergistic and stronger for longer rather than shorter SA periods. In studies examining Dutch and Swedish male construction workers, the joint association of obesity and physical working conditions with work disability was synergistic [28, 29], but in a previous Finnish study, physically strenuous work did not further increase the risk for perceived work disability among 46-year-old employees with overweight/obesity [30]. Although shorter SA periods are associated with longer SA periods, it is plausible that longer SA periods more strongly reflect chronic health problems and longer-lasting decreases in work ability. Additionally, longer

Table 3. Rate ratio (RR) and 95% confidence intervals (CIs) for sickness absence (SA) periods of 1–7 and ≥8 days among women and men with and without overweight (BMI ≥25 kg/m^2) and exposure to mentally strenuous work

SA periods			Model 1		Model 2		Model 3		Model 4	
	Exposure group	*n* (%)	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
1–7 days										
Women	Mentally strenuous work/overweight									
	Neither	1,733 (47)	1.00		1.00		1.00		1.00	
	Work exposure only	342 (9)	1.22	1.07–1.39	1.21	1.06–1.38	1.21	1.06–1.37	1.16	1.02–1.33
	Overweight only	1,061 (29)	1.32	1.21–1.44	1.31	1.20–1.42	1.28	1.18–1.40	1.15	1.06–1.26
	Both	234 (6)	1.42	1.22–1.65	1.41	1.22–1.64	1.39	1.20–1.62	1.18	1.01–1.37
Men	Mentally strenuous work/overweight									
	Neither	372 (39)	1.00		1.00		1.00		1.00	
	Work exposure only	61 (6)	0.94	0.69–1.28	0.93	0.68–1.28	0.98	0.72–1.35	0.93	0.68–1.28
	Overweight only	436 (46)	1.01	0.86–1.18	1.01	0.86–1.18	1.01	0.86–1.18	0.94	0.80–1.10
	Both	84 (9)	1.18	0.91–1.54	1.19	0.91–1.55	1.19	0.91–1.55	1.14	0.87–1.49
≥8 days										
Women	Mentally strenuous work/overweight									
	Neither	1,733 (47)	1.00		1.00		1.00		1.00	
	Work exposure only	342 (9)	1.54	1.26–1.89	1.52	1.24–1.87	1.52	1.24–1.86	1.43	1.16–1.76
	Overweight only	1,061 (29)	1.38	1.20–1.59	1.37	1.19–1.57	1.32	1.14–1.52	1.21	1.05–1.40
	Both	234 (6)	1.93	1.55–2.41	1.91	1.53–2.39	1.83	1.46–2.29	1.56	1.24–1.96
Men	Mentally strenuous work/overweight									
	Neither	372 (39)	1.00		1.00		1.00		1.00	
	Work exposure only	61 (6)	1.48	0.86–2.56	1.48	0.86–2.55	1.56	0.90–2.70	1.48	0.84–2.59
	Overweight only	436 (46)	1.65	1.24–2.19	1.64	1.23–2.19	1.61	1.21–2.15	1.49	1.11–2.01
	Both	84 (9)	2.52	1.67–3.80	2.51	1.66–3.79	2.47	1.63–3.73	2.42	1.58–3.70

Model 1: adjusted for age. Model 2: adjusted for model 1 + marital and employment status. Model 3: adjusted for model 2 + alcohol use and smoking. Model 4: adjusted for model 3 + prior SA.

SA periods require a medical certificate of disability from a physician. In a previous Finnish study, physically strenuous working conditions were more strongly associated with longer SA periods than shorter [16]. Overweight/obesity can impose additional strain on an individual's body, especially the musculoskeletal system, as an exposure to physically strenuous working conditions. However, among young employees, it can be that the strenuous effects of overweight/obesity and physically strenuous working conditions might not be as pronounced as among older employees, for example, due to a shorter exposure time and improved capacity to recover.

We found that exposure to mentally strenuous work was associated with increased rates of SA periods. However, among men, there was no association with SA periods of 1–7 days. The number of men was reduced in comparison to women, thus the results for men should be cautiously interpreted. For both women and men, the RRs for SA periods were highest for those with simultaneous overweight/obesity and exposure to mentally strenuous work. The interaction between overweight/obesity and mentally strenuous work was additive for SA periods of both 1–7 and ≥8 days. Both overweight/obesity and exposure to mentally strenuous work were independently associated with SA periods of ≥8 days, which is in accordance with previous studies, showing that both overweight/obesity and exposure to mentally strenuous working conditions are risk factors for work disability [18, 24–27, 38].

Methodological Considerations

The main strength of this study was the use of a large cohort including young and midlife employees representing a wide range of different occupations. Another strength was the use of the employer's register data on SA periods, including short SA periods which are not included in national data registers since SA periods lasting <10 working days in Finland are

usually covered by the employer. However, information on weight, height, and covariates were self-reported, which may lead to biased estimates of the measures. For example, studies have shown that people tend to overestimate their height and underestimate their weight [39]. However, in a previous study on midlife Finnish employees, BMI based on self-reports predicted SA periods similarly to objectively measured BMI [40]. We excluded 69 participants who reported they were pregnant, but it remains a limitation that a question on pregnancy was not included in the questionnaire. Women typically gain 8–15 kg during pregnancy, especially the last months of pregnancy. In 2021, there were 701,900 20–40-year-old women in Finland, and during the same year, 47,391 children were born among 20–40-year-old women in Finland [41]. This means that approximately 7% of 20–40-year-old women in Finland were pregnant during one calendar year. Therefore, it is likely that the current study includes a small number of women who have gained weight due to pregnancy at baseline.

Although the response rate was acceptable (51.5%) and the respondents represent the target population broadly [31], non-response and risk of a healthy worker effect remains a potential limitation. However, by also including those who responded to the shorter telephone interview, we were able to improve the socioeconomic representativeness of the data [31]. A previous study has examined the correlation between the single-item measures of perceived physical and mental working conditions used in this study with multi-item measures of physical and psychosocial working conditions, which are available only for those who responded to the online or postal questionnaire [32]. The study showed that mentally strenuous work correlated with Karasek's model of job demands and job strain but not with job control, and physically strenuous work and hours per day spent in physical work correlated with physical work and was also weakly correlated with hazardous exposure and desktop work. We performed sensitivity analyses in which we used the multi-item measure of physical working conditions, and the results were similar for physical work and hazardous exposure, however, weaker for desktop work (results not shown).

We were able to adjust for several covariates; however, residual confounding is possible. We did not adjust for socioeconomic position due to the risk of overadjustment as socioeconomic position and working conditions are strongly associated. In the sensitivity analyses, we adjusted for education, and the results were similar for mentally strenuous work but somewhat weaker for physically strenuous work; however, the results remained statistically significant for SA periods of ≥8 days (results not shown). Furthermore, although the study design is prospective and we adjusted for SA periods 1 year prior to baseline, causality should be interpreted cautiously. It is also important to consider that the generalizability of the results is limited since the cohort included only Finnish municipal employees, of whom the majority (78%) was women. Since previous studies have focused on Northern Europe, further studies are needed, especially from non-European countries where, for example, social security systems and SA entitlements largely differ from the Nordic countries. However, also between the Nordic countries, it is difficult to compare SA rates due to, for example, differences in how SA days are registered [42].

Conclusion

Our study showed that young and midlife employees with overweight/obesity and exposure to strenuous physical and mental working conditions had the highest rates of SA periods. When planning preventive actions, both individual- and workplace-related risk factors for SA should be considered to support career longevity, for example, by modifying working conditions and work tasks, especially among employees with limitations in their functioning and an increased risk for SA. Additionally, employers might benefit from providing employees adequate support for weight management and adherence to healthy lifestyles while improving employees' working conditions. Preventing obesity and work disability is important for individuals, employers, and society.

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Statement of Ethics

The Helsinki Health Study protocol was reviewed and approved by the Ethics Committee of the Faculty of Medicine, University of Helsinki, date of decision February 14, 2017 and the City of Helsinki, date of decision April 13, 2017. Participation in the study was voluntary and full confidentiality was guaranteed. A written

informed consent was obtained for participation in this study, and a separate written informed consent to link the Helsinki Health Study survey to register data was asked for.

Conflict of Interest Statement

The authors declare no competing interests.

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Author Contributions

A.S. performed statistical analyses, interpreted results, and drafted the manuscript. T.L., J.O., E.R., J.E., and J.S. contributed to designing the study, interpreting results, and drafting the manuscript. All of the authors approved the final manuscript.

Data Availability Statement

Data are not publicly available due to strict data protection laws and can only be accessed by the members of the study group (https://www.helsinki.fi/en/researchgroups/helsinki-health-study/data-protection-statement). Further inquiries can be directed to the corresponding author.

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