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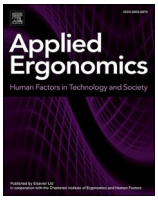

Employees' work breaks and their physical and mental health: Results from a representative German survey

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ABSTRACT

This study aimed to investigate the prevalence of three characteristics of work break organization, namely skipping work breaks, interruptions of work breaks, and meal break duration, and their relationships with physical and mental health. We used data from the BAuA-Working Time Survey 2017, a representative workforce survey in Germany, and restricted the sample to 5979 full-time employees. Logistic regression analyses were conducted with in total five health complaints as dependent variables: back pain and low back pain, pain in the neck and shoulder region, general tiredness, faintness, or fatigue, physical exhaustion, and emotional exhaustion. Many employees often skipped their work breaks (29%) and experienced break interruptions (16%). Frequent skipping of work breaks was significantly positively, that is detrimentally, related to all five health complaints and frequent interruptions of work breaks also, except for neck and shoulder pain. Meal break duration was significantly negatively, that is beneficially, related to physical exhaustion.

1. Introduction

Recovery from work plays an important role in the relationship between work, stress, and health (Geurts et al., 2014; Geurts and Sonnentag, 2006). The effort-recovery model (Meijman and Mulder, 1998) provides a theoretical explanation for this. It proposes that performing work tasks requires effort and thus causes physical and mental load reactions such as accelerated heart rate or fatigue (see also Binnewies and Sonnentag, 2008; Geurts and Sonnentag, 2006). To mitigate these load reactions, employees need time in which they do not have to work or face similar demands, thus, time during which recovery can occur. Specifically, recovery means that "the psycho-physiological systems that have been activated during work can return to baseline levels" (Geurts et al., 2014, p. 199). Since different work tasks such as heavy physical work or mainly mentally demanding tasks activate different psycho-physiological systems, recovery may encompass the relief of different functional systems. This is also why recovery can occur through various activities ranging from passive rest to active activities that complement or, rather, counterbalance work activities. However, if recovery time is insufficient, employees must invest additional compensatory effort to fulfill work tasks adequately (Geurts and Sonnentag, 2006; Meijman and Mulder, 1998). Thus, acute load reactions may accumulate over time and lead to chronic physical and mental reactions in the long term, for example, health problems such as prolonged fatigue and exhaustion or manifest musculoskeletal and psychosomatic diseases (Geurts and Sonnentag, 2006; Meijman and Mulder, 1998).

Recovery can occur in various temporal and spatial settings that can be categorized into recovery in a work context (internal or at-work recovery) and recovery in a non-work context, so recovery during leisure time (external or off-work recovery) (Geurts and Sonnentag, 2006; see also Chan et al., 2022; Cropley et al., 2020). For example, at-work recovery can occur via work breaks and other energy-management strategies such as task changes or reflecting on the meaning of one's work (Fritz et al., 2011), while off-work recovery concerns recovery during free evenings, weekends, vacations, and sabbaticals (Sonnentag et al., 2017, 2022). Work breaks are one of the most important opportunities for at-work recovery. These temporary work interruptions allow employees to recover and thus prevent the accumulation of work- or stress-related load reactions over working time (Wendsche et al., 2016).

Due to this essential role of work breaks for employees' recovery and thus their health, many countries have laws mandating work breaks.

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Specifically, many national laws and EU regulations (Working Time Directive 2003/88/EC) demand on working days longer than 6 h that one or more *breaks of a certain total duration* be taken at the latest after six consecutive working hours (ILO, 2016). Different national regulations and collective agreements exist on whether work breaks count as paid or unpaid working time (Eurofound, 2019; ILO, 2016). In Germany, the context of our study, it is stipulated that work shall be interrupted by predetermined work breaks lasting at least 30 min if the working time is between six and 9 h, and 45 min if the working time is longer than 9 h (German Working Hours Act, ArbZG, § 4). The work breaks may be divided into periods lasting at least 15 min each and are usually unpaid for most employees. In this regard, skipping breaks and interrupting them pose a potential threat to these standards.

It should be noted that these legal time limits for work breaks were not so much derived from concrete ergonomic threshold values but are the results of negotiations by social partners and politics (Linder and Nygaard, 1998). Some tentative evidence supports these limits, or at least the protective effect of the duration and timing of work breaks for workplace safety (Fischer et al., 2017). However, shorter breaks, specifically micro-breaks lasting less than 10 min, may also promote well-being (Albulescu et al., 2022). While it is theoretically assumed that employees' load reactions, and thus their needs for recovery (and breaks), are dependent on the specific type, intensity, and duration of work demands as well as their performance prerequisites (Meijman and Mulder, 1998; Rohmert, 1984), laws must generalize. To outweigh these generalizations to at least some extent, there may be other more specific rules on work breaks, such as collective agreements.

Different work break types can be distinguished not only based on their duration, but also their functions and the activities performed during them. For instance, there are rest breaks, toilet breaks, coffee or tea breaks, lunch or meal breaks (hereafter referred to as *meal breaks*), and prayer breaks. In practice, the meal break is the most common and longest break during a workday for many employees (Sianoja et al., 2016).

To date, there has been little research on the effect of work breaks on employee health (Eurofound, 2019; for reviews see Albulescu et al., 2022; Chan et al., 2022; Lyubykh et al., 2022; Wendsche et al., 2017; Wendsche et al., 2016). However, in line with the assumptions of the effort-recovery model (Meijman and Mulder, 1998), some studies found that work breaks are related to reduced fatigue (e.g., Blasche et al., 2022; Cropley et al., 2020; Cropley et al., 2022; Ho et al., 2014) and improved health (e.g., Cropley et al., 2022; Faucett et al., 2007; Lohmann-Haislah et al., 2019; Park et al., 2021; Sianoja et al., 2016; Wu et al., 2012). For instance, in a study with Austrian hospital physicians, self-determined rest breaks related to reduced fatigue during work (Blasche et al., 2022). Another study with Chinese coal miners revealed that insufficient recovery time during the working day – operationalized as a total break duration of fewer than 10 min – was associated with low back pain (Xu et al., 2012). Moreover, Lohmann-Haislah et al. (2019) found that skipping work breaks is associated with more psychosomatic and musculoskeletal complaints in German nurses. Finally, other studies revealed that taken work breaks are associated with a lower risk for work-related injuries or "accidents" (Arlinghaus et al., 2012; Lombardi et al., 2014; Park et al., 2020) due to their protective function against the accumulation of fatigue.

However, many of these studies focused on specific occupational groups. Hence, little is known about the prevalence and health effects of work breaks across occupational groups. Data across occupational groups is needed to further understand the potential of mandatory working time standards for health protection and identify implementation gaps in specific occupational groups. Moreover, although different work break characteristics (e.g., frequent break skipping and work break duration) may be correlated, many previous studies in this stream of research studied the different characteristics in isolation. Thus, until now, the single and combined relations with employee health remain primarily masked. However, distinguishing between single and combined relations is crucial for understanding which work break characteristics are actually relevant for employee health. Consequently, evidence from large-scale and representative employee populations and extensive consideration of various work break characteristics are needed.

In this study, we contribute to the literature by using data from a nationally representative study of the German workforce and considering relationships between different work break characteristics and various physical and mental health complaints. First, we aim to investigate the distribution of essential organizational characteristics for work breaks among German employees in general and different occupational groups. More specifically, we examine three characteristics that relate to the legal implementation of the corresponding break-related European core standards in the German Working Time Act: skipping work breaks, interruptions of work breaks, and duration of the meal break. Second, we investigate their relations to physical and mental health complaints. We test three hypotheses regarding the relationships between work break organization and health complaints based on the theoretical assumptions of the effort-recovery model (Meijman and Mulder, 1998) and related empirical findings discussed above.

Hypothesis 1. Frequent skipping of work breaks positively relates to employees' health complaints; that is, employees with frequent skipping of work breaks more often report health complaints.

Hypothesis 2. Frequent interruptions of work breaks positively relate to employees' health complaints; that is, employees with frequent interruptions of work breaks more often report health complaints.

Hypothesis 3. The duration of employees' meal breaks negatively relates to their health complaints; that is, employees with longer duration of meal breaks more rarely report health complaints.

2. Materials and methods

2.1. Sample and procedure

We used data from the BAuA-Working Time Survey 2017 (version 1, https://doi.org/10.21934/baua.azb17.suf.1) (Brauner et al., 2019), a large-scale and representative survey of the German working population, including employees working at least ten paid hours per week. Using computer-assisted telephone interviews, about 10,500 employees were surveyed regarding a wide range of topics related to working conditions, especially working time, health, and well-being. Data can be weighted or calibrated according to the microcensus 2016 of the Federal Statistical Office of Germany to ensure its representativeness. Häring et al. (2018) and Wöhrmann et al. (2021) provide a detailed description of the survey sample and methodology (including information about the adjustment weight).

For this study, we restricted the sample to full-time employees (35 h or more per week) aged 18 to 65, excluding self-employed persons and family workers. In addition, participants who could not give information on average meal break duration due to high variation in duration and participants with breaks or work interruptions mandated by the employer that are longer than 2 h on a regular work day were excluded, resulting in a sample of N = 6144. Finally, the sample was further reduced to N = 5979 participants due to participants missing values for at least one of the investigated variables. Sixty-three percent of the sample was male. The average age was 48.3 years (SD = 10.1), and the average weekly working time was 43.3 h (SD = 6.4). Participants worked in a wide variety of branches and occupations. Further sample characteristics are reported in Table 1.

2.2. Measures

2.2.1. Work break characteristics

We assessed *frequent skipping of work breaks* with a yes- (= 1) or no-

Table 1
Sample characteristics.

Variable	Total sample (unweighted data)		Total sample (weighted data)	
	N	%	N	%
Total	5979	100	6035[a]	100
Gender				
Male	3780	63	3895	65
Female	2199	37	2139	35
Educational level				
Low or medium	2608	44	3570	59
High	3371	56	2464	41
Underage child in household				
No	4173	70	4164	69
Yes	1806	30	1871	31
Occupational sector[b]				
Sector 1	1577	26	2008	33
Sector 2	1292	22	1127	19
Sector 3	2034	34	1707	28
Sector 4	484	8	372	6
Sector 5	592	10	820	14
Type of work				
Mainly mentally active	3741	63	2945	49
Mainly physically active	321	5	495	8
Equally mentally and physically active	1917	32	2595	43
Leadership position				
No	3793	63	4028	67
Yes	2186	37	2007	33
Shift work				
No	5431	91	5258	87
Yes	548	9	777	13
	M	SD	M	SD
Age	48.3	10.1	43.2	11.6
Weekly working hours	43.3	6.4	43.2	6.6

[a] The higher sample size of the weighted data is due to individuals having an adjustment weight greater than 1, which in turn is due to the fact that individuals with some characteristics are underrepresented in the study sample in comparison to the total population of employees in Germany working at least ten paid hours per week.

[b] Sector 1 = occupations in the production of goods; sector 2 = occupations in personal services; sector 3 = occupations in business administration and other business related services; sector 4 = service occupations in the IT-sector and the natural sciences; sector 5 = other occupations in commercial services.

(= 0) answer to the question "Does it happen often that work breaks are skipped on workdays of more than 6 h? We are referring to breaks of more than 15 min." This question was formulated according to German legislation with the German Working Hours Act (ArbZG, § 4) stipulating that employees may not work more than 6 h without a work break. Accordingly, work should be interrupted by predetermined work breaks of at least 30 min if the working time is between six and 9 h, and 45 min if the working time exceeds 9 h. The work breaks may be divided into periods of at least 15 min each. *Frequent interruptions of work breaks* were assessed with the question "How often does it happen that you have to interrupt or shorten your breaks? Is that often, sometimes, rarely, or never?" using a dummy coding for "often" (= 1) for our analyses (all other responses coded with "0"). Moreover, *meal break duration* was assessed with the open question "What is the usual duration of your lunch or meal break?" (in minutes).

There were significant moderate correlations between the three work break characteristics, supporting our assumption of correlated but distinct aspects of work break organization. Specifically, the correlation between frequent skipping of work breaks and frequent interruptions of work breaks was φ (phi coefficient) = 0.429, the correlation between frequent skipping of work breaks and meal break duration was r_{pb} (point-biserial correlation coefficient) = −0.199, and finally, the correlation between frequent interruptions of work breaks and meal break duration was r_{pb} = −0.226 (all ps < 0.001).

Table 2
Descriptive statistics of work break characteristics and control variables (weighted data, N = 6035).

Variable	Frequent skipping of work breaks	Frequent interruptions of work breaks	Meal break duration	
	Yes %	Yes %	M	SD
Total	29	16	34.7	17.9
Gender				
Male	27	13	35.6	16.4
Female	31	22	32.9	20.4
Educational level				
Low or medium	26	15	34.1	17.2
High	32	18	35.5	18.9
Underage child in household				
No	29	16	34.7	17.9
Yes	29	17	34.6	17.9
Occupational sector[a]				
Sector 1	21	9	34.7	15.6
Sector 2	44	35	31.1	23.8
Sector 3	29	14	36.2	16.3
Sector 4	20	9	37.5	16.3
Sector 5	30	15	35.1	17.1
Type of work				
Mainly mentally active	29	16	36.2	18.1
Mainly physically active	22	10	33.9	15.4
Equally mentally and physically active	29	18	33.1	18.1
Leadership position				
No	25	14	34.9	18.3
Yes	36	20	34.2	17.2
Shift work				
No	28	15	36.0	18.3
Yes	36	24	25.7	11.8
	r_{pb}	r_{pb}	r	
Age	−0.066**	−0.029	0.011	
Weekly working hours	0.183**	0.177**	−0.008	

*p < 0.01. **p < 0.001.

[a] Sector 1 = occupations in the production of goods; sector 2 = occupations in personal services; sector 3 = occupations in business administration and other business related services; sector 4 = service occupations in the IT-sector and the natural sciences; sector 5 = other occupations in commercial services.

2.2.2. Physical and mental health complaints

We assessed the five health complaints (1) *back pain and low back pain*, (2) *pain in the neck and shoulder region*, (3) *general tiredness, faintness, or fatigue*, (4) *physical exhaustion*, and (5) *emotional exhaustion*, each with a yes- (= 1) or no- (= 0) answer. The question was introduced with: "Please tell me whether you have often had the following health complaints during work or on working days in the last twelve months."

2.2.3. Control variables

Various variables may affect employee health. We used control variables to minimize the possibility that the results were due to aspects other than the work-break characteristics of interest. Specifically, in line with research regarding work break characteristics and employee health and well-being (e.g., Cropley et al., 2020; Lohmann-Haislah et al., 2019; Wendsche and Lohmann-Haislah, 2016), we accounted for socio-demographic aspects and working conditions with the following control variables: *gender* (0 = male, 1 = female), *age* (in years), *educational level* (0 = low or medium, i.e., school education or vocational training, 1 = high, i.e., academic degree or master craftsman's diploma), *underage child in household* (0 = no, 1 = yes), *occupational sector* according to the German classification of occupations (four dummy variables, reference category: sector 3, i.e., occupations in business administration and other business related services), *type of work* (two

Table 3
Descriptive statistics of work break characteristics and health complaints (weighted data, N = 6035).

Variable	Back pain and low back pain		Pain in the neck and shoulder region		General tiredness, faintness, or fatigue		Physical exhaustion		Emotional exhaustion	
	No %	Yes %	No %	Yes %	No %	Yes %	No %	Yes %	No %	Yes %
Total	52	48	48	52	49	51	62	38	72	28
Frequent skipping of work breaks										
No	54	46	50	50	53	47	66	34	76	24
Yes	47	53	43	57	41	59	52	48	60	40
Frequent interruptions of work breaks										
No	54	46	49	51	52	48	65	35	76	24
Yes	43	57	40	60	33	67	46	54	50	50
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
Meal break duration	35.2 (17.0)	34.1 (18.9)	35.6 (18.7)	33.8 (17.2)	36.3 (18.0)	33.1 (17.8)	36.2 (18.4)	32.1 (16.9)	35.4 (17.4)	32.9 (19.2)

dummy variables, reference category: equally mentally and physically active), *leadership position* (0 = no, 1 = yes), *shift work* (0 = no, i.e., no rotating shifts or work exclusively at night, 1 = yes, i.e., rotating shifts or work exclusively at night), and *weekly working hours*.

2.3. Statistical analyses

We used IBM SPSS Statistics 28 for data processing, including checking assumptions of logistic regressions, and statistical analyses. To examine how the three work break characteristics were distributed among German employees in general and depending on socio-demographic aspects and working conditions, percentage shares, mean values, and standard deviations were calculated using weighted data.

We conducted logistic regression analyses using unweighted data[1] to test our hypotheses on relationships between work break characteristics and employee health. We tested five models for each of the five health complaints as outcomes. We first calculated models (Model 1 to Model 3), in each of which only one of the three work break characteristics was included. In the following, we considered all three work break characteristics simultaneously (Model 4). Finally, we adjusted Model 4 by including the control variables (Model 5), which served as the basis for the hypothesis testing. We set the significance level to $p < 0.01$ due to the large sample size.

Besides, we conducted additional explorative analyses to examine whether the relationships between work break characteristics and employee health differed between occupational groups. To this end, we reran the logistic regression analyses stratified by occupational sectors.

3. Results

3.1. Descriptive results

Table 1, Table 2, and Table 3 show the descriptive statistics of all study variables. As shown in Table 2, 29% of the employees skip their work breaks frequently, and 16% reported that their breaks are often interrupted. The average meal break duration was about 35 min (M = 34.7, SD = 17.9).

As visible in Table 2, the distribution of work break skipping and interruptions differed for various socio-demographic aspects. For example, women reported frequent interruptions of work breaks (22% vs. 13%) more often than men. In addition, employees with a high educational level reported frequently skipping work breaks (32% vs. 26%) more often than those with a low or medium educational level. Moreover, differences in the distribution were also apparent for different working conditions. For example, we found that employees with occupations in personal services (sector 2) and shift workers reported poor work break organization (i.e., shorter duration and more often frequently skipped and interrupted work breaks) more often.

The percentage shares for health complaints (Table 3) were as expected: Across all five health complaints, employees reporting frequent skipping and frequent interruptions of work breaks reported frequent complaints more often than employees without frequent skipping and interruptions of work breaks. In addition, employees with frequent complaints reported a slightly shorter average meal break duration than employees without frequent health complaints.

3.2. Results of hypotheses testing

Table 4 shows the results of the logistic regression analysis. For Model 1 to Model 3, which are the models including only one of the three work break characteristics, we found a significant relationship between the respective work break characteristic and the respective health complaint. In other words, while frequent skipping and interruptions of work breaks were each significantly positively, that is detrimentally, related to all five health complaints, meal break duration was significantly negatively, that is beneficially, related to all five health complaints. R^2-values were rather small and ranged from 0.002 to 0.025 (Cox and Snell, 1989) or 0.003 to 0.036 (Nagelkerke, 1991), with values for the health complaints of general tiredness, faintness, or fatigue, physical exhaustion, and emotional exhaustion mainly being higher than those for back pain and low back pain and pain in the neck and shoulder region.

In Model 4, which included all three work break characteristics simultaneously, frequent skipping of work breaks and frequent interruptions of work breaks were still significantly positively related to all five health complaints. The duration of employees' meal breaks was significantly negatively related to general tiredness, faintness, or fatigue, and physical exhaustion but not to back pain and low back pain, pain in the neck and should region, and emotional exhaustion.

In the fully adjusted Model 5 (with control variables),[2] the overall pattern of results remained robust to that of Model 4 with two exceptions: Reporting frequently interrupted work breaks did no longer significantly relate to pain in the neck and shoulder region, and employees' meal break duration did no longer significantly relate to general tiredness, faintness, or fatigue.

Overall, the results support Hypothesis 1, that employees with frequent skipping of work breaks more often report health complaints. Moreover, our study results mainly support Hypothesis 2, which proposed a statistically positive, that is detrimental, relationship between frequently interrupted work breaks and employees' health complaints.

[1] Unweighted data were used since the models included control variables, some of which were also used in sample weighting.

[2] For a more detailed presentation of the results of Model 5, including the values for control variables, see Table A1 in Appendix A.

Table 4
Results from logistic regression analysis with work break characteristics as independent variables and health complaints as dependent variables (unweighted data, N = 5979).

	Back pain and low back pain		Pain in the neck and shoulder region		General tiredness, faintness, or fatigue		Physical exhaustion		Emotional exhaustion	
	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)
Model 1										
Frequent skipping of work breaks	0.347** (0.057)	1.415 (1.223–1.638)	0.365** (0.057)	1.441 (1.244–1.669)	0.569** (0.057)	1.767 (1.524–2.048)	0.631** (0.058)	1.880 (1.619–2.183)	0.684** (0.060)	1.983 (1.697–2.316)
R^2 (Cox & Snell)	0.006		0.007		0.017		0.019		0.021	
R^2 (Nagelkerke)	0.008		0.009		0.022		0.027		0.030	
$\chi^2(1)$	37.472		41.417		99.949		117.628		127.015	
Model 2										
Frequent interruptions of work breaks	0.452** (0.069)	1.572 (1.314–1.880)	0.417** (0.071)	1.517 (1.265–1.819)	0.806** (0.073)	2.239 (1.856–2.700)	0.831** (0.070)	2.296 (1.917–2.751)	0.895** (0.071)	2.448 (2.037–2.941)
R^2 (Cox & Snell)	0.007		0.006		0.021		0.023		0.025	
R^2 (Nagelkerke)	0.009		0.008		0.028		0.032		0.036	
$\chi^2(1)$	42.495		35.550		128.970		139.905		153.540	
Model 3										
Meal break duration	−0.006** (0.002)	0.994 (0.990–0.998)	−0.005** (0.002)	0.995 (0.991–0.998)	−0.010** (0.002)	0.990 (0.986–0.994)	−0.014** (0.002)	0.986 (0.982–0.991)	−0.006** (0.002)	0.994 (0.989–0.998)
R^2 (Cox & Snell)	0.002		0.002		0.007		0.011		0.002	
R^2 (Nagelkerke)	0.003		0.003		0.009		0.015		0.003	
$\chi^2(1)$	13.756		13.563		40.649		65.653		13.953	
Model 4										
Frequent skipping of work breaks	0.218** (0.063)	1.244 (1.057–1.464)	0.256** (0.063)	1.292 (1.098–1.521)	0.339** (0.064)	1.404 (1.192–1.653)	0.379** (0.065)	1.460 (1.235–1.727)	0.447** (0.068)	1.564 (1.313–1.863)
Frequent interruptions of work breaks	0.308** (0.078)	1.361 (1.114–1.664)	0.253* (0.079)	1.287 (1.051–1.577)	0.580** (0.081)	1.786 (1.451–2.198)	0.556** (0.079)	1.743 (1.422–2.137)	0.667** (0.080)	1.949 (1.584–2.397)
Meal break duration	−0.003 (0.002)	0.997 (0.993–1.001)	−0.003 (0.002)	0.997 (0.993–1.001)	−0.005* (0.002)	0.995 (0.991–0.999)	−0.008** (0.002)	0.992 (0.988–0.997)	0.000 (0.002)	1.000 (0.996–1.004)
R^2 (Cox & Snell)	0.010		0.010		0.028		0.033		0.032	
R^2 (Nagelkerke)	0.013		0.013		0.038		0.045		0.046	
$\chi^2(3)$	59.393		57.672		172.164		200.923		196.677	
Model 5[a]										
Frequent skipping of work breaks	0.314** (0.066)	1.369 (1.155–1.622)	0.316** (0.066)	1.372 (1.158–1.625)	0.356** (0.065)	1.427 (1.206–1.689)	0.437** (0.068)	1.547 (1.300–1.842)	0.434** (0.070)	1.544 (1.290–1.848)
Frequent interruptions of work breaks	0.318** (0.082)	1.374 (1.111–1.698)	0.166 (0.083)	1.180 (0.953–1.462)	0.521** (0.084)	1.683 (1.356–2.089)	0.469** (0.083)	1.598 (1.290–1.979)	0.540** (0.084)	1.716 (1.381–2.132)
Meal break duration	0.000 (0.002)	1.000 (0.996–1.004)	−0.001 (0.002)	0.999 (0.995–1.003)	−0.004 (0.002)	0.996 (0.992–1.001)	−0.005* (0.002)	0.995 (0.991–1.000[b])	0.001 (0.002)	1.001 (0.997–1.005)
R^2 (Cox & Snell)	0.056		0.049		0.048		0.071		0.054	
R^2 (Nagelkerke)	0.075		0.066		0.064		0.098		0.077	
$\chi^2(16)$	343.056		302.058		293.238		440.331		329.523	

Note. B = beta values; SE = standard error; exp b = odds ratio; CI = confidence interval.
*p < 0.01. **p < 0.001.
[a] Model 5 is adjusted for gender, age, educational level, underage child in household, occupational sectors according to the German classification of occupations, type of work, leadership position, shift work, and weekly working hours.
[b] This value is 1.000 due to rounding; it is in fact slightly less than 1.000.

However, we did not find the expected relationship for the musculoskeletal health complaint of pain in the neck and shoulder region after adjusting for socio-demographic factors and working conditions.

Finally, results partially support Hypothesis 3, which relates to the role of meal break duration and health. More specifically, the proposed negative, that is beneficial, relationship between the duration of employees' meal breaks and health complaints was only robust (after adjustments for other break characteristics and control variables) for one of the five outcomes, namely physical exhaustion.[3]

3.3. Results of additional explorative analyses

Results of logistic regression analysis stratified by occupational sectors are shown in Table B1 to Table B5 in Appendix B. Overall, they point towards a similar pattern of results as the results from the total sample. More specifically, the direction and magnitude of the beta values and the odds ratios (exp b) were similar to the findings in the total sample, underlining that especially frequent skipping of work breaks and frequent interruptions of work breaks are associated with physical and mental health complaints. However, due to smaller sample sizes of the occupational groups and larger standard errors, fewer relationships were significant, especially in the smallest groups, that is sector 4 (i.e., service occupations in the IT-sector and the natural sciences) and sector 5 (i.e., other occupations in commercial services). Most significant relationships between break characteristics and health complaints were found in sector 2 (i.e., occupations in personal services), which was characterized by the highest prevalence of frequent skipping of work breaks and frequent interruptions of work breaks as well as the shortest average meal break duration.

Some results for some occupational groups, however, differed somewhat more from those of the total sample. For instance, in sector 2, the relationship between frequent interruptions of work breaks and pain in the neck and shoulder region had a negative sign. Furthermore, some larger differences between sectors were apparent. For example, the odds ratio for frequent skipping of work breaks in relation to physical exhaustion was notably greater in sector 4 than in sector 1 (i.e., occupations in the production of goods).

4. Discussion

This study aimed to estimate the prevalence of various characteristics of work break organization, namely skipping of work breaks, interruptions of work breaks, and meal break duration. Moreover, the study investigated how these work break characteristics relate to employees' health complaints. By using data from a large-scale and representative survey of the German workforce and investigating both single and combined relationships between work break characteristics and health complaints, our results are highly generalizable and extend previous research on work breaks. We found that many employees frequently skip and experience interruptions of their work breaks. Furthermore, results show associations between the three investigated work break characteristics, especially skipped and interrupted work breaks, and health complaints.

On the one hand, we found an average meal break duration of about 35 min and thus slightly above the German legal requirement for work breaks of 30 min (if the working time is between six and 9 h). On the other hand, the prevalence estimates of frequently skipping mandatory and interrupted work breaks were relatively high. Moreover, the prevalence rates differed between different employee groups. For example, women, employees in personal services, employees with leadership positions, and shift workers showed increased risks for poor work break organization, conflicting with national working time standards and recommendations from the ergonomic literature (Eurofound, 2019). Given the importance of work breaks for employees' recovery and health, further supported by our study results, these high prevalence rates are concerning.

Our results revealed significant but small relationships between the three examined work break characteristics, especially skipped and interrupted work breaks and health complaints. That the effect sizes reported in this study are rather small can be explained by the fact that health is determined by a multitude of factors, of which work-related variables in general, and specific work break characteristics in particular, make up only a small part. However, our results are in line with previous research showing associations between work breaks and employee health (e.g., Lohmann-Haislah et al., 2019; Sianoja et al., 2016; Wu et al., 2012; Xu et al., 2012). Moreover, our results support the theoretical assumptions of the effort-recovery model (Meijman and Mulder, 1998) with regard to at-work recovery, more specifically, work breaks.

Since we considered different work break characteristics individually and simultaneously, our study results allow an estimation of single and combined relationships between the three work break characteristics and employee health. We found that the relationships between frequent skipping as well as interruptions of work breaks and health remained robust after considering the respective two other work break characteristics. However, the single and combined relationships between meal break duration and health complaints varied. Specifically, when frequent skipping and frequent interruptions of work breaks were included in the analyses, the duration of employees' meal breaks was only related to two of the five health complaints, namely general tiredness, faintness, or fatigue, and physical exhaustion. Thus, break duration does not play an important role with regard to health complaints beyond frequent skipping of work breaks and interruptions of work breaks. This indicates that it is not the average break duration itself, but rather other aspects of work break organization – such as a work situation in which breaks are rarely skipped or interrupted – that are crucial for employee health. That the risks of a reduced work break duration are no longer significant when considering various work break characteristics in combination has also been shown in a study by Wendsche et al. (2021), who examined the relationship between work break organization and nurses' leaving intentions. Future research is needed to investigate the (temporal and dynamic) relationships between the various characteristics of work break organization in affecting employees' health.

In addition, we found that not all investigated work break and health relationships remained significant when adjusting for various socio-demographic factors and working conditions. This and the fact that many of these socio-demographic factors and working conditions were directly related to the work break characteristics under investigation (as depicted in Table 2) indicate that the relationship between these aspects and their association with employee health is more complex. Therefore, future studies should investigate these relationships in more depth, for instance, by using a longitudinal design and investigating a mediating role of work break characteristics in the relationship between working conditions and employee health.

Supplementary analyses in that we stratified for occupational sectors supported our finding that especially frequent skipping and frequent interruptions of work breaks are related to various physical and mental health complaints, indicating that this holds across different occupational groups. However, our results also indicate some differences between occupational groups. Thus, future studies should investigate in more detail whether relationships between work break characteristics and employee health differ between occupational groups. For example, they could examine more specific occupational groups or focus on different types of work activities to allow the deduction of specific recommendations for particular groups of employees. Besides, it could be

[3] To test the robustness of our results, we also conducted logistic regression analyses with weighted data. The pattern of results and conclusions did not change. Regarding Model 5, the only difference when using weighted data is that meal break duration was significantly related to general tiredness, faintness, or fatigue, which was not the case when using unweighted data.

examined whether different types of break activities, such as socializing with colleagues or going for a walk, differ in their importance for recovery and health among employees in different occupational groups or with different work activities.

4.1. Limitations and further future research directions

Some limitations of our study should be mentioned. First, due to the use of data from a sample of employees in Germany, the generalizability of our study results to other countries might be limited. Although the assumption that recovery has the same effects for all individuals is common in the recovery literature, we cannot rule out the possibility that our results would have been different in countries with different legal requirements, collective agreements, or cultural values (Chan et al., 2022). For instance, Chan et al. (2022) discussed the possibility that employees from cultures with a long-term orientation (Hofstede et al., 2005) might find at-work recovery, including work breaks, less valuable than employees from cultures with a short-term orientation. Thus, we recommend future research examining the relationships between various characteristics of work break organization and employee health for other countries and cultures. In addition to aspects of country and culture, further potential moderators should be investigated, for example, at the individual level. For instance, previous research on off-work recovery already suggests that individual characteristics such as heavy work investment (Wendsche and Lohmann-Haislah, 2017) or workaholism (Bakker et al., 2013) might act as moderators.

Another limitation is that we had no information on additional, potentially important work break characteristics. In a recent review, Lyubykh et al. (2022) proposed that work breaks can be described in terms of five features: initiator, duration, frequency, activities, and experiences. Based on this comprehensive description or categorization of work break features, future studies should continue investigating combined effects of various work break characteristics. The fact that the single and combined relationships between work break characteristics and health differed to some degree in our study underlines the need to consider multiple characteristics of work breaks simultaneously.

Furthermore, some methodological limitations should be acknowledged. Due to the cross-sectional nature of the data, we cannot make any causal statements about the directions of the relationships. Although our assumption that work break characteristics affect employee health is theoretically based (Meijman and Mulder, 1998), we cannot rule out reverse relationships, that is, health complaints affecting work break characteristics. For example, on the one hand, it would be conceivable that employees with poor health require longer work break durations (however, our results indicate that employees with longer meal break durations more rarely report some complaints, which would contradict this possibility). On the other hand, it would also be conceivable that employees with poor health skip breaks or shorten them more often to compensate for lower productivity potentially due to their health status. Another methodological limitation is unobserved heterogeneity. Although we adjusted our analyses for many control variables, we cannot rule out that additional aspects, such as extensive time and performance pressure or insufficient job control, play a role in the relationship between work break organization and health. Besides, our data are all self-reported and thus carry the risk of common-method bias. Therefore, we recommend longitudinal and experimental studies, as well as the use of objective work time data on work breaks and physiological data on health status or medical diagnoses for future studies.

Moreover, the data used was collected in 2017. It is possible that more recent events such as the COVID-19-pandemic and associated changes in working conditions – for example, the very high workload in some sectors such as healthcare or the increase in remote work and thus in work-time control – have changed the framework conditions for work breaks as well as their relevance. Hence, future research could investigate whether and how the changed working conditions affect the relationships investigated in this study.

4.2. Practical implications

Our study shows that many employees skip their work breaks and experience work break interruptions. Besides, we found that especially skipped and interrupted work breaks, rather than the duration of meal breaks, relate to employees' health complaints. Therefore, the main implication of our study is that employers and employees should ensure that breaks are not skipped or interrupted. Particular attention should be paid to those employee groups, who, according to our study, have particularly high prevalence rates of poor work break organization. Several actions are possible to avoid or at least reduce skipping and interruptions of work breaks. For instance, it could help to schedule work breaks in advance and communicate fixed times for work breaks to colleagues, supervisors, clients, and others. Besides, it could help to educate employees about the relevance of work breaks for their health.

Theoretical assumptions (Meijman and Mulder, 1998) suggest that not only passive activities such as resting, but also active activities that activate or drain different physiological systems than the preceding work activities, and thus complement or compensate for them, help recovery. Therefore, it is recommended that break activities be coordinated with work activities, such as exercising during work breaks for knowledge workers with office jobs. Since at-work recovery is not only achieved through taking work breaks but also through work-related energy management strategies (Sonnentag et al., 2022), actions related to these strategies could also be considered.

Regarding the political level of implications, our analyses and results do not allow concluding on whether the legally stipulated extent and duration of work breaks are sufficient. However, by showing that non-compliance with this regulations, that is, frequent skipping of work breaks and frequent interruptions of work breaks, is associated with health complaints, they underline that a good organization of work breaks, in which work breaks are neither skipped nor interrupted, is an important instrument for occupational safety and health.

5. Conclusions

By investigating three characteristics of work break organization in a nationally representative German sample, this study contributes to a deeper understanding of the prevalence and health effects of work breaks. Although work breaks are mandatory in Germany, our data indicate that many employees often skip their breaks and experience break interruptions. Consistent with previous research showing relationships between work breaks and employee health (e.g., Lohmann-Haislah et al., 2019; Sianoja et al., 2016; Wu et al., 2012; Xu et al., 2012) and supporting the theoretical assumptions of the effort-recovery-model (Meijman and Mulder, 1998), our results also show that the three investigated work break characteristics, especially skipped and interrupted work breaks relate to employees' health complaints. Thus, employers and employees should try to avoid work break skipping and interruptions. In addition, future research should continue to investigate the combined effects of various work break characteristics to gain more insights into the interaction of these characteristics in relation to employee health.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Results from logistic regression analysis including values for the control variables

Table A1
Results from logistic regression analysis with work break characteristics as independent variables and health complaints as dependent variables (unweighted data, N = 5979).

	Back pain and low back pain		Pain in the neck and shoulder region		General tiredness, faintness, or fatigue		Physical exhaustion		Emotional exhaustion	
	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)
Model 5										
Frequent skipping of work breaks	0.314**	1.369	0.316**	1.372	0.356**	1.427	0.437**	1.547	0.434**	1.544
	(0.066)	(1.155–1.622)	(0.066)	(1.158–1.625)	(0.065)	(1.206–1.689)	(0.068)	(1.300–1.842)	(0.070)	(1.290–1.848)
Frequent interruptions of work breaks	0.318**	1.374	0.166	1.180	0.521**	1.683	0.469**	1.598	0.540**	1.716
	(0.082)	(1.111–1.698)	(0.083)	(0.953–1.462)	(0.084)	(1.356–2.089)	(0.083)	(1.290–1.979)	(0.084)	(1.381–2.132)
Meal break duration	0.000	1.000	−0.001	0.999	−0.004	0.996	−0.005*	0.995	0.001	1.001
	(0.002)	(0.996–1.004)	(0.002)	(0.995–1.003)	(0.002)	(0.992–1.001)	(0.002)	(0.991–1.000[a])	(0.002)	(0.997–1.005)
Gender	0.283**	1.327	0.821**	2.273	0.370**	1.447	0.462**	1.587	0.485**	1.625
	(0.064)	(1.124–1.566)	(0.064)	(1.927–2.681)	(0.064)	(1.229–1.705)	(0.067)	(1.335–1.886)	(0.069)	(1.361–1.939)
Age	0.008*	1.008	0.003	1.003	−0.013**	0.988	−0.003	0.997	−0.005	0.995
	(0.003)	(1.001–1.015)	(0.003)	(0.996–1.010)	(0.003)	(0.981–0.995)	(0.003)	(0.990–1.005)	(0.003)	(0.988–1.003)
Educational level	−0.228**	0.796	−0.244**	0.784	−0.110	0.896	−.0171*	0.843	−0.084	0.920
	(0.061)	(0.680–0.931)	(0.061)	(0.670–0.917)	(0.061)	(0.766–1.048)	(0.064)	(0.714–0.994)	(0.067)	(0.773–1.094)
Underage child in household	0.051	1.053	−0.002	0.998	−0.111	0.895	−0.111	0.895	0.050	1.052
	(0.062)	(0.898–1.234)	(0.061)	(0.853–1.166)	(0.061)	(0.765–1.046)	(0.065)	(0.757–1.058)	(0.067)	(0.885–1.250)
Occupational sectors[b]										
Sector 1	0.075	1.078	0.038	1.039	0.121	1.129	0.143	1.154	−0.085	0.918
	(0.081)	(0.875–1.327)	(0.080)	(0.847–1.275)	(0.080)	(0.920–1.386)	(0.086)	(0.926–1.438)	(0.090)	(0.729–1.157)
Sector 2	−0.157	0.855	−0.082	0.922	0.136	1.145	0.117	1.124	0.165	1.179
	(0.082)	(0.692–1.056)	(0.081)	(0.747–1.136)	(0.081)	(0.930–1.411)	(0.085)	(0.903–1.399)	(0.086)	(0.945–1.471)
Sector 4	−0.105	0.901	−0.052	0.949	0.154	1.166	−0.137	0.872	−0.103	0.902
	(0.110)	(0.678–1.197)	(0.106)	(0.722–1.248)	(0.105)	(0.889–1.530)	(0.121)	(0.638–1.192)	(0.121)	(0.661–1.233)
Sector 5	0.162	1.176	0.098	1.103	−0.023	0.977	0.067	1.069	−0.174	0.840
	(0.106)	(0.895–1.544)	(0.105)	(0.841–1.446)	(0.105)	(0.745–1.282)	(0.111)	(0.804–1.421)	(0.120)	(0.617–1.144)
Type of work										
Mainly mentally active	−0.647**	0.524	−0.087	0.917	0.169	1.184	−0.422**	0.656	0.332**	1.394
	(0.071)	(0.436–0.628)	(0.071)	(0.764–1.101)	(0.071)	(0.986–1.422)	(0.074)	(0.542–0.793)	(0.080)	(1.135–1.711)
Mainly physically active	0.340*	1.404	0.007	1.007	0.221	1.247	0.551**	1.735	0.290	1.337
	(0.127)	(1.014–1.945)	(0.125)	(0.731–1.388)	(0.125)	(0.903–1.722)	(0.125)	(1.257–2.396)	(0.141)	(0.931–1.920)
Leadership position	−0.094	0.910	−0.009	0.991	−0.178*	0.837	−0.130	0.878	−0.069	0.933
	(0.058)	(0.784–1.057)	(0.057)	(0.855–1.149)	(0.058)	(0.721–0.970)	(0.061)	(0.750–1.028)	(0.064)	(0.792–1.100)
Shift work	0.020	1.020	−0.008	0.993	0.485**	1.624	0.150	1.162	0.416**	1.515
	(0.099)	(0.790–1.317)	(0.100)	(0.767–1.284)	(0.102)	(1.249–2.112)	(0.101)	(0.896–1.507)	(0.107)	(1.149–1.998)
Weekly working hours	0.000	1.000	0.000	1.000	0.011	1.011	0.016**	1.016	0.011	1.012
	(0.004)	(0.988–1.012)	(0.004)	(0.988–1.011)	(0.005)	(0.999–1.023)	(0.005)	(1.004–1.028)	(0.005)	(0.999–1.024)
Constant	−0.345	0.708	−0.259	0.772	−0.128	0.880	−1.080**	0.340	−1.854**	0.157
	(0.264)		(0.261)		(0.264)		(0.275)		(0.285)	
R^2 (Cox & Snell)	0.056		0.049		0.048		0.071		0.054	
R^2 (Nagelkerke)	0.075		0.066		0.064		0.098		0.077	
$\chi^2(16)$	343.056		302.058		293.238		440.331		329.523	

Note. B = beta values; SE = standard error; exp b = odds ratio; CI = confidence interval.
Gender: 0 = male, 1 = female; age: in years, = continuous; educational level: 0 = low or medium (i.e., school education or vocational training), 1 = high (i.e., academic degree or master craftsman's diploma); underage child in household: 0 = no, 1 = yes; occupational sector according to the German classification of occupations: four dummy variables, reference category = sector 3 (i.e., occupations in business administration and other business related services); type of work: two dummy variables, reference category = equally mentally and physically active; leadership position: 0 = no, 1 = yes; shift work: 0 = no (i.e., no rotating shifts or work exclusively at night), 1 = yes (i.e., rotating shifts or work exclusively at night); weekly working hours: = continuous.
*p < 0.01. **p < 0.001.
[a] This value is 1.000 due to rounding; it is in fact slightly less than 1.000.
[b] Sector 1 = occupations in the production of goods; sector 2 = occupations in personal services; sector 4 = service occupations in the IT-sector and the natural sciences; sector 5 = other occupations in commercial services.

Appendix B. Results from logistic regression analysis stratified by occupational sectors

Table B1
Results from logistic regression analysis with work break characteristics as independent variables and back pain and low back pain as dependent variable (unweighted data).

	Sector 1[a] (N = 1577)		Sector 2[a] (N = 1292)		Sector 3[a] (N = 2034)		Sector 4[a] (N = 484)		Sector 5[a] (N = 592)	
	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)
Model 1										
Frequent skipping of work breaks	0.147	1.159	0.504**	1.655	0.329**	1.390	0.359	1.432	0.432	1.541
	(0.121)	(0.850–1.581)	(0.113)	(1.235–2.217)	(0.099)	(1.077–1.794)	(0.226)	(0.799–2.566)	(0.179)	(0.970–2.446)
R^2 (Cox & Snell)	0.001		0.015		0.005		0.005		0.010	
R^2 (Nagelkerke)	0.001		0.020		0.007		0.007		0.013	
$\chi^2(1)$	1.495		19.832		11.028		2.485		5.871	
Model 2										
Frequent interruptions of work breaks	0.361	1.435	0.576**	1.779	0.404*	1.498	0.402	1.495	0.372	1.451
	(0.171)	(0.923–2.230)	(0.118)	(1.311–2.413)	(0.128)	(1.076–2.086)	(0.356)	(0.598–3.739)	(0.234)	(0.794–2.651)
R^2 (Cox & Snell)	0.003		0.018		0.005		0.003		0.004	
R^2 (Nagelkerke)	0.004		0.024		0.007		0.004		0.006	
$\chi^2(1)$	4.480		23.856		9.835		1.250		2.574	
Model 3										
Meal break duration	0.000	1.000	−0.009*	0.991	−0.009*	0.991	−0.005	0.995	0.004	1.004
	(0.003)	(0.993–1.008)	(0.003)	(0.984–0.998)	(0.003)	(0.984–0.999)	(0.007)	(0.978–1.013)	(0.005)	(0.991–1.017)
R^2 (Cox & Snell)	0.000		0.008		0.004		0.001		0.001	
R^2 (Nagelkerke)	0.000		0.011		0.006		0.001		0.001	
$\chi^2(1)$	0.031		10.730		8.852		0.501		0.630	
Model 4										
Frequent skipping of work breaks	0.068	1.071	0.290	1.336	0.208	1.232	0.305	1.357	0.385	1.470
	(0.131)	(0.765–1.499)	(0.129)	(0.959–1.861)	(0.110)	(0.927–1.637)	(0.238)	(0.735–2.505)	(0.194)	(0.891–2.424)
Frequent interruptions of work breaks	0.337	1.401	0.385*	1.470	0.228	1.256	0.227	1.255	0.240	1.271
	(0.185)	(0.870–2.256)	(0.135)	(1.039–2.080)	(0.143)	(0.868–1.818)	(0.381)	(0.470–3.349)	(0.259)	(0.653–2.475)
Meal break duration	0.001	1.001	−0.005	0.995	−0.006	0.994	−0.003	0.997	0.006	1.006
	(0.003)	(0.994–1.009)	(0.003)	(0.988–1.002)	(0.003)	(0.986–1.002)	(0.007)	(0.980–1.015)	(0.005)	(0.993–1.020)
R^2 (Cox & Snell)	0.003		0.025		0.009		0.006		0.013	
R^2 (Nagelkerke)	0.004		0.034		0.012		0.009		0.018	
$\chi^2(3)$	4.971		33.226		18.597		3.102		7.848	
Model 5[b]										
Frequent skipping of work breaks	0.266	1.305	0.333	1.396	0.267	1.306	0.367	1.443	0.450	1.568
	(0.139)	(0.913–1.866)	(0.135)	(0.985–1.977)	(0.113)	(0.976–1.749)	(0.259)	(0.742–2.809)	(0.203)	(0.930–2.643)
Frequent interruptions of work breaks	0.458	1.581	0.409*	1.505	0.218	1.243	0.119	1.126	0.191	1.210
	(0.195)	(0.955–2.615)	(0.143)	(1.041–2.175)	(0.147)	(0.852–1.815)	(0.394)	(0.409–3.105)	(0.269)	(0.605–2.420)
Meal break duration	0.003	1.003	−0.001	0.999	−0.004	0.996	0.003	1.003	0.005	1.005
	(0.003)	(0.995–1.011)	(0.003)	(0.992–1.006)	(0.003)	(0.988–1.004)	(0.007)	(0.985–1.022)	(0.006)	(0.990–1.020)
R^2 (Cox & Snell)	0.067		0.095		0.024		0.049		0.055	
R^2 (Nagelkerke)	0.089		0.127		0.033		0.067		0.073	
$\chi^2(12)$	109.186		129.124		49.552		24.208		33.293	

Note. B = beta values; SE = standard error; exp b = odds ratio; CI = confidence interval.
*p < 0.01. **p < 0.001.
[a] Sector 1 = occupations in the production of goods; sector 2 = occupations in personal services; sector 3 = occupations in business administration and other business related services; sector 4 = service occupations in the IT-sector and the natural sciences; sector 5 = other occupations in commercial services.
[b] Model 5 is adjusted for gender, age, educational level, underage child in household, type of work, leadership position, shift work, and weekly working hours.

Table B2
Results from logistic regression analysis with work break characteristics as independent variables and pain in the neck and shoulder region as dependent variable (unweighted data).

	Sector 1[a] (N = 1577)		Sector 2[a] (N = 1292)		Sector 3[a] (N = 2034)		Sector 4[a] (N = 484)		Sector 5[a] (N = 592)	
	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)
Model 1										
Frequent skipping of work breaks	0.424**	1.528	0.422**	1.525	0.221	1.248	0.385	1.469	0.196	1.216
	(0.121)	(1.118–2.089)	(0.115)	(1.135–2.049)	(0.099)	(0.968–1.609)	(0.221)	(0.833–2.593)	(0.177)	(0.770–1.920)
R^2 (Cox & Snell)	0.008		0.011		0.002		0.006		0.002	
R^2 (Nagelkerke)	0.010		0.014		0.003		0.008		0.003	
$\chi^2(1)$	12.323		13.695		5.058		3.048		1.218	
Model 2										
Frequent interruptions of work breaks	0.543*	1.721	0.224	1.251	0.434**	1.543	0.303	1.354	0.304	1.355
	(0.173)	(1.101–2.691)	(0.119)	(0.921–1.701)	(0.132)	(1.099–2.166)	(0.351)	(0.548–3.348)	(0.232)	(0.745–2.463)
R^2 (Cox & Snell)	0.006		0.003		0.005		0.002		0.003	
R^2 (Nagelkerke)	0.008		0.004		0.007		0.002		0.004	
$\chi^2(1)$	10.017		3.562		11.095		0.745		1.729	
Model 3										
Meal break duration	−0.006	0.994	−0.004	0.996	−0.009*	0.991	0.004	1.004	0.002	1.002
	(0.003)	(0.985–1.002)	(0.003)	(0.989–1.002)	(0.003)	(0.984–0.999)	(0.006)	(0.988–1.021)	(0.005)	(0.989–1.015)
R^2 (Cox & Snell)	0.003		0.002		0.005		0.001		0.000	
R^2 (Nagelkerke)	0.003		0.003		0.007		0.001		0.000	
$\chi^2(1)$	4.081		2.853		10.061		0.497		0.144	
Model 4										
Frequent skipping of work breaks	0.310	1.363	0.395*	1.484	0.065	1.067	0.376	1.457	0.128	1.136
	(0.131)	(0.973–1.911)	(0.130)	(1.062–2.073)	(0.110)	(0.804–1.415)	(0.232)	(0.802–2.645)	(0.192)	(0.692–1.865)
Frequent interruptions of work breaks	0.351	1.420	0.011	1.011	0.326	1.385	0.205	1.228	0.272	1.313
	(0.187)	(0.877–2.300)	(0.136)	(0.712–1.436)	(0.146)	(0.951–2.017)	(0.376)	(0.466–3.232)	(0.256)	(0.680–2.537)
Meal break duration	−0.004	0.996	−0.002	0.998	−0.007	0.993	0.007	1.007	0.003	1.003
	(0.003)	(0.988–1.004)	(0.003)	(0.991–1.005)	(0.003)	(0.986–1.001)	(0.007)	(0.990–1.024)	(0.005)	(0.990–1.017)
R^2 (Cox & Snell)	0.011		0.011		0.009		0.009		0.004	
R^2 (Nagelkerke)	0.015		0.015		0.011		0.012		0.006	
$\chi^2(3)$	18.097		14.461		17.507		4.208		2.606	
Model 5[b]										
Frequent skipping of work breaks	0.415*	1.514	0.444**	1.559	0.171	1.186	0.559	1.749	0.236	1.266
	(0.136)	(1.067–2.148)	(0.135)	(1.102–2.205)	(0.115)	(0.882–1.594)	(0.256)	(0.903–3.385)	(0.201)	(0.755–2.124)
Frequent interruptions of work breaks	0.386	1.471	−0.055	0.947	0.358	1.430	0.254	1.289	0.126	1.135
	(0.192)	(0.896–2.414)	(0.143)	(0.656–1.367)	(0.152)	(0.965–2.118)	(0.396)	(0.464–3.578)	(0.265)	(0.573–2.247)
Meal break duration	−0.003	0.997	−0.001	0.999	−0.005	0.995	0.012	1.012	0.004	1.004
	(0.003)	(0.989–1.005)	(0.003)	(0.992–1.006)	(0.003)	(0.988–1.003)	(0.007)	(0.994–1.031)	(0.006)	(0.990–1.019)
R^2 (Cox & Snell)	0.032		0.058		0.061		0.068		0.053	
R^2 (Nagelkerke)	0.042		0.077		0.082		0.091		0.070	
$\chi^2(12)$	50.902		76.840		128.385		34.010		32.061	

Note. B = beta values; SE = standard error; exp b = odds ratio; CI = confidence interval.
*p < 0.01. **p < 0.001.
[a] Sector 1 = occupations in the production of goods; sector 2 = occupations in personal services; sector 3 = occupations in business administration and other business related services; sector 4 = service occupations in the IT-sector and the natural sciences; sector 5 = other occupations in commercial services.
[b] Model 5 is adjusted for gender, age, educational level, underage child in household, type of work, leadership position, shift work, and weekly working hours.

Table B3
Results from logistic regression analysis with work break characteristics as independent variables and general tiredness, faintness, or fatigue as dependent variable (unweighted data).

	Sector 1[a] (N = 1577)		Sector 2[a] (N = 1292)		Sector 3[a] (N = 2034)		Sector 4[a] (N = 484)		Sector 5[a] (N = 592)	
	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)
Model 1										
Frequent skipping of work breaks	0.409**	1.506	0.591**	1.805	0.601**	1.824	0.670*	1.955	0.402	1.495
	(0.121)	(1.102–2.058)	(0.116)	(1.340–2.432)	(0.099)	(1.412–2.356)	(0.225)	(1.094–3.494)	(0.178)	(0.947–2.362)
R^2 (Cox & Snell)	0.007		0.020		0.018		0.019		0.009	
R^2 (Nagelkerke)	0.010		0.027		0.024		0.025		0.012	
$\chi^2(1)$	11.490		26.494		37.194		9.081		5.164	
Model 2										
Frequent interruptions of work breaks	0.854**	2.348	0.697**	2.008	0.765**	2.149	0.865	2.375	0.770**	2.161
	(0.180)	(1.479–3.729)	(0.123)	(1.463–2.756)	(0.133)	(1.524–3.030)	(0.376)	(0.901–6.257)	(0.238)	(1.171–3.986)
R^2 (Cox & Snell)	0.015		0.025		0.017		0.012		0.018	
R^2 (Nagelkerke)	0.020		0.034		0.022		0.016		0.024	
$\chi^2(1)$	23.948		33.180		34.330		5.676		10.933	
Model 3										
Meal break duration	−0.005	0.995	−0.008*	0.992	−0.014**	0.986	−0.006	0.994	−0.007	0.993
	(0.003)	(0.987–1.003)	(0.003)	(0.985–0.998)	(0.003)	(0.978–0.994)	(0.006)	(0.978–1.010)	(0.005)	(0.981–1.006)
R^2 (Cox & Snell)	0.002		0.008		0.012		0.002		0.003	
R^2 (Nagelkerke)	0.002		0.011		0.016		0.002		0.004	
$\chi^2(1)$	2.760		10.646		24.254		0.903		1.733	
Model 4										
Frequent skipping of work breaks	0.214	1.238	0.344*	1.410	0.389**	1.475	0.562	1.754	0.207	1.229
	(0.131)	(0.883–1.737)	(0.130)	(1.008–1.972)	(0.110)	(1.111–1.957)	(0.235)	(0.957–3.214)	(0.193)	(0.748–2.021)
Frequent interruptions of work breaks	0.724**	2.063	0.490**	1.633	0.464*	1.590	0.588	1.801	0.638	1.892
	(0.192)	(1.257–3.386)	(0.139)	(1.143–2.334)	(0.147)	(1.088–2.324)	(0.398)	(0.645–5.025)	(0.260)	(0.969–3.696)
Meal break duration	−0.002	0.998	−0.004	0.996	−0.009*	0.991	−0.002	0.998	−0.003	0.997
	(0.003)	(0.990–1.005)	(0.003)	(0.989–1.003)	(0.003)	(0.983–0.999)	(0.007)	(0.981–1.015)	(0.005)	(0.983–1.010)
R^2 (Cox & Snell)	0.017		0.033		0.029		0.024		0.021	
R^2 (Nagelkerke)	0.023		0.045		0.039		0.032		0.028	
$\chi^2(3)$	27.556		43.725		60.136		11.693		12.525	
Model 5[b]										
Frequent skipping of work breaks	0.248	1.281	0.315	1.371	0.454**	1.574	0.680*	1.975	0.220	1.246
	(0.136)	(0.902–1.819)	(0.133)	(0.973–1.932)	(0.113)	(1.175–2.109)	(0.255)	(1.023–3.812)	(0.200)	(0.744–2.088)
Frequent interruptions of work breaks	0.750**	2.117	0.427*	1.532	0.501**	1.651	0.626	1.870	0.576	1.778
	(0.197)	(1.273–3.521)	(0.143)	(1.060–2.215)	(0.152)	(1.117–2.440)	(0.409)	(0.651–5.368)	(0.268)	(0.891–3.549)
Meal break duration	0.000	1.000	−0.003	0.997	−0.008	0.992	0.001	1.001	−0.002	0.998
	(0.003)	(0.992–1.007)	(0.003)	(0.990–1.004)	(0.003)	(0.984–1.000)	(0.007)	(0.984–1.019)	(0.006)	(0.984–1.012)
R^2 (Cox & Snell)	0.038		0.057		0.052		0.049		0.055	
R^2 (Nagelkerke)	0.051		0.077		0.070		0.065		0.074	
$\chi^2(12)$	61.847		76.390		109.476		24.273		33.571	

Note. B = beta values; SE = standard error; exp b = odds ratio; CI = confidence interval.
*p < 0.01. **p < 0.001.
[a] Sector 1 = occupations in the production of goods; sector 2 = occupations in personal services; sector 3 = occupations in business administration and other business related services; sector 4 = service occupations in the IT-sector and the natural sciences; sector 5 = other occupations in commercial services.
[b] Model 5 is adjusted for gender, age, educational level, underage child in household, type of work, leadership position, shift work, and weekly working hours.

Table B4
Results from logistic regression analysis with work break characteristics as independent variables and physical exhaustion as dependent variable (unweighted data).

	Sector 1[a] (N = 1577)		Sector 2[a] (N = 1292)		Sector 3[a] (N = 2034)		Sector 4[a] (N = 484)		Sector 5[a] (N = 592)	
	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)
Model 1										
Frequent skipping of work breaks	0.236	1.267	0.822**	2.276	0.688**	1.989	0.733*	2.082	0.388	1.474
	(0.124)	(0.921–1.742)	(0.115)	(1.692–3.062)	(0.103)	(1.527–2.590)	(0.238)	(1.126–3.848)	(0.179)	(0.929–2.339)
R^2 (Cox & Snell)	0.002		0.039		0.022		0.019		0.008	
R^2 (Nagelkerke)	0.003		0.053		0.030		0.028		0.011	
$\chi^2(1)$	3.616		51.912		44.452		9.121		4.672	
Model 2										
Frequent interruptions of work breaks	0.573**	1.774	0.900**	2.459	0.738**	2.093	0.661	1.936	0.672*	1.958
	(0.171)	(1.142–2.757)	(0.120)	(1.806–3.350)	(0.130)	(1.496–2.927)	(0.367)	(0.752–4.985)	(0.231)	(1.081–3.547)
R^2 (Cox & Snell)	0.007		0.043		0.015		0.006		0.014	
R^2 (Nagelkerke)	0.010		0.058		0.022		0.009		0.019	
$\chi^2(1)$	11.076		57.394		31.331		3.056		8.497	
Model 3										
Meal break duration	−0.009	0.991	−0.014**	0.986	−0.015**	0.985	−0.014	0.986	−0.003	0.997
	(0.004)	(0.981–1.001)	(0.003)	(0.978–0.994)	(0.003)	(0.976–0.993)	(0.008)	(0.966–1.006)	(0.005)	(0.984–1.011)
R^2 (Cox & Snell)	0.004		0.018		0.011		0.007		0.000	
R^2 (Nagelkerke)	0.006		0.024		0.016		0.011		0.001	
$\chi^2(1)$	6.346		23.201		22.857		3.561		0.246	
Model 4										
Frequent skipping of work breaks	0.063	1.066	0.508**	1.662	0.493**	1.637	0.645	1.905	0.220	1.246
	(0.136)	(0.751–1.512)	(0.130)	(1.189–2.323)	(0.115)	(1.218–2.200)	(0.252)	(0.996–3.645)	(0.196)	(0.753–2.061)
Frequent interruptions of work breaks	0.486*	1.626	0.594**	1.812	0.380*	1.462	0.237	1.267	0.569	1.767
	(0.186)	(1.006–2.627)	(0.136)	(1.277–2.571)	(0.147)	(1.002–2.133)	(0.400)	(0.453–3.546)	(0.254)	(0.918–3.403)
Meal break duration	−0.007	0.993	−0.007	0.993	−0.009*	0.991	−0.010	0.990	0.001	1.001
	(0.004)	(0.983–1.003)	(0.003)	(0.986–1.001)	(0.003)	(0.982–1.000[b])	(0.008)	(0.970–1.010)	(0.005)	(0.987–1.014)
R^2 (Cox & Snell)	0.010		0.061		0.030		0.024		0.016	
R^2 (Nagelkerke)	0.013		0.081		0.042		0.036		0.022	
$\chi^2(3)$	15.321		80.960		61.552		11.731		9.761	
Model 5[c]										
Frequent skipping of work breaks	0.169	1.184	0.529**	1.697	0.570**	1.767	0.744*	2.104	0.289	1.335
	(0.142)	(0.821–1.705)	(0.134)	(1.202–2.397)	(0.119)	(1301.-2.401)	(0.277)	(1.030–4.295)	(0.207)	(0.783–2.274)
Frequent interruptions of work breaks	0.519*	1.681	0.561**	1.752	0.347	1.415	0.210	1.233	0.560	1.751
	(0.194)	(1.021–2.767)	(0.141)	(1.218–2.520)	(0.151)	(0.958–2.089)	(0.415)	(0.423–3.594)	(0.266)	(0.882–3.476)
Meal break duration	−0.004	0.996	−0.004	0.996	−0.007	0.993	−0.008	0.992	0.000	1.000
	(0.004)	(0.987–1.005)	(0.003)	(0.988–1.003)	(0.003)	(0.985–1.002)	(0.008)	(0.971–1.013)	(0.006)	(0.985–1.014)
R^2 (Cox & Snell)	0.044		0.095		0.056		0.068		0.082	
R^2 (Nagelkerke)	0.061		0.127		0.079		0.102		0.111	
$\chi^2(12)$	71.782		128.955		117.296		34.195		50.812	

Note. B = beta values; SE = standard error; exp b = odds ratio; CI = confidence interval.
*p < 0.01. **p < 0.001.

[a] Sector 1 = occupations in the production of goods; sector 2 = occupations in personal services; sector 3 = occupations in business administration and other business related services; sector 4 = service occupations in the IT-sector and the natural sciences; sector 5 = other occupations in commercial services.

[b] This value is 1.000 due to rounding; it is in fact slightly less than 1.000.

[c] Model 5 is adjusted for gender, age, educational level, underage child in household, type of work, leadership position, shift work, and weekly working hours.

Table B5
Results from logistic regression analysis with work break characteristics as independent variables and emotional exhaustion as dependent variable (unweighted data).

	Sector 1[a] (N = 1577)		Sector 2[a] (N = 1292)		Sector 3[a] (N = 2034)		Sector 4[a] (N = 484)		Sector 5[a] (N = 592)	
	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)	B (SE)	exp b (99% CI)
Model 1										
Frequent skipping of work breaks	0.732**	2.078	0.702**	2.018	0.575**	1.777	0.339	1.403	0.490	1.633
	(0.133)	(1.475–2.930)	(0.117)	(1.494–2.726)	(0.103)	(1.362–2.318)	(0.246)	(0.744–2.646)	(0.200)	(0.975–2.735)
R^2 (Cox & Snell)	0.018		0.028		0.015		0.004		0.010	
R^2 (Nagelkerke)	0.028		0.038		0.021		0.006		0.015	
$\chi^2(1)$	29.031		36.560		30.557		1.847		5.901	
Model 2										
Frequent interruptions of work breaks	1.163**	3.198	0.714**	2.042	0.732**	2.080	0.536	1.709	0.736*	2.087
	(0.175)	(2.036–5.023)	(0.120)	(1.498–2.784)	(0.131)	(1.486–2.913)	(0.373)	(0.654–4.469)	(0.244)	(1.113–3.914)
R^2 (Cox & Snell)	0.026		0.027		0.015		0.004		0.015	
R^2 (Nagelkerke)	0.039		0.037		0.021		0.006		0.022	
$\chi^2(1)$	41.504		35.332		30.542		1.957		8.659	
Model 3										
Meal break duration	−0.010	0.990	−0.004	0.996	−0.008	0.992	−0.006	0.994	0.003	1.003
	(0.005)	(0.978–1.002)	(0.003)	(0.990–1.003)	(0.003)	(0.984–1.000)	(0.007)	(0.975–1.014)	(0.006)	(0.989–1.018)
R^2 (Cox & Snell)	0.003		0.001		0.003		0.001		0.001	
R^2 (Nagelkerke)	0.005		0.002		0.004		0.002		0.001	
$\chi^2(1)$	5.264		1.751		6.381		0.619		0.349	
Model 4										
Frequent skipping of work breaks	0.458*	1.582	0.506**	1.659	0.396**	1.486	0.250	1.284	0.313	1.368
	(0.148)	(1.080–2.316)	(0.132)	(1.181–2.330)	(0.116)	(1.103–2.003)	(0.261)	(0.656–2.513)	(0.221)	(0.775–2.414)
Frequent interruptions of work breaks	0.903**	2.468	0.503**	1.654	0.499**	1.646	0.380	1.463	0.649	1.913
	(0.192)	(1.504–4.049)	(0.137)	(1.162–2.352)	(0.146)	(1.129–2.401)	(0.402)	(0.520–4.117)	(0.273)	(0.947–3.864)
Meal break duration	−0.003	0.997	0.002	1.002	−0.002	0.998	−0.003	0.997	0.007	1.007
	(0.004)	(0.986–1.007)	(0.003)	(0.995–1.009)	(0.003)	(0.990–1.006)	(0.008)	(0.977–1.017)	(0.006)	(0.992–1.022)
R^2 (Cox & Snell)	0.033		0.038		0.021		0.006		0.020	
R^2 (Nagelkerke)	0.049		0.052		0.030		0.010		0.030	
$\chi^2(3)$	52.215		50.031		43.482		3.100		12.122	
Model 5[b]										
Frequent skipping of work breaks	0.437*	1.548	0.481**	1.618	0.444**	1.559	0.536	1.710	0.378	1.460
	(0.154)	(1.040–2.304)	(0.134)	(1.146–2.283)	(0.119)	(1.147–2.120)	(0.283)	(0.825–3.543)	(0.229)	(0.809–2.634)
Frequent interruptions of work breaks	0.869**	2.386	0.444*	1.560	0.505**	1.657	0.521	1.684	0.537	1.711
	(0.200)	(1.427–3.988)	(0.140)	(1.087–2.238)	(0.151)	(1.123–2.444)	(0.418)	(0.574–4.942)	(0.281)	(0.829–3.529)
Meal break duration	−0.002	0.998	0.002	1.002	−0.001	0.999	0.000	1.000	0.009	1.009
	(0.004)	(0.988–1.008)	(0.003)	(0.995–1.010)	(0.003)	(0.991–1.008)	(0.008)	(0.979–1.021)	(0.006)	(0.993–1.025)
R^2 (Cox & Snell)	0.052		0.047		0.042		0.038		0.052	
R^2 (Nagelkerke)	0.079		0.064		0.059		0.057		0.078	
$\chi^2(12)$	84.328		62.553		86.787		18.749		31.796	

Note. B = beta values; SE = standard error; exp b = odds ratio; CI = confidence interval.
*p < 0.01. **p < 0.001.
[a] Sector 1 = occupations in the production of goods; sector 2 = occupations in personal services; sector 3 = occupations in business administration and other business related services; sector 4 = service occupations in the IT-sector and the natural sciences; sector 5 = other occupations in commercial services.
[b] Model 5 is adjusted for gender, age, educational level, underage child in household, type of work, leadership position, shift work, and weekly working hours.

References

Albulescu, P., Macsinga, I., Rusu, A., Sulea, C., Bodnaru, A., Tulbure, B.T., 2022. "Give me a break!" A systematic review and meta-analysis on the efficacy of micro-breaks for increasing well-being and performance. PLoS One 17, e0272460. https://doi.org/10.1371/journal.pone.0272460.

Arlinghaus, A., Lombardi, D.A., Courtney, T.K., Christiani, D.C., Folkard, S., Perry, M.J., 2012. The effect of rest breaks on time to injury - a study on work-related ladder-fall injuries in the United States. Scand. J. Work. Environ. Health 38, 560–567. https://doi.org/10.5271/sjweh.3292.

Bakker, A.B., Demerouti, E., Oerlemans, W., Sonnentag, S., 2013. Workaholism and daily recovery: a day reconstruction study of leisure activities. J. Organ. Behav. 34, 87–107. https://doi.org/10.1002/job.1796.

Binnewies, C., Sonnentag, S., 2008. Recovery after work: unwinding from daily job stress. In: Burke, R.J., Cooper, C.L. (Eds.), Long Work Hours Culture: Causes, Consequences and Choices. Emerald Group Publishing, Bingley, pp. 275–294.

Blasche, G., Arlinghaus, A., Crevenna, R., 2022. The impact of rest breaks on subjective fatigue in physicians of the General Hospital of Vienna. Wien. Klin. Wochenschr. 134, 156–161. https://doi.org/10.1007/s00508-021-01949-1.

Brauner, C., Vieten, L., Tornowski, M., Michel, A., Wöhrmann, A.M., 2019. Datendokumentation des Scientific Use File der BAuA-Arbeitszeitbefragung 2017, baua: Datendokumentation [Data documentation of the scientific use file of the BAuA Working Time Survey 2017]. Bundesanstalt für Arbeitsschutz und Arbeitsmedizin, Dortmund/Berlin/Dresden [in German].

Chan, P.H.H., Howard, J., Eva, N., Tse, H.H.M., 2022. A systematic review of at-work recovery and a framework for future research. J. Vocat. Behav. 137, 103747 https://doi.org/10.1016/j.jvb.2022.103747.

Cox, D.R., Snell, D.J., 1989. The Anaysis of Binary Data, second ed. Chapman & Hall, London.

Cropley, M., Rydstedt, L.W., Andersen, D., 2020. Recovery from work: testing the effects of chronic internal and external workload on health and well-being. J. Epidemiology Community Health 74, 919–924. https://doi.org/10.1136/jech-2019-213367.

Cropley, M., Weidenstedt, L., Leick, B., Sütterlin, S., 2022. Working from home during lockdown: the association between rest breaks and well-being. Ergonomics, 1–11. https://doi.org/10.1080/00140139.2022.2095038.

Eurofound, 2019. Rest Breaks from Work: Overview of Regulations, Research and Practice. Publications Office of the European Union, Luxembourg.

Faucett, J., Meyers, J., Miles, J., Janowitz, I., Fathallah, F., 2007. Rest break interventions in stoop labor tasks. Appl. Ergon. 38, 219–226. https://doi.org/10.1016/j.apergo.2006.02.003.

Fischer, D., Lombardi, D.A., Folkard, S., Willetts, J., Christiani, D.C., 2017. Updating the "Risk Index": a systematic review and meta-analysis of occupational injuries and work schedule characteristics. Chronobiol. Int. 34, 1423–1438. https://doi.org/10.1080/07420528.2017.1367305.

Fritz, C., Lam, C.F., Spreitzer, G.M., 2011. It's the little things that matter: an examination of knowledge workers' energy management. Acad. Manag. Perspect. 25, 28–39. https://doi.org/10.5465/amp.25.3.zol28.

Geurts, S.A.E., Beckers, D.G.J., Tucker, P., 2014. Recovery from demanding work hours. In: Peeters, M.C.W., De Jonge, J., Taris, T.W. (Eds.), An Introduction to Contemporary Work Psychology. Wiley Blackwell, Hoboken (NJ), pp. 196–219.

Geurts, S.A.E., Sonnentag, S., 2006. Recovery as an explanatory mechanism in the relation between acute stress reactions and chronic health impairment. Scand. J. Work. Environ. Health 32, 482–492. https://doi.org/10.5271/sjweh.1053.

Häring, A., Schütz, H., Middendorf, L., Hausen, J., Brauner, C., Wöhrmann, A.M., 2018. Methodenbericht und Fragebogen zur BAuA-Arbeitszeitbefragung 2017 [Methodological report and questionnaire for the BAuA Working Time Survey 2017]. Bundesanstalt für Arbeitsschutz und Arbeitsmedizin, Dortmund/Berlin/Dresden [in German].

Ho, W.-Y., Sung, C.Y.Y., Yu, Q.-H., Chan, C.C.H., 2014. Effectiveness of computerized risk assessment system on enhancing workers' occupational health and attitudes towards occupational health. Work 48, 471–484. https://doi.org/10.3233/WOR-141916.

Hofstede, G., Hofstede, G.J., Minkov, M., 2005. Cultures and Organizations: Software of the Mind, vol. 2. McGraw-Hill, New York.

ILO, 2016. Rest periods: definitions and dimensions, Fact sheet. Available from. https://www.ilo.org/global/topics/collective-bargaining-labour-relations/publications/WCMS_491374/lang–en/index.htm.

Linder, M., Nygaard, I., 1998. Rest in the rest of the world. Comp. Labor Law Policy J. 20, 105–124. https://iro.uiowa.edu/discovery/fulldisplay/alma9983557366702771/01IOWA_INST:ResearchRepository.

Lohmann-Haislah, A., Wendsche, J., Schulz, A., Schöllgen, I., Escobar Pinzon, L.C., 2019. Einflussfaktoren und Folgen des Ausfalls gesetzlicher Ruhepausen bei Pflegekräften in Deutschland [Determinants and outcomes of skipping mandatory rest breaks in German nurses]. Z. Arb. Wiss. 73, 418–438. https://doi.org/10.1007/s41449-019-00173-y [in German].

Lombardi, D.A., Jin, K., Courtney, T.K., Arlinghaus, A., Folkard, S., Liang, Y., Perry, M.J., 2014. The effects of rest breaks, work shift start time, and sleep on the onset of severe injury among workers in the People's Republic of China. Scand. J. Work. Environ. Health 40, 146–155. https://doi.org/10.5271/sjweh.3395.

Lyubykh, Z., Gulseren, D., Premji, Z., Wingate, T.G., Deng, C., Bélanger, L.J., Nick, N., 2022. Role of work breaks in well-being and performance: a systematic review and future research agenda. J. Occup. Health Psychol. 27, 470–487. https://doi.org/10.1037/ocp0000337.

Meijman, T.F., Mulder, G., 1998. Psychological aspects of workload. In: Drenth, P.J.D., De Wolff, C.J. (Eds.), Handbook of Work and Organizational Psychology. Psychology Press, Hove, pp. 5–33.

Nagelkerke, N.J.D., 1991. A note on a general definition of the coefficient of determination. Biometrika 78, 691–692.

Park, S., Lee, J., Lee, J.-H., 2021. Insufficient rest breaks at workplace and musculoskeletal disorders among Korean kitchen workers. Saf. Health Work 12, 225–229. https://doi.org/10.1016/j.shaw.2021.01.012.

Park, S., Lee, W., Lee, J.-H., 2020. Can workplace rest breaks prevent work-related injuries related to long working hours? J. Occup. Environ. 62, 179–184. https://doi.org/10.1097/JOM.0000000000001772.

Rohmert, W., 1984. Das Belastung-Beanspruchungs-Konzept [Stressor-strain concept]. Z. Arb. Wiss. 38, 193–200 [in German].

Sianoja, M., Kinnunen, U., de Bloom, J., Korpela, K., Geurts, S.A.E., 2016. Recovery during lunch breaks: testing long-term relations with energy levels at work. Scandinavian Journal of Work and Organizational Psychology 1. https://doi.org/10.16993/sjwop.13.

Sonnentag, S., Cheng, B.H., Parker, S.L., 2022. Recovery from work: advancing the field toward the future. Annu. Rev. Organ. Psychol. Organ. Behav. 9, 33–60. https://doi.org/10.1146/annurev-orgpsych-012420-091355.

Sonnentag, S., Venz, L., Casper, A., 2017. Advances in recovery research: what have we learned? What should be done next? J. Occup. Health Psychol. 22, 365–380. https://doi.org/10.1037/ocp0000079.

Wendsche, J., Ghadiri, A., Bengsch, A., Wegge, J., 2017. Antecedents and outcomes of nurses' rest break organization: a scoping review. Int. J. Nurs. Stud. 75, 65–80. https://doi.org/10.1016/j.ijnurstu.2017.07.005.

Wendsche, J., Lohmann-Haislah, A., 2016. Psychische Gesundheit in der Arbeitswelt – Pausen [Mental health in the working world - work breaks]. Bundesanstalt für Arbeitsschutz und Arbeitsmedizin, Dortmund/Berlin/Dresden [in German].

Wendsche, J., Lohmann-Haislah, A., 2017. A meta-analysis on antecedents and outcomes of detachment from work. Front. Psychol. 7 https://doi.org/10.3389/fpsyg.2016.02072.

Wendsche, J., Lohmann-Haislah, A., Wegge, J., 2016. The impact of supplementary short rest breaks on task performance – a meta-analysis. sozialpolitik.ch 2, 2–3. https://doi.org/10.18753/2297-8224-75.

Wendsche, J., Paridon, H., Blasche, G., 2021. Nurses' rest breaks and organizational leaving intentions. Psychol. Health Med. 1–11. https://doi.org/10.1080/13548506.2021.1950784.

Wöhrmann, A.M., Brauner, C., Michel, A., 2021. BAuA-working time survey (BAuA-WTS; BAuA-Arbeitszeitbefragung). Jahrb. Natl. Okon. Stat. 241, 287–295. https://doi.org/10.1515/jbnst-2020-0035.

Wu, S., He, L., Li, J., Wang, J., Wang, S., 2012. Visual display terminal use increases the prevalence and risk of work-related musculoskeletal disorders among Chinese office workers: a cross-sectional study. J. Occup. Health 54, 34–43. https://doi.org/10.1539/joh.11-0119-OA.

Xu, G., Pang, D., Liu, F., Pei, D., Wang, S., Li, L., 2012. Prevalence of low back pain and associated occupational factors among Chinese coal miners. BMC Publ. Health 12 (149). https://doi.org/10.1186/1471-2458-12-149.