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RESEARCH ARTICLE

Understanding the bright side and the dark side of telework: An empirical analysis of working conditions and psychosomatic health complaints

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Abstract

In the course of digitisation, work away from the principal office using information and communications technology (telework, telecommuting, and mobile work) has established itself in various segments of the labour market. Still, the impact of telework on employees' health is far from clear and is often controversially discussed at the individual, organisational and political level—but also in social research. Against this background, we analyse the effects of telework on employees' psychosomatic health complaints with the help of large-scale and representative German survey data. Applying the statistical method of path analysis, we find indirect relationships between telework and employees' health via working time control, time pressure, boundaryless working hours, relationships with coworkers, and disturbances and interruptions. These findings add to the debate on the beneficial and detrimental effects of digitisation by focusing on significant working conditions related to telework.

KEYWORDS

disturbances and interruptions, mental health, path analysis, psychosomatic health complaints, social relationships, telecommuting, telework, time pressure, working time

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INTRODUCTION

Since the invention of the microprocessor in the early 1970s, information and communications technologies (ICT) have fundamentally transformed the world of work (Eurofound, 2018). Telework (also referred to as telecommuting, mobile work or virtual work), which we consider as paid work away from the principal office for at least a portion of the work week, using computers and ICT (Sardeshmukh et al., 2012, p. 194), has become ever more popular.

Even before the Covid-19 pandemic, the share of employees with a teleworking agreement was increasing. During the Covid-19 pandemic in 2020, however, in many countries, employees who could perform their work tasks from home were asked to do so. Looking ahead to the post-Covid-19 world, both employees and companies are faced with the decision of whether they want to maintain telework to a comparable extent. Early evidence suggests that the Corona pandemic has markedly increased firms' and employees' willingness to telework (Bonin et al., 2020; OECD, 2020).

Indeed, teleworking had been a heavily debated political issue for many decades before the pandemic. In 2002, the European social partners signed a framework agreement on telework to ensure that teleworkers enjoy the general protection afforded to employees (European Social Partners, 2006). This agreement covered a wide range of issues, including health and safety, data protection and the general organisation of work. Despite this formal progress, teleworking has remained a controversial topic and many companies—including IT companies such as Yahoo!—have been speaking out against this type of work arrangement (Boell et al., 2016). At present, the prevalence and institutionalisation of telework still differ markedly between countries (Messenger et al., 2017; Ojala & Pyöriä, 2018). In the member states of the EU, relatively large shares of employees in Denmark, Sweden, the Netherlands and the UK work outside the employer's premises using ICT, whereas telework is relatively unpopular in Greece and Italy (Messenger et al., 2017). Generally, the prevalence of telework also varies widely across sectors (OECD, 2020). Whereas it is very common to telework in knowledge-intensive services, this is (still) rather uncommon in manufacturing.

Debates about telework are important because it can have positive and negative effects on employees (e.g., job satisfaction: Gajendran & Harrison, 2007), their families (e.g., work-family conflict: Allen et al., 2013), coworkers (e.g., team performance: van der Lippe & Lippényi, 2019) and the organisation (e.g., firm performance: Martínez Sánchez et al., 2007). Especially, the currently increasing shares of teleworkers point to the importance for politics to further regulate telework as well as for organisations to provide and implement telework environments and work cultures that consider the (occupational) health and safety of their employees. To this end, it is important to understand how telework affects employees' health. The aim of our study is therefore to examine the consequences of telework for employees in more detail. While there is already meta-analytic evidence for the role of telework for constructs related to employees' work-life balance (Allen et al., 2013; Gajendran & Harrison, 2007), there is only little research on the role of telework for health-related outcomes (c.f., Allen et al., 2015; Tavares, 2017). On the one hand, health-related outcomes due to the ergonomic situation including sitting for a long time can be expected. On the other hand, telework could also affect aspects of mental health such as exhaustion or depressive symptoms. The question of whether teleworking indeed has the potential to promote or impair aspects of employees' mental health is highly relevant for at least three reasons. First, mental health problems are associated with high social and economic costs; second mental health problems are correlated with lower productivity of workers (OECD, 2015); and

third, there is hardly any scientific evidence or research regarding the health effects of telework. The few empirical studies that investigated health aspects in the context of telework yield inconclusive, very small, or even insignificant correlations (Allen et al., 2015). Moreover, the paths and mechanisms via which telework affects mental health are far from clear. This is the starting point for our empirical investigation.

Although some empirical studies on the correlates of telework regarding working conditions as well as aspects related to mental health (e.g., exhaustion: Sardeshmukh et al., 2012) do exist, it becomes evident that the state of research concerning telework and its effect on mental health is rather fragmentary (cf. Allen et al., 2015; Johnson et al., 2020; Tavares, 2017). In general, studies on telework have several other disadvantages: Apart from the fact that the definitions of telework differ between studies (see Allen et al., 2015), many surveys rely only on a small number of respondents or focus exclusively on single companies or industries. Meta-analyses (Allen et al., 2013; Gajendran & Harrison, 2007) and literature reviews (Allen et al., 2015; Charalampous et al., 2019; Johnson et al., 2020; Tavares, 2017) are useful here. Nevertheless, these publications tend to report findings in isolation from each other (e.g., telework and relationships with coworkers) without outlining a comprehensive theoretical or empirical model of the consequences of telework.

The general research question of this article is: Does telework affect employees' mental health indirectly via different working conditions? More specifically, we examine the employees' situation with regard to psychosomatic health complaints, which comprise different aspects of mental health such as headache, dejection, irritability, sleeping problems and exhaustion.

We contribute to the literature in several ways: First, we aim at spelling out a more comprehensive model to specify the effects of telework on psychosomatic health complaints as an aspect of mental health. The general idea is that teleworking should change employees' working conditions (more precisely working time arrangements and interactions with coworkers); this should in turn have further consequences for teleworkers' psychosomatic health complaints. We root our hypotheses in job-demands resources (JD-R) theory (Demerouti et al., 2001), which assumes that working conditions can be classified into job demands and job resources that play a crucial role for employees' health. JD-R theory has been proven to provide a sensible framework in the study of outcomes of telework (Eurofound, 2020; Sardeshmukh et al., 2012). Second, to analyse the overall proposed study model including indirect effects, we use the methodology of path analysis. This methodological approach is in accordance with our theoretical reasoning and hence particularly promising for analysing the data. Third, we answer our research question with the help of large-scale representative national survey data instead of focusing on small samples, single industries, or firms. In general, the prevalence of telework varies significantly in international comparison (Messenger et al., 2017; Ojala & Pyöriä, 2018); sometimes, rates are even far below expectations (Hynes, 2014). Analysing the German case is interesting because the number of teleworkers is rather low in this country, with only small increases over the years (Bonin et al., 2020; Brenke, 2014). Fourth, following the recommendation of Allen et al. (2015), we analyse the effects of participating in telework but also the extent of telework. This is reasonable, as in practice, the question is not only whether employees should telework at all, but also for how many days per week absence from the office is advisable.

In a nutshell, we argue that inconclusive findings regarding the effects of telework and employee outcomes occur because telework alters working conditions which affects employees' mental health positively and negatively at the same time. Our findings support these assumptions, and we find that also the extent of telework plays an important role.

THEORETICAL PERSPECTIVES AND HYPOTHESES

Already as early as the 1970s, Jack Nilles expressed the idea of a "decentralisation of information industry organisations" with the help of "telecommunication and information-processing technologies" (Nilles, 1975, p. 1142). Even at this initial stage, numerous benefits of working from home were discussed, including the possibility of saving costs for office space or improving work-life balance (Bailey & Kurland, 2002). Eventually, the development of new technologies changed the scope of telework: mobile computers, wireless Internet connections and cell phones opened up the possibility of working from almost anywhere without being tied to one's home (Messenger & Gschwind, 2016).

In scientific discourse today, a wide range of terms are used to describe gainful employment outside the office building with the help of ICT. Apart from telework, the terminology used also includes telecommuting, mobile work or virtual work (Allen et al., 2015; Bailey & Kurland, 2002; Messenger et al., 2017). In the following, we use the term telework synonymously with the other terms. It also includes ICT-based working from home.

In order to understand and explain the effects of telework on the mental health of employees, theoretical considerations on job demands and job resources are promising. The JD-R model (Bakker & Demerouti, 2007; Demerouti et al., 2001) assumes that job demands are aspects of the job that require certain physiological and/or psychological effort. High job demands can therefore exhaust the mental and physical resources of employees, which can result in strain and health problems. Job resources, on the other hand, are those aspects of the job that are functional for goal achievement, stimulate personal growth and can reduce the physiological and psychological costs related with job demands (Bakker & Demerouti, 2007). Thus, job resources have the potential to affect employees' health by buffering the effects of job demands on job strain, and by enhancing motivation through the fulfilment of basic human needs for autonomy, competence and relatedness.

Drawing on the concept of job demands and job resources, we developed a theoretical study model (Figure 1) that postulates that telework does not impact the health of employees directly but indirectly via working conditions. We hypothesise that telework changes the working conditions of gainful employment in such a way that certain job resources and job demands related to

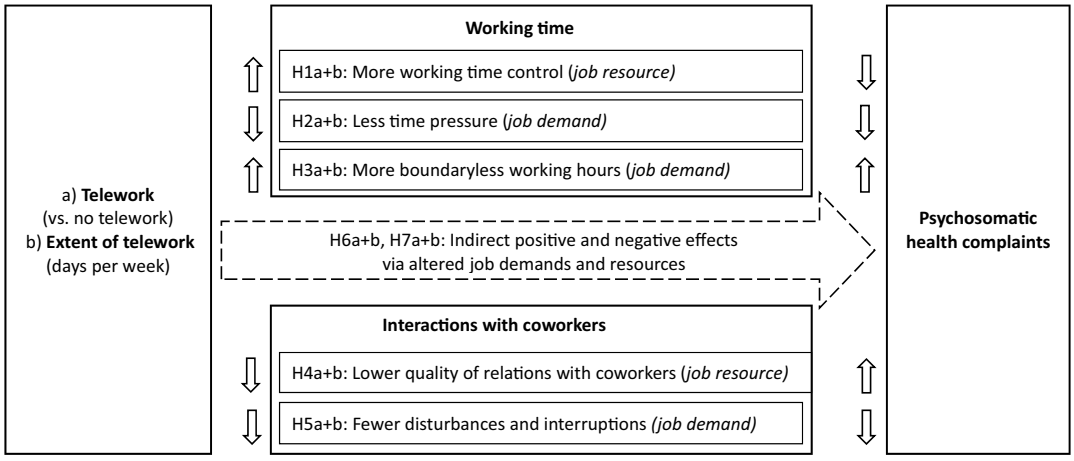

FIGURE 1 Theoretical model of indirect effects of telework on psychosomatic health complaints including hypotheses. H = hypothesis.

working time and to interactions with coworkers are enhanced while others are decreased. We further assume that these job demands and job resources in turn affect psychosomatic health complaints of individuals. Based on this, we hypothesise indirect positive and negative effects of telework on psychosomatic health complaints with job demands and job resources being the central mechanisms.

How telework affects working conditions

Working conditions related to working time and interactions with coworkers have been repeatedly emphasised by the economy, more specifically by trade unions and employers' associations (European Social Partners, 2006), to be important aspects for the quality of work. Also, research has shown that aspects of working time and interactions with coworkers are central working conditions that are affected by telework (for a review on the status of scientific findings in the context of telework, see Allen et al., 2015, Tavares, 2017 or Johnson et al., 2020). In the following, we explore the role telework plays for different aspects of working time and interactions with coworkers.

Working time

Working time control

Working away from the office increases teleworkers' scope of action (Messenger et al., 2017) giving workers significant autonomy in deciding when to start work, when to take breaks, and when to end the working day. The ability to work virtually at any time enhances teleworkers' autonomy as a central job resource in general (Hackman & Oldham, 1976). While Thulin et al. (2019) find no significant relationship between time use control and telework practice, most studies emphasise such links between telework and feelings of flexibility and increased working time autonomy (Gajendran & Harrison, 2007; Messenger et al., 2017; Tremblay, 2002). We therefore hypothesise:

Hypothesis 1a Telework (vs. no telework) is positively related to working time control.

With regard to the extent of telework, it can be assumed that working hours can also be arranged more freely if employees can spend longer periods working from home or elsewhere outside the office. That the extent of telework is related to higher general autonomy at work has been shown in earlier research (Sardeshmukh et al., 2012).

Hypothesis 1b The extent of telework is positively related to working time control.

Time pressure

Today, many people perceive time pressure to be a central problem in their lives (Rosa, 2015). High pressure in the job requires high physical and psychological effort and is therefore regarded a central job demand (Bakker & Demerouti, 2007). Telework may feel like a "retreat" from work

that helps to counteract such time pressure (Vesala & Tuomivaara, 2015). Moreover, teleworkers do not have to commute to and from work as often as employees without the possibility to work from home. This saves time per se and there is no pressure to arrive at the office at a certain time (Gajendran & Harrison, 2007). We hypothesise:

Hypothesis 2a Telework (vs. no telework) is negatively related to time pressure.

In line with the considerations above, the more days per week employees work from home the less time pressure they should be likely to experience—for example because less commuting is necessary. In line with earlier research (Sardeshmukh et al., 2012), we therefore propose:

Hypothesis 2b The extent of telework is negatively related to time pressure.

Boundaryless working hours

Telework gives employees the opportunity to work not only in different places but also at almost any time. This flexibility and temporal autonomy can carry the risk of undermining official legislation regarding the length of working hours and taking breaks. On the one hand, it is not always easy for employers to monitor compliance with these time limits when it comes to telework. Teleworkers, on the other hand, run the risk of exploiting themselves: telework not only provides a means to cope with high workloads but is also likely to deprive employees of social cues rooted in workplace culture as when to begin and end the working day or when to take breaks. In any case, the empirical findings so far support the assumption that telework is related to overtime (Glass & Noonan, 2016). In addition, it has been shown that teleworkers often work evenings and/or weekends (Messenger et al., 2017). Telework can foster temporal decoupling of working hours of team members including the supervisor, which can result in being contacted for work-related issues during breaks and after work hours. This may increase feelings of having to be permanently available. These three aspects possibly induced by telework—overtime work, evening and weekend work, and permanent availability via ICT—indicate an erosion of the temporal boundaries of work (Voß, 1998) and can be regarded as an increased job demand. We therefore hypothesise:

Hypothesis 3a Telework (vs. no telework) is positively related to boundaryless working hours.

It can be assumed that the more time is spent working from home or elsewhere other than on the employer's premises, the greater becomes the risk of unrestricted working hours. Therefore, we assume:

Hypothesis 3b The extent of telework is positively related to boundaryless working hours.

Interaction with coworkers

Quality of relations with coworkers

Working at home or at another location outside the office building can severely affect employees' interactions with their coworkers. Telework may reduce the frequency of contact with coworkers,

but it may also affect relationship quality through reduced cooperation between employees and reduced social support (Gajendran & Harrison, 2007). Networking, spontaneous discussions and the exchange of informal information are becoming less frequent (Cooper & Kurland, 2002). Eventually, telework can lead to reduced trust and team spirit. Media use can only compensate for personal contacts to a certain extent (Lai & Burchell, 2008) because of lack of spontaneity and synchronicity of communication as well as the challenge to transmit subtle emotions to one's counterpart (Golden, 2006). We therefore hypothesise:

Hypothesis 4a Telework (vs. no telework) is negatively related to the quality of social relations with coworkers.

It can be assumed that less time spent with coworkers at the workplace results in a change in the quality of contacts with coworkers. In line with earlier research (Gajendran & Harrison, 2007; Sardeshmukh et al., 2012), we therefore expect:

Hypothesis 4b The extent of telework is negatively related to the quality of social relations with coworkers.

Disturbances and interruptions at work

Disturbances and interruptions at work constitute a job demand, as they can make it difficult to concentrate on certain work tasks and may also be perceived as annoying. There is a variety of reasons for interruptions and disturbances at work: These include poor materials, equipment malfunctions, but also interruptions caused by social interaction (Weiss, 2002). In fact, many of the disturbances at work are caused by social interactions with coworkers. Gossip, overlong lunches, telephone calls, or frequent coffee breaks lead to recurring interruptions. Moreover, interpersonal communication is not always harmonious. From this point of view, teleworking may also serve as a retreat when workers have to concentrate, for example, to complete long-term work projects (Windeler et al., 2017). We therefore assume:

Hypothesis 5a Telework (vs. no telework) is negatively related to disturbances and interruptions at work.

Hypothesis 5b The extent of telework is negatively related to disturbances and interruptions at work.

Altered working conditions and psychosomatic health complaints

Mental illness is on the rise in many countries (OECD, 2015). Still, the connection between mental health problems and telework is not yet clear (Tavares, 2017). As described above, telework may have a noticeable impact on working time and interactions with coworkers. Such changes in work arrangements should have an impact well beyond working life. We presume that changes in working conditions caused by telework affect employees' mental health. As outlined above, we assume telework to alter certain job demands and job resources related to working time and interactions with coworkers at the same time. In line with considerations of the JD-R model

(Bakker & Demerouti, 2007), these altered working conditions have the potential to trigger processes that positively (enhanced job resources, reduced job demands) and negatively (reduced job resources, enhanced job demands) affect employees' mental health.

Studies show that employees who are exposed to high work demands have increased rates of psychosomatic complaints, depression and burnout. Resources such as social support at work act as health-protecting factors (Demerouti et al., 2001).

Thus, if telework facilitates working time demands in terms of boundaryless working hours (longer working hours, weekend work, permanent availability), this may ultimately promote psychosomatic complaints (Ojala et al., 2014) due to disruptions of family/private-life, the inability to detach from work mentally as well as reduced recovery periods.

A recurring empirical finding is that high-quality social relationships are conducive to the health of workers (Karasek & Theorell, 1990). Thus, if teleworking has a negative impact on the quality of relations with coworkers, this may also result in an increased prevalence of psychosomatic health complaints. The loss of such "social capital" (Coleman, 1990) or resources can also lead to feelings of isolation and loneliness (Charalampous et al., 2019; Lai & Burchell, 2008; Tavares, 2017).

Hypothesis 6a Telework (vs. no telework) is indirectly and positively related to psychosomatic health complaints via (1) increased boundaryless working hours and (2) lower quality of relations with coworkers.

The dose of teleworking should also play a decisive role in this context and we therefore hypothesise:

Hypothesis 6b The extent of telework is indirectly and positively related to psychosomatic health complaints via (1) increased boundaryless working hours and (2) lower quality of relations with coworkers.

In contrast, telework has the potential to improve employees' working conditions through increased job resources and reduced job demands. As outlined above, job resources act as health-protecting factors (Demerouti et al., 2001). If, for example, telework gives employees more autonomy in terms of when they perform their work (increased working time control), it should be beneficial to mental health (see also Karasek, 1979). This is because employees are better able to align work with their personal needs and their specific productivity cycles (Messenger et al., 2017). Work scheduling autonomy has also been shown to have positive effects on job satisfaction (Golden & Veiga, 2005). Teleworking may also reduce job demands, which are likely to negatively affect the health of employees, for example, through exhaustion (Bakker & Demerouti, 2007; Sardeshmukh et al., 2012). Above, we hypothesised that telework could buffer against time pressure. As telework also has the potential to prevent stressful disturbances and interruptions at work, this should be beneficial for mental health.

Hypothesis 7a Telework (vs. no telework) is indirectly and negatively related to psychosomatic health complaints via (1) more working time control, (2) less time pressure, and (3) fewer interruptions at work.

Again, based on our hypotheses that the extent of telework also matters for altered job demands and job resources, we hypothesise:

Hypothesis 7b *The extent of telework is indirectly and negatively related to psychosomatic health complaints via (1) more working time control, (2) less time pressure, and (3) fewer interruptions at work.*

METHOD

Sample and procedures

We used data from the 2015 BAuA-Working Time Survey, a large-scale survey that is representative of the German working population (except those working less than ten hours per week; Brauner et al., 2019; Häring et al., 2016; Wöhrmann et al., 2020). The survey involved computer-assisted telephone interviews with about 20,000 employees in Germany conducted by professional interviewers. Randomly generated landline and mobile phone numbers were used to draw a random sample. Participants had to be at least 15 years old and had to work at least 10 h per week in a paid job. Thus, the sample consists of employees of all ages and educational groups working across various economic branches and jobs. The interviews took 35 min on average and covered a wide range of topics related to work and well-being with a focus on aspects related to working time.

For the present study, we used data from 9165 qualified and highly qualified white-collar employees aged 65 years and younger who reported to use modern information and communication technology for their work. We used this selected sample to make it more homogenous in terms of the increased likelihood of telework. Sex was evenly distributed (51% male; see also Table 1 for further descriptive sample information). The subsample of 1348 teleworkers who gave information on the number of teleworking days per week consisted of 65% men.

Measurement

Telework was assessed with the question "Do you have a telework agreement with your employer?", and to assess the *extent of telework*, participants who answered yes to this question were asked, "On how many days per week do you make use of this telework agreement?" All of the teleworkers stated to telework at least some part of their working time.

Time pressure was assessed with the question, "How often do you have to work under high deadline or performance pressure?" Answer possibilities were never (1), rarely (2), sometimes (3), and often (4).

Working time control was assessed with three items from the control over work time scale by Valcour (2007). We used slightly adapted items from a German translation with items such as: "How much control do you have over when you begin and end each workday?" A five-point Likert scale from 1 (*very little control*) to 5 (*very high control*) was used. The internal consistency (Cronbach's alpha) in the present sample was $\alpha = 0.76$. Results of confirmatory factor analysis (CFA) were mixed, $\chi^2(2) = 374.355$; $p < 0.001$, CFI = 0.960; RMSEA = 0.014, and exploratory factor analysis revealed one factor with an eigenvalue above 1.

To measure *boundaryless working hours*, we built an index of three aspects of blurring of boundaries related to the length and timing of work: permanent availability, overtime work, and work on Sundays. Permanent availability was measured with the question "How often are you contacted by employees, coworkers, supervisors, or customers in your private life?" Those who

TABLE 1 Descriptive statistics of study variables

	Complete study sample (*N* = 9165)	**Teleworkers (*N* = 1348)**
	Mean (*SD*)	**Mean (*SD*)**
Sex (1 = male)	0.51	0.65
Age	46.19 (10.19)	45.39 (9.56)
Education (1 = higher education)	0.62	0.76
Living with partner	0.74	0.80
Child in household	0.36	0.44
Financial difficulties	2.03	1.79
Full-time work	0.77	0.82
Large company	0.43	0.51
Working time control	3.71 (0.98)	4.21 (0.75)
Time pressure	3.44 (0.74)	3.55 (0.67)
Boundaryless working hours	0.36 (0.67)	0.57 (0.82)
Relations with coworkers	3.68 (0.48)	3.64 (0.50)
Disturbances and interruptions	3.43 (0.74)	3.33 (0.77)
Psychosomatic health complaints	2.30 (2.03)	2.26 (2.01)
Telework	0.18 (“yes”)	1.92 (“days per week”)
Occupational sector	**Percent**	**Percent**
Production occupations	18	14
Personal services	22	16
Business administration and other business-related services	47	49
Service occupations in the IT sector and the natural sciences	9	19
Other occupations in commercial service	4	3
Economic sector (NACE code)	**Percent**	**Percent**
Agriculture (A)	1	0
Manufacturing (without construction; B–E)	28	32
Construction (F)	3	1
Trade, transportation, hospitality, or information (G–J)	17	26
Finance, real estate, business services (K–N)	19	21
Public and private services (O–U)	32	18

indicated that this was often the case were coded with 1—as opposed to those who were sometimes, rarely, or never contacted (coded 0). Overtime work was determined from the difference between actual and contractual weekly working hours. From this, a dummy variable was generated indicating those who worked more than five hours overtime per week. Sunday work was defined as working at least three Sundays (or public holidays) per month. The index for boundaryless working hours was derived from the number of temporal boundary blurring aspects and

could thus range from 0 (none of the three aspects) to 3 (all three aspects). Exploratory factor analysis revealed a one-factor solution (eigenvalue above 1).

Quality of social relations with coworkers was assessed with three items covering aspects of feeling of belonging, good working relationships, and support, for example: "How often do you get help and support for your work from your coworkers if you need it?" Ratings were given on a 4-point scale with 1 (*never*), 2 (*rarely*), 3 (*sometimes*), and 4 (*often*). Internal consistency in the present sample was $\alpha = 0.61$. Exploratory factor analysis supported the assumption that the three items represent one dimension.

Disturbances and interruptions at work were assessed with the question "Please tell me in each case whether these aspects occur often (4), sometimes (3), rarely (2), or never (1) in your occupational activity. How often does it happen in your occupational activity that your work is disturbed or interrupted, for example by coworkers, poor materials, machine malfunctions, or phone calls?".

To measure *psychosomatic health complaints*, we used a list of health complaints that we aggregated into an index following Franke (2015). Participants were asked to indicate whether the following eight health complaints occurred frequently in the last 12 months while working / on work days: headache; fatigue, weariness or lassitude; stomach and digestion complaints, tension and irritability, sleep disorders, dejection, physical exhaustion and emotional exhaustion. Thus, the index ranges from 0 (*none of the psychosomatic health complaints*) to 8 (*all of the psychosomatic health complaints*). CFA revealed good fit of the one factor solution, $\chi^2(14) = 383.826$; $p < 0.001$, CFI = 0.968; RMSEA = 0.054).

As different working conditions and health can be related to socio-demographic aspects (Brenke, 2014; Sarbu, 2015), we included the following control variables: sex (0 = female, 1 = male), age (in years), education (0 = school education or vocational training, 1 = academic degree or master craftsman's diploma), living with a partner (0 = no, 1 = yes), child in household (0 = no, 1 = yes), financial difficulties ("If you think of your household's total monthly income, is your household able to make ends meet?" with a scale from 1 (*very easily*) to 5 (*with great difficulties*), company size (0 = small and medium-sized companies with up to 249 employees, 1 = large companies with at least 250 employees), occupational sector (Bundesagentur für Arbeit, 2015), and economic sector (Eurostat, 2008).

Analytical strategy

We conducted path analyses using Mplus version 7.4 (Muthén & Muthén, 2015) to test our hypotheses. In a first step, telework vs. no telework served as the independent variable. In a second step, we estimated the model with the subsample of teleworkers and the extent of telework as the independent variable. Missing values were modelled using a maximum likelihood estimator (Wang et al., 2017). To account for any deviations from normality, we used bootstrapping (with 10,000 draws) in the testing of indirect effects (Preacher & Hayes, 2008). We evaluated model fit with an absolute fit index (root mean square error of approximation, RMSEA; Steiger, 1990) as well as an incremental fit index (comparative fit index, CFI; Bentler, 1990). The chi-square value will be reported but not used for the interpretation of model fit because it rejects reasonable models in large samples due to its sensitivity to sample size. We included sex, age, education, living with partner, child in household, financial difficulties, full-time work, and company size, occupational sector and economic sector as control variables regressed on all study variables but the independent variables. For all significance testing a 1% alpha level was applied due to the large sample size.

RESULTS

Preliminary analysis

Means, standard deviations, and correlations of the study variables are presented in Tables 1 and 2. Similar to previous studies and in line with our theoretical assumptions, we found no significant correlations between telework and psychosomatic health complaints. We then inspected the baseline model (fully identified) to evaluate the explanatory impact of control variables. They explained a small amount of variance in psychosomatic health complaints ($R^2 = 0.06$). Structural coefficients suggested that being male and being older showed a negative relationship with psychosomatic health complaints, whereas living with a partner and financial difficulties showed a positive relationship. Child in household, full-time employment, company size and occupational sectors were unrelated to psychosomatic health complaints, and higher education and working in construction (NACE code F) just missed significance.

Hypotheses testing

Telework vs. no telework

The model showed good fit to the data, $\chi^2(10) = 388.11$; $p < 0.001$, CFI = 0.932; RMSEA = 0.069. Figure 2 displays the path-analytic findings regarding the direct relationships. We found telework to be related to more working time control (H1a) on the one hand, and to increased boundaryless working hours (H3a), on the other hand. However, contradictory to our hypothesis, that

TABLE 2 Correlations of study variables

Variable	1.	2.	3.	4.	5.	6.
1. Sex (1 = male)		0.06*	0.10**	−0.13**	−0.05*	−0.08**
2. Age	−0.05**		0.01	−0.16**	−0.16**	−0.04
3. Education (1 = higher education)	0.17**	0.03*		−0.056*	−0.01	−0.12**
4. Living with partner	−0.09**	−0.11**	−0.06**		−0.26**	0.04
5. Child in household	0.05**	−0.21**	0.02*	−0.26**		0.11**
6. Financial difficulties	−0.11**	−0.02	−0.17**	0.13**	0.09**	
7. Full-time work	0.5**	−0.05**	0.12**	0.05**	−0.16**	−0.09**
8. Large company	0.13**	−0.01	0.10**	−0.01	0.02	−0.15**
9. Working time control	0.17**	0.01	0.09**	−0.06**	0.06**	−0.19**
10. Time pressure	0.03**	0.02	0.09**	−0.021*	0.01	0.02
11. Boundaryless working hours	0.07**	−0.03**	0.07**	0.02	−0.01	0.01
12. Relations with coworkers	−0.03*	−0.06**	0.01	−0.03**	0.06**	−0.11**
13. Disturbances and interruptions	−0.01	−0.04**	0.01	−0.01	0.01	0.03**
14. Psychosomatic health complaints	−0.15**	−0.05**	−0.04**	0.07**	0.00	0.20**
15. Telework	0.13**	−0.06**	0.14**	−0.05**	0.08**	−0.12**

Note: $N = 1219–9165$. *$p < 0.01$, **$p < 0.001$; correlations for complete sample below the diagonal (telework: 1 = yes); correlations for sample of teleworkers above the diagonal (telework: extent of telework).

telework is related to less time pressure (H2a), we found telework to be related to more time pressure. With regard to interactions with coworkers, we proposed that telework would be related to a lower quality of relations with coworkers (H4a) but also to less disturbances and interruptions (H5a). Both hypotheses were confirmed.

We found the working conditions that could be regarded as job resources (working time control, relations with coworkers) to be related to less psychosomatic health complaints. The working conditions regarded as job demands (time pressure, boundaryless working hours, disturbances and interruptions) were related to more psychosomatic health complaints. We proposed significant indirect relationships of telework with psychosomatic health complaints via these working conditions. Table 3 gives an overview of the hypotheses, their confirmation or rejection as well as the coefficients for the indirect effects. In support of our hypotheses, telework was indirectly related to more psychosomatic health complaints via boundaryless working hours (H6a1) and quality of relations with coworkers (H6a2). Telework was indirectly related to less psychosomatic health complaints via more working time control (H7a1) and fewer disturbances and interruptions (H7a3). Again, contradictory to our hypothesis, we find a positive indirect effect of telework on psychosomatic health complaints via time pressure (H7a2).

Altogether, the study variables explained 19% of variance in psychosomatic health complaints ($\Delta R^2 = 0.13$ in comparison to baseline model). In a nutshell, most hypotheses were supported by the data. Subgroup analyses showed hardly any differences between men and women. One exception is a non-significant relationship of telework and relations with coworkers for male employees and a subsequently non-significant indirect effect on psychosomatic health complaints.

7.	8.	9.	1.	11.	12.	13.	14.	15.
0.46**	0.08**	0.09**	0.07*	0.08**	0.01	−0.01	−0.15**	−0.03
0.06*	0.03	0.06*	0.01	0.00	−0.09**	−0.07*	−0.04	0.12**
0.08**	0.10**	−0.02	0.04	0.05	0.03	0.04	−0.01	−0.07*
0.04	−0.03	−0.05	−0.02	0.02	0.00	0.00	0.07*	−0.03
−0.18**	0.04	0.03	0.01	−0.05	0.05	0.01	−0.02	0.00
−0.06*	−0.16**	−0.11**	−0.05	0.00	−0.10**	0.00	0.12**	0.04
	0.11**	−0.04	0.16**	0.11**	−0.06*	0.09**	−0.03	−0.02
0.14**		0.07**	0.08**	−0.10**	0.06*	0.05	−0.04	−0.12**
0.08**	0.16**		−0.06*	−0.03	0.09**	−0.05	−0.20**	0.00
0.09**	0.06**	−0.07**		0.20**	−0.06*	0.31**	0.21**	−0.01
0.07**	−0.04**	−0.10**	0.15**		−0.12**	0.13**	0.16**	0.18**
−0.04**	0.02*	0.10**	−0.09**	−0.07**		0.04	−0.24**	−0.15**
0.07**	0.05**	−0.03**	0.28**	0.06**	−0.03**		0.22**	−0.12**
−0.05**	−0.04**	−0.20**	0.23**	0.12**	−0.26**	0.19**		0.01
0.06**	0.09**	0.24**	0.08**	0.11**	−0.02*	−0.05**	−0.01	

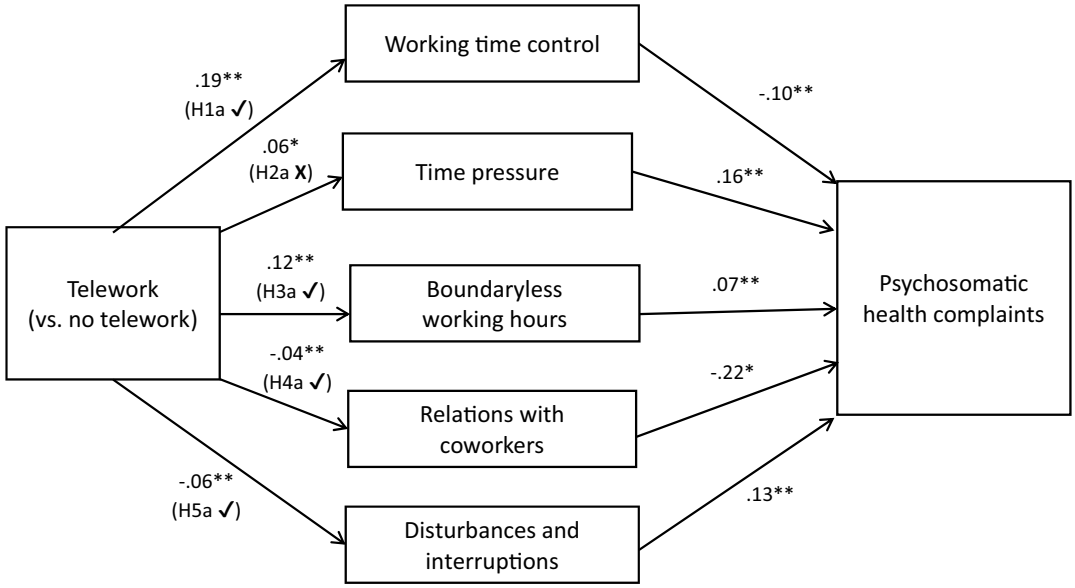

FIGURE 2 Path model showing relationships between telework, working conditions and health complaints ($N = 8931$). Standardised coefficients; * $p < .01$, ** $p < .001$; ✓ hypothesis confirmed, ✗ hypothesis rejected.

Extent of telework

The model was a good fit to the data, $\chi^2(9) = 69.68$; $p < 0.001$, CFI = 0.920; RMSEA = 0.071. Structural relationships are shown in Figure 3. Concerning working time, we hypothesised the extent of telework to be positively related to working time control (H1b) and boundaryless working hours (H3b), but being negatively correlated with time pressure. However, in our sample, we only find the extent of telework to be positively related to boundaryless working hours, but to be unrelated to working time control as well as to time pressure. Thus, Hypotheses 1b and 2b were not confirmed. Regarding interactions with coworkers we find—in line with our hypotheses—the extent of telework to be negatively related to the quality of relations with coworkers (H4b) and to disturbances and interruptions (H5b).

Regarding the proposed indirect effects (see Table 4), we find the extent of telework to be indirectly related to more psychosomatic health complaints via increased boundaryless working hours (H6b1) and decreased quality of relations with coworkers (H6b2). However, we find non-significant indirect effects of the extent of telework on psychosomatic health complaints via working time control (H7b1) as well as time pressure (H7b2). Thus, Hypotheses 7b1 and 7b2 were not supported. Finally, as proposed, the extent of telework was indirectly related to more psychosomatic health complaints via disturbances and interruptions (H7b3).

Altogether, the variables in the model explained 18% in psychosomatic health complaints. Subgroup analyses of men and women showed that the extent of telework was less related to boundaryless working hours for female employees resulting in a non-significant indirect effect on psychosomatic health complaints.

TABLE 3 Indirect effects of telework on psychosomatic health complaints via working conditions with bootstrapped confidence intervals

Indirect effects of telework on psychosomatic health complaints					
H6: more psychosomatic health complaints H7: less psychosomatic health complaints	via	Coeff	SE	CI LL	CI UL
H6a1 ✓	↑ boundaryless working hours	0.01**	0.00	0.00	0.01
H6a2 ✓	↓ relations with coworkers	0.01**	0.00	0.00	0.01
H7a1 ✓	↑ working time control	−0.01**	0.00	−0.02	−0.01
H7a2 ✗	↓ time pressure	0.01**	0.00	0.01	0.01
H7a3 ✓	↓ disturbances/ interruptions	−0.01**	0.00	−0.01	−0.00

Note: $N = 8931$. ✓ hypothesis confirmed, ✗ hypothesis rejected; **$p < 0.001$, Coeff = standardised coefficient, SE = standard error, CI LL = lower level of 95% confidence interval, CI UL = upper level of 95% confidence interval; arrows indicate an hypothesised increase (↑) or decrease (↓) of the respective working condition.

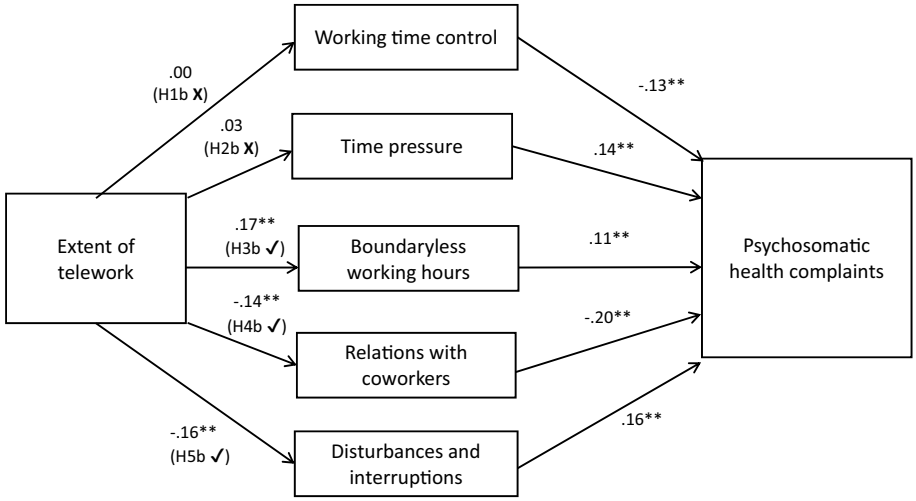

FIGURE 3 Path model showing relationships between extent of telework, working conditions and health complaints ($N = 1319$). Standardised coefficients; * $p < .01$, ** $p < .001$; ✓ hypothesis confirmed, ✗ hypothesis rejected.

DISCUSSION

Against the background of limited and inconclusive findings regarding the relationship of telework and health in earlier research (cf. Allen et al., 2015), the aim of the current study was to investigate the pathways and mechanisms through which telework could affect employees' mental health. We found working conditions related to working time and interactions with coworkers to be altered in teleworkers. We could further show that telework, which was unrelated

TABLE 4 Indirect effects of the extent of telework on psychosomatic health complaints via working conditions with bootstrapped confidence intervals

Indirect effects of the extent of telework on psychosomatic health complaints					
H6: more psychosomatic health complaints H7: less psychosomatic health complaints	via	Coeff	SE	CI LL	CI UL
H6b1 ✓	↑ boundaryless working hours	0.02**	0.01	0.01	0.03
H6b2 ✓	↓ relations with coworkers	0.03**	0.01	0.02	0.04
H7b1 ✗	↑ working time control	0.00	0.00	−0.01	0.01
H7b2 ✗	↓ time pressure	0.01	0.00	−0.01	0.01
H7b3 ✓	↓ disturbances/ interruptions	−0.02**	0.01	−0.04	−0.01

Note: $N = 1319$. ✓ hypothesis confirmed, ✗ hypothesis rejected; **$p < 0.001$, Coeff = standardised coefficient, SE = standard error, CI LL = lower level of 95% confidence interval, CI UL = upper level of 95% confidence interval; arrows indicate an hypothesised increase (↑) or decrease (↓) of the respective working condition.

to psychosomatic health complaints on a bivariate level, was indirectly related to psychosomatic health complaints via these working conditions.

Our theoretical model is primarily based on the idea of job demands and resources as underlying mechanisms (Bakker & Demerouti, 2007; Demerouti et al., 2001). Regarding working time, the job resource working time control as well as the job demands time pressure and boundaryless working hours were investigated. Indeed, teleworkers had higher working time control than non-teleworkers. This is in line with our hypotheses as well as earlier research that found telework to be related to autonomy in general and schedule control in particular (cf. Allen et al., 2015). However, contrary to our hypothesis, the extent of telework was unrelated to working time control. Thus, the mere opportunity to work from elsewhere—that is, greater autonomy regarding the place of work— but not the extent of actual work from elsewhere is accompanied by greater autonomy regarding the timing of work. For example, telework may facilitate going to a doctor's appointment without having to take the day off. However, greater working time control may also be a prerequisite for the possibility to telework. It is also possible that other actors (e.g., family members) take control over employees' working time flexibility with increasing days spent at home or elsewhere outside the principal office. This might counteract the possible gains in teleworkers' working time control (cf., Thulin et al., 2019).

We hypothesised teleworkers to have reduced time pressure. However, the opposite was the case. Thus, our results also contradict Vesala and Tuomivaara (2015) who found a decrease in experienced time pressure for a smaller sample of teleworkers living in a rural environment ($n = 46$) over several weeks. The findings of the current study may be explained by the fact that having the possibility to work from home without direct supervision can be related to certain leadership styles, such as management by objectives (Taskin & Devos, 2005). Employees have to manage themselves to attain the goals set for them, which may result in employees putting themselves under pressure. Thulin et al. (2019) point out that teleworking outside regular working hours is associated with an increased experience of time pressure, which at least implicitly supports our idea. However, as the current study relies on cross-sectional data only, we cannot rule out that time pressure could be an antecedent of telework. Employees who experience a lot

of time pressure at work may use telework as a coping strategy (Peters & van der Lippe, 2007) that provides the opportunity to get work done outside of regular working hours. In addition, the extent of telework was unrelated to time pressure in our study. This contradicts findings from Sardeshmukh et al. (2012) who found the extent of telework to be negatively related to time pressure. One reason for this could be the very different samples in the studies.

Another working time demand we assumed to be related to telework is boundaryless working hours. It is related to telework as such, but it becomes even stronger with the increasing extent of telework. This finding is in line with our hypotheses as well as with some earlier research that indicates that teleworkers often work overtime (Glass & Noonan, 2016). Although telework has been researched quite extensively in the context of work-life interference, evidence from multivariate analyses on the relationship of telework with increased working time demands that shift or erode boundaries between work and private life is hard to find. Thus, our findings regarding boundaryless working hours contribute to the literature not only by showing that teleworkers are more likely to experience boundaryless working hours but also that this becomes even more severe with more time spent teleworking.

Concerning interactions with coworkers, the findings regarding the quality of relations with coworkers support earlier findings from studies with smaller and more selected samples that workplace relationships suffer more with a decreasing degree of face-to-face interactions (Cooper & Kurland, 2002; Golden, 2006). The mere possibility of telework is already accompanied by lower quality relations with coworkers, and the extent of telework shows an even stronger connection. However, the same is true of a reduction in disturbances at work. Teleworkers experience fewer disturbances than other employees—the more so the more days per week they telework. This is in line with the idea of Windeler et al. (2017) that social interaction at the workplace has a cost and telework can be a helpful tool to tackle this issue. Based on a large-scale representative sample for Germany, we thus find support for the argument, that telework has the potential to generally reduce disturbances and interruptions in one's occupational activity. Thus, less physical presence in the office has both advantages and disadvantages. A promising strategy for future research would certainly be to investigate disturbances, distractions and interruptions occurring *at home* in more detail (cf., Delanoeije et al., 2019). In addition to poor working materials and un-ergonomic workplaces, interruptions by family members, but also by television or radio could be critical to working from home.

Drawing on considerations of the JD-R model (Bakker & Demerouti, 2007) and an extensive line of literature (Rothe et al., 2017), we assumed and found that job demands have the potential to detrimentally affect employees' mental health, while job resources trigger processes that can beneficially affect health. Although others have also found direct effects of telework on health-related outcomes (e.g., exhaustion: Sardeshmukh et al., 2012), we found telework to be rather indirectly related to employees' psychosomatic health complaints via certain working conditions. One explanation could be that compared to exhaustion, psychosomatic health complaints are more distal health-related aspects.

Our study adds to the literature by simultaneously investigating working conditions altered through telework and the effect of these working conditions on employees' health based on a rather comprehensive theoretical model and large-scale representative survey data for Germany. In addition to investing so far under-researched aspects such as boundaryless working hours or disturbances and interruptions, we show that the separate analyses of the occurrence of telework and the extent of telework reveal that different mechanisms may be at work. This underlines the importance of separating those two aspects when examining workplace arrangements (cf., Allen et al., 2015).

Limitations and directions for future research

Our empirical analyses are based on recent large-scale and representative survey data for Germany (BAuA-Working Time Survey). Not being restricted to small sample sizes or specific units of analysis (e.g., single firms) allowed us to draw conclusions for the workforce at large. The high number of variables also enabled us to control for a variety of potentially confounding factors (omitted variable bias) that might influence employees' participation in telework as well as their working conditions and psychosomatic health complaints. That said, the data also come with some limitations. First, they are cross-sectional, meaning that common method bias could have inflated correlations. As mentioned above, we cannot rule out the possibility that some working conditions may be antecedents and not outcomes of telework, even though our assumptions seem plausible from a theoretical point of view. Therefore, no causal inferences can be drawn. For future research, we suggest that researchers collect large-scale longitudinal data focusing on issues of digitisation and the world of work. Intervention studies seem to be particularly promising in this respect. Further, more objective data could supplement questionnaire data in such study designs, which often rely on self-reports only.

In addition, there are limits to the external validity (generalisability) of our results. The number of teleworkers in Germany at the time of data collection for this study was rather low in international comparison (Brenke, 2014). If this implies that telework still faces severe problems in Germany, this country case might be particularly suitable to generally uncover problems and challenges of telework. Nonetheless, our findings may not be completely generalisable to other countries. It would be instructive to replicate the analyses for countries belonging to different welfare state regimes or types of market economy. Furthermore, we used a selected sample of qualified and highly qualified white-collar employees to make it more homogenous in terms of the increased likelihood of telework. Investigating telework in less highly skilled staff could add important findings to the literature. However, in the current data set, the number of low-skilled white-collar employees and blue-collar workers who were teleworkers was too small to allow for separate analyses. Due to telework becoming more and more common, future waves of the survey data used in this study may provide the possibility to investigate telework in this group of the less highly skilled.

Implications for practice

According to political claims, teleworkers should be protected from poor working conditions in the same way as office workers (European Social Partners, 2006). In fact, this study shows that the working conditions between both groups differ substantially. It is important to recognise that telework itself is neither good nor bad. However, it is related to certain working conditions, and employers as well as employees should be aware of this as well. Our study offers some implications for practice. First, as telework is related to lower quality relationships with coworkers, some jobs in which employees rely on one another and are required to interact and exchange ideas to effectively perform their work tasks might be less apt for telework (Allen et al., 2015; Boell et al., 2016). As our empirical evidence has shown, the quality of social relations at work suffers in proportion with the number of days spent teleworking; hence, limiting telework to a certain number of days per week could be a reasonable option in general. Second, telework is also clearly related to boundaryless working hours. To prevent

this, clear rules and processes should be in place that regulate when employees have to be available and how they should signal work overload to prevent overtime work. Some companies like Volkswagen have applied technical solutions to solve this problem by shutting down work servers after the end of regular working time (BBC, 2011). Teleworkers should also receive specific training, including time management and work organisation, and they should be informed about possible detrimental effects of blurring the boundaries between work and private life (Tremblay, 2002).

Many forms of telework offer employees the possibility to do their work from almost anywhere: at home, in a café, in a hotel room, with a customer, or on the road in a bus or plane or to bridge the time in waiting rooms. In fact, most of the work performed outside the principal office is done at peoples' homes (Pfisterer et al., 2013). Due to the increase in home-based telework during the Covid-19 pandemic, it is likely to be established to a high extent after the crisis (Backhaus et al., 2020; Bonin et al., 2020). This also implies that home offices should be designed in appropriate ways (Ng, 2010). Several aspects, including internet connectivity, work equipment, lighting, space requirements, or possible distractions at home should be optimised, as this could be another source of stress and deplete workers' resources. With the expansion of telework arrangements, interferences of work and family need to be investigated more closely, too (Allen et al., 2013; Delanoeije et al., 2019; Thulin et al., 2019). Solutions to such potential conflicts often lie in negotiation processes between partners, but structural adjustments and solutions should not be neglected either. This includes the intensified provision of childcare facilities.

Policy-makers could also support the mental health of teleworkers by introducing regulations that provide protection standards that include the provision of job resources and the limitation of job demands regarding ergonomic but also regarding other working conditions. Examples are the mandatory documentation of working times, the implementation of flexibility in work schedules, and the right and ability to disconnect from work to enable (psychological) detachment from work during rest periods and on free days (cf., International Labour Organisation, 2020).

CONFLICT OF INTEREST

Both authors confirm that there is no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available as scientific use file (BAuA-AZB2015_SUF_1 (Version 1, https://doi.org/10.21934/baua.azb15.suf.1)) from the research data centre of the Bundesanstalt für Arbeitsschutz und Arbeitsmedizin at www.baua.de/forschungsdaten.

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