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Original Article

Walking the tightrope between work and home: the role of job/home resources in the relation between job/home demands and employee health and well-being

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Abstract: The present study investigated the role of job/home resources in the relation between job/home demands and exhaustion, job satisfaction, work-home interference, and home-work interference during the COVID-19 pandemic. We explored the prevalence of job/home demands and resources during the COVID-19 pandemic, and examined whether working at different locations (i.e., working from home or at the office) affects how both job/home demands and resources are associated with employees' health and well-being. An online cross-sectional survey study using self-report questionnaires was carried out among the networks of the International Commission on Occupational Health (ICOH) association (*N*=153). The findings of this study illustrated that (1) cognitive job demands/resources and emotional home demands/resources were crucial in predicting employee health and well-being; (2) a conceptual match was detected between corresponding demands and resources; (3) subgroup analysis showed that employees were not heavily affected by the different working locations during the pandemic. In conclusion, this study confirms the positive role of job/home resources. We suggest that cultivating specific job/home resources and establishing an appropriate match between specific job/home resources and corresponding job/home demands is necessary to ensure employees' health and well-being in times of a pandemic.

Key words: COVID-19, Job/home demands, Job/home resources, DISC model, Exhaustion, Job satisfaction, Work-home interference, Home-work interference

Introduction

The COVID-19 pandemic has had a major (and often negative) impact on many aspects of people's lives, leading

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to unprecedented changes in working behaviors, family experiences, and personal well-being[1]. Changes in working conditions due to pandemic-related measures such as public lockdowns and mandatory working from home (WFH) have strongly affected employees' health and well-being[1]. Due to these changes, many employees and organizations around the world are struggling to adapt to "the new normal" brought about by the COVID-19 outbreak. Different from what was previously the case, during the COVID-19 pandemic WFH became a way of working that many employees cannot always decide about themselves. Admittedly, the effects of WFH were not always negative[2–4]. Previous research on WFH shows that WFH tends to be characterized by a high degree of flexibility, convenience, autonomy, and productivity[5–8], particularly during the COVID-19 pandemic[9]. However, it may also cause a sense of loneliness, exhaustion, and feelings of isolation[10]. Most importantly, WFH creates a blurred boundary between work and home associated with conflicts between work and family roles[11–15]. Specifically, the closure of companies and schools has forced many employees to work from home, among them people who must cope with the multiple demands of balancing family and work, especially for female workers and when young children are present[13, 15]. As such, the blurred boundary created by WFH could jeopardize work-home balance for many employees[14].

Therefore, we believe that during the COVID-19 pandemic, the negative effects of WFH on worker well-being and performance became more pronounced, while its positive effects became weaker. As a result, WFH during COVID-19 implied that employees had to deal with greater interference between home and work than before, which we believe negatively affects their health and well-being. It also triggers stress related to pending job tasks as well as increasing home demands[4, 16, 17], which are likely to deplete an individual's energy reserves and to reduce people's health and well-being[18].

The present research explores how (mandatory) WFH as a "new normal of working" affects the health and well-being of employees. Usually, adopting this flexible way of working should be an intervention that requires a good preparation to support employees' productivity and ensures them a better work-home balance[4, 16]. Therefore, while examining this "new normal of working" in times of the COVID-19 pandemic, the present study considered demands and resources from both work and home domains[17, 19–21] to investigate (1) the prevalence of job/home demands and job/home resources during the COVID-19 pandemic compared to the pre-COVID-19 period, and (2) how both job/home demands and job/home resources are related to employees' health and well-being during the pandemic.

Demands and resources in the work and home domains

Demands and resources in the work domain. Several job stress models have revealed that employee health and well-being can be explained, among other things, by both job demands and job resources[19–22]. Job demands refer to work-related tasks that require immediate or prolonged effort[19, 20]. Job resources can be defined as work-related means that can be used when employees must deal with these job demands[19, 20]. For instance, Karasek's[22] Job Demand-Control Model assumes that job strain is caused by high job demands and low job control. In addition, Demerouti *et al.*'s[23] Job Demands-Resources Model proposes that any job demand and any job resource may affect employee health and well-being, as long as these demands and resources are relevant to a particular job.

Although these examples of universal approaches to job stress have been very successful[24], a drawback of them is that they consider job demands and job resources as global and unidimensional constructs, thereby obscuring the differential impact of specific dimensions of each construct[20, 21]. In reaction to this view, De Jonge and Dormann[20, 21] developed the Demand-Induced Strain Compensation (DISC) Model. The DISC Model states that job demands and job resources are multidimensional constructs that consist of cognitive, emotional, and physical dimensions. A second drawback of the two earlier models is that they propose that any job resource can deal with any job demand to combat adverse health and poor well-being. However, these so-called moderating- or buffer-effect models have received mixed empirical support[21, 24]. One important reason why research has failed to find moderating or buffer effects is described in the DISC Model's matching principle: specific dimensions of job demands and job resources (i.e., cognitive, emotional and/or physical) should match to detect moderating effects of job resources in the prediction of employee outcomes. For example, emotional support from colleagues is most likely to moderate the relation between emotional demands (e.g., conflict with a supervisor) and emotional exhaustion. Conversely, offering emotional support is unlikely to moderate the effect (if any) of high physical demands on cognitive functioning.

Taking demands and resources to the home domain. In line with the theoretical models discussed above, home de-

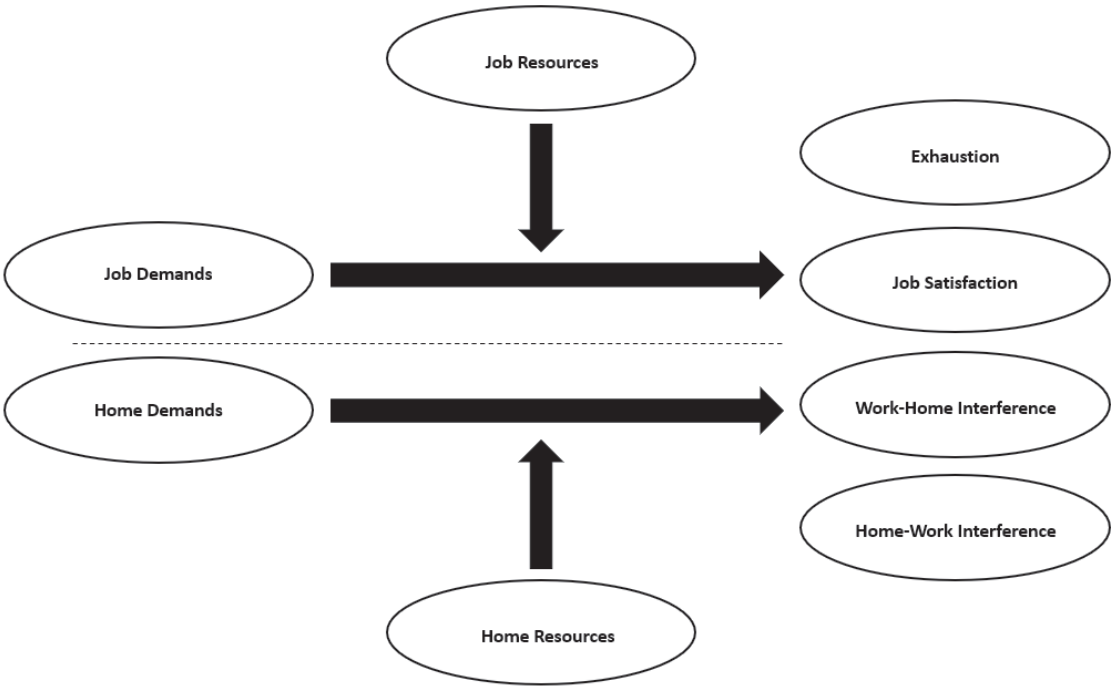

Fig. 1. Conceptual model of the present study.

mands can be defined as home-related tasks that require a certain amount of cognitive, emotional and/or physical effort (e.g., helping kids with school work, childcare and domestic work). In a similar vein, home resources can be described as home-related assets that can be employed to deal with those demands at home (e.g., Internet information, support from spouse and family members, ergonomic domestic aids). It is also highly likely that specific home demands and home resources should match to detect moderating or buffering effects of home resources in the prediction of health and well-being. Scarce available empirical research in this area showed that home demands and home resources have a direct, rather than a moderating effect on employee burnout (i.e., emotional exhaustion) as well as on work-home interference (WHI) and home-work interference (HWI)[17]. Moreover, by assessing the potential impact of home demands on health and well-being outcomes, it adds to our understanding of how individuals balance work and home responsibilities[17].

Aim, hypotheses and research questions

The present study aims to investigate (1) the prevalence of both job/home demands and job/home resources during the COVID-19 pandemic compared to the pre-COVID-19 period, and (2) how both job/home demands and job/home resources are associated with employees' health and well-being during this pandemic. Moreover, in line with the DISC Model[20, 21], we assume that specific job/home demands and job/home resources should match to detect moderating effects of job/home resources in the prediction of employee health/well-being. Our conceptual model is depicted in Fig. 1.

In the present study we attempt to capture the pandemic's impact on employee health/well-being by focusing on employee exhaustion as a key component of the burnout concept, on work/home and home/work interference, and on job satisfaction. These criterion variables are included because together they cover a wide array of aspects of worker health and well-being[25].

Based on previous theoretical and empirical research, we expect that:

Hypothesis 1: Higher job demands (i.e., cognitive, emotional, and physical) are associated with higher levels of employee adverse health/well-being (H1a), while this relation is moderated (i.e., buffered) by matching job resources (H1b).

Hypothesis 2: Higher home demands (i.e., cognitive, emotional, and physical) are associated with higher levels of employee adverse health/well-being (H2a), while this

relation is moderated (i.e., buffered) by matching home resources (H2b).

Furthermore, we are not aware of any related research (either COVID-19 or non-COVID-19) that simultaneously investigated demands and resources from both the work and home domains, concerning the three dimensions mentioned above. We will therefore also explore two research questions:

1) What is the prevalence of job/home demands and job/home resources during the COVID-19 pandemic?
2) During the COVID-19 pandemic, will working at different locations (i.e., either working from home or at the office) affect how both job/home demands and job/home resources are associated with employees' health and well-being?

Methods

Design, Procedure and Participants

This study was conducted using a cross-sectional survey. Participants were invited to fill out an online questionnaire during the COVID-19 pandemic from January to June, 2021. They were mainly recruited from networks of the International Commission on Occupational Health (ICOH) association; that is, ICOH-WOPS and ICOH-CVD. ICOH-WOPS deals with occupational health researchers who study work organization and psychosocial factors, whereas ICOH-CVD is a professional network of occupational health physicians and researchers dealing with work-related factors and cardiovascular health. Additional participants were recruited via the authors' personal networks and public social media, such as LinkedIn, Twitter, and Facebook. At closing of the survey, 153 participants completed the questionnaire. The average age of the participants was 43.2 years (*SD*=12.8) and 34.6% was male. More than half (53.6%) of the participants held a PhD degree and about a third (35.3%) of them held a master's degree. Participants had an average working experience of 19.7 years (*SD*=12.6), and 66.0% of them were employed in health care or education sectors. As far as continents and countries involved are concerned, 51.9% of the participants came from Europe (mostly the Netherlands, Belgium, Denmark, and Germany), 23.7% came from Asia-Pacific (Australia, Malaysia, China, and Japan in particular), 18.5% came from North- and South-America (mostly USA), 3.3% from the UK, and finally 2.0% of the participants came from Africa (i.e., South-Africa and Senegal). Finally, as for the COVID-19 pandemic situation in their living country, 91.5% of participants reported that their countries were facing COVID-19 lockdowns at the time of conducting the survey. Moreover, 34.0% of the participants reported that they were forced to work at home, and 47.7% of participants indicated that they were required to work at home "as much as possible". Further, 11.8% of participants reported that their management did not force or require them where to work, and only 3.3% of participants reported that they were required to work in the office as much as possible. Overall, 78.4% of the participants (*N*=120) said they worked mainly from home, while 21.6% of the participants (*N*=33) worked mainly at the office or elsewhere. An introduction of the research aims and a data confidentiality statement were posted to all participants on the first page of the questionnaire. All the participants gave their informed consent for inclusion before they chose to participate in this study. This study was conducted in agreement with the ethics code of the American Psychological Association (APA) and Declaration of Helsinki (DoH), as well as the Netherlands Institute for Psychologists (NIP). The ethical approval was approved by the ethical review board of Utrecht University (Approval Number: 20-654).

Measures

Job demands and job resources

The DISC Questionnaire (DISQ) 3.1[26] was employed to measure cognitive, emotional and physical job demands and job resources. Different versions of this well-validated questionnaire have been applied internationally and widely in various occupational groups, demonstrating good psychometric properties[27–29]. Each dimension of the DISQ consists of 3 items, except for the 4-item cognitive resources subscale. All items were rated from 1 (Never or Very rarely) to 5 (Very often or Always). Example items for job demands are "At work, I have to display high levels of concentration and precision" (Cognitive demands; Cronbach's $\alpha = 0.81$), "At work, I have to deal with people (e.g., clients, colleagues, or supervisors) whose problems touched me emotionally." (Emotional demands; Cronbach's $\alpha = 0.81$), and "At work, I have to perform a lot of physically strenuous tasks to carry out my job" (Physical demands; Cronbach's $\alpha = 0.78$). Example items of resources are "I have the opportunity to determine my own work method" (Cognitive resources; Cronbach's $\alpha = 0.76$), "I get emotional support from others (e.g., clients, colleagues, or supervisors) when a threatening situation at work occurred." (Emotional resources; Cronbach's $\alpha = 0.86$), and "At work, I am able to take a physical break when things got physically strenuous." (Physical resources; Cronbach's $\alpha = 0.73$).

Home demands and home resources

Home demands and home resources also contained cognitive, emotional and physical dimensions, and were measured by a 6-item shortened version of the DISC-HOME scale from earlier research[30]. Example items are "At home, I have to perform a lot of physically strenuous tasks" (Physical home demand) and "I receive emotional support from others (e.g., relatives, friends, or neighbors) when a threatening situation occurred at home" (Emotional home resource). All six items were scored on a 5-point frequency scale, ranging from 1 (Never or Very rarely) to 5 (Very often or Always).

Work-home interference and home-work interference

Work-home interference (WHI) and home-work interference (HWI) were measured by 6 items taken from the Survey Work-home Interaction/NijmeGen (SWING)[31]. Example items are "You have to work so hard that you do not have time for any of your hobbies." (WHI; Cronbach's α = 0.90) and "You have difficulty concentrating on your work because you are preoccupied with domestic matters." (HWI; Cronbach's α = 0.75). Items were rated on a 5-point frequency scale, ranging from 1 (Never) to 5 (Always).

Emotional exhaustion

Emotional exhaustion was measured using the corresponding 5-item scale from the Maslach Burnout Inventory – General Survey (MBI–GS)[32]. An example item is "I feel used up at the end of the workday" (Cronbach's α = 0.95). Items were rated on a seven-point response scale ranging from 0 (Never) to 6 (Daily).

Job satisfaction

Job satisfaction was measured with one item. Single-item measures may be as acceptable or even be more appropriate than multi-item scales, especially when the construct of interest is relatively narrow or unambiguous to respondents[33]. We used one item to tap general job satisfaction[34], namely "I am satisfied with my job" (0 = Never, 6 = Daily).

Demographic characteristics

Demographics used in this study were gender (0 = male, 1 = female), age (in years), working hours per day (in hours), the number of children at home, working location (in percentages of working from home, office, or elsewhere), and educational level (ranging from 1, pre-school, to 9, doctoral degree). These demographic variables were used as control variables as they seem important in COVID-19-based studies[13, 15].

Statistical Analysis

Firstly, we computed means, standard deviations, and Pearson zero-order correlations to obtain an initial overview of the survey data. Secondly, in order to investigate the prevalence of job/home demands and job/home resources between COVID-19 and pre-COVID-19, we compared mean differences of demands and resources with previous cross-national – pre-COVID-19 – studies conducted by Bova *et al.*[27] and Van de Ven and Vlerick[35] using one-way ANOVAs (research question 1). Thirdly, we performed hierarchical multiple regression analyses (HMRAs) to investigate the associations between (1) job/home demands and job/home resources, and (2) the four health/well-being outcomes. Lastly, due to the hierarchical nature of our analyses, the HMRAs were conducted with simultaneous entry of variables in each hierarchical step. All analyses were performed in IBM SPSS Statistics 26 (SPSS Inc., Chicago, IL, USA).

Generally, no significant violations of linear regression assumptions were detected. Our HRMAs were built up as follows. First, all demographic variables were simultaneously entered as potential confounders. Second, before computing multiplicative interaction terms (i.e., demands × resources), we standardized the main terms of each dimension of demands and resources (i.e., cognitive, emotional, and physical) for both the work and home domain to avoid multi-collinearity. It should be noted that all interactions were of cognitive, emotional, or physical kind according to the main assumption of DISC theory. The final regression equation can be depicted as $\hat{y} = jz_n + (ax_1 + bx_2 + cx_1x_2) + (dx_3 + ex_4 + fx_3x_4) + (gx_5 + hx_6 + ix_5x_6) + e$, in which the outcome variable is reflected by $\hat{y}$, the demographics by jz_n, the cognitive interaction effect by $(ax_1 + bx_2 + cx_1x_2)$, the emotional interaction effect by $(dx_3 + ex_4 + fx_3x_4)$, the physical interaction effect by $(gx_5 + hx_6 + ix_5x_6)$, and finally the error term by e. Third, according to the theoretical assumptions of different types of demands and resources, we conducted separate analyses for the work and home domains with regard to the four outcome variables (see also Fig. 1). Therefore, eight HMRA analyses were conducted − four for each domain.

Unstandardized beta-coefficients (*B*) and their significance for individual predictor variables were presented, as well as the standard error (*SE*) and explained variance (R^2) of the final regression model. Incremental F-tests (F_{inc}) and R^2 Change values were presented for regression model

Table 1. Means, Standard Deviations, and Mean Comparisons of the current study with two previous studies

	1) Current study (N=153) Mean (SD)	*2) Bova et al. (2013) (N=1,629) Mean (SD)*	*3) Van de Ven & Vlerick (2013) (N=1,533) Mean (SD)*	*df (between)*	*F*	*Post hoc*
1. Gender	66.4% female	50.6% female	5.0% female			
2. Age	43.16 (12.77)	40.96 (11.09)	43.18 (10.14)	2	17.65***	1>2, 2<3
3. Children at home	0.78 (1.12)	N/A	N/A			
4. Working hours	8.26 (2.39)	N/A	N/A			
5. Educational level	8.38 (0.85)	N/A	N/A			
6. Cogn. job demands	4.00 (0.74)	3.67 (0.64)	3.67 (0.64)	2	19.11***	1>2, 1>3
7. Emot. job demands	2.61 (0.93)	2.69 (0.72)	2.89 (0.72)	2	33.84***	1<3, 2<3
8. Phys. job demands	1.48 (0.67)	2.17 (1.06)	2.87 (1.16)	2	226.56***	1<2, 1<3, 2<3
9. Cogn. job resources	3.87 (0.70)	3.52 (0.66)	3.24 (0.61)	2	117.87***	1>2, 1>3, 2>3
10. Emot. job resources	3.31 (0.99)	3.60 (0.74)	2.95 (0.76)	2	287.08***	1<2, 1>3, 2>3
11. Phys. job resources	3.09 (1.16)	3.56 (0.91)	3.45 (0.84)	2	21.94***	1<2, 1<3, 2>3
12. Cogn. home demands	3.28 (1.16)	N/A	N/A			
13. Emot. home demands	2.93 (1.15)	N/A	N/A			
14. Phys. home demands	2.05 (1.04)	N/A	N/A			
15. Cogn. home resources	4.01 (0.95)	N/A	N/A			
16. Emot. home resources	3.67 (1.11)	N/A	N/A			
17. Phys. home resources	3.10 (1.31)	N/A	N/A			
18. WHI	3.14 (1.02)	N/A	N/A			
19. HWI	2.10 (0.81)	N/A	N/A			
20. Exhaustion	3.96 (1.53)	N/A	N/A			
21. Job satisfaction	4.63 (1.46)	N/A	N/A			

Note: Cogn. = cognitive; Emot. = emotional; Phys. = physical; WHI = work-home interference; HWI = home-work interference.
* $p<0.05$; ** $p<0.01$; *** $p<0.001$.

comparisons.

Finally, to answer research question 2, we tested if it would be necessary to split the sample in two subgroups; that is, (1) working from home, and (2) working at the office or else. To this aim, a dummy variable depicting working from home (denoted 1) and working at the office (denoted 0) was created. This dummy variable was added in the final step of each regression model, along with the whole set of control and standardized predictor variables. Eight tests were performed in total, one for each outcome measure and each regression model (work or home domain). Two out of these eight tests (25.0%) showed significantly different regression models between the two subgroups. Therefore, separate subgroup analyses for the working from home versus the working from the office or elsewhere groups were empirically justified.

Results

Means and standard deviations are presented in Table 1, which also includes the mean differences comparisons for the three dimensions of job demands and job resources (i.e., cognitive, emotional, and physical) with two pre-COVID-19 studies conducted by Bova *et al.*[27] and Van de Ven and Vlerick[35]. As far as job demands are concerned, our participants reported relatively high cognitive demands at work during the COVID-19 pandemic (M=4.00; SD=0.74). This was significantly higher than in the Bova *et al.*[27] study (M=3.67, SD=0.64) and the Van de Ven and Vlerick[35] study (M=3.67, SD=0.64). In contrast, physical job demands in the current study (M=1.48; SD=0.67) were rated significantly lower than those in the two earlier studies (M=2.17, SD=1.06 and M=2.87, SD=1.16, respectively). Finally, our participants reported lower emotional job demands compared to the study of Van de Ven and Vlerick[35] (M=2.61, SD=0.93 vs. M=2.89, SD=0.72), but no significant differences between our sample and the Bova *et al.*[58] study were detected.

In terms of job resources, respondents reported significantly lower physical job resources (M=3.09; SD=1.16) during the COVID-19 pandemic than those of the two pre-pandemic studies (M=3.56, SD=0.91 and M=3.45, SD=0.84, respectively). Contrarily, our participants reported significantly higher cognitive job resources (M=3.87,

SD=0.90) than their counterpart in the other two samples (*M*=3.52, *SD*=0.66 and *M*=3.24 *SD*=0.61, respectively). As far as emotional job resources are concerned, our participants reported having an average level of emotional job resources (*M*=3.31, *SD*=0.99) during COVID-19, but this was significantly lower than in the Bova *et al.*[27] study (*M*=3.60, *SD*=0.74), and significantly higher than the findings by Van de Ven and Vlerick[35] (*M*=2.95, *SD*=0.76).

Furthermore, the Pearson zero-order correlations in Table 2 show that almost all demands from both the work and home domains were positively associated with work-home and home-work interference, except for the association of physical home demands with work-home interference and the relation of cognitive job demands with home-work interference. The same is true for all demands from both domains with regard to emotional exhaustion, but not for physical home demands. Finally, all resources from both the work and home domains were positively associated with job satisfaction, whereas all dimensions of job resources were negatively related to employee exhaustion.

In line with our hypotheses, we tested a moderation- or interaction-effect model against a main-effect model for all four outcome variables in both the work domain (Table 3) and home domain (Table 4). Findings showed that none of the incremental F-tests between the main-effect and interaction-effect models reached significance at $p<0.05$. This implies that none of the assumed interaction-effect models were superior to the main-effect models. Therefore, below we only describe the results of the main-effect models.

Job demands and job resources as predictors of employee health and well-being

Table 3 shows the HMRA results for the main-effect models of job demands and job resources as predictors of employee health and well-being.

Predictors of exhaustion. With respect to employee exhaustion, results showed two significant main effects of job demands and job resources. Specifically, higher cognitive job demands were related to more feelings of exhaustion ($B=0.39$, $p<0.001$). Conversely, higher cognitive job resources were related to less feelings of exhaustion ($B=-0.63$, $p<0.001$). Both cognitive job demands and cognitive job resources explained 43.0% of the variance in exhaustion.

Predictors of job satisfaction. In terms of job satisfaction, we found significant main effects of job demands and job resources for all three dimensions (i.e., cognitive, emotional, and physical). Specifically, higher emotional job demands were related to less job satisfaction ($B=-0.30$, $p<0.01$). In addition, cognitive job resources ($B=0.62$, $p<0.001$) and emotional job resources ($B=0.37$, $p<0.001$) were positively associated with job satisfaction. Finally, higher physical job demands were associated with more job satisfaction ($B=0.33$, $p<0.01$). The final regression model explained 49.0% of the variance in job satisfaction.

Predictors of work-home interference. Regarding work-home interference (WHI), we found that WHI was positively associated with job cognitive demands ($B=0.23$, $p<0.01$) and negatively related to the corresponding resources ($B=-0.21$, $p<0.05$). The best-fitting regression model explained 39.0% of the variance in WHI.

Predictors of home-work interference. Regarding HWI, only physical job demands indicated a significant relation with it ($B=0.15$, $p<0.05$). Higher physical job demands were related to higher HWI. Lastly, 37.0% of the variance in HWI was explained in the final regression model by the job-related predictors.

Home demands and home resources as predictors of employee health and well-being

Table 4 shows the HMRA results for the main-effect models of home demands and home resources as predictors of employee health and well-being.

Predictors of exhaustion. Regarding exhaustion, findings revealed two significant predictor variables. Specifically, higher emotional home demands were related to more feelings of exhaustion ($B=0.51$, $p<0.01$). Further, higher emotional home resources were associated with less feelings of exhaustion ($B=-0.26$, $p<0.05$). The best-fitting regression model explained 23.0% of the variance in exhaustion.

Predictors of job satisfaction. As far as home demands/resources as predictors of job satisfaction are concerned, both emotional home demands and emotional home resources showed significant associations. Specifically, higher emotional home demands were related to less job satisfaction ($B=-0.47$, $p<0.01$), whereas higher emotional home resources were related to more job satisfaction ($B=0.46$, $p<0.001$). The best-fitting regression model explained 29.0% of the variance in job satisfaction.

Predictors of work-home interference. Findings revealed that only emotional home demands were positively related to WHI ($B=0.32$, SE=0.10, $p<0.01$) The total explained variance of WHI was 37.0%.

Predictors of home-work interference. Regarding HWI, emotional home demands ($B=0.19$, SE=0.08, $p<0.05$) and physical home demands ($B=0.21$, SE=0.07, $p<0.01$) were

Table 2. Pearson zero-order correlations among the study variables (*N*=153)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Gender	1																				
2. Age	−0.07	1																			
3. Children at home	−0.03	0.08	1																		
4. Working hours	−0.03	−0.01	0.04	1																	
5. Educational level	−0.07	0.13	−0.06	0.24**	1																
6. Cogn. job demands	0.03	−0.01	−0.04	0.33**	0.19*	1															
7. Emot. job demands	−0.05	−0.12	0.05	0.23**	0.09	0.32**	1														
8. Phys. job demands	−0.22**	−0.16*	0.20*	0.09	−0.02	0.00	0.41**	1													
9. Cogn. job resources	−0.05	0.13	−0.07	0.01	−0.01	−0.02	−0.20*	−0.02	1												
10. Emot. job resources	−0.04	−0.07	0.10	0.02	−0.08	−0.15	−0.05	0.08	0.37**	1											
11. Phys. job resources	−0.22**	0.14	0.04	0.08	0.04	0.01	0.22**	0.25**	0.35**	0.15	1										
12. Cogn. home demands	−0.07	−0.10	0.00	0.21*	0.07	0.36**	0.36**	0.20*	−0.08	−0.02	0.10	1									
13. Emot. home demands	−0.05	−0.13	0.20*	0.12	0.12	0.35**	0.55**	0.24**	−0.14	−0.05	0.08	0.59**	1								
14. Phys. home demands	−0.01	−0.15	0.30**	0.07	0.08	−0.03	0.33**	0.46**	0.01	0.09	0.08	0.09	0.36**	1							
15. Cogn. home resources	−0.14	0.17*	0.02	0.07	0.21*	0.22**	−0.03	0.02	0.33**	0.18*	0.31**	0.11	0.00	−0.06	1						
16. Emot. home resources	0.01	−0.16	0.00	0.17*	0.02	0.11	−0.04	−0.04	0.32**	0.48**	0.14	−0.08	0.00	0.09	0.28**	1					
17. Phys. home resources	−0.24**	0.04	−0.02	0.00	0.03	−0.11	−0.03	0.21*	0.26**	0.23**	0.56**	0.02	−0.10	0.16	0.36**	0.21*	1				
18. Exhaustion	0.10	−0.19*	−0.05	0.01	0.10	0.28**	0.37**	0.16*	−0.46**	−0.27**	−0.16*	0.27**	0.38**	0.1	−0.02	−0.13	−0.15	1			
19. Job satisfaction	−0.12	0.15	0.16*	0.05	0.00	−0.09	−0.25**	0.13	0.52**	0.45**	0.18*	−0.07	−0.18*	0.11	0.25**	0.32**	0.22**	−0.58**	1		
20. WHI	−0.01	−0.17*	0.13	0.40**	0.21**	0.39**	0.34**	0.19*	−0.27**	−0.11	−0.09	0.35**	0.44**	0.14	0.00	−0.02	−0.10	0.59**	−0.21**	1	
21. HWI	−0.02	−0.18*	0.31**	−0.11	0.00	0.01	0.29**	0.36**	−0.20*	−0.07	−0.08	0.16*	0.39**	0.40**	−0.12	−0.16*	−0.05	0.45**	−0.14	0.40**	1

Note: Cogn. = cognitive; Emot. = emotional; Phys. = physical; WHI = work-home interference; HWI = home-work interference. * $p<0.05$; ** $p<0.01$ (two-tailed).

Table 3. Hierarchical regression models of employee health/well-being outcomes with job demands and job resources as predictor variables (*N*=153)

Source	Dependent Variable							
	Exhaustion		Job satisfaction		Work-home Interference		Home-work Interference	
	B	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*
Control Variables								
Gender	0.22	0.23	−0.06	0.21	0.00	0.16	−0.02	0.12
Age	−0.01	0.01	0.01	0.01	−0.01	0.01	−0.01	0
Children at home	−0.07	0.10	0.16	0.09	0.10	0.07	0.19***	0.06
Actual working hours	−0.06	0.05	0.03	0.04	0.12***	0.03	−0.06*	0.03
Education	−0.01	0.14	0.11	0.13	0.08	0.10	0.00	0.08
Job Demands and Job Resources								
Cogn. job demands	0.39***	0.12	−0.02	0.11	0.23**	0.08	0.00	0.06
Emot. job demands	0.22	0.14	−0.30**	0.12	0.13	0.09	0.12	0.07
Phys. job demands	0.12	0.13	0.33**	0.12	0.04	0.09	0.15*	0.07
Cogn. job resources	−0.63***	0.13	0.62***	0.12	−0.21*	0.09	−0.10	0.07
Emot. job resources	−0.17	0.12	0.37***	0.10	−0.03	0.08	−0.07	0.06
Phys. job resources	−0.03	0.14	−0.05	0.12	−0.04	0.09	−0.05	0.07
Interaction effects								
Cogn. demands × cogn. resources (J)	−0.08	0.08	0.13	0.08	0.06	0.06	−0.02	0.05
Emot. demands × emot. resources (J)	0.08	0.10	−0.11	0.09	0.01	0.07	0.05	0.06
Phys. demands × phys. resources (J)	0.13	0.13	0.05	0.12	0.07	0.09	0.16*	0.07
Subgroup analysis								
Working location	−0.35	0.26	0.11	0.24	−0.13	0.18	−0.35*	0.14
Model Test	R^2 = 0.43 F (15,127) = 6.33***		R^2 = 0.49 F (15,128) = 8.03***		R^2 = 0.39 F (15,129) = 5.44***		R^2 = 0.37 F (15,128) = 5.04***	
R^2 Change	0.01		0.02		0.01		0.03	
Incremental *F*	0.87		1.38		0.79		2.22	

Note: Cogn. = cognitive; Emot. = emotional; Phys. = physical; J = job. * p<0.05; ** p<0.01; *** p<0.001 (two-tailed).

positively associated with HWI. Besides, more emotional home resources (B=−0.13, SE=0.07, p<0.05) were related to less HWI. The total explained variance of HWI was 36.0%.

Working at home versus working at the office or elsewhere

To answer research question 2, a subgroup analysis was conducted to compare the findings for employees who worked from home to those working at the office or elsewhere. The corresponding analyses showed that the different working locations significantly affected participants' home-work interference level only (work domain: B=−0.35, p<0.05; home domain: B=−0.28, p<0.05) and not the other outcome measures. Therefore, subgroup regression analyses were conducted for subgroup 1 (working at home, N=120) and subgroup 2 (working at the office or else, N=33) for HWI in each domain (i.e., job demands /resources and home demands/resources − see Tables 5 and 6). In the job demands/resources context, in the case employees worked from home, higher physical job demands (B=0.18, p<0.05) and lower cognitive job resources (B=−0.18, p<0.05) were associated with more HWI. The explained variance for the final model in this subgroup was 39.0%. In the home demands/resources context, for employees working from home, higher physical demands were again related to more HWI (B=0.26, p<0.001). The explained variance of the best fitting model was 35.0%. The results of subgroup analysis also showed that there was no significant predictor for HWI in the working at the office context.

Discussion

The present study tried to understand the particular role of job/home resources in the relation between job/home demands and employees' health and well-being during the COVID-19 pandemic. Specifically, we investigated (1) the prevalence of both job/home demands and job/home resources during the COVID-19 pandemic in comparison with two pre-COVID-19 studies, and (2) how both job/home demands and job/home resources are associated with

Table 4. Hierarchical regression models of employee health/well-being outcomes with home demands and home resources as predictor variables (*N*=153)

Source	Dependent Variable							
	Exhaustion		Job satisfaction		Work-home Interference		Home-work Interference	
	B	SE	B	SE	B	SE	B	SE
Control Variables								
Gender	0.28	0.26	−0.22	0.24	0.05	0.16	−0.03	0.13
Age	−0.02	0.01	0.02*	0.01	−0.01	0.01	−0.01	0.00
Children at home	−0.15	0.12	0.22	0.11	0.07	0.07	0.16**	0.06
Actual working hours	0.02	0.06	−0.02	0.05	0.15***	0.03	−0.04	0.03
Education	0.01	0.17	−0.01	0.15	0.10	0.10	−0.03	0.08
Home Demands and Home Resources								
Cogn. home demands	0.03	0.16	0.21	0.15	0.09	0.10	0.00	0.08
Emot. home demands	0.51**	0.17	−0.47**	0.15	0.32**	0.10	0.19*	0.08
Phys. home demands	0.13	0.15	0.19	0.14	−0.03	0.09	0.21**	0.07
Cogn. home resources	0.17	0.14	0.20	0.13	0.03	0.09	−0.01	0.07
Emot. home resources	−0.26*	0.14	0.46***	0.13	−0.08	0.08	−0.13*	0.07
Phys. home resources	−0.26	0.16	0.11	0.15	−0.06	0.10	−0.04	0.08
Interaction effects								
Cogn. demands × cogn. resources (H)	0.01	0.11	0.09	0.11	0.12	0.07	0.01	0.06
Emot. demands × emot. resources (H)	−0.05	0.12	−0.04	0.11	−0.09	0.07	−0.04	0.06
Phys. demands × phys. resources (H)	−0.10	0.15	0.14	0.13	−0.02	0.09	−0.03	0.07
Subgroup analysis								
Working location	−0.03	0.30	−0.21	0.28	−0.06	0.19	−0.28*	0.15
Model Test	$R^2 = 0.23$ $F(15,123) = 2.38^{***}$		$R^2 = 0.29$ $F(15,125) = 3.35^{***}$		$R^2 = 0.37$ $F(15,125) = 4.95^{***}$		$R^2 = 0.36$ $F(15,125) = 4.61^{***}$	
R^2 Change	0.01		0.01		0.02		0.004	
Incremental *F*	0.31		0.72		1.31		0.27	

Note: Cogn. = cognitive; Emot. = emotional; Phys. = physical; H = home. * $p<0.05$; ** $p<0.01$; *** $p<0.001$ (two-tailed)

employees' health and well-being during this pandemic. In line with our theoretical framework, we hypothesized that, in both the work office and the home office contexts, higher job demands (i.e., cognitive, emotional, physical) are associated with higher levels of employee adverse health/well-being (H1a), while this relation is moderated (i.e., buffered) by matching job resources (H1b). In addition, we assumed that higher home demands (i.e., cognitive, emotional, physical) are associated with higher levels of employee adverse health/well-being (H2a), while this relation is moderated (i.e., buffered) by matching home resources (H2b). Finally, the following two research questions were explored: (1) during the COVID-19 pandemic, what is the prevalence of both job/home demands and job/home resources, and (2) during the COVID-19 pandemic, will working at different locations (i.e., working either from home or at the work office) affect how both job/home demands and job/home resources are associated with employees' health and well-being?

Regarding our first research question, a comparison of our findings to two previous cross-national studies that were conducted before the COVID-19 pandemic[27, 35], showed that during this pandemic the mean scores on cognitive job demands and cognitive job resources were rated significantly higher than in a regular period. In addition, emotional job demands were rated significantly lower during COVID-19 compared to the study of Van de Ven and Vlerick[35], but were not significantly different from those in the study of Bova *et al.*[27]. Further, while participants reported an average level of emotional job resources during COVID-19, this was significantly lower than what was found by Bova *et al.*[27] and significantly higher than what was reported in the Van de Ven and Vlerick[35] study. Finally, both physical job demands and physical job resources during the COVID-19 pandemic were rated significantly lower than those in the two studies that were conducted in a normal period. Thus, it appears that, compared with the pre-COVID-19 studies, the higher degree of telecommuting brought about by this epidemic seems to have enlarged employees' cognitive job demands and has fully mobilized employees to use their corresponding cognitive job resources. Besides, public lockdowns forced many employees to work from home for a sometimes very substantial period of time, meaning that the physical demands of their

Table 5. Hierarchical subgroup regression models of HWI with job demands and job resources as predictor variables (Subgroup 1: *n*=120; Subgroup 2: *n*=33)

Source	Dependent Variable			
	Home-work Interference			
	Subgroup 1 (Home Office)		Subgroup 2 (Work Office/Else)	
	B	SE	B	SE
Control Variables				
Gender	−0.12	0.14	0.71	0.42
Age	0.00	0.01	0.00	0.01
Children at home	0.15*	0.06	0.31	0.17
Actual working hours	−0.04	0.03	−0.13	0.10
Education	0.02	0.08	−0.04	0.28
Job Demands and Job Resources				
Cogn. job demands	−0.03	0.08	−0.05	0.15
Emot. job demands	0.13	0.08	0.14	0.19
Phys. job demands	0.18*	0.09	0.05	0.18
Cogn. job resources	−0.18*	0.08	0.14	0.20
Emot. job resources	−0.04	0.08	−0.05	0.18
Phys. job resources	−0.03	0.08	−0.16	0.24
Model Test	$R^2 = 0.39$ F (14,98) = 4.43***		$R^2 = 0.54$ F (14,16) = 1.32	

Note: Cogn. = cognitive; Emot. = emotional; Phys. = physical. * $p<0.05$; ** $p<0.01$; *** $p<0.001$ (two-tailed).

Table 6. Hierarchical subgroup regression models of HWI with home demands and home resources as predictor variables (Subgroup 1: *n*=120; Subgroup 2: *n*=33)

Source	Dependent Variable			
	Home-work Interference			
	Subgroup 1 (Home Office)		Subgroup 2 (Work Office/Else)	
	B	SE	B	SE
Control Variables				
Gender	−0.2	0.14	0.68	0.42
Age	−0.01	0.01	0.00	0.01
Children at home	0.13	0.07	0.23	0.18
Actual working hours	−0.03	0.03	−0.09	0.09
Education	−0.04	0.09	−0.01	0.31
Home Demands and Home Resources				
Cogn. home demands	0.03	0.09	0.02	0.25
Emot. home demands	0.16	0.09	0.28	0.24
Phys. home demands	0.26***	0.08	0.12	0.19
Cogn. home resources	0.03	0.08	−0.19	0.18
Emot. home resources	−0.14	0.08	0.02	0.19
Phys. home resources	−0.07	0.09	0.01	0.25
Model Test	$R^2 = 0.35$ F (14,97) = 3.73***		$R^2 = 0.63$ F (14,14) = 1.72	

Note: Cogn. = cognitive; Emot. = emotional; Phys. = physical. * $p<0.05$; ** $p<0.01$; *** $p<0.001$ (two-tailed).

work may have been different – and perhaps lower – than would otherwise have been the case. If so, this may explain why in our sample the ratings of physical job demands and resources were significantly lower than in previous research.

Second, controlling for demographic variables, our findings interestingly indicated that especially cognitive job demands and resources as well as emotional home demands and resources were important as predictors of employee health and well-being during the pandemic. For instance, low cognitive job demands and high cognitive job resources were associated with less feelings of exhaustion, higher job satisfaction, and less WHI. In contrast, home demands and resources have shown different priorities for each outcome: emotional home demands and emotional home resources were rated significantly contributing to successively more and less exhaustion, less and more job satisfaction, as well as more and less HWI. Thus, our research appears the features that also highlighted by previous related studies[11, 36–38]. Since the public lockdown forced most employees to start mandatory working from home and effectively distanced themselves socially for a long time, the blurred boundary between work and private life would be created[11]. Over time, there are two types of job strain: cognitive and emotional strain[36, 37]. Specifically, a perceived imbalance between private life and work pressure (i.e., lack of psychological detachment from work) would increase cognitive and emotional strain of teleworkers[36, 37], thereby intensifying the job demands. Moreover, as suggested by Fosslien and Duffy[38], long-time video conferencing may trigger a new hurdle to teleworkers, namely "Zoom fatigue", a phenomenon of emotional strain[38]. Thus, this might also be understood as one of the reasons about the emotional dimension dominating the home demands and resources. Therefore, cognitive job demands and job resources, as well as emotional home demands and home resources might be considered as the dominant factors for predicting employees' health and well-being during the COVID-19 pandemic.

Third, as regards our second research question, employees were affected by different working locations during the COVID-19 period, but this only applied to HWI. For participants who were working from home, both physical work and home demands, and emotional home demands emerged as predictors for HWI. As for the resources they reported, higher cognitive job resources and higher emotional home resources were associated with less homework interference. In the case participants are working at the work office or else, results showed no significant predictors for HWI.

Theoretical implications

Our findings advance the study of job/home demands and job/home resources during the COVID-19 pandemic in several ways. First, this study reveals that the DISC Model[20, 21] is a suitable theoretical framework to study job/home demands and job/home resources in the prediction of employees' health and well-being during this pandemic. This study extends the use of this job stress model to the home domain as well. Both working at home and working at the work office reveal substantial relations between (1) job/home demands and job/home resources and (2) health and well-being outcomes. Although we did not find matching moderating effects of job and home resources, it appears that conceptual matching demands and resources were found in 6 out of 8 'main-effect' regression models (3 in each context). For instance, emotional home resources matched emotional home demands in the prediction of employee exhaustion. Apart from power problems in finding significant interaction effects[36], our results are in line with the DISC Model's assumptions[20, 21] as well as the proposition of functional self-regulation that refers to people would be more favorable to first opt for matching resources to regulate corresponding demands[39]. This is promising for future research in both the home work and office work domains. Moreover, introducing and expanding demands and resources with cognitive, emotional, and physical dimensions demonstrated a promising avenue for examining both work- and home-related research[20, 21]. The demand triptych showed that, during the COVID-19 pandemic, employees were particularly dealing with high cognitive job demands, which was also a key predictor for both exhaustion and WHI. This is in line with other COVID-19-related studies[40–42] at also quite logical for this kind of employees during a pandemic. At the same time, they indicated that cognitive job resources were powerful to combat these demands and, hence, to reduce exhaustion and WHI as well as to increase job satisfaction. Generally, current findings successfully prove that no matter the work office or home office area, job and home resources do have a positive association with employees' health and well-being[43, 44].

Finally, it is interesting to note that high emotional home demands were related to all four health/well-being outcomes during the COVID-19 pandemic. This is in agreement with the studies of Sascha Abdel *et al.*[42] and Meyer *et al.*[14]. At the same time, employees indicated that emotional home resources were powerful to deal with these demands and, hence, to increase job satisfaction and to reduce ex-

haustion and HWI. Again, this agrees with the DISC Model's matching principle[21]. Moreover, the forced nature of working from home (WFH) in the context of the pandemic did not reveal many differences compared to working at the office or else. Apart from potential power problems, our subgroup analyses showed that only HWI was affected by different working locations during the COVID-19 pandemic. However, the main effects described above disappeared but for physical job/home demands. Moreover, a significant main effect of cognitive job resources popped up in the home office subgroup. So, WFH brought about by the COVID-19 pandemic might have blurred the boundaries between work and home, but has hardly any effect on the relation between demands/resources and employees' health and well-being.

Practical implications

The current findings have implications for practice as well. The COVID-19 pandemic forced most employees to start working from home for an unexpectedly long time. While reducing health risks due to COVID-19, it could create additional pressure for employees, particularly for home office workers. Modern information technology has helped home office workers to work at home in this special period, but it has also blurred the boundaries between work and home life. Especially, employees often have to share the same working space with family members who also worked from home or took online classes[45].

The current study confirmed the basic assumptions of the DISC Model[20, 21] and the idea of functional self-regulation[39], given the conceptual match between demands and resources detected, especially in cognitive (job) and emotional (home) dimensions, which were crucial to predict employees' health and well-being. Thus, we should uncover ways how to actively and effectively respond to demands as well as explore how to facilitate and improve adequate job/home resources. Based on the current findings, we propose three practical points.

First, given the findings with regard to job demands and job resources, the current study indicates that cognitive job resources can be considered as primary importance to cope with cognitive job demands to improve employees' health and well-being. Therefore, in line with previous research[28, 29], providing employees with adequate cognitive resources at work will be highly recommended. For example, giving employees more job autonomy, better access to helpful information, or better administrative support from employees' organizations seem to be optimal ways to optimize employees' health and well-being during a pandemic.

Second, as regards home demands and home resources, findings suggest a more nuanced view. Emotional home demands and resources were related to all four health/well-being outcomes during the COVID-19 pandemic. Therefore, we argue that family support might play an important role here. Good family support can significantly moderate and enhance job satisfaction[46] and job performance[47], as well as improve the overall quality of life[48] and reduce the interference between work and home[49]. Furthermore, the perceived family support also appears to contribute to individuals' stress management of social isolation and the sense of loneliness that could derive from COVID-19[50]. For that very reason, we suggest that family members should create a supportive climate in coping with pandemic-induced working and home pressures to optimize health and well-being.

Third, our research also notices that the two subgroup participants (home office/work office) were not heavily affected by the different working contexts during the pandemic − they only showed difference in home-work interference. This may be because of the conflicts between work roles and family roles when they mandatory work from home, which presents difficulties for employees to manage home demands with little preparation[51]. For example, besides the contribution of household chores (i.e., cooking and cleaning), employees have to take more extra caring hours for their (young) children than in the past because of the disruption of childcare and school education during the pandemic. They also need to spend more quality time with their spouse or family members because the public lockdown reduces the opportunities for them to have fun elsewhere (i.e., hanging out with friends). Therefore, as suggested by Shao *et al.*[52], the building of empathy between organizations and employees is especially important when the mandatory WFH occurred. Understanding the relationships between employees and their family members might be particularly essential given that more and more organizations are intending to arrange flexible working schedules for their employees during and even after this tough period[53].

Strengths, limitations and future research directions

One strength of this study is that it focused not only on job characteristics as predictors of employee health and well-being during the pandemic, but also on home characteristics and how they combined. Another strength is that we extended the DISC Model as a theory-guided framework to the home context, and simultaneously investigated demands and resources both from the work and home do-

mains. The corresponding findings proved that the DISC Model is a reliable and applicable demand- and resource-related model, which can be widely extended to domains outside of work[54, 55]. In spite of these strengths, our study has some limitations as well. A first limitation is the use of a cross-sectional research design, meaning that causal inferences are not warranted. Longitudinal research is necessary to investigate the assumed causal order of the study concepts more profoundly. Notwithstanding this, well-conducted cross-sectional research is still necessary and pivotal in exploratory research[56]. As the present study is among the few to focus on demands, resources and outcomes in both the home and work domains, the use of a cross-sectional design was deemed appropriate here.

Secondly, the results were obtained entirely through self-report surveys. This might lead to method bias, which is often referred to as "common method variance" or "nuisance"[57]. Although researchers generally agree that this type of bias might affect the results of studies using self-report questionnaires, there is no consensus on the severity of this type of bias[57, 58]. Despite different opinions, taking more objective measures or multiple methods of the variables into consideration for future studies is recommended.

A third limitation is the relatively low sample size (N=153) obtained in this study. We need larger sample sizes in future studies in order to minimize errors as much as possible, but also to achieve more power. The latter is particularly true for our subgroup analyses that consisted of successively 120 and 33 people.

Fourth, the current study was mainly performed within an academic association with highly educated participants. Therefore, the sample was somewhat different compared to other types of workers and those of the two pre-COVID-19 studies, which precludes solid conclusions as well as the generalizability of its findings to other populations. A relatively single group of people could be exposed to relatively similar demands and resources at work or study which could impact individual well-being[59]. On the other hand, our respondents belong to different countries and cultures which might compensate for this. For future research, in line with the matching principle of the DISC Model, it is recommended to further validate the moderating effect of matching home resources in the relation between home demands and employees' health and well-being.

Finally, in addition to health and well-being outcomes, it is recommended to examine the particular role of employee performance indicators as well, such as task performance, contextual performance, and counterproductive work behavior in the relation between demands and resources in both the office work and home work domain[60].

Conclusions

The present study expands current job stress research by (1) investigating job/home demands and job/home resources during the pandemic outbreak simultaneously, and (2) exploring employees who work at different locations (i.e., home office or work office/elsewhere). Most importantly, our findings showed that, first, cognitive job demands/resources and emotional home demands/resources were powerful in predicting employees' health and well-being outcomes during the COVID-19 pandemic. Second, although the assumed interaction effects were not significant, the conceptual match of demands/resources was still detected by 6 out of 8 main effects, so the function of resources in effectively responding to demands is empirically established. Third, the empirical results showed that respondents were not heavily affected by the different working contexts (i.e., home office vs. work office) during such a pandemic, but this still needs to be validated in a relatively larger sample size. Based on these findings, we conclude that this study explores the prevalence of job/home demands and job/home resources during the COVID-19 pandemic, and mainly proves that a decent (at least sufficient) level of matching job/home resources will effectively cope with corresponding job/home demands to improve employees' health and well-being, not only in normal time but also in the mandatory WFH brought by the COVID-19 pandemic.

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