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Linking job demands and resources through well-being with physicians' work ability: a path analysis

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7 **Linking job demands and resources through well-being with physicians' work ability: a**
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9 **path analysis**
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54 figures, references and declarations)
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Abstract

Objective: To investigate whether occupational well-being (work engagement and burnout) mediates the relationships of job demands and resources with physicians' work ability.

Design: Multicenter observational study

Setting: Academic and non-academic hospitals in the Netherlands

Participants: Three hundred eighty-five medical specialists participated in this study. About half of them were male (50.1%), most worked in a non-surgical specialty (64.7%) and non-academic hospital (81.3%).

Primary and secondary outcome measures: Work ability was measured with selected items from the validated Questionnaire of Experience and Evaluation of Work 2.0 (QEEW2.0). Work engagement was measured with the Utrecht Work Engagement Scale, and burnout was measured with the exhaustion subscale of the Oldenburg Burnout Inventory. For measuring job demands (workload and bureaucratic burden) and job resources (development opportunities, participation in decision-making, inspirational leadership, relationships with colleagues) we used the QEEW2.0, except for bureaucratic burden which was measured with the Three Item Red Tape scale.

Results: Work engagement and burnout mediated the relationships of job demands and resources with physicians' work ability. Development opportunities ($b=0.44$; 95% CI, 0.31 to 0.58; $p<0.001$) and relationships with colleagues ($b=0.22$; 95% CI, 0.04 to 0.394; $p=0.019$) were positively related and workload ($b=-0.29$; 95% CI, -0.44 to -0.13; $p<0.001$) was negatively related to work engagement. Development opportunities ($b=-0.25$; 95% CI, -0.36 to -0.15; $p<0.001$) was negatively related and workload ($b=0.66$; 95% CI, 0.53 to 0.79; $p<0.001$) was positively related to burnout. Work engagement was positively related ($b=0.12$; 95% CI, 0.05 to 0.19; $p<0.001$) and burnout negatively related ($b=-0.40$; 95% CI, -0.48 to -0.32; $p<0.001$) to work ability.

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3 **Conclusions:** Work-engaged physicians with low levels of burnout seem better able to manage work
4 tasks successfully. Hospitals may attenuate excessive workloads and facilitate development
5 opportunities to enhance physicians' work engagement and reduce burnout. Good relationships with
6 colleagues also seem to benefit physicians' work engagement.
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13 Keywords: job demands and resources, work engagement, burnout, work ability, physicians
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19 **Strengths and limitations of this study**

- 22 • This study provides more specific insight into how job demands and resources are related to
23 physicians' work engagement and burnout, as well as to their work ability by including these
24 concepts in one model.
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- 27 • This study used validated measurements that were chosen based on theory and a needs
28 assessment.
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- 31 • This study included a varied sample of physicians from multiple academic and non-academic
32 hospitals in the Netherlands, contributing to the generalizability of our results.
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- 35 • Participation was voluntary, which might have resulted in a selection bias. However, this does
36 not necessarily influence the strength of the observed relationships, which were in line with
37 the literature.
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- 40 • Due to the cross-sectional study design, no causal inferences can be made.
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Introduction

Physicians' work engagement is of worldwide interest as it benefits physician retention and the cost-efficiency and quality of patient care [1-4]. Work engagement is a positive, fulfilling, work-related state of mind characterized by vigor, dedication, and absorption [5]. Work-engaged physicians communicate better with patients and colleagues, report fewer medical errors, and show higher levels of work ability [2, 4, 6]. In modern practice, many physicians report a lack of work engagement and high levels of burnout [7, 8]. Burnout is defined as a work-related syndrome characterized by exhaustion, cynicism, and inefficacy [5]. Work engagement and burnout are different aspects of physicians' occupational well-being and often have opposite consequences. Physicians with high burnout levels are more likely to make medical errors, leave the profession, and their patients report less satisfaction [9]. Therefore, reducing physicians' burnout and enhancing engagement is a top priority for medical professional associations and hospitals [1, 9-11].

Hospitals can reduce burnout rates and promote work engagement by optimizing working conditions in the organization [9, 12-14]. These working conditions are, based on the evidence-based job demands and resources model (JD-R), categorized into job demands and resources [15, 16]. Job demands are job aspects that require physical, cognitive, or emotional efforts, such as excessive workloads [15, 16]. Excessive workloads, emotional burdens, role conflicts, and work-home interferences may increase physician burnout and lower work engagement [9, 12]. On the other hand, job resources, such as collegial support and development opportunities, may enhance physicians' work engagement and ameliorate burnout as they assist in coping with job demands and stimulate personal growth [14-16]. An optimal balance between job demands and resources can reduce physician burnout and enhance their engagement [15, 16]. In turn, less burned-out and more work-engaged physicians are better able to perform their work [9, 17].

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3 Physicians' ability to perform their work is conceptualized as work ability, i.e. being able to manage
4 certain work tasks successfully, akin to definitions used in other studies [18-20]. Researchers linked
5 impaired work ability with the risk of reduced quality, sickness absence, and early retirement [18].
6
7 Working conditions have been shown to affect work ability in various settings [18-20]. In particular,
8 emotional burdens and high workloads seem to reduce physicians' work ability [18]. Contrastingly,
9 studies indicate that social relationships and support at work, development opportunities, and
10 autonomy benefit physicians' work ability [19, 20]. Physicians who experience more work engagement
11 report higher scores on work ability [20]. Following the JD-R model, work engagement and burnout
12 mediate relationships of job demands and resources with work ability [15, 16].
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16 The above clearly shows that various studies have investigated relationships of job demands and
17 resources with physicians' work engagement or burnout [12, 13, 21, 22]. Also, studies have
18 investigated relationships of work engagement or burnout with performance or work ability [2, 14, 20,
19 23]. However, especially among physicians, few studies investigate these constructs in concert [24].
20 Therefore, it is unclear which job demands and resources should be targeted to help physicians
21 become less burned-out and more work-engaged professionals who perform well in their work [24].
22 Accordingly, this study answers the research question: Do work engagement and burnout mediate the
23 relationships of job demands and resources with work ability? Such knowledge can inform
24 interventions to improve physicians' working conditions, well-being, and performance.
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Methods

Study setting and population

Data from this study were collected from April 2017 to June 2018 in the context of a nationwide well-being program for physicians in 50 clinical departments of 16 Dutch hospitals [25, 26]. In total, 649 residents and medical specialists were invited to participate in the online survey (response rate 71.6%). This study focused on medical specialists only (hereafter physicians). Participation was voluntary and participants' anonymity and confidentiality were safeguarded.

Measurements

This study included previously validated measurements of job demands and resources [27, 28], work engagement [29], burnout [30], and work ability [27]. The included job demands and resources were identified via a needs assessment among physicians, which was part of the nationwide well-being program development [26].

Job demands included in this study were workload and bureaucratic burden. Workload was measured using the 6-item scale on workload of the Questionnaire on the Experience and Evaluation of Work 2.0 (QEEW 2.0), with responses ranging from 1 ('never') to 4 ('always') [27]. Bureaucratic demands were measured by the Three Item Red Tape Scale (TIRT), with responses ranging from 1 ('not burdensome') to 5 ('burdensome'), 1 ('necessary') to 5 ('unnecessary'), and 1 ('effective') to 5 ('ineffective') [28]. Two researchers independently translated the English version into Dutch, which another bilingual researcher subsequently back-translated.

Job resources included development opportunities, participation in decision making, inspirational leadership, and relationships with colleagues, and were measured using the QEEW 2.0 [27]. The development opportunities scale (3 items) and participation in decision making scale (4 items) had

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3 response options ranging from 1 ('totally disagree') to 5 ('totally agree'). Responses to the inspirational
4 leadership scale (4 items) and relationship with colleagues scale (5 items) ranged from 1 ('never') to 4
5 ('always').
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10 Work engagement (9 items) was measured using the Utrecht Work Engagement Scale [29]. An example
11 item is "at my work, I feel bursting with energy". Physicians rated their engagement on a scale from 1
12 ('Never') to 7 ('Always/Daily').
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18 Burnout was measured by the exhaustion subscale (8 items) of the Oldenburg Burnout Inventory [30].
19 Exhaustion is considered the core dimension of burnout [12, 31]. Physicians scored items from 1
20 ('Strongly disagree') to 5 ('Strongly agree'). An example item is "there are days when I feel tired before
21 I arrive at work".
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28 Physicians rated their work ability using eight selected items from the subscales willingness to perform
29 and ability to perform from the QEEW 2.0 16-item work fatigue scale [27]. The item selection
30 shortened the total survey length, considering physicians' limited time, and was made in collaboration
31 with a physician in a formal leadership role. The statement "please indicate which situation applies
32 most to you" was repeated eight times, with different and contrasting response options on a 5-point
33 answer scale, e.g. 1 ('attention keeps dropping') to 5 ('no problem with attention') and 1 ('taking risks
34 that are actually to great') to 5 ('taking no risks').
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44 We also collected data on respondents' sex (male, female), specialty type (surgical, non-surgical,
45 supporting, non-medical), years since completing the first registration as medical specialist
46 (categorical) and hospital type (academic, non-academic), which we included as covariates in the
47 analysis.
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Statistical analyses

Sample characteristics were represented using descriptive statistics. Mean scale scores were computed by averaging the item scores. Means, standard deviations and inter-correlations were calculated to understand the main variables and their mutual relationships. The reliability of all included measurement scales was checked using Cronbach's alpha, with values of ≥ 0.70 considered acceptable [32]. These analyses were performed in IBM SPSS Statistics version 26.

To answer our research question, we conducted a path analysis using Lavaan 0.6-9 in R version 3.6.3. Path analysis is a subset of structural equation modelling that allows for the estimation of regression coefficients of both direct, indirect and total effects among variables [33]. Path analysis can be used to analyze models that are more complex than multiple regression [33]. Respondents with missing data were not included in the analysis.

Endogenous variables in our path analysis were work engagement, burnout and work ability (Figure 1). Exogenous variables in the model included job demand and resources and covariates. Covariates were coded as binary variables: sex (male, female), hospital type (non-academic, academic), specialty (non-surgical, surgical), type of contract (full-time, part-time), and years since first registration as medical specialist (≤ 10 years, ≥ 11 years). Indirect effects of all job demands and resources on work ability via engagement and exhaustion were modelled. The syntax of the path model is presented in the supplemental material.

The assumption of multivariate normality was checked in R using the MVN package. As our data did not meet the assumption of multivariate normality, we used maximum likelihood estimation (MLM) with robust standard errors and a Satorra-Bentler scaled test statistic [34]. Good model fit was assessed using the following *robust* fit indices [34]: chi-square $p > .05$, Comparative Fit Index (CFI) $\geq .95$, Tucker-Lewis index (TLI) $\geq .95$, Root Mean Square Error of Approximation (RSMEA) $\leq .08$.

Ethical approval

Ethical approval was waived by the Medical Ethics Committee of the Academic Medical Center (ID XT4-118). All participants gave written informed consent before taking part.

Patient and Public Involvement

No patients or members of the public were involved in this study.

Results

Sample characteristics

In total, 385 physicians participated in this study (Table 1). About half was male (50.1%), most worked in a non-surgical specialty (64.7%) and a non-academic hospital (81.3%). Table 2 presents the Cronbach's alpha's, means, standard deviations, and inter-correlations of the main variables.

Table 1. Participant characteristics

Characteristics	Valid percent (n = 385)
<i>Sex</i>	
Male	50.1% (n = 193)
Female	49.9% (n = 192)
<i>Year since first registration</i>	
0-5 years	24.0% (n = 86)
6-10 years	26.5% (n = 95)
11-15 years	21.2% (n = 76)
16-21 years	16.2% (n = 58)
22-45 years	12.3% (n = 44)
Missing	n = 26
<i>Specialty type</i>	
Medical	54.0% (n = 208)
Surgical	35.3% (n = 136)
Other	10.7% (n = 41)
<i>Hospital type</i>	
Academic	18.7% (n = 72)
Non-academic	81.3% (n = 313)
<i>Contract type</i>	

Full-time	55.3% (<i>n</i> = 213)
Part-time	44.7% (<i>n</i> = 172)

Table 2. Cronbach's alpha's means, standard deviations and inter-correlations of the main variables

Variables†	Cronbach's alpha	M(SD)	1.	2.	3.	4.	5.	6.	7.	8.
1. Development opportunities	0.83	4.08 (0.69)	-							
2. Participation decision making	0.83	3.62 (0.77)	0.44*	-						
3. Inspirational leadership	0.92	2.56 (0.84)	0.31*	0.41*	-					
4. Relationships colleagues	0.76	3.38 (0.48)	0.26*	0.36*	0.29*	-				
5. Bureaucratic burden	0.76	3.14 (0.75)	-0.20*	-0.36*	-0.22*	-0.20*	-			
6. Workload	0.79	2.88 (0.52)	-0.05	-0.32*	-0.14*	-0.16*	0.15*	-		
7. Work engagement	0.90	5.35 (0.85)	0.45*	0.39*	0.28*	0.30*	-0.22*	-0.24*	-	
8. Burnout	0.88	2.69 (0.75)	-0.31*	-0.43*	-0.27*	-0.29*	0.24*	0.56*	-0.54*	-
9. Work ability	0.83	3.81 (0.58)	0.24*	0.31*	0.20*	0.25*	-0.18*	-0.39*	0.46*	-0.63*

* All correlations were significant at the $p < .01$ level (2-tailed).

† Answer scales 1. (1-5), 2. (1-5), 3. (1-4), 4. (1-4), 5. (1-5), 6. (1-4), 7. (1-7), 8. (1-5), 9. (1-5).

Figure 1 depicts the results of the path analysis. The robust model fit statistics were as follows: chi-square = 5.728, $df=6$, $p=.454$ (Satorra-Bentler correction 1.042); CFI=1.000; TLI=1.003; RMSEA=0.000, $p=.851$, 90% CI, 0.000 to 0.068, indicating good model fit. The analysis showed that the job resources 'development opportunities' ($b=0.44$; 95% CI, 0.31 to 0.58; $p<0.001$) and 'relationships with colleagues' ($b=0.22$; 95% CI, 0.04 to 0.394; $p=0.019$) were positively related and the job demand 'workload' ($b=-0.29$; 95% CI, -0.44 to -0.13; $p<0.001$) was negatively related to work engagement. Development opportunities ($b=-0.25$; 95% CI, -0.36 to -0.15; $p<0.001$) was negatively related and workload was positively to burnout ($b=0.66$; 95% CI, 0.53 to 0.79; $p<0.001$). Work engagement mediated the relationships of development opportunities (indirect effect (IE), $b=0.06$; 95% CI, 0.02 to 0.09; $p=.002$), relationships with colleagues (IE, $b=0.03$; 95% CI, 0.00 to 0.05; $p=0.048$) and workload (IE, $b=-0.04$; 95% CI, -0.06 to 0.01; $p=0.015$) with work ability. Burnout also mediated the relationships of development opportunities (IE, $b=0.10$; 95% CI, 0.05 to 0.15; $p<0.001$) and workload (IE, $b=-0.26$; 95% CI, -0.34 to

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3 0.19; $p < 0.001$) with work ability. Work engagement ($b = 0.12$; 95% CI, 0.05 to 0.19; $p < 0.001$) was
4 positively related and burnout ($b = -0.40$; 95% CI, -0.48 to -0.32; $p < 0.001$) was negatively related to work
5 ability. Finally, the job resource 'inspirational leadership' and job demand 'bureaucratic burden' did
6 not relate to physicians' work engagement, burnout or their work ability.
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16 Discussion

17 18 19 *Main findings*

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22 Physicians reporting more job demands in terms of higher workloads felt more burned-out, less
23 engaged, and less able to perform their work tasks. Contrastingly, physicians who experienced
24 sufficient job resources in terms of development opportunities and positive relationships with
25 colleagues reported higher work engagement levels. Work-engaged physicians reported higher work
26 ability levels than those burned-out. Work engagement and burnout mediated the relationships of job
27 demands and resources with work ability.
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40 *Explanation of findings*

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42 Workload was a substantial job demand negatively relating to physicians' well-being and work ability.
43 It seems that an early outcome of heavy workloads is physicians' perception of distress. When distress
44 endures, it makes the work less pleasant and exhausts physicians' resources to cope with job demands,
45 leading to reduced work ability [15, 16]. Meta-analyses on interventions to improve physicians' well-
46 being show that organizational strategies to alleviate workloads result in the most considerable
47 reduction in physicians' burnout [35, 36]. Given increasing patient care volumes and responsibilities
48 to safeguard the continuity of care, reducing workloads might be challenging. However, for the
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3 sustainability of the medical workforce, physicians' and patients' health, chronic excessive workloads
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5 cannot be accepted.
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8 Enhancing job resources is an alternative but somewhat less effective strategy to improve physicians'
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10 well-being [35, 36]. Based on our results, enhancing physicians' professional development
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12 opportunities and relationships with colleagues seems instrumental to improving physicians' well-
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14 being and work ability, matching previous studies [12, 14, 19, 20]. Physicians might obtain energy from
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16 developing themselves, such as taking a course of personal interest [12, 14, 37]. Positive relationships
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18 with colleagues may contribute to a positive and psychologically safe work environment, vital for
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20 engagement and satisfaction at work [38]. While we did not find relationships with colleagues to
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22 associate with burnout, several studies reported that collegial support can reduce burnout [9, 12, 39],
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24 for example, through mitigating job demands by providing needed information or emotional support
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26 [12].
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31 In contrast with the literature [9, 40-44], this study did not find a relationship between bureaucratic
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33 burden and physicians' work engagement or burnout. Bureaucracy is concerned with standardizing
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35 and centralizing decision-making, formal policies, and procedures to make healthcare more reliable,
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37 accessible, and cost-effective [44]. Excessive bureaucracy decouples formal organizational policies and
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39 procedures from how physicians do their work [44]. Researchers also refer to professional dissonance
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41 and moral injury to describe physicians' discomfort when medical professional values conflict with the
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43 values intrinsic to their work settings – reportedly a leading cause of burnout [45, 46]. Still, bureaucracy
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45 is not inherently wrong. Accordingly, we observed that physicians reported some usefulness of the
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47 policies and procedures they experienced, which might explain the absent relation between
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49 bureaucratic burden and burnout.
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54 We also observed absence of a relationship between inspirational leadership and physicians' work
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56 engagement and burnout. It is often assumed that leadership at strategic and operational levels is
57
58 crucial for physicians' well-being. Leaders can shape general working conditions and organizational
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3 cultures, and inspire their followers [1, 9, 47]. This study measured the supervisor's ability to
4 communicate a vision, a sense of work purpose, and make physicians enthusiastic for their work. A
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6 previous study found that higher supervisors' leadership scores reduced physicians' likelihood of
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8 burnout and increased the possibility of satisfaction [48]. It would be interesting to investigate cultural
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10 and contextual differences in physicians' leadership preferences and needs. Perhaps Dutch medical
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12 specialists have other needs than being inspired by their leaders, but future research should confirm
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14 such statements.
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19 Lastly, this study confirms that physicians' well-being is related to their work ability [18-20]. In
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21 particular, physicians with higher burnout levels reported attentional lapses, struggle with planning
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23 and conducting subsequent tasks, and high risk-taking behaviors. Several studies have linked
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25 physicians' burnout symptoms with an increased likelihood of making medical errors [9, 23, 49, 50];
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27 this might be due to decreased work ability [20]. The negative consequences of impaired well-being
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29 and work ability may not directly have adverse consequences for patients. Researchers argue that
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31 exhausted physicians adopt performance protection strategies to protect their patients by dropping
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33 secondary tasks [10]. Still, such strategies can indirectly have adverse consequences for the quality of
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35 patient care; a longitudinal study showed that physicians' exhaustion eroded teamwork and thereby
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37 patient safety [51].
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46 *Strengths and limitations*

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48 This study contributed to the existing literature by providing more insight into relationships of job
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50 demands and resources with physicians' work engagement, exhaustion, and work ability. Furthermore,
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52 this study included medical specialists from multiple disciplines and hospitals in the Netherlands,
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54 contributing to the generalizability of our findings.
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3 Although the work ability measurements were based on an item selection to guarantee the fit of items
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5 to the study context, the act of selecting from a validated scale may potentially have compromised the
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7 validity of our measurement.
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10 Participation in this study was voluntary, which might have led to a selection bias, meaning that
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12 physicians with high or low levels of occupational well-being might have been overrepresented.
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14 However, a selection bias does not necessarily influence the strength of the relationships found. The
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16 results of this study were mostly in line with the literature [12, 14].
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20 Moreover, although physicians' data from multiple professional disciplines might contribute to the
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22 generalizability of our results, each professional discipline and workplace will have specific job
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24 demands and resources that this study might not have identified.
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28 Lastly, causal inferences could not be made due to the cross-sectional study design.
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34 *Implications for research and practice*

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37 Future research could further establish linkages between physicians' workplace, well-being, and
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39 performance. Given the current body of knowledge, adopting longitudinal research designs and more
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41 objective performance measures is welcomed [17, 52]. It would be valuable if such studies would
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43 include negative and positive well-being indicators, such as work engagement and burnout.
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47 This study confirms previous findings that reducing workload is important for reducing physicians'
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49 burnout and its negative consequences for physicians' performance [9]. Potential strategies to reduce
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51 workload are duty hour limits, optimizing electronic medical records, or additional staff to support
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53 physicians [9, 35, 36]. In addition, healthcare organizations can facilitate development opportunities
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55 and support building relationships with colleagues to promote work engagement. The effectiveness of
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3 interventions will depend on the implementation context and thus always requires careful
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5 consideration.
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10 11 *Conclusions*

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14 Physicians' work engagement and burnout mediated the relationships of various job demands and
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16 resources with their work ability. This study suggests that improving work engagement could facilitate
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18 work ability, yet reducing burnout may have the highest potential for this purpose. Addressing
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20 excessive workloads and creating opportunities for physicians' professional growth seem effective in
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22 relieving burnout and improving physicians' work engagement. Facilitating good collegial relationships
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24 will further benefit physicians' work engagement.
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38
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41 N/A.
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48 **Competing interests**

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51 None declared.
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Author contributions

MD conceptualized and designed the study; acquired, analyzed and interpreted study data; drafted the article; and gave final approval of the version to be published. RS conceptualized and designed the study; acquired, analyzed and interpreted study data; critically revised the article; and gave final approval of the version to be published. MS conceptualized and designed the study; analyzed and interpreted study data; critically revised the article; and gave final approval of the version to be published. KL provided feedback on the study design; acquired and interpreted study data; critically revised the article; and gave final approval of the version to be published. All authors agree to be accountable for all aspects of the study in ensuring that questions related to the accuracy or integrity of any part of the study are appropriately investigated and resolved.

Data availability statement

Data may be obtained from a third party and are not publicly available. No additional data available, as data are protected under contract with participating medical centers. Nonetheless, inquiries about potential research collaboration can be directed to Professor Kiki Lombarts (m.j.lombarts@amsterdamumc.nl)

Ethical approval

Ethical approval was waived by the Medical Ethics Committee of the Academic Medical Center (ID XT4-118). All participants gave informed consent before taking part.

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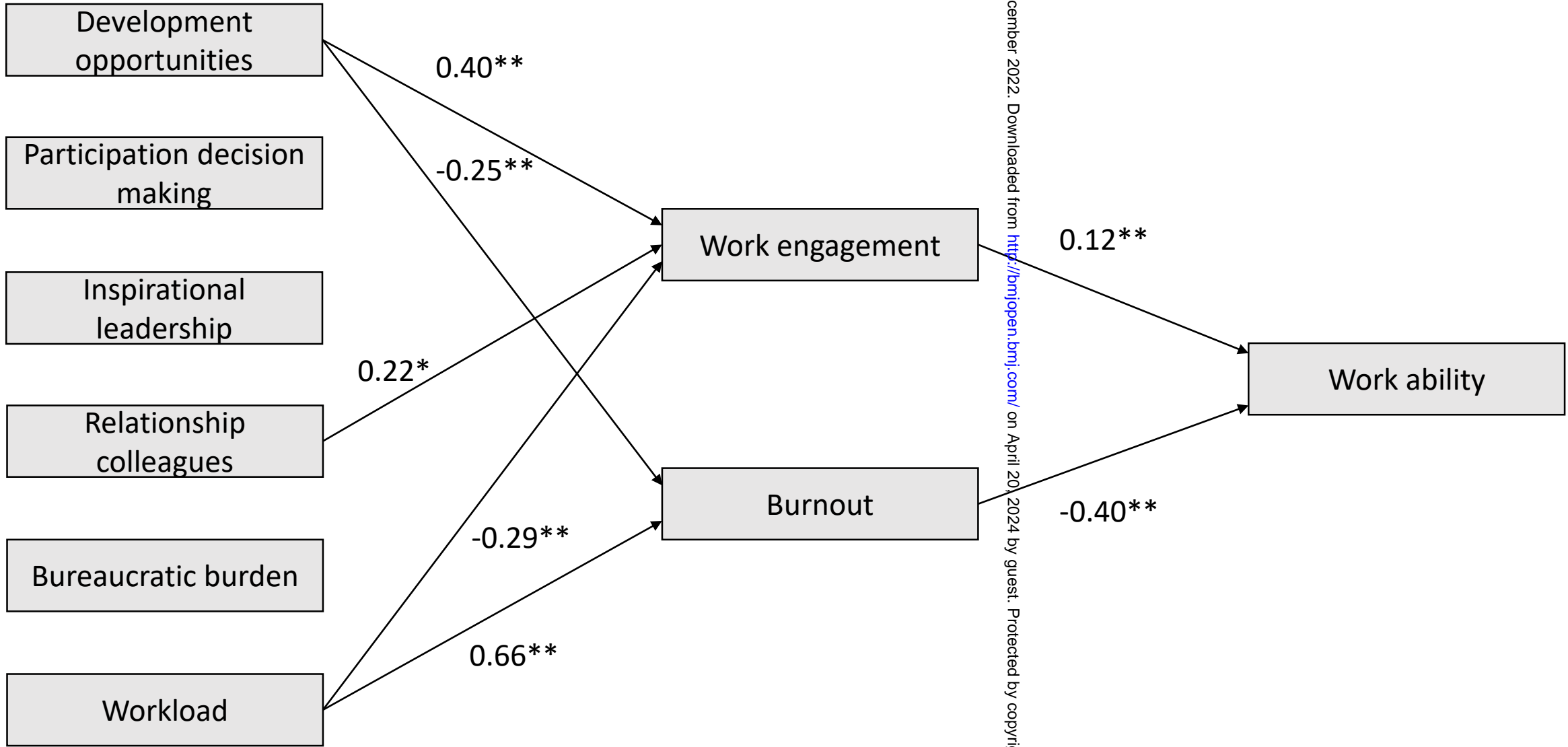
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3 Caption: Figure 1. Results of the path analysis. * $p < 0.05$ ** $P \leq 0.001$ Note: only significant estimates are
4 depicted. Estimates are adjusted for sex, hospital type, years since registration and contract type.
5
6 Contract type related to engagement ($b = -0.27$; 95% CI, -0.44 to -0.11; $p = 0.001$) and exhaustion ($b = -$
7
8 0.15; 95% CI, -0.01 to -0.29; $p = 0.031$). Hospital type was related to engagement ($b = -0.21$; 95% CI, 0.02
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10 0.15; 95% CI, -0.01 to -0.29; $p = 0.031$). Hospital type was related to engagement ($b = -0.21$; 95% CI, 0.02
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12 to 0.39; $p = 0.016$). Years since registration as medical specialist was related to performance ability
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14 ($b = 0.15$; 95% CI, 0.05 to 0.25; $p = 0.002$). The model was based on $n = 359$ due to 26 missings on years
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16 since registration as medical specialist.
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SYNTAX

```
model1 <- '  
#measurement model  
#regressions  
Work engagement ~ a1*DO + a2*PD + a3*LI + a4*RC + a5*BB + a6*WL + SEX + HOSP_TYPE + YEARSR  
+ FTPT  
Burnout ~ a11*DO + a22*PD + a33*LI + a44*RC + a55*BB + a66*WL + SEX + HOSP_TYPE + YEARSR +  
FTPT  
Work ability ~ b*work engagement + b1*burnout + SEX + HOSP_TYPE + YEARSR + FTPT  
#indirect effects via burnout (BO) and work engagement (ENG)  
IndENG_LM := a1*b  
IndENG_DB := a2*b  
IndENG_IL := a3*b  
IndENG_RC := a4*b  
IndENG_RD := a5*b  
IndENG_WD := a6*b  
IndBO_LM := a11*b1  
IndBO_DB := a22*b1  
IndBO_IL := a33*b1  
IndBO_RC := a44*b1  
IndBO_RD := a55*b1  
IndBO_WD := a66*b1  
#RESIDUALS  
Burnout~~Work engagement'
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```
DO = development opportunities  
PD = participation in decision making  
LI = Inspirational leadership  
RC = relationship with colleagues  
BB = bureaucratic burden  
WL = Workload
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STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1,2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4,5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6,7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6,7
Bias	9	Describe any efforts to address potential sources of bias	8
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8
		(b) Describe any methods used to examine subgroups and interactions	NA
		(c) Explain how missing data were addressed	8
		(d) If applicable, describe analytical methods taking account of sampling strategy	NA
		(e) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9,10
		(b) Give reasons for non-participation at each stage	NR
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9,10
		(b) Indicate number of participants with missing data for each variable of interest	9,10
Outcome data	15*	Report numbers of outcome events or summary measures	10

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Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10,11
		(b) Report category boundaries when continuous variables were categorized	NA
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13,14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11,12,13
Generalisability	21	Discuss the generalisability (external validity) of the study results	13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

A structural equation modeling analysis on relationships of job demands and resources with work engagement, burnout and work ability: an observational study among physicians in Dutch hospitals

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Manuscript ID	bmjopen-2022-062603.R1
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Primary Subject Heading:	Mental health
Secondary Subject Heading:	Health services research, Mental health
Keywords:	MENTAL HEALTH, HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Organisation of health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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6 2 **A structural equation modeling analysis on relationships of job demands and resources**
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14 5 Maarten Debets^{1,2}, Renée Scheepers³, Milou Silkens⁴ & Kiki Lombarts^{1,2}
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57 20 Word count: 3994 (excluding abstract, strengths and limitations (article summary), tables and figures,
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59 21 references and declarations)
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3 **1 Abstract**
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6 **2 Objective:** To investigate to what extent work engagement mediates the relationships of job resources
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3 with work ability, and to what extent burnout mediates the relationships of job demands and resources
4 with work ability.

5 Design: Multicenter observational study.

6 Setting: Academic and non-academic hospitals in the Netherlands.

7 Participants: Physicians (n=385) participated in this study.

8 Primary and secondary outcome measures: We measured work ability with selected items from the
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validated Questionnaire of Experience and Evaluation of Work 2.0 (QEEW2.0), work engagement with
the Utrecht Work Engagement Scale, and burnout with the exhaustion subscale of the Oldenburg
Burnout Inventory. The job demand 'workload' and job resources 'development opportunities',
'participation in decision making', 'inspirational leadership', and 'relationships with colleagues' were
measured using the QEEW2.0. The job demand 'bureaucratic burden' was measured with the Three
Item Red Tape scale. A structural equation model was built to answer our research question.

15 Results: Work engagement mediated relationships of job resources with physicians' work ability, and
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burnout mediated relationships of job resources and demands with work ability. Development
opportunities ($\beta=0.39$, $SE=0.12$, $p<0.001$), participation in decision making ($\beta=0.18$, $SE=0.08$, $p=0.028$),
and relationships with colleagues ($\beta=0.19$, $SE=0.19$, $p=0.002$) positively related to work engagement.
Development opportunities ($\beta=-0.20$, $SE=0.08$, $p=0.004$) negatively related and workload ($\beta=0.51$,
 $SE=0.19$, $p<0.001$) positively related to burnout. Work engagement ($\beta=0.22$, $SE=0.04$, $p<0.001$) was
positively related and burnout ($\beta=-0.56$, $SE=0.06$, $p<0.001$) negatively related to work ability.

22 Conclusions: Physicians' work engagement and burnout mediated the relationships of various job
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demands and resources with their work ability. More work-engaged and less burned-out physicians

1 reported better work ability. Hospitals may attenuate excessive workloads and facilitate development
2 opportunities, participation in decision making, and good collegial relationships to enhance physicians'
3 occupational well-being and performance.

4 Keywords: job demands and resources, work engagement, burnout, work ability, physicians,
5 structural equation model (SEM)

7 **Strengths and limitations of this study**

- 8 • This study provides more specific insight into relationships of job demands and resources with
9 physicians' work engagement, burnout, and work ability.
- 10 • This study used validated measurements that were chosen based on theory and a needs
11 assessment.
- 12 • This study included a varied sample of physicians from multiple academic and non-academic
13 hospitals in the Netherlands, contributing to the generalizability of our results.
- 14 • Participation was voluntary, which might have resulted in a selection bias. However, this does
15 not necessarily influence the strength of the observed relationships, which were in line with
16 the literature.
- 17 • Due to the cross-sectional study design, no causal inferences can be made.

1 Introduction

2 In contemporary medical practice, many physicians report a lack of work engagement and experience
3 high levels of burnout [1, 2]. Work engagement is a positive, fulfilling, work-related state of mind
4 characterized by vigor, dedication, and absorption, whereas burnout is defined as a work-related
5 syndrome characterized by exhaustion, cynicism, and inefficacy [3]. Work engagement and burnout
6 are different aspects of physicians' occupational well-being that are negatively related and lead to
7 contrasting outcomes [4, 5]. Physicians' work engagement benefits physician retention and the cost-
8 efficiency and quality of patient care [6-9]. Work-engaged physicians communicate better with
9 patients and colleagues, report fewer medical errors, and show higher levels of work ability [7, 9, 10].
10 Physicians with high burnout levels, however, are more likely to make medical errors, leave the
11 profession, and their patients report less satisfaction [11, 12]. Therefore, reducing physicians' burnout
12 and enhancing engagement is a top priority for medical professional associations and hospitals [6, 11,
13 13, 14].

14 Hospitals can reduce burnout rates and promote work engagement by optimizing working conditions
15 in the organization [11, 15-17]. These working conditions are, based on the evidence-based job
16 demands and resources model (JD-R), categorized into job demands and resources [4, 18]. Job
17 demands are job aspects that require physical, cognitive, or emotional efforts, such as excessive
18 workloads [4, 18]. Job resources, such as development opportunities, assist in coping with job
19 demands, are functional in achieving work goals, and stimulate personal growth [4, 18].

20 The main premise of the JD-R model is that excessive job demands trigger stress reactions – the health
21 impairment process – whereas having abundant job resources leads to higher motivation and
22 productivity – the motivational process [4, 18]. Hence, excessive job demands lead to burnout and
23 abundant job resources to work engagement. According to the JD-R model, work engagement
24 mediates relationships of job resources with performance outcomes, and burnout does so for job
25 demands. Furthermore, job resources can also directly reduce burnout and thereby mitigate the

1 negative consequences of burnout for performance [19]. In addition, the JD-R model considers that
2 job resources can attenuate the negative consequences of job demands on burnout and job demands
3 can reduce the positive effect of job resources on work engagement [4, 18]. For example, Bakker et al.
4 found that social support from colleagues attenuated the ramifications of excessive workload on
5 burnout (exhaustion) [20]. However, the evidence for these interaction effects is inconsistent [21],
6 while research has systematically provided evidence for the health impairment and motivational
7 process in the JD-R model [18, 19].

8 As job demands and resources are specific to their context and setting, a needs assessment among
9 physicians in the current setting under study – Dutch hospitals – informed the selection of job demands
10 and resources to be investigated [22]. The importance of the selected job demands (i.e. bureaucratic
11 burden, workload) and resources (development opportunities, participation in decision making,
12 inspirational leadership, relationships with colleagues) for physicians' well-being has been previously
13 demonstrated in the medical setting [10, 11, 17, 23-25]. Despite this, more knowledge of physicians'
14 perceptions of bureaucracy and inspirational leadership is needed. Although researchers report that
15 bureaucracy is a leading cause of physician burnout [26, 27], we are unaware of studies that have
16 investigated physicians' perceptions of bureaucracy in relation to their well-being and performance
17 using the JD-R model. Furthermore, leadership is also important in the medical setting: Shanafelt et al.
18 found that physicians who attribute good leadership qualities to their supervisor report less burnout
19 [28]. However, a meta-analysis could not confirm the positive relationship between engaging
20 leadership and work engagement due to limited studies [29].

21 Less burned-out and more work-engaged physicians are better able to perform their work [11, 30].
22 Physicians' ability to perform their work is conceptualized as the coping dimension of work ability [31],
23 i.e. having the physical and mental capacity to manage certain work tasks successfully. Researchers
24 linked impaired work ability with the risk of reduced quality, sickness absence, and early retirement
25 [32]. Job demands have been shown to affect work ability in various settings [32-34]. In particular, high

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3 1 workloads seem to reduce physicians' work ability [32]. Contrastingly, studies indicate that job
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5 2 resources including social relationships and support at work, development opportunities, and
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7 3 autonomy benefit physicians' work ability [33, 34]. Physicians who experience more work engagement
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10 4 report higher scores on work ability [34].

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13 5 The above shows the evidence base for the JD-R model in various contexts, including healthcare.
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15 6 Previous studies have investigated relationships of job demands and resources with physicians' work
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17 7 engagement or burnout [15, 16, 23, 35] or relationships of work engagement or burnout with
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19 8 performance or work ability [7, 17, 34, 36]. Still, studies using the JDR model and investigating job
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21 9 demands and resources in relation to physicians' well-being and performance in one measurement
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23 10 model are scarce [24]. Furthermore, knowledge about physicians' perceptions of bureaucratic
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25 11 demands and inspirational leadership concerning their well-being and performance is also limited [29].
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28 12 Lastly, insight into the interaction effects of job demands and resources in specific (medical) contexts
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30 13 is welcome due to inconsistent evidence [21]. Healthcare organizations could use such knowledge to
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32 14 determine which job demands and resources to address to reduce physicians' burnout and enhance
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34 15 their engagement, subsequently, performance [24]. Therefore, following the JD-R model, this study
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36 16 investigates the relationships of job demands and resources with physicians' work engagement,
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38 17 burnout, and work ability (figure 1). More specifically, this study answers the research question: to
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40 18 what extent does work engagement mediate the relationships of job resources with work ability, and
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42 19 to what extent does burnout mediate the relationships of job demands and resources with work
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44 20 ability? Investigating the potential interactions of job demands and resources is a sub-aim of this study.
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46 21 The obtained knowledge can inform interventions to improve physicians' working conditions, well-
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1 **Methods**

2 *Study setting and population*

3 Data from this study were collected from April 2017 to June 2018 in the context of a nationwide well-
4 being program for physicians in 50 clinical departments of 16 Dutch hospitals [22, 37]. In total, 118
5 residents and 531 medical specialists were invited to participate in the online survey. This study
6 focused on medical specialists only (hereafter physicians). Of the 531 physicians invited, 385
7 completed the survey (72.5% response rate). Due to the settings of the survey, only complete data was
8 received. Missing data could only occur due to wrong data entry on demographic variables.

9

10 *Measurements*

11 This study included previously validated measurements of job demands and resources [38, 39], work
12 engagement [40], burnout [41], and work ability [38]. The included job demands and resources were
13 identified via a needs assessment among physicians, which was part of the nationwide well-being
14 program development [22]. In the needs assessment, physicians rated working conditions of interest
15 to be included in the well-being program, hence the online survey to collect data for this study.

16 Job demands included in this study were workload and bureaucratic burden. Workload was measured
17 using the 6-item scale on workload of the Questionnaire on the Experience and Evaluation of Work 2.0
18 (QEEW 2.0), with responses ranging from 1 ('never') to 4 ('always') [38]. Bureaucratic demands were
19 measured by the Three Item Red Tape Scale (TIRT), with responses ranging from 1 ('not burdensome')
20 to 5 ('burdensome'), 1 ('necessary') to 5 ('unnecessary'), and 1 ('effective') to 5 ('ineffective') [39]. Two
21 researchers independently translated the English version into Dutch, which another bilingual
22 researcher subsequently back-translated.

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3 1 Job resources included development opportunities, participation in decision making, inspirational
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5 2 leadership, and relationships with colleagues, and were measured using the QEEW 2.0 [38]. The
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7 3 development opportunities scale (3 items) and participation in decision making scale (4 items) had
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9 4 response options ranging from 1 ('totally disagree') to 5 ('totally agree'). Responses to the inspirational
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11 5 leadership scale (4 items) and relationship with colleagues scale (5 items) ranged from 1 ('never') to 4
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14 6 ('always').

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17 7 Work engagement (9 items) was measured using the Utrecht Work Engagement Scale [40]. An example
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19 8 item is "at my work, I feel bursting with energy". Physicians rated their engagement on a scale from 1
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21 9 ('Never') to 7 ('Always/Daily').

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25 10 Burnout was measured by the exhaustion subscale (8 items) of the Oldenburg Burnout Inventory [41].
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27 11 Exhaustion is considered the core dimension of burnout [15, 42]. Physicians scored items from 1
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29 12 ('Strongly disagree') to 5 ('Strongly agree'). An example item is "there are days when I feel tired before
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31 13 I arrive at work".

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35 14 Physicians rated their work ability using eight selected items from the subscales willingness to perform
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37 15 and ability to perform from the QEEW 2.0 16-item work fatigue scale [38]. The item selection
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39 16 shortened the total survey length, considering physicians' limited time, and was made in collaboration
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41 17 with a physician in a formal leadership role. The statement "please indicate which situation applies
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43 18 most to you" was repeated eight times, with different and contrasting response options on a 5-point
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45 19 answer scale, with higher scores indicating a better work ability: 'attention keeps dropping' to 'no
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47 20 problem with attention'; 'difficulty concentrating' to 'no concentration difficulties'; 'difficulty with
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49 21 planning own actions' to 'acting effortlessly'; 'unable to easily do different things in succession' to 'able
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51 22 to transition from one task to another without any problems'; 'taking risks that are actually too great'
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53 23 to 'taking no risks'; 'working on automatic pilot' to 'working with attention'; 'continue working costs
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55 24 the greatest effort' to 'continue working effortlessly'; 'needing to overcome resistance before acting'
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57 25 to 'getting to activity without any problems').
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3 1 We also collected data on respondents' sex (male, female), specialty type (surgical, non-surgical,
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5 2 supporting, non-medical), years since completing the first registration as medical specialist
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7 3 (categorical) and hospital type (academic, non-academic), which we included as covariates in the
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9 4 analysis.

10 11 12 13 5 14 15 16 6 *Statistical analyses*

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19 7 Missing values were imputed using expectation maximization (EM). Sample characteristics were
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21 8 represented using descriptive statistics. Means, standard deviations and inter-correlations were
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23 9 calculated to understand the variables under investigation and their mutual relationships. Mean scale
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25 10 scores were computed by averaging the item scores. Before computing scales, confirmatory factor
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27 11 analyses on the items of individual constructs were performed and the contribution of each item to
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29 12 the reliability of the scale was checked, i.e. improvement or deterioration in Cronbach's alpha. Items
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31 13 with factor loadings lower than 0.30 and that affected the scale's reliability negatively were considered
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33 14 for deletion. Due to the low factor loadings and decrease in Cronbach's alpha, one item of the work
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35 15 ability scale was dropped: 'taking risks that are actually too great' to 'taking no risks'. The reliability of
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37 16 all included measurement scales was checked using Cronbach's alpha, with values of ≥ 0.70 considered
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39 17 acceptable [43]. These analyses were performed in IBM SPSS Statistics version 26.

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44 18 To answer our research question, we build a structural equation model in Lavaan 0.6-9 in R version
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46 19 3.6.3, following the literature about the JD-R model (figure 1) [18, 19]. Endogenous variables in our
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48 20 SEM – variables that are changed or determined by its relationships with other variables in the model
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50 21 – were work engagement, burnout and work ability. Exogenous variables – variables not determined
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52 22 by the model – included job demand and resources. The SEM included the relationships of the
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54 23 individual job resources development opportunities, participation in decision making, inspirational
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56 24 leadership and relationships with colleagues on work engagement and burnout. The SEM also included
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58 25 the relationships of the individual job demands bureaucratic burden and workload on burnout.

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3 1 Furthermore, the relationships of work engagement and burnout on work ability were included.
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5 2 Indirect relationships of job demands and resources via burnout or/and work engagement on work
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7 3 ability were calculated.
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10 4 The SEM was specified in a way that each latent construct had three indicators. This was achieved by
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12 5 item parceling, which can reduce random error, approximate latent constructs better and improve
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14 6 model efficiency, especially in the case of noises (e.g. correlated residuals) and small sample sizes [44].
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16 7 We applied the radial algorithm for parceling, meaning items with the smallest distance between factor
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18 8 loadings were grouped together by mean averaging [44].
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22 9 Potential interaction effects were investigated for significant relationships of job demands with
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24 10 burnout and job resources with work engagement. Latent interaction terms were calculated using the
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26 11 double-mean centering approach in the SemTools 0.5-5 package [45].
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30 12 Covariates were included to the regressions in the structural model if they showed a relationship, i.e.
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32 13 correlation, with the dependent variables under investigation. All covariates were coded as binary
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34 14 variables: sex (male, female), hospital type (non-academic, academic), specialty (non-surgical,
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36 15 surgical), type of contract (full-time, part-time), and years since first registration as medical specialist
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38 16 (≤ 10 years, ≥ 11 years).
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42 17 The assumption of multivariate normality was checked in R using the MVN 5.9 package. As our data
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44 18 did not meet the assumption of multivariate normality, we used maximum likelihood estimation
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46 19 (MLM) with robust standard errors and a Satorra-Bentler scaled test statistic [46]. Model fit was
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48 20 assessed using the following *robust* fit indices [46]: Comparative Fit Index (CFI) and Tucker-Lewis index
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50 21 (TLI) both with values of $\geq .90$ indicating acceptable fit and $\geq .95$ of good fit, Root Mean Square Error
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52 22 of Approximation (RSMEA) $\leq .10$ indicating acceptable fit and <0.06 good fit, and chi-square $p \geq 0.05$ for
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54 23 good fit [47]. The fit indices are presented for the SEM without latent interaction terms as these can
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56 24 strongly influence the fit indices.
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3 1 *Ethical approval*
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6 2 The institutional ethical review board of the Amsterdam UMC provided a waiver declaring the Medical
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8 3 Research Involving Human Subjects Act (WMO) did not apply to the current study (ID XT4-118). All
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10 4 participants gave written informed consent before taking part.
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16 6 *Patient and Public Involvement*
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20 7 Physicians were consulted to inform the choices about the inclusion of job demands and resources in
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22 8 the online survey by means of a needs assessment. One physician with a formal leadership role
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24 9 informed the item selection of the work ability construct. Researchers made the final decision about
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26 10 which job demands and resources to include in the survey and physicians had no role in designing or
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29 11 conducting this study.
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35 13 **Results**
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38 14 *Sample characteristics*
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41 15 In total, 385 physicians participated in this study (Table 1). About half was male (50.1%), most worked
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43 16 in a non-surgical specialty (64.7%) and a non-academic hospital (81.3%). Table 2 presents the
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45 17 Cronbach's alpha's, means, standard deviations, and inter-correlations of the variables under
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47 18 investigation. The 26 missing values on 'years since registration' were imputed using EM.
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1 Table 1. Participant characteristics

Characteristics	Valid percent (<i>n</i> = 385)
<i>Sex</i>	
Male	50.1% (<i>n</i> = 193)
Female	49.9% (<i>n</i> = 192)
<i>Year since first registration</i>	
0-5 years	24.0% (<i>n</i> = 86)
6-10 years	26.5% (<i>n</i> = 95)
11-15 years	21.2% (<i>n</i> = 76)
16-21 years	16.2% (<i>n</i> = 58)
22-45 years	12.3% (<i>n</i> = 44)
Missing	<i>n</i> = 26
<i>Specialty type</i>	
Medical	54.0% (<i>n</i> = 208)
Surgical	35.3% (<i>n</i> = 136)
Other	10.7% (<i>n</i> = 41)
<i>Hospital type</i>	
Academic	18.7% (<i>n</i> = 72)
Non-academic	81.3% (<i>n</i> = 313)
<i>Contract type</i>	
Full-time	55.3% (<i>n</i> = 213)
Part-time	44.7% (<i>n</i> = 172)

Table 2. Cronbach's alpha's means, standard deviations and inter-correlations of the main variables

Variables†	Cronbach's alpha	M(SD)	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Development opportunities	0.83	4.08 (0.69)	-													
2. Participation decision making	0.83	3.62 (0.77)	0.44**	-												
3. Inspirational leadership	0.92	2.56 (0.84)	0.31**	0.41**	-											
4. Relationships colleagues	0.76	3.38 (0.48)	0.26**	0.36**	0.29**	-										
5. Bureaucratic burden	0.76	3.14 (0.75)	-0.20**	-0.36**	-0.22**	-0.20**	-									
6. Workload	0.79	2.88 (0.52)	-0.05	-0.32**	-0.14**	-0.16**	0.15**	-								
7. Work engagement	0.90	5.35 (0.85)	0.45**	0.39**	0.28**	0.30**	-0.22**	-0.24**	-							
8. Burnout	0.88	2.69 (0.75)	-0.31**	-0.43**	-0.27**	-0.29**	0.24**	0.56**	-0.54**	-						
9. Work ability	0.85	3.81 (0.63)	0.25**	0.30**	0.18**	0.22**	-0.18**	-0.38**	0.46**	-0.63**	-					
10. SEX	n/a	n/a	0.03	-0.12*	0.00	0.06	-0.05	0.22**	-0.02	0.21**	-0.15**	-				
11. Years since first registration	n/a	n/a	-0.18**	-0.02	-0.13*	-0.19**	0.02	-0.12*	-0.02	-0.09	0.15**	-0.19**	-			
12. Specialty type	n/a	n/a	0.02	-0.08	-0.06	-0.06	0.08	0.18**	0.08	0.09	0.02	-0.04	0.00	-		
13. Hospital type	n/a	n/a	0.04	-0.15**	0.00	-0.05	0.16**	0.12*	0.07	0.02	-0.05	0.08	0.00	0.19**	-	
14. Contract type	n/a	n/a	0.09	-0.06	0.12*	0.17*	-0.03	0.15**	-0.07	0.17**	-0.16**	0.51**	-0.22**	-0.10	0.05	-

* Correlation is significant at the p<.05 level (2-tailed).

** Correlation is significant at the p<.01 level (2-tailed).

† Answer scales 1. (1-5), 2. (1-5), 3. (1-4), 4. (1-4), 5. (1-5), 6. (1-4), 7. (1-7), 8. (1-5), 9. (1-5), 10. (0=male, 1=female), 11. (0=≤ 10 years, 1=≥ 11 years), 12. (0=non-surgical, 1=surgical), 13. (0=non-academic, 1=academic), 14. (0= full-time, 1=part-time).

Note: non-parametric correlations were calculated for variables 11. to 14.

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1 *Structural Equation Model*

2 Figure 2 depicts the results of the SEM. The robust model fit statistics were as follows: chi-
3 square = 722.203, df=372, p<0.001 (Satorra-Bentler correction 1.068); CFI=0.933; TLI=0.922;
4 RMSEA=0.051, p=.562, 90% CI, 0.046 to 0.057, indicating acceptable model fit. Here we present
5 standardized coefficients. The SEM model specifications and comprehensive output including
6 unstandardized coefficients is presented in the supplementary materials.

7 The analysis showed that the job resources 'development opportunities' ($\beta=0.39$, SE=0.12, p<0.001),
8 'participation in decision making' ($\beta=0.18$, SE=0.08, p=0.028), and 'relationships with colleagues'
9 ($\beta=0.19$, SE=0.19, p=0.002) were positively related to work engagement. Development opportunities
10 ($\beta=-0.20$, SE=0.08, p=0.004) was negatively related and the job demand 'workload' was positively to
11 burnout ($\beta=0.51$, SE=0.19, p<0.001). The job demand 'bureaucratic burden' moderated the
12 relationship of relationships with colleagues and work engagement ($\beta=-0.10$, SE=0.15, p=0.015).
13 Workload moderated the relationship between participation in decision making and work engagement
14 ($\beta=-0.15$, SE=0.10, p=0.005).

15 Work engagement mediated the relationships of development opportunities (indirect effect (IE),
16 $\beta=0.08$, SE=0.03, p=0.005) and relationships with colleagues (IE, $\beta=0.04$, SE=0.04, p=0.021) with work
17 ability. The indirect effect of participation in decision making (IE, $\beta=0.04$, SE=0.01, p=0.061) on work
18 ability through work engagement was not significant. Burnout mediated the relationships of
19 development opportunities (IE, $\beta=0.11$, SE=0.04, p=0.007) and workload (IE, $\beta=-0.29$, SE=0.06,
20 p<0.001) with work ability. Work engagement ($\beta=0.22$, SE=0.04, p<0.001) was positively related and
21 burnout ($\beta=-0.56$, SE=0.06, p<0.001) was negatively related to work ability. Finally, the job resource
22 'inspirational leadership' did not relate to physicians' work engagement, burnout or work ability.

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1 Discussion

2 *Main findings*

3 Physicians reporting more job demands in terms of higher workloads and insufficient job resources in
4 terms of development opportunities felt more burned out and less able to perform their work tasks.
5 On the other hand, physicians who experienced sufficient job resources in terms of development
6 opportunities, abilities to participate in decision making, and positive relationships with colleagues
7 reported higher work engagement levels. Work-engaged physicians reported higher work ability levels
8 than those burned-out. Work engagement mediated the relationships of development opportunities
9 and relationships with colleagues with work ability. Burnout mediated the relationship of development
10 opportunities and workload with work ability.

12 *Explanation of findings*

13 This study provides more evidence for the health impairment and motivational process proposed by
14 the JD-R model [4, 18, 19]. Our results confirm the importance of development resources (participation
15 in decision making) in comparison to social resources (relationships with colleagues) or more general
16 job resources (participation in decision making) [29]. Furthermore, the findings that high workloads
17 and excessive bureaucratic burdens reduced the positive relationships of 'participation in decision
18 making' and 'relationships with colleagues' with physicians' work engagement contribute to the
19 inconsistent literature about interaction effects [21].

20 Workload was a substantial job demand negatively relating to physicians' burnout and work ability. It
21 seems that an early outcome of heavy workloads is physicians' perception of distress. When distress
22 endures, it makes the work less pleasant and exhausts physicians' resources to cope with job demands,
23 leading to reduced work ability [4, 18]. Under high workloads, physicians' work engagement benefitted
24 less from being able to participate in decisions making, e.g., influencing scheduling and the division of

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3 1 tasks. Under such circumstances, they might be hindered in influencing decisions in a way that benefits
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5 2 their work engagement. For example, being able to influence scheduling is of less help when the only
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7 3 choice is between non-preferred options due to high workloads. In addition, physicians might rather
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9 4 prefer to spend time on patients than participating in decision making in the face of high workloads
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11 5 [48]. Meta-analyses on interventions to improve physicians' well-being show that organizational
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13 6 strategies to alleviate workloads substantially reduce physicians' burnout [49, 50]. However, reducing
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15 7 workloads might be challenging due to increasing patient care volumes and responsibilities to
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17 8 safeguard the continuity of care.

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21 9 Rather than reducing job demands, enhancing job resources is an alternative strategy to improve
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23 10 physicians' work engagement and reduce burnout [49, 50]. Based on our results, enhancing physicians'
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25 11 professional development opportunities, ability to participate in decision making, and relationships
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27 12 with colleagues seem instrumental to improving physicians' occupational well-being and work ability,
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29 13 matching previous studies [15, 17, 33, 34].

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34 14 In contrast with expectations based on the literature [11, 51-55], this study did not find a relationship
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36 15 between bureaucratic burden and physicians' burnout. It could be that some bureaucracy assists
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38 16 physicians' in their professional performance. Bureaucracy is concerned with standardizing and
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40 17 centralizing decision-making, formal policies, and procedures to make healthcare more reliable,
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42 18 accessible, and cost-effective [55]. One study found that some bureaucracy contributed to the job
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44 19 satisfaction of long-term care staff because it is crucial for the smooth functioning of the organization
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46 20 [56]. Accordingly, we observed that physicians reported some usefulness of the policies and
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48 21 procedures they experienced, which might explain the absent relation between bureaucratic burden
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50 22 and burnout. However, following the literature about challenging and hindering job demands [57],
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52 23 when bureaucracy hinders physicians in task fulfillment, it becomes detrimental to their occupational
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54 24 well-being.

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3 1 While we did not observe a direct relationship between bureaucratic burden and physicians' burnout,
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5 2 bureaucracy was indirectly and negatively related to physicians' work engagement. Under excessive
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7 3 bureaucracy, good collegial relationships seem less beneficial to physicians' work engagement. One
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9 4 potential explanation is that colleagues' efforts to help and support are less effective in the context of
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11 5 excessive bureaucracy. A meta-analysis found that bureaucracy negatively related to communication
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13 6 between employees and reduced perceptions of organizational support [58].
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17 7 Furthermore, this study did not find a relationship between inspirational leadership and physicians'
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19 8 work engagement and burnout. It is often assumed that leadership at strategic and operational levels
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21 9 is crucial for physicians' well-being. Leaders can shape general working conditions and organizational
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23 10 cultures, and inspire their followers [6, 11, 59]. This study measured the supervisor's ability to
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25 11 communicate a vision, a sense of work purpose, and make physicians enthusiastic for their work. A
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27 12 previous study found that higher supervisors' leadership scores reduced physicians' likelihood of
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29 13 burnout and increased the possibility of satisfaction [28]. It would be interesting to investigate cultural
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31 14 and contextual differences in physicians' leadership preferences and needs. Perhaps Dutch medical
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33 15 specialists have other needs than being inspired by their leaders, but future research should confirm
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35 16 such statements.
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40 17 This study confirms that work engagement and burnout relate to physicians' work ability [32-34]. In
41
42 18 particular, physicians with higher burnout reported attentional lapses and struggled with planning and
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44 19 conducting subsequent tasks. The benefits of work engagement are often observable in extra-role
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46 20 behaviors [60], which might explain the stronger relationship of burnout with work ability compared
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48 21 to work engagement. The work ability measurement in this study reflected physicians' physical and
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50 22 mental capacity to manage certain work tasks successfully, predominantly referring to in-role or task
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52 23 performance.
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57 24 Several studies have linked physicians' burnout symptoms with an increased likelihood of making
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59 25 medical errors [11, 36, 61, 62]; this might be due to decreased work ability [34]. The negative
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3 1 consequences of impaired well-being and work ability may not directly have adverse consequences for
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5 2 patients. Researchers argue that exhausted physicians adopt performance protection strategies to
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7 3 protect their patients by dropping secondary tasks [13]. Still, such strategies can indirectly have
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9 4 adverse consequences for the quality of patient care; a longitudinal study showed that physicians'
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11 5 exhaustion eroded teamwork and thereby patient safety [63].
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17 18 7 *Strengths and limitations*

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21 8 This study contributed to the existing literature by providing more insight into relationships of job
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23 9 demands and resources with physicians' work engagement, burnout, and work ability. Furthermore,
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25 10 this study included physicians from multiple disciplines and hospitals in the Netherlands, contributing
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27 11 to the generalizability of our findings.
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31 12 A limitation of this study is that the work ability measurement was based on a selection of validated
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33 13 items instead of the validated Work Ability Index (WAI) [64]. Although this may have compromised the
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35 14 validity of our measurement, the item selection guaranteed the fit of items to the study context.
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38 15 Participation in this study was voluntary, which might have led to a selection bias, meaning that
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40 16 physicians with high or low levels of occupational well-being might have been overrepresented.
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43 17 However, a selection bias does not necessarily influence the strength of the relationships found. The
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45 18 results of this study were mostly in line with the literature [15, 17, 29].
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48 19 Moreover, although physicians' data from multiple professional disciplines might contribute to the
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50 20 generalizability of our results, each professional discipline and workplace will have specific job
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52 21 demands and resources that this study might not have identified. Nonetheless, we selected the job
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54 22 demands and resources that were applicable to the majority of physicians – of diverse specialties –
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56 23 included in our previous needs assessment [22]. Lastly, causal inferences could not be made due to the
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58 24 cross-sectional study design.
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3 1 *Implications for research and practice*
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6 2 Future research could further establish linkages between physicians' workplace, well-being, and
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8 3 performance. Given the current body of knowledge, adopting longitudinal research designs and more
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10 4 objective performance measures are welcomed [30, 65]. It would be valuable if such studies
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12 5 investigated when job demands are perceived as challenging or hindering and which type of job
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14 6 resources are most beneficial [57]. In addition, physicians perceptions of bureaucracy and leadership
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16 7 in relation to their occupational well-being and performance deserves more attention [29].
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20 8 This study confirms previous findings that reducing workload is important for reducing physicians'
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22 9 burnout and its negative consequences for physicians' performance [11]. Potential strategies to reduce
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24 10 workload are duty hour limits, optimizing electronic medical records, or additional staff to support
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26 11 physicians [11, 49, 50]. In addition, healthcare organizations can facilitate development opportunities,
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28 12 participation in decision making, and support building relationships with colleagues to promote work
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30 13 engagement. The effectiveness of interventions will depend on the implementation context and thus
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32 14 always requires careful consideration.
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40 16 *Conclusions*
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43 17 Physicians' work engagement and burnout mediated the relationships of various job demands and
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45 18 resources with their work ability. This study suggests that physicians report better work ability when
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47 19 experiencing low burnout and high work engagement levels. In relieving burnout and improving
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49 20 physicians' work engagement, hospitals may consider addressing excessive workloads and creating
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51 21 opportunities for physicians' professional development. Facilitating good collegial relationships and
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53 22 participation in decision making may further benefit physicians' work engagement.
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4 Competing interests

5 None declared.

6 Author contributions

7 MD conceptualized and designed the study; acquired, analyzed and interpreted study data; drafted
8 the article; and gave final approval of the version to be published. RS conceptualized and designed the
9 study; acquired, analyzed and interpreted study data; critically revised the article; and gave final
10 approval of the version to be published. MS conceptualized and designed the study; analyzed and
11 interpreted study data; critically revised the article; and gave final approval of the version to be
12 published. KL provided feedback on the study design; acquired and interpreted study data; critically
13 revised the article; and gave final approval of the version to be published. All authors agree to be
14 accountable for all aspects of the study in ensuring that questions related to the accuracy or integrity
15 of any part of the study are appropriately investigated and resolved.

1 **Data availability statement**

2 Data may be obtained from a third party and are not publicly available. No additional data available,
3 as data are protected under contract with participating medical centers. Nonetheless, inquiries about
4 potential research collaboration can be directed to Professor Kiki Lombarts
5 (m.j.lombarts@amsterdamumc.nl).

7 **Data transparency statement**

8 The data of this study was partly used in a different study investigating associations of job demands
9 and resources with patient-related burnout among physicians [37]. While this study investigates the
10 same job demands and resources, all dependent variables in this study – work engagement, burnout,
11 and work ability – have not previously been investigated.

13 **Ethical approval**

14 The institutional ethical review board of the Amsterdam UMC provided a waiver declaring the Medical
15 Research Involving Human Subjects Act (WMO) did not apply to the current study (ID XT4-118). All
16 participants gave written informed consent before taking part.

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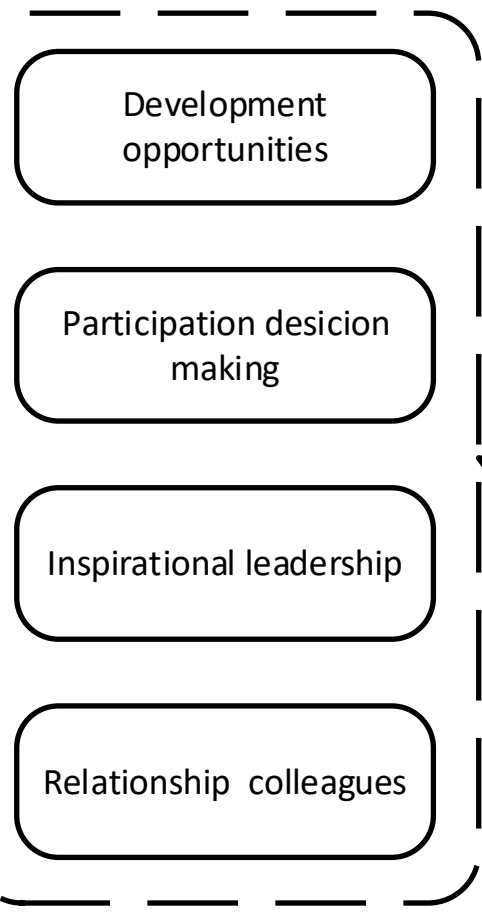
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49 19 Fig. 1. Conceptual model; Individual job demands and resources are investigated, not all relationships
50 20 are depicted for clarity reasons; dotted lines represent potential interactions of job demands and
51 21 resources.

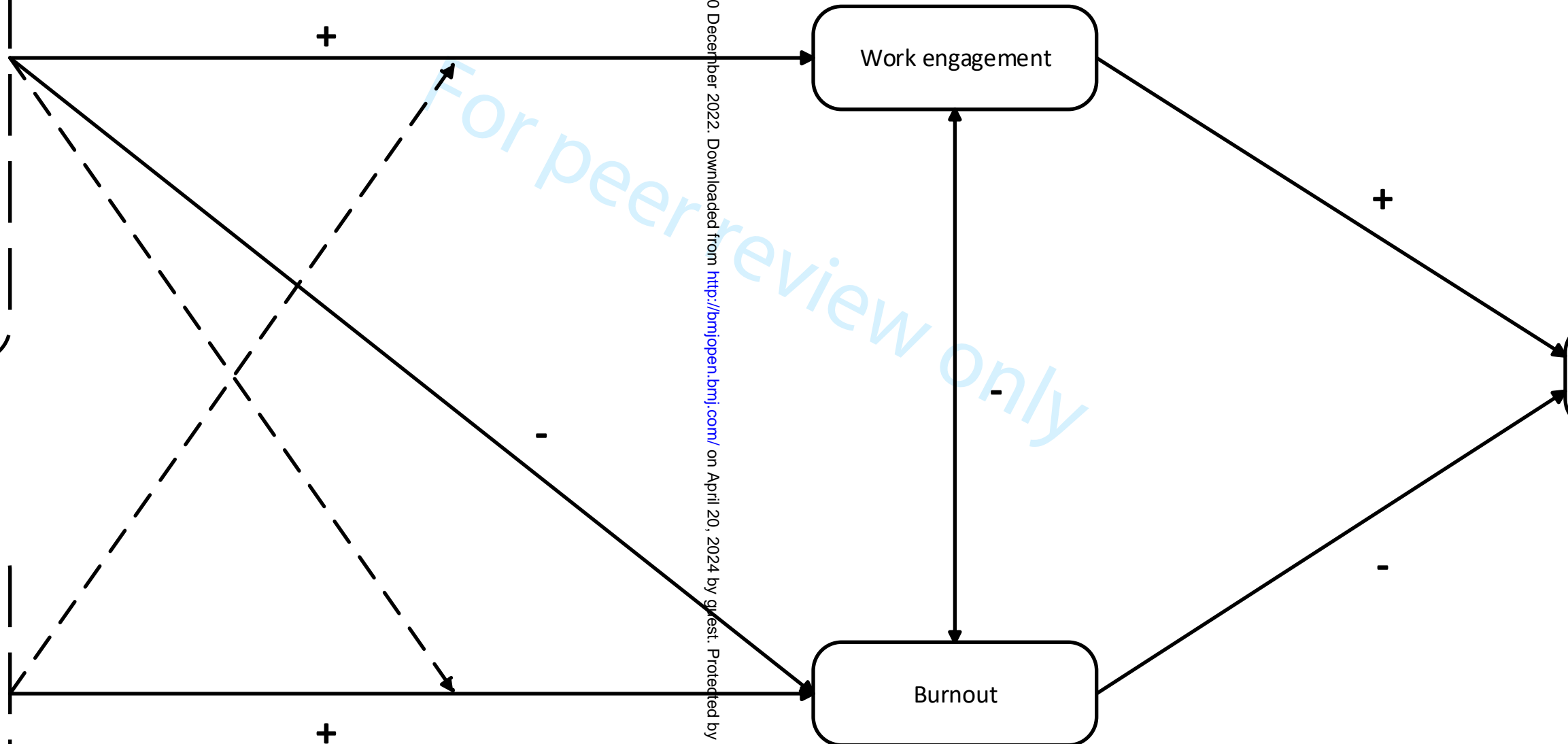
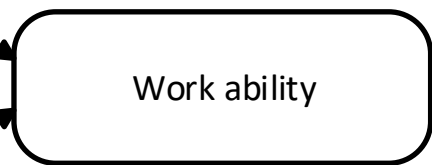
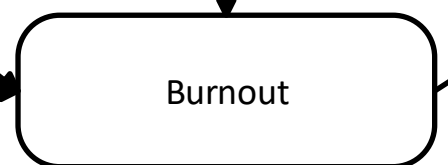
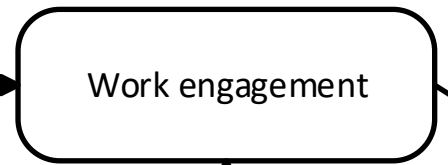
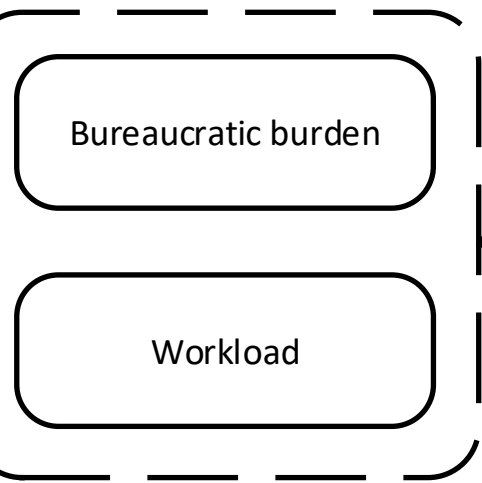
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54 22 Fig. 2. Structural model. Notes: n=385; **p<.001, *p<.05; standardized coefficients are displayed;
55 23 measurement model and covariance between exogenous variables are not displayed.
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Job resources

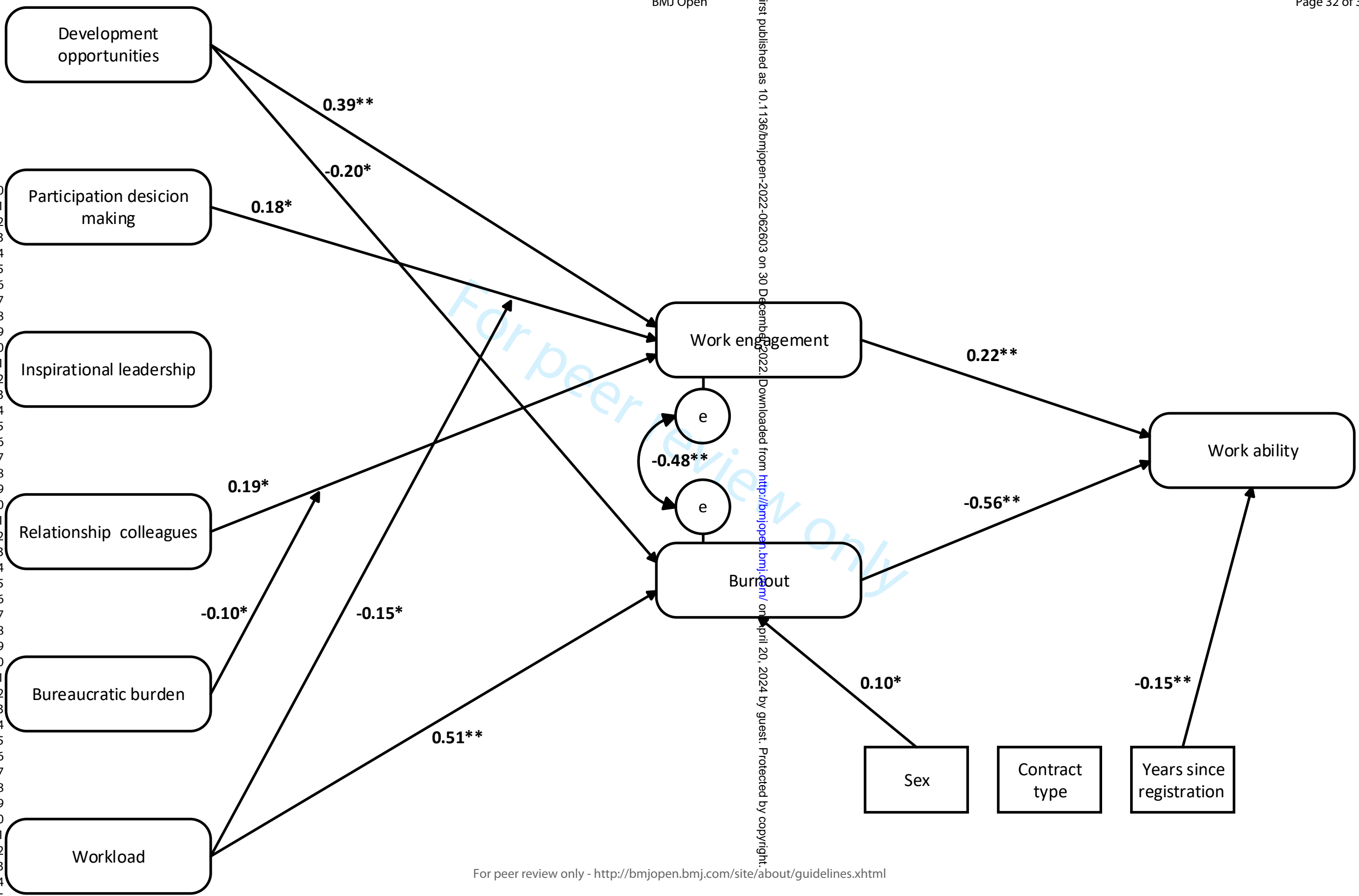


Job demands



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Structural Equation Model <- '

#Measurement model, latent variables

Development opportunities (DO) =~ DO1 + DO2 + DO3

Participation decision making (PD) =~ PD1 + PD2 + PD34

Inspirational leadership (IL) =~ IL13 + IL2 + IL4

Relationship colleagues (RC) =~ RC1 + RC24 + RC35

Bureaucratic burden (BB) =~ BB1 + BB2 + BB3

Workload (WL) =~ WL24 + WL36 + WL15

Work engagement (WE) =~ WE125 + WE347 + WE689

Burnout (BO) =~ BO37 + BO248 + BO156

Work ability (WA) =~ WA136 + WA24 + WA78

WL*PD =~ WL24.PD1 + WL24.PD2 + WL24.PD34 + WL36.PD1 + WL36.PD2 + WL36.PD34 + WL15.PD1 + WL15.PD34

BB*RC =~ BB1.RC1 + BB2.RC24 + BB1.RC35 + BB2.RC1 + BB2.RC24 + BB2.RC35 + BB3.RC1 + BB3.RC24 + BB3.RC35

#Regressions

WE ~ a1*DO + a2*PD + IL + a3*RC + WL*PD + BB*RC

BO ~ a4*DO + PD + IL + RC + BB + a5*WL + Sex + Contract type

WA ~ b*WE + b1*BO + Sex + Contract type + Years since registration as medical specialist

Residual (co)variances

BO~~WE

#Indirect effects (independent variable / mediator / dependent variable)

DO/WE/WA := a1*b

PD/WE/WA := a2*b

RC/WE/WA := a3*b

DO/BO/WA := a4*b1

WL/BO/WA := a5*b1'

Latent variables									
Measurement model	Operator	Manif var.	estimate	se	z-value	sig	ci.lower	ci.upper	std.all
Development opp.	=~	DO1	1.000	0.000	NA	NA	1.000	1.000	0.709
Development opp.	=~	DO2	1.427	0.127	11.260	0.000	1.177	1.676	0.878
Development opp.	=~	DO3	1.078	0.106	10.149	0.000	0.866	1.286	0.765
Participation decision	=~	PD1	1.000	0.000	NA	NA	1.000	1.000	0.819
Participation decision	=~	PD2	0.981	0.057	17.164	0.000	0.866	1.093	0.844

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Participation decision	=~	PD34	0.703	0.054	13.013	0.000	0.599	0.809	0.718
Inspirational leadership	=~	IL13	1.000	0.000	NA	NA	1.000	1.000	0.930
Inspirational leadership	=~	IL2	0.884	0.039	22.726	0.000	0.809	0.960	0.831
Inspirational leadership	=~	IL4	0.964	0.037	26.001	0.000	0.899	1.036	0.846
Relationship colleagues	=~	RC1	1.000	0.000	NA	NA	1.000	1.000	0.460
Relationship colleagues	=~	RC24	2.006	0.000	7.076	0.000	1.451	2.562	0.872
Relationship colleagues	=~	RC35	1.438	0.226	6.354	0.000	0.999	1.882	0.567
Bureaucratic burden	=~	BB1	1.000	0.000	NA	NA	1.000	1.000	0.626
Bureaucratic burden	=~	BB2	1.108	0.107	10.364	0.000	0.899	1.318	0.773
Bureaucratic burden	=~	BB3	1.084	0.109	9.983	0.000	0.871	1.296	0.769
Workload	=~	WL24	1.000	0.000	NA	NA	1.000	1.000	0.672
Workload	=~	WL36	1.322	0.091	14.573	0.000	1.141	1.500	0.906
Workload	=~	WL15	0.774	0.063	12.372	0.000	0.651	0.896	0.731
Work engagement	=~	WE125	1.000	0.000	NA	NA	1.000	1.000	0.820
Work engagement	=~	WE347	1.022	0.066	15.500	0.000	0.899	1.151	0.856
Work engagement	=~	WE689	0.930	0.061	15.206	0.000	0.811	1.050	0.732
Burnout	=~	BO37	1.000	0.000	NA	NA	1.000	1.000	0.806
Burnout	=~	BO248	1.172	0.055	21.277	0.000	1.061	1.280	0.901
Burnout	=~	BO156	1.028	0.053	19.323	0.000	0.921	1.132	0.867
Work ability	=~	WA136	1.000	0.000	NA	NA	1.000	1.000	0.845
Work ability	=~	WA24	1.087	0.063	17.356	0.000	0.961	1.210	0.803
Work ability	=~	WA78	1.041	0.062	16.753	0.000	0.911	1.162	0.803
Workload*participation d.	=~	WL24*PD1	1.000	0.000	NA	NA	1.000	1.000	0.644
Workload*participation d.	=~	WL24*PD2	0.990	0.069	14.424	0.000	0.851	1.124	0.678
Workload*participation d.	=~	WL24*PD34	0.713	0.084	8.516	0.000	0.541	0.878	0.550
Workload*participation d.	=~	WL36*PD1	1.210	0.110	10.963	0.000	0.994	1.426	0.768
Workload*participation d.	=~	WL36*PD1	1.152	0.119	9.698	0.000	0.911	1.385	0.784
Workload*participation d.	=~	WL36*PD34	0.828	0.126	6.574	0.000	0.581	1.075	0.646
Workload*participation d.	=~	WL15*PD1	0.785	0.099	7.972	0.000	0.591	0.979	0.686
Workload*participation d.	=~	WL15*PD2	0.788	0.103	7.686	0.000	0.581	0.989	0.701
Workload*participation d.	=~	WL15*PD34	0.564	0.099	5.715	0.000	0.371	0.757	0.573
Bureau. bur.*relation. col.	=~	BB1*RC1	1.000	0.000	NA	NA	1.000	1.000	0.378

Bureau. bur.*relation. col.	=~	BB1*RC24	1.726	0.338	5.110	0.000	1.0663	2.389	0.596
Bureau. bur.*relation. col.	=~	BB1*RC35	1.473	0.256	5.758	0.000	0.979	1.974	0.449
Bureau. bur.*relation. col.	=~	BB2*RC1	0.932	0.160	5.817	0.000	0.613	1.247	0.412
Bureau. bur.*relation. col.	=~	BB2*RC24	2.029	0.537	3.777	0.000	0.971	3.082	0.755
Bureau. bur.*relation. col.	=~	BB2*RC35	1.587	0.335	4.743	0.000	0.933	2.243	0.576
Bureau. bur.*relation. col.	=~	BB2*RC1	0.974	0.148	6.590	0.000	0.683	1.264	0.433
Bureau. bur.*relation. col.	=~	BB2*RC24	1.962	0.494	3.971	0.000	0.993	2.930	0.746
Bureau. bur.*relation. col.	=~	BB2*RC35	1.584	0.340	4.662	0.000	0.918	2.250	0.571
Regressions									
Dependent variable	Operator	predictor	estimate	se	z-value	sig	ci.lower	ci.upper	std.all
Work engagement	~	DO	0.561	0.122	4.601	0.000	0.321	0.800	0.387
Work engagement	~	PD	0.168	0.077	2.196	0.028	0.011	0.319	0.175
Work engagement	~	IL	0.044	0.056	0.790	0.430	-0.061	0.153	0.047
Work engagement	~	RC	0.590	0.194	3.039	0.002	0.211	0.971	0.194
Work engagement	~	WL*PD	-0.267	0.095	-2.798	0.005	-0.453	-0.080	-0.145
Work engagement	~	BB*RC	-0.371	0.152	-2.442	0.015	-0.663	-0.073	-0.095
Burnout	~	DO	-0.234	0.080	-2.920	0.004	-0.392	-0.077	-0.198
Burnout	~	PD	-0.088	0.055	-1.594	0.111	-0.197	0.020	-0.112
Burnout	~	IL	-0.042	0.038	-1.094	0.274	-0.119	0.033	-0.054
Burnout	~	RC	-0.274	0.146	-1.885	0.059	-0.560	0.011	-0.110
Burnout	~	BB	0.024	0.047	0.505	0.614	-0.061	0.117	0.023
Burnout	~	WL	0.716	0.083	8.681	0.000	0.551	0.878	0.511
Burnout	~	Sex	0.133	0.058	2.284	0.022	0.011	0.246	0.103
Burnout	~	Contract t.	0.053	0.058	0.919	0.358	-0.051	0.168	0.041
Work ability	~	WE	0.152	0.043	3.532	0.000	0.061	0.237	0.215
Work ability	~	BO	-0.483	0.062	-7.743	0.000	-0.604	-0.360	-0.558
Work ability	~	Sex	-0.015	0.055	-0.270	0.787	-0.181	0.094	-0.013
Work ability	~	Years regis.	0.167	0.050	3.327	0.001	0.061	0.265	0.150
Work ability	~	Contract t.	-0.015	0.058	-0.258	0.796	-0.121	0.099	-0.013
Covariances									
Latent variable (ltv)	Operator	Ltv abbr.	estimate	se	z-value	sig	ci.lower	ci.upper	std.all
Work engagement	~~	BO	-0.126	0.021	-5.883	0.000	-0.168	-0.084	-0.476

bmjopen-2022-062863

Development opp.	~~	PD	0.238	0.036	6.554	0.000	0.16693	0.309	0.537
Development opp.	~~	IL	0.168	0.031	5.473	0.000	0.1088	0.228	0.372
Development opp.	~~	RC	0.048	0.011	4.494	0.000	0.0283	0.069	0.343
Development opp.	~~	BB	-0.091	0.022	-4.123	0.000	-0.1514	-0.048	-0.272
Development opp.	~~	WL	-0.033	0.016	-2.121	0.034	-0.0683	-0.003	-0.133
Development opp.	~~	WL*PD	0.019	0.018	1.021	0.307	-0.0147	0.054	0.080
Development opp.	~~	BB*RC	0.001	0.006	0.232	0.817	-0.0121	0.014	0.013
Participation decision	~~	IL	0.330	0.044	7.494	0.000	0.2488	0.416	0.483
Participation decision	~~	RC	0.086	0.020	4.362	0.000	0.0419	0.125	0.407
Participation decision	~~	BB	-0.218	0.037	-5.853	0.000	-0.2914	-0.145	-0.433
Participation decision	~~	WL*PD	0.022	0.033	0.669	0.503	-0.0442	0.087	0.063
Participation decision	~~	BB*RC	-0.007	0.014	-0.484	0.628	-0.0381	0.020	-0.040
Inspirational leadership	~~	RC	0.069	0.017	3.994	0.000	0.0318	0.103	0.321
Inspirational leadership	~~	BB	-0.134	0.034	-3.979	0.000	-0.2000	-0.068	-0.260
Inspirational leadership	~~	WL	-0.070	0.022	-3.197	0.001	-0.1112	-0.027	-0.182
Inspirational leadership	~~	WL*PD	-0.011	0.023	-0.484	0.629	-0.0519	0.033	-0.031
Inspirational leadership	~~	BB*RC	-0.001	0.013	-0.079	0.937	-0.0127	0.025	-0.006
Relationship colleagues	~~	BB	-0.031	0.011	-2.838	0.005	-0.0513	-0.010	-0.196
Relationship colleagues	~~	WL	-0.023	0.008	-2.723	0.006	-0.0369	-0.006	-0.193
Relationship colleagues	~~	WL*PD	-0.007	0.008	-0.854	0.393	-0.0213	0.009	-0.064
Relationship colleagues	~~	BB*RC	0.005	0.006	0.832	0.405	-0.0067	0.018	0.101
Bureaucratic burden	~~	WL	0.053	0.019	2.794	0.005	0.0141	0.090	0.187
Bureaucratic burden	~~	WL*PD	0.013	0.017	0.737	0.461	-0.0111	0.047	0.049
Bureaucratic burden	~~	BB*RC	0.006	0.015	0.394	0.694	0.0212	-0.035	0.047
Workload	~~	WL*PD	0.011	0.018	0.614	0.539	-0.0212	0.047	0.057
Workload	~~	BB*RC	0.002	0.006	0.301	0.763	-0.0104	0.013	0.019
Workload*participation d.	~~	BB*RC	0.006	0.007	0.898	0.369	-0.0087	0.020	0.072
Variances									
Variable	Operator	Variable	estimate	se	z-value	sig	ci.lower	ci.upper	std.all
DO1	NA	NA	0.290	0.034	8.508	0.000	0.2225	0.356	0.497
DO2	NA	NA	0.177	0.034	5.136	0.000	0.1088	0.244	0.228
DO3	NA	NA	0.242	0.029	8.224	0.000	0.1854	0.300	0.415

1	PD1	NA	NA	0.327	0.040	8.254	0.000	0.249	0.405	0.329
2	PD2	NA	NA	0.259	0.040	6.457	0.000	0.189	0.338	0.287
3	PD34	NA	NA	0.310	0.033	9.470	0.000	0.249	0.374	0.484
4	IL13	NA	NA	0.109	0.024	4.477	0.000	0.066	0.156	0.135
5	IL2	NA	NA	0.244	0.029	8.402	0.000	0.189	0.301	0.309
6	IL4	NA	NA	0.257	0.030	8.539	0.000	0.199	0.315	0.284
7	RC1	NA	NA	0.249	0.027	9.370	0.000	0.199	0.301	0.789
8	RC24	NA	NA	0.084	0.026	3.224	0.001	0.038	0.135	0.239
9	RC35	NA	NA	0.291	0.036	8.043	0.000	0.229	0.361	0.678
10	BB1	NA	NA	0.590	0.054	10.970	0.000	0.489	0.696	0.608
11	BB2	NA	NA	0.315	0.045	6.966	0.000	0.229	0.404	0.403
12	BB3	NA	NA	0.308	0.052	5.921	0.000	0.209	0.410	0.408
13	WL24	NA	NA	0.255	0.024	10.596	0.000	0.209	0.302	0.549
14	WL36	NA	NA	0.080	0.016	4.859	0.000	0.048	0.112	0.179
15	WL15	NA	NA	0.109	0.009	11.989	0.000	0.099	0.127	0.466
16	WE125	NA	NA	0.300	0.036	8.394	0.000	0.239	0.370	0.327
17	WE347	NA	NA	0.234	0.035	6.679	0.000	0.169	0.303	0.267
18	WE689	NA	NA	0.460	0.049	9.333	0.000	0.369	0.557	0.464
19	BO37	NA	NA	0.223	0.021	10.753	0.000	0.189	0.263	0.351
20	BO248	NA	NA	0.132	0.017	7.954	0.000	0.099	0.164	0.189
21	BO156	NA	NA	0.144	0.017	8.561	0.000	0.119	0.177	0.248
22	WA136	NA	NA	0.124	0.021	5.767	0.000	0.089	0.166	0.286
23	WA24	NA	NA	0.201	0.028	7.132	0.000	0.149	0.256	0.355
24	WA78	NA	NA	0.184	0.025	7.478	0.000	0.139	0.232	0.355
25	WL24*PD1	NA	NA	0.255	0.033	7.856	0.000	0.199	0.319	0.585
26	WL24*PD2	NA	NA	0.209	0.033	6.401	0.000	0.149	0.273	0.540
27	WL24*PD34	NA	NA	0.213	0.031	6.837	0.000	0.159	0.274	0.698
28	WL36*PD1	NA	NA	0.185	0.027	6.789	0.000	0.139	0.238	0.410
29	WL36*PD1	NA	NA	0.151	0.025	5.944	0.000	0.109	0.201	0.385
30	WL36*PD34	NA	NA	0.174	0.028	6.163	0.000	0.119	0.229	0.583
31	WL15*PD1	NA	NA	0.126	0.015	8.153	0.000	0.099	0.156	0.529
32	WL15*PD2	NA	NA	0.117	0.015	7.760	0.000	0.089	0.146	0.508

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WL15*PD34	NA	NA	0.118	0.019	6.067	0.000	0.083	0.156	0.672
BB1*RC1	NA	NA	0.245	0.037	6.674	0.000	0.179	0.317	0.857
BB1*RC24	NA	NA	0.221	0.035	6.320	0.000	0.158	0.290	0.645
BB1*RC35	NA	NA	0.351	0.054	6.531	0.000	0.244	0.457	0.799
BB2*RC1	NA	NA	0.174	0.025	7.033	0.000	0.122	0.222	0.830
BB2*RC24	NA	NA	0.127	0.016	7.861	0.000	0.091	0.158	0.429
BB2*RC35	NA	NA	0.208	0.029	7.274	0.000	0.152	0.264	0.669
BB2*RC1	NA	NA	0.168	0.028	5.897	0.000	0.112	0.224	0.812
BB2*RC24	NA	NA	0.126	0.019	6.470	0.000	0.088	0.164	0.444
BB2*RC35	NA	NA	0.212	0.028	7.547	0.000	0.151	0.267	0.674
Development opp.	NA	NA	0.293	0.054	5.441	0.000	0.182	0.399	1.000
Participation decision	NA	NA	0.668	0.067	10.022	0.000	0.531	0.799	1.000
Inspirational leadership	NA	NA	0.698	0.050	13.975	0.000	0.601	0.796	1.000
Relationship colleagues	NA	NA	0.067	0.019	3.554	0.000	0.031	0.103	1.000
Bureaucratic burden	NA	NA	0.380	0.062	6.088	0.000	0.251	0.503	1.000
Workload	NA	NA	0.210	0.030	6.940	0.000	0.151	0.269	1.000
Work engagement	NA	NA	0.357	0.045	7.862	0.000	0.261	0.446	0.580
Burnout	NA	NA	0.196	0.025	7.956	0.000	0.141	0.244	0.474
Work ability	NA	NA	0.146	0.019	7.858	0.000	0.111	0.182	0.473
Workload*participation d.	NA	NA	0.182	0.032	5.588	0.000	0.111	0.245	1.000
Bureau. bur.*relation. col.	NA	NA	0.041	0.015	2.688	0.007	0.019	0.071	1.000
Indirect effects									
Indp. var / mediator	Dep var	Operator	estimate	se	z-value	sig	ci.lower	ci.upper	std.all
DO / WE	WA	:=	0.085	0.031	2.794	0.005	0.023	0.145	0.083
PD / WE	WA	:=	0.026	0.014	1.872	0.061	-0.061	0.052	0.038
RC / WE	WA	:=	0.090	0.039	2.310	0.021	0.014	0.166	0.042
DO / BO	WA	:=	0.113	0.042	2.701	0.007	0.031	0.195	0.110
WL / BO	WA	:=	-0.346	0.057	-6.073	0.000	-0.457	-0.234	-0.285

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1,2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4,5,6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7,8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7,8
Bias	9	Describe any efforts to address potential sources of bias	9,10
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9,10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	10
		(b) Describe any methods used to examine subgroups and interactions	10
		(c) Explain how missing data were addressed	7,9
		(d) If applicable, describe analytical methods taking account of sampling strategy	NA
		(e) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	11,12
		(b) Give reasons for non-participation at each stage	NR
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11,12
		(b) Indicate number of participants with missing data for each variable of interest	11,12
Outcome data	15*	Report numbers of outcome events or summary measures	13
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	14

		(b) Report category boundaries when continuous variables were categorized	NA
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	18
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15-19
Generalisability	21	Discuss the generalisability (external validity) of the study results	18
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

A structural equation modeling analysis on relationships of job demands and resources with work engagement, burnout and work ability: an observational study among physicians in Dutch hospitals

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6 2 **A structural equation modeling analysis on relationships of job demands and resources**
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9 3 **with work engagement, burnout and work ability: an observational study among**
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11 4 **physicians in Dutch hospitals**
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57 20 Word count: 3993 (excluding abstract, strengths and limitations (article summary), tables and figures,
58
59 21 references and declarations)
60

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3 **1 Abstract**
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6 **2 Objective:** To investigate to what extent work engagement mediates the relationships of job resources
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3 with work ability, and to what extent burnout mediates the relationships of job demands and resources
4 with work ability.

5 **Design:** Multicenter observational study.

6 **Setting:** Academic and non-academic hospitals in the Netherlands.

7 **Participants:** Physicians (n=385) participated in this study.

8 **Primary and secondary outcome measures:** We measured work ability with selected items from the
9 validated Questionnaire of Experience and Evaluation of Work 2.0 (QEEW2.0), work engagement with
10 the Utrecht Work Engagement Scale, and burnout with the exhaustion subscale of the Oldenburg
11 Burnout Inventory. The job demand 'workload' and job resources 'development opportunities',
12 'participation in decision making', 'inspirational leadership', and 'relationships with colleagues' were
13 measured using the QEEW2.0. The job demand 'bureaucratic burden' was measured with the Three
14 Item Red Tape scale. A structural equation model was built to answer our research question.

15 **Results:** Work engagement mediated relationships of job resources with physicians' work ability, and
16 burnout mediated relationships of job resources and demands with work ability. Development
17 opportunities ($\beta=0.39$, $SE=0.12$, $p<0.001$), participation in decision making ($\beta=0.18$, $SE=0.08$, $p=0.028$),
18 and relationships with colleagues ($\beta=0.19$, $SE=0.19$, $p=0.002$) were positively related to work
19 engagement. Development opportunities ($\beta=-0.20$, $SE=0.08$, $p=0.004$) was negatively related and
20 workload ($\beta=0.51$, $SE=0.19$, $p<0.001$) was positively related to burnout. Work engagement ($\beta=0.22$,
21 $SE=0.04$, $p<0.001$) was positively related and burnout ($\beta=-0.56$, $SE=0.06$, $p<0.001$) was negatively
22 related to work ability.

1 **Conclusions:** Physicians' work engagement and burnout mediated the relationships of various job
2 demands and resources with their work ability. More work-engaged and less burned-out physicians
3 reported better work ability. Hospitals may attenuate excessive workloads and facilitate development
4 opportunities, participation in decision making, and good collegial relationships to enhance physicians'
5 occupational well-being and performance.

6 Keywords: job demands and resources, work engagement, burnout, work ability, physicians,
7 structural equation model (SEM)

9 **Strengths and limitations of this study**

- 10 • This study provides more specific insight into relationships of job demands and resources with
11 physicians' work engagement, burnout, and work ability.
- 12 • This study used validated measurements that were chosen based on theory and a needs
13 assessment.
- 14 • This study included a varied sample of physicians from multiple academic and non-academic
15 hospitals in the Netherlands, contributing to the generalizability of our results.
- 16 • Participation was voluntary, which might have resulted in a selection bias. However, this does
17 not necessarily influence the strength of the observed relationships, which were in line with
18 the literature.
- 19 • Due to the cross-sectional study design, no causal inferences can be made.

1 Introduction

2 In contemporary medical practice, many physicians report a lack of work engagement and experience
3 high levels of burnout [1, 2]. Work engagement is a positive, fulfilling, work-related state of mind
4 characterized by vigor, dedication, and absorption, whereas burnout is defined as a work-related
5 syndrome characterized by exhaustion, cynicism, and inefficacy [3]. Work engagement and burnout
6 are different aspects of physicians' occupational well-being that are negatively related and lead to
7 contrasting outcomes [4, 5]. Physicians' work engagement benefits physician retention and the cost-
8 efficiency and quality of patient care [6-9]. Work-engaged physicians communicate better with
9 patients and colleagues, report fewer medical errors, and show higher levels of work ability [7, 9, 10].
10 Physicians with high burnout levels, however, are more likely to make medical errors, leave the
11 profession, and their patients report less satisfaction [11, 12]. Therefore, reducing physicians' burnout
12 and enhancing engagement is a top priority for medical professional associations and hospitals [6, 11,
13 13, 14].

14 Hospitals can reduce burnout rates and promote work engagement by optimizing working conditions
15 in the organization [11, 15-17]. These working conditions are, based on the evidence-based job
16 demands and resources model (JD-R), categorized into job demands and resources [4, 18]. Job
17 demands are job aspects that require physical, cognitive, or emotional efforts, such as excessive
18 workloads [4, 18]. Job resources, such as development opportunities, assist in coping with job
19 demands, are functional in achieving work goals, and stimulate personal growth [4, 18].

20 The main premise of the JD-R model is that excessive job demands trigger stress reactions – the health
21 impairment process – whereas having abundant job resources leads to higher motivation and
22 productivity – the motivational process [4, 18]. Hence, excessive job demands lead to burnout and
23 abundant job resources to work engagement. According to the JD-R model, work engagement
24 mediates relationships of job resources with performance outcomes, and burnout does so for job
25 demands. Furthermore, job resources can also directly reduce burnout and thereby mitigate the

1 negative consequences of burnout for performance [19]. In addition, the JD-R model considers that
2 job resources can attenuate the negative consequences of job demands on burnout and job demands
3 can reduce the positive effect of job resources on work engagement [4, 18]. For example, Bakker et al.
4 found that social support from colleagues attenuated the ramifications of excessive workload on
5 burnout (exhaustion) [20]. However, the evidence for these interaction effects is inconsistent [21],
6 while research has systematically provided evidence for the health impairment and motivational
7 process in the JD-R model [18, 19].

8 As job demands and resources are specific to their context and setting, a needs assessment among
9 physicians in the current setting under study – Dutch hospitals – informed the selection of job demands
10 and resources to be investigated [22]. The importance of the selected job demands (i.e. bureaucratic
11 burden, workload) and resources (development opportunities, participation in decision making,
12 inspirational leadership, relationships with colleagues) for physicians' well-being has been previously
13 demonstrated in the medical setting [10, 11, 17, 23-25]. Despite this, more knowledge of physicians'
14 perceptions of bureaucracy and inspirational leadership is needed. Although researchers report that
15 bureaucracy is a leading cause of physician burnout [26, 27], we are unaware of studies that have
16 investigated physicians' perceptions of bureaucracy in relation to their well-being and performance
17 using the JD-R model. Furthermore, leadership is also important in the medical setting: Shanafelt et al.
18 found that physicians who attribute good leadership qualities to their supervisor report less burnout
19 [28]. However, a meta-analysis could not confirm the positive relationship between engaging
20 leadership and work engagement due to limited studies [29].

21 Less burned-out and more work-engaged physicians are better able to perform their work [11, 30].
22 Physicians' ability to perform their work is conceptualized as the coping dimension of work ability [31],
23 i.e. having the physical and mental capacity to manage certain work tasks successfully. Researchers
24 linked impaired work ability with the risk of reduced quality, sickness absence, and early retirement
25 [32]. Job demands have been shown to affect work ability in various settings [32-34]. In particular, high

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3 1 workloads seem to reduce physicians' work ability [32]. Contrastingly, studies indicate that job
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5 2 resources including social relationships and support at work, development opportunities, and
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7 3 autonomy benefit physicians' work ability [33, 34]. Physicians who experience more work engagement
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10 4 report higher scores on work ability [34].
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13 5 The above shows the evidence base for the JD-R model in various contexts, including healthcare.
14
15 6 Previous studies have investigated relationships of job demands and resources with physicians' work
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17 7 engagement or burnout [15, 16, 23, 35] or relationships of work engagement or burnout with
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19 8 performance or work ability [7, 17, 34, 36]. Still, studies using the JDR model and investigating job
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21 9 demands and resources in relation to physicians' well-being and performance in one measurement
22
23 10 model are scarce [24]. Furthermore, knowledge about physicians' perceptions of bureaucratic
24
25 11 demands and inspirational leadership concerning their well-being and performance is also limited [29].
26
27 12 Lastly, insight into the interaction effects of job demands and resources in specific (medical) contexts
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29 13 is welcome due to inconsistent evidence [21]. Healthcare organizations could use such knowledge to
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31 14 determine which job demands and resources to address to reduce physicians' burnout and enhance
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33 15 their engagement, subsequently, performance [24]. Therefore, following the JD-R model, this study
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35 16 investigates the relationships of job demands and resources with physicians' work engagement,
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37 17 burnout, and work ability (figure 1). More specifically, this study answers the research question: to
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39 18 what extent does work engagement mediate the relationships of job resources with work ability, and
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41 19 to what extent does burnout mediate the relationships of job demands and resources with work
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43 20 ability? Investigating the potential interactions of job demands and resources is a sub-aim of this study.
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45 21 The obtained knowledge can inform interventions to improve physicians' working conditions, well-
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47 22 being, and performance.
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1 **Methods**

2 *Study setting and population*

3 Data from this study were collected from April 2017 to June 2018 in the context of a nationwide well-
4 being program for physicians in 50 clinical departments of 16 Dutch hospitals [22, 37]. In total, 118
5 residents and 531 medical specialists were invited to participate in the online survey. This study
6 focused on medical specialists only (hereafter physicians). Of the 531 physicians invited, 385
7 completed the survey (72.5% response rate). Due to the settings of the survey, only complete data was
8 received. Missing data could only occur due to wrong data entry on demographic variables.

9

10 *Measurements*

11 This study included previously validated measurements of job demands and resources [38, 39], work
12 engagement [40], burnout [41], and work ability [38]. The included job demands and resources were
13 identified via a needs assessment among physicians, which was part of the nationwide well-being
14 program development [22]. In the needs assessment, physicians rated working conditions of interest
15 to be included in the well-being program, hence the online survey to collect data for this study.

16 Job demands included in this study were workload and bureaucratic burden. Workload was measured
17 using the 6-item scale on workload of the Questionnaire on the Experience and Evaluation of Work 2.0
18 (QEEW 2.0), with responses ranging from 1 ('never') to 4 ('always') [38]. Bureaucratic demands were
19 measured by the Three Item Red Tape Scale (TIRT), with responses ranging from 1 ('not burdensome')
20 to 5 ('burdensome'), 1 ('necessary') to 5 ('unnecessary'), and 1 ('effective') to 5 ('ineffective') [39]. Two
21 researchers independently translated the English version into Dutch, which another bilingual
22 researcher subsequently back-translated.

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3 1 Job resources included development opportunities, participation in decision making, inspirational
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5 2 leadership, and relationships with colleagues, and were measured using the QEEW 2.0 [38]. The
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7 3 development opportunities scale (3 items) and participation in decision making scale (4 items) had
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9 4 response options ranging from 1 ('totally disagree') to 5 ('totally agree'). Responses to the inspirational
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11 5 leadership scale (4 items) and relationship with colleagues scale (5 items) ranged from 1 ('never') to 4
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14 6 ('always').

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17 7 Work engagement (9 items) was measured using the Utrecht Work Engagement Scale [40]. An example
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19 8 item is "at my work, I feel bursting with energy". Physicians rated their engagement on a scale from 1
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21 9 ('Never') to 7 ('Always/Daily').

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25 10 Burnout was measured by the exhaustion subscale (8 items) of the Oldenburg Burnout Inventory [41].
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27 11 Exhaustion is considered the core dimension of burnout [15, 42]. Physicians scored items from 1
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29 12 ('Strongly disagree') to 5 ('Strongly agree'). An example item is "there are days when I feel tired before
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31 13 I arrive at work".

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35 14 Physicians rated their work ability using eight selected items from the subscales willingness to perform
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37 15 and ability to perform from the QEEW 2.0 16-item work fatigue scale [38]. The item selection
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39 16 shortened the total survey length, considering physicians' limited time, and was made in collaboration
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41 17 with a physician in a formal leadership role. The statement "please indicate which situation applies
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43 18 most to you" was repeated eight times, with different and contrasting response options on a 5-point
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45 19 answer scale, with higher scores indicating a better work ability: 'attention keeps dropping' to 'no
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47 20 problem with attention'; 'difficulty concentrating' to 'no concentration difficulties'; 'difficulty with
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49 21 planning own actions' to 'acting effortlessly'; 'unable to easily do different things in succession' to 'able
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51 22 to transition from one task to another without any problems'; 'taking risks that are actually too great'
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53 23 to 'taking no risks'; 'working on automatic pilot' to 'working with attention'; 'continue working costs
54
55 24 the greatest effort' to 'continue working effortlessly'; 'needing to overcome resistance before acting'
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57 25 to 'getting to activity without any problems').
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3 1 We also collected data on respondents' sex (male, female), specialty type (surgical, non-surgical,
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5 2 supporting, non-medical), years since completing the first registration as medical specialist
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7 3 (categorical) and hospital type (academic, non-academic), which we included as covariates in the
8
9 4 analysis.

10 11 12 13 5 14 15 16 6 *Statistical analyses*

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19 7 Missing values were imputed using expectation maximization (EM). Sample characteristics were
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21 8 represented using descriptive statistics. Means, standard deviations and inter-correlations were
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23 9 calculated to understand the variables under investigation and their mutual relationships. Mean scale
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25 10 scores were computed by averaging the item scores. Before computing scales, confirmatory factor
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27 11 analyses on the items of individual constructs were performed and the contribution of each item to
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29 12 the reliability of the scale was checked, i.e. improvement or deterioration in Cronbach's alpha. Items
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31 13 with factor loadings lower than 0.30 and that affected the scale's reliability negatively were considered
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33 14 for deletion. Due to the low factor loadings and decrease in Cronbach's alpha, one item of the work
34
35 15 ability scale was dropped: 'taking risks that are actually too great' to 'taking no risks'. The reliability of
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37 16 all included measurement scales was checked using Cronbach's alpha, with values of ≥ 0.70 considered
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39 17 acceptable [43]. These analyses were performed in IBM SPSS Statistics version 26.

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44 18 To answer our research question, we build a structural equation model in Lavaan 0.6-9 in R version
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46 19 3.6.3, following the literature about the JD-R model (figure 1) [18, 19]. Endogenous variables in our
47
48 20 SEM – variables that are changed or determined by its relationships with other variables in the model
49
50 21 – were work engagement, burnout and work ability. Exogenous variables – variables not determined
51
52 22 by the model – included job demand and resources. The SEM included the relationships of the
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54 23 individual job resources development opportunities, participation in decision making, inspirational
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56 24 leadership and relationships with colleagues on work engagement and burnout. The SEM also included
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58 25 the relationships of the individual job demands bureaucratic burden and workload on burnout.

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3 1 Furthermore, the relationships of work engagement and burnout on work ability were included.
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5 2 Indirect relationships of job demands and resources via burnout or/and work engagement on work
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7 3 ability were calculated.
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10 4 The SEM was specified in a way that each latent construct had three indicators. This was achieved by
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12 5 item parceling, which can reduce random error, approximate latent constructs better and improve
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14 6 model efficiency, especially in the case of noises (e.g. correlated residuals) and small sample sizes [44].
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16 7 We applied the radial algorithm for parceling, meaning items with the smallest distance between factor
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18 8 loadings were grouped together by mean averaging [44].
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22 9 Potential interaction effects were investigated for significant relationships of job demands with
23
24 10 burnout and job resources with work engagement. Latent interaction terms were calculated using the
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26 11 double-mean centering approach in the SemTools 0.5-5 package [45].
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30 12 Covariates were included to the regressions in the structural model if they showed a relationship, i.e.
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32 13 correlation, with the dependent variables under investigation. All covariates were coded as binary
33
34 14 variables: sex (male, female), hospital type (non-academic, academic), specialty (non-surgical,
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36 15 surgical), type of contract (full-time, part-time), and years since first registration as medical specialist
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38 16 (≤ 10 years, ≥ 11 years).
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41
42 17 The assumption of multivariate normality was checked in R using the MVN 5.9 package. As our data
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44 18 did not meet the assumption of multivariate normality, we used maximum likelihood estimation
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46 19 (MLM) with robust standard errors and a Satorra-Bentler scaled test statistic [46]. Model fit was
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48 20 assessed using the following *robust* fit indices [46]: Comparative Fit Index (CFI) and Tucker-Lewis index
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50 21 (TLI) both with values of $\geq .90$ indicating acceptable fit and $\geq .95$ of good fit, Root Mean Square Error
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52 22 of Approximation (RSMEA) $\leq .10$ indicating acceptable fit and <0.06 good fit, and chi-square $p \geq 0.05$ for
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54 23 good fit [47]. The fit indices are presented for the SEM without latent interaction terms as these can
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56 24 strongly influence the fit indices.
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2
3 1 *Ethical approval*
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5

6 2 The institutional ethical review board of the Amsterdam UMC provided a waiver declaring the Medical
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8 3 Research Involving Human Subjects Act (WMO) did not apply to the current study (ID XT4-118). All
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10 4 participants gave written informed consent before taking part.
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16 6 *Patient and Public Involvement*
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20 7 Physicians were consulted to inform the choices about the inclusion of job demands and resources in
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22 8 the online survey by means of a needs assessment. One physician with a formal leadership role
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24 9 informed the item selection of the work ability construct. Researchers made the final decision about
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26 10 which job demands and resources to include in the survey and physicians had no role in designing or
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29 11 conducting this study.
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35 13 **Results**
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38 14 *Sample characteristics*
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41 15 In total, 385 physicians participated in this study (Table 1). About half was male (50.1%), most worked
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43 16 in a non-surgical specialty (64.7%) and a non-academic hospital (81.3%). Table 2 presents the
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45 17 Cronbach's alpha's, means, standard deviations, and inter-correlations of the variables under
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47 18 investigation. The 26 missing values on 'years since registration' were imputed using EM.
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1 Table 1. Participant characteristics

Characteristics	Valid percent (<i>n</i> = 385)
<i>Sex</i>	
Male	50.1% (<i>n</i> = 193)
Female	49.9% (<i>n</i> = 192)
<i>Year since first registration</i>	
0-5 years	24.0% (<i>n</i> = 86)
6-10 years	26.5% (<i>n</i> = 95)
11-15 years	21.2% (<i>n</i> = 76)
16-21 years	16.2% (<i>n</i> = 58)
22-45 years	12.3% (<i>n</i> = 44)
Missing	<i>n</i> = 26
<i>Specialty type</i>	
Medical	54.0% (<i>n</i> = 208)
Surgical	35.3% (<i>n</i> = 136)
Other	10.7% (<i>n</i> = 41)
<i>Hospital type</i>	
Academic	18.7% (<i>n</i> = 72)
Non-academic	81.3% (<i>n</i> = 313)
<i>Contract type</i>	
Full-time	55.3% (<i>n</i> = 213)
Part-time	44.7% (<i>n</i> = 172)

Table 2. Cronbach's alpha's means, standard deviations and inter-correlations of the main variables

Variables†	Cronbach's alpha	M(SD)	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Development opportunities	0.83	4.08 (0.69)	-													
2. Participation decision making	0.83	3.62 (0.77)	0.44**	-												
3. Inspirational leadership	0.92	2.56 (0.84)	0.31**	0.41**	-											
4. Relationships colleagues	0.76	3.38 (0.48)	0.26**	0.36**	0.29**	-										
5. Bureaucratic burden	0.76	3.14 (0.75)	-0.20**	-0.36**	-0.22**	-0.20**	-									
6. Workload	0.79	2.88 (0.52)	-0.05	-0.32**	-0.14**	-0.16**	0.15**	-								
7. Work engagement	0.90	5.35 (0.85)	0.45**	0.39**	0.28**	0.30**	-0.22**	-0.24**	-							
8. Burnout	0.88	2.69 (0.75)	-0.31**	-0.43**	-0.27**	-0.29**	0.24**	0.56**	-0.54**	-						
9. Work ability	0.85	3.81 (0.63)	0.25**	0.30**	0.18**	0.22**	-0.18**	-0.38**	0.46**	-0.63**	-					
10. Sex	n/a	n/a	0.03	-0.12*	0.00	0.06	-0.05	0.22**	-0.02	0.21**	-0.15**	-				
11. Years since first registration	n/a	n/a	-0.18**	-0.02	-0.13*	-0.19**	0.02	-0.12*	-0.02	-0.09	0.15**	-0.19**	-			
12. Specialty type	n/a	n/a	0.02	-0.08	-0.06	-0.06	0.08	0.18**	0.08	0.09	0.02	-0.04	0.00	-		
13. Hospital type	n/a	n/a	0.04	-0.15**	0.00	-0.05	0.16**	0.12*	0.07	0.02	-0.05	0.08	0.00	0.19**	-	
14. Contract type	n/a	n/a	0.09	-0.06	0.12*	0.17*	-0.03	0.15**	-0.07	0.17**	-0.16**	0.51**	-0.22**	-0.10	0.05	-

* Correlation is significant at the p<.05 level (2-tailed).

** Correlation is significant at the p<.01 level (2-tailed).

† Answer scales 1. (1-5), 2. (1-5), 3. (1-4), 4. (1-4), 5. (1-5), 6. (1-4), 7. (1-7), 8. (1-5), 9. (1-5), 10. (0=male, 1=female), 11. (0=≤ 10 years, 1=≥ 11 years), 12. (0=non-surgical, 1=surgical), 13. (0=non-academic, 1=academic), 14. (0= full-time, 1=part-time).

Notes: non-parametric correlations were calculated for variables 11 to 14; correlation coefficients were rounded to two decimal places.

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1 *Structural Equation Model*

2 Figure 2 depicts the results of the SEM. The robust model fit statistics were as follows: chi-
3 square = 722.203, df=372, p<0.001 (Satorra-Bentler correction 1.068); CFI=0.933; TLI=0.922;
4 RMSEA=0.051, p=.562, 90% CI, 0.046 to 0.057, indicating acceptable model fit. Here we present
5 standardized coefficients. The SEM model specifications and comprehensive output including
6 unstandardized coefficients is presented in the supplementary materials.

7 The analysis showed that the job resources 'development opportunities' ($\beta=0.39$, SE=0.12, p<0.001),
8 'participation in decision making' ($\beta=0.18$, SE=0.08, p=0.028), and 'relationships with colleagues'
9 ($\beta=0.19$, SE=0.19, p=0.002) were positively related to work engagement. Development opportunities
10 ($\beta=-0.20$, SE=0.08, p=0.004) was negatively related and the job demand 'workload' was positively to
11 burnout ($\beta=0.51$, SE=0.19, p<0.001). The job demand 'bureaucratic burden' moderated the
12 relationship of relationships with colleagues and work engagement ($\beta=-0.10$, SE=0.15, p=0.015).
13 Workload moderated the relationship between participation in decision making and work engagement
14 ($\beta=-0.15$, SE=0.10, p=0.005).

15 Work engagement mediated the relationships of development opportunities (indirect effect (IE),
16 $\beta=0.08$, SE=0.03, p=0.005) and relationships with colleagues (IE, $\beta=0.04$, SE=0.04, p=0.021) with work
17 ability. The indirect effect of participation in decision making (IE, $\beta=0.04$, SE=0.01, p=0.061) on work
18 ability through work engagement was not significant. Burnout mediated the relationships of
19 development opportunities (IE, $\beta=0.11$, SE=0.04, p=0.007) and workload (IE, $\beta=-0.29$, SE=0.06,
20 p<0.001) with work ability. Work engagement ($\beta=0.22$, SE=0.04, p<0.001) was positively related and
21 burnout ($\beta=-0.56$, SE=0.06, p<0.001) was negatively related to work ability. Finally, the job resource
22 'inspirational leadership' did not relate to physicians' work engagement, burnout or work ability.

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1 Discussion

2 *Main findings*

3 Physicians reporting more job demands in terms of higher workloads and insufficient job resources in
4 terms of development opportunities felt more burned out and less able to perform their work tasks.
5 On the other hand, physicians who experienced sufficient job resources in terms of development
6 opportunities, abilities to participate in decision making, and positive relationships with colleagues
7 reported higher work engagement levels. Work-engaged physicians reported higher work ability levels
8 than those burned-out. Work engagement mediated the relationships of development opportunities
9 and relationships with colleagues with work ability. Burnout mediated the relationship of development
10 opportunities and workload with work ability.

12 *Explanation of findings*

13 This study provides more evidence for the health impairment and motivational process proposed by
14 the JD-R model [4, 18, 19]. Our results confirm the importance of development resources (participation
15 in decision making) in comparison to social resources (relationships with colleagues) or more general
16 job resources (participation in decision making) [29]. Furthermore, the findings that high workloads
17 and excessive bureaucratic burdens reduced the positive relationships of 'participation in decision
18 making' and 'relationships with colleagues' with physicians' work engagement contribute to the
19 inconsistent literature about interaction effects [21].

20 Workload was a substantial job demand negatively relating to physicians' burnout and work ability. It
21 seems that an early outcome of heavy workloads is physicians' perception of distress. When distress
22 endures, it makes the work less pleasant and exhausts physicians' resources to cope with job demands,
23 leading to reduced work ability [4, 18]. Under high workloads, physicians' work engagement benefitted
24 less from being able to participate in decisions making, e.g., influencing scheduling and the division of

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3 1 tasks. Under such circumstances, they might be hindered in influencing decisions in a way that benefits
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5 2 their work engagement. For example, being able to influence scheduling is of less help when the only
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7 3 choice is between non-preferred options due to high workloads. In addition, physicians might rather
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9 4 prefer to spend time on patients than participating in decision making in the face of high workloads
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11 5 [48]. Meta-analyses on interventions to improve physicians' well-being show that organizational
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13 6 strategies to alleviate workloads substantially reduce physicians' burnout [49, 50]. However, reducing
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15 7 workloads might be challenging due to increasing patient care volumes and responsibilities to
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17 8 safeguard the continuity of care.

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21 9 Rather than reducing job demands, enhancing job resources is an alternative strategy to improve
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23 10 physicians' work engagement and reduce burnout [49, 50]. Based on our results, enhancing physicians'
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25 11 professional development opportunities, ability to participate in decision making, and relationships
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27 12 with colleagues seem instrumental to improving physicians' occupational well-being and work ability,
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29 13 matching previous studies [15, 17, 33, 34].

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34 14 In contrast with expectations based on the literature [11, 51-55], this study did not find a relationship
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36 15 between bureaucratic burden and physicians' burnout. It could be that some bureaucracy assists
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38 16 physicians' in their professional performance. Bureaucracy is concerned with standardizing and
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40 17 centralizing decision-making, formal policies, and procedures to make healthcare more reliable,
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42 18 accessible, and cost-effective [55]. One study found that some bureaucracy contributed to the job
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44 19 satisfaction of long-term care staff because it is crucial for the smooth functioning of the organization
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46 20 [56]. Accordingly, we observed that physicians reported some usefulness of the policies and
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48 21 procedures they experienced, which might explain the absent relation between bureaucratic burden
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50 22 and burnout. However, following the literature about challenging and hindering job demands [57],
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52 23 when bureaucracy hinders physicians in task fulfillment, it becomes detrimental to their occupational
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54 24 well-being.

1 While we did not observe a direct relationship between bureaucratic burden and physicians' burnout,
2 bureaucracy was indirectly and negatively related to physicians' work engagement. Under excessive
3 bureaucracy, good collegial relationships seem less beneficial to physicians' work engagement. One
4 potential explanation is that colleagues' efforts to help and support are less effective in the context of
5 excessive bureaucracy. A meta-analysis found that bureaucracy negatively related to communication
6 between employees and reduced perceptions of organizational support [58].

7 Furthermore, this study did not find a relationship between inspirational leadership and physicians'
8 work engagement and burnout. It is often assumed that leadership at strategic and operational levels
9 is crucial for physicians' well-being. Leaders can shape general working conditions and organizational
10 cultures, and inspire their followers [6, 11, 59]. This study measured the supervisor's ability to
11 communicate a vision, a sense of work purpose, and make physicians enthusiastic for their work. A
12 previous study found that higher supervisors' leadership scores reduced physicians' likelihood of
13 burnout and increased the possibility of satisfaction [28]. It would be interesting to investigate cultural
14 and contextual differences in physicians' leadership preferences and needs. Perhaps Dutch medical
15 specialists have other needs than being inspired by their leaders, but future research should confirm
16 such statements.

17 This study confirms that work engagement and burnout relate to physicians' work ability [32-34]. In
18 particular, physicians with higher burnout reported attentional lapses and struggled with planning and
19 conducting subsequent tasks. The benefits of work engagement are often observable in extra-role
20 behaviors [60], which might explain the stronger relationship of burnout with work ability compared
21 to work engagement. The work ability measurement in this study reflected physicians' physical and
22 mental capacity to manage certain work tasks successfully, predominantly referring to in-role or task
23 performance.

24 Several studies have linked physicians' burnout symptoms with an increased likelihood of making
25 medical errors [11, 36, 61, 62]; this might be due to decreased work ability [34]. The negative

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3 1 consequences of impaired well-being and work ability may not directly have adverse consequences for
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5 2 patients. Researchers argue that exhausted physicians adopt performance protection strategies to
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7 3 protect their patients by dropping secondary tasks [13]. Still, such strategies can indirectly have
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9 4 adverse consequences for the quality of patient care; a longitudinal study showed that physicians'
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11 5 exhaustion eroded teamwork and thereby patient safety [63].
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17 18 7 *Strengths and limitations*

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21 8 This study contributed to the existing literature by providing more insight into relationships of job
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23 9 demands and resources with physicians' work engagement, burnout, and work ability. Furthermore,
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25 10 this study included physicians from multiple disciplines and hospitals in the Netherlands, contributing
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27 11 to the generalizability of our findings.
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31 12 A limitation of this study is that the work ability measurement was based on a selection of validated
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33 13 items instead of the validated Work Ability Index (WAI) [64]. Although this may have compromised the
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35 14 validity of our measurement, the item selection guaranteed the fit of items to the study context.
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38 15 Participation in this study was voluntary, which might have led to a selection bias, meaning that
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40 16 physicians with high or low levels of occupational well-being might have been overrepresented.
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43 17 However, a selection bias does not necessarily influence the strength of the relationships found. The
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45 18 results of this study were mostly in line with the literature [15, 17, 29].
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48 19 Moreover, although physicians' data from multiple professional disciplines might contribute to the
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50 20 generalizability of our results, each professional discipline and workplace will have specific job
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52 21 demands and resources that this study might not have identified. Nonetheless, we selected the job
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54 22 demands and resources that were applicable to the majority of physicians – of diverse specialties –
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56 23 included in our previous needs assessment [22]. Lastly, causal inferences could not be made due to
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58 24 the cross-sectional study design.
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3 1 *Implications for research and practice*
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6 2 Future research could further establish linkages between physicians' workplace, well-being, and
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8 3 performance. Given the current body of knowledge, adopting longitudinal research designs and more
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10 4 objective performance measures are welcomed [30, 65]. It would be valuable if such studies
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12 5 investigated when job demands are perceived as challenging or hindering and which type of job
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14 6 resources are most beneficial [57]. In addition, physicians perceptions of bureaucracy and leadership
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16 7 in relation to their occupational well-being and performance deserves more attention [29].
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20 8 This study confirms previous findings that reducing workload is important for reducing physicians'
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22 9 burnout and its negative consequences for physicians' performance [11]. Potential strategies to reduce
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24 10 workload are duty hour limits, optimizing electronic medical records, or additional staff to support
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26 11 physicians [11, 49, 50]. In addition, healthcare organizations can facilitate development opportunities,
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28 12 participation in decision making, and support building relationships with colleagues to promote work
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30 13 engagement. The effectiveness of interventions will depend on the implementation context and thus
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32 14 always requires careful consideration.
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40 16 *Conclusions*
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43 17 Physicians' work engagement and burnout mediated the relationships of various job demands and
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45 18 resources with their work ability. This study suggests that physicians report better work ability when
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47 19 experiencing low burnout and high work engagement levels. In relieving burnout and improving
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49 20 physicians' work engagement, hospitals may consider addressing excessive workloads and creating
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51 21 opportunities for physicians' professional development. Facilitating good collegial relationships and
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53 22 participation in decision making may further benefit physicians' work engagement.
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4 Competing interests

5 None declared.

6 Author contributions

7 MD conceptualized and designed the study; acquired, analyzed and interpreted study data; drafted
8 the article; and gave final approval of the version to be published. RS conceptualized and designed the
9 study; acquired, analyzed and interpreted study data; critically revised the article; and gave final
10 approval of the version to be published. MS conceptualized and designed the study; analyzed and
11 interpreted study data; critically revised the article; and gave final approval of the version to be
12 published. KL provided feedback on the study design; acquired and interpreted study data; critically
13 revised the article; and gave final approval of the version to be published. All authors agree to be
14 accountable for all aspects of the study in ensuring that questions related to the accuracy or integrity
15 of any part of the study are appropriately investigated and resolved.

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3 **1 Data availability statement**
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6 2 Data may be obtained from a third party and are not publicly available. No additional data available,
7
8 3 as data are protected under contract with participating medical centers. Nonetheless, inquiries about
9
10 4 potential research collaboration can be directed to Professor Kiki Lombarts
11
12 5 (m.j.lombarts@amsterdamumc.nl).
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19 **7 Data transparency statement**
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22 8 The data of this study was partly used in a different study investigating associations of job demands
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24 9 and resources with patient-related burnout among physicians [37]. While this study investigates the
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26 10 same job demands and resources, all dependent variables in this study – work engagement, burnout,
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28 11 and work ability – have not previously been investigated.
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35 **13 Ethical approval**
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38 14 The institutional ethical review board of the Amsterdam UMC provided a waiver declaring the Medical
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40 15 Research Involving Human Subjects Act (WMO) did not apply to the current study (ID XT4-118). All
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42 16 participants gave written informed consent before taking part.
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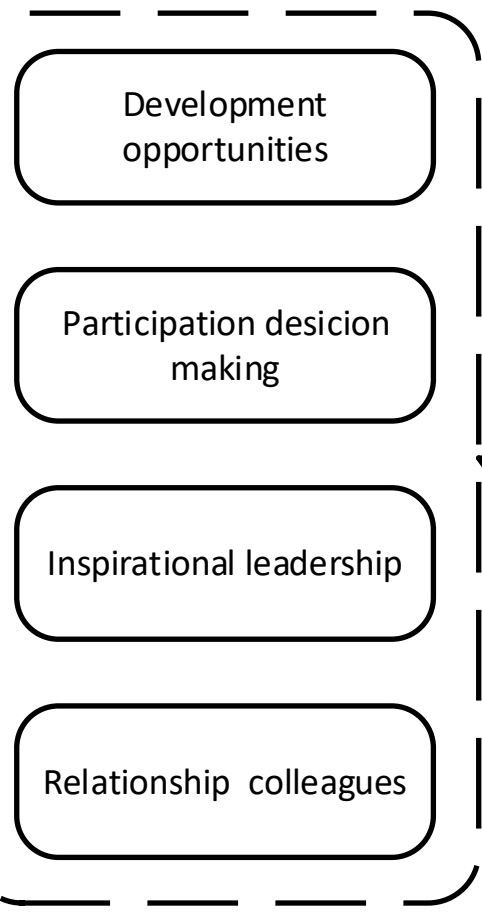
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49 19 Fig. 1. Conceptual model. Individual job demands and resources are investigated, not all relationships
50 20 are depicted for clarity reasons; dotted lines represent potential interactions of job demands and
51 21 resources.

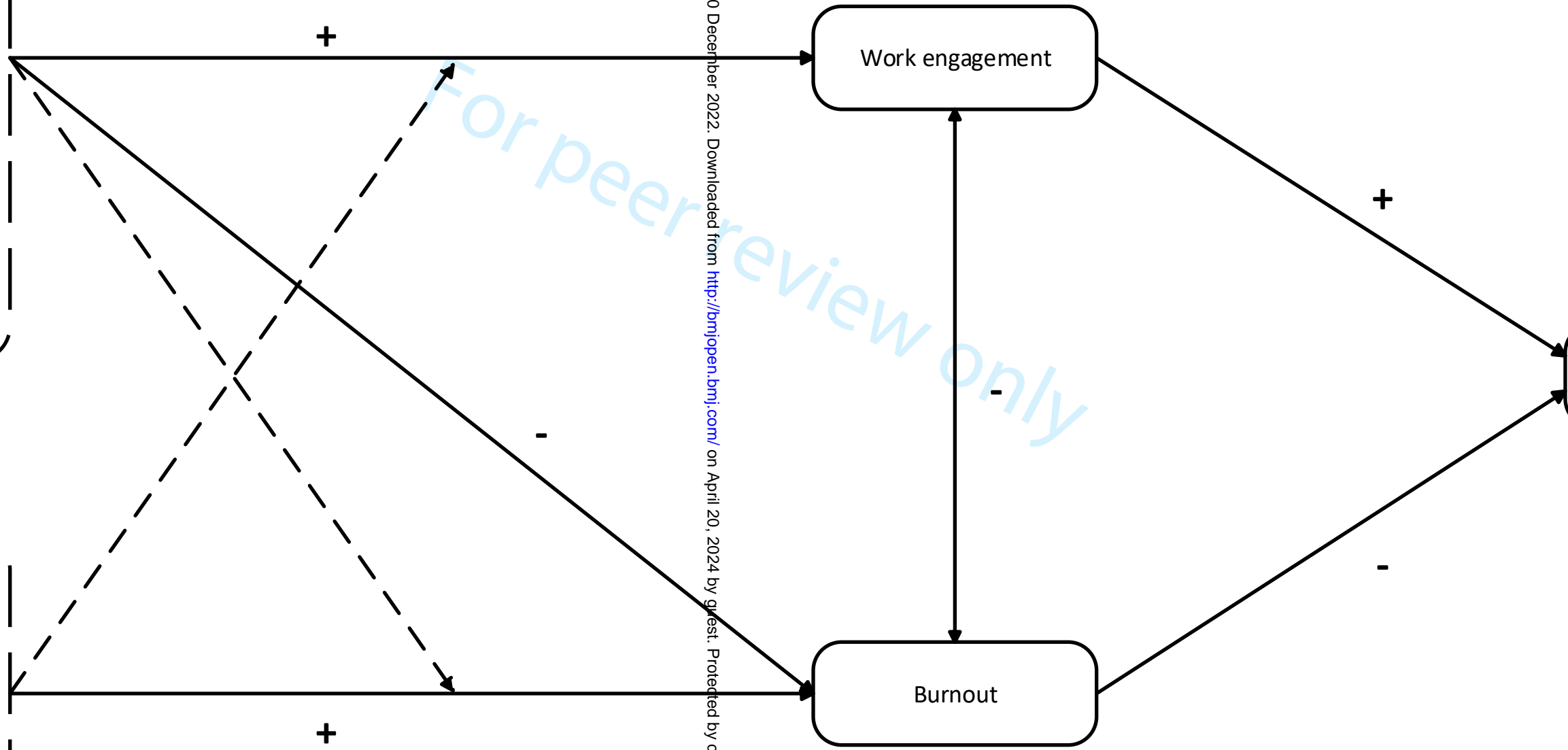
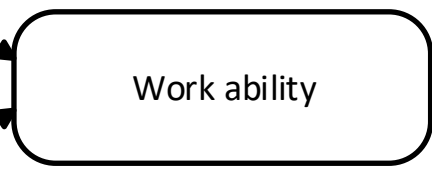
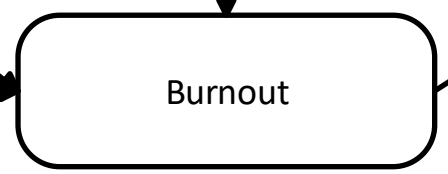
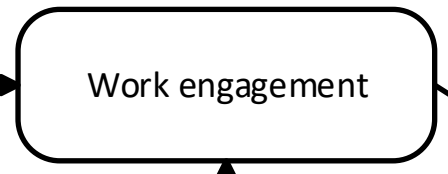
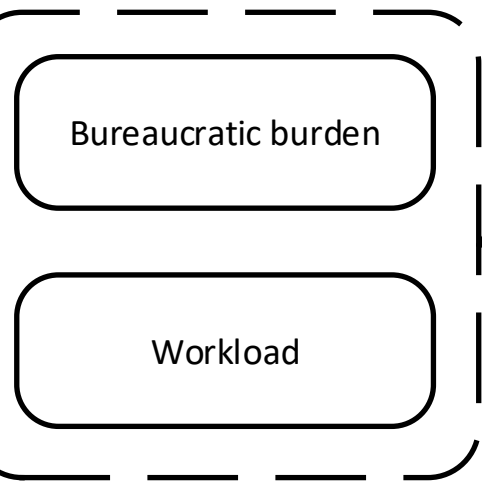
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54 22 Fig. 2. Structural model. Notes: n=385; **p<.001, *p<.05; standardized coefficients are displayed;
55 23 measurement model and covariance between exogenous variables are not displayed.
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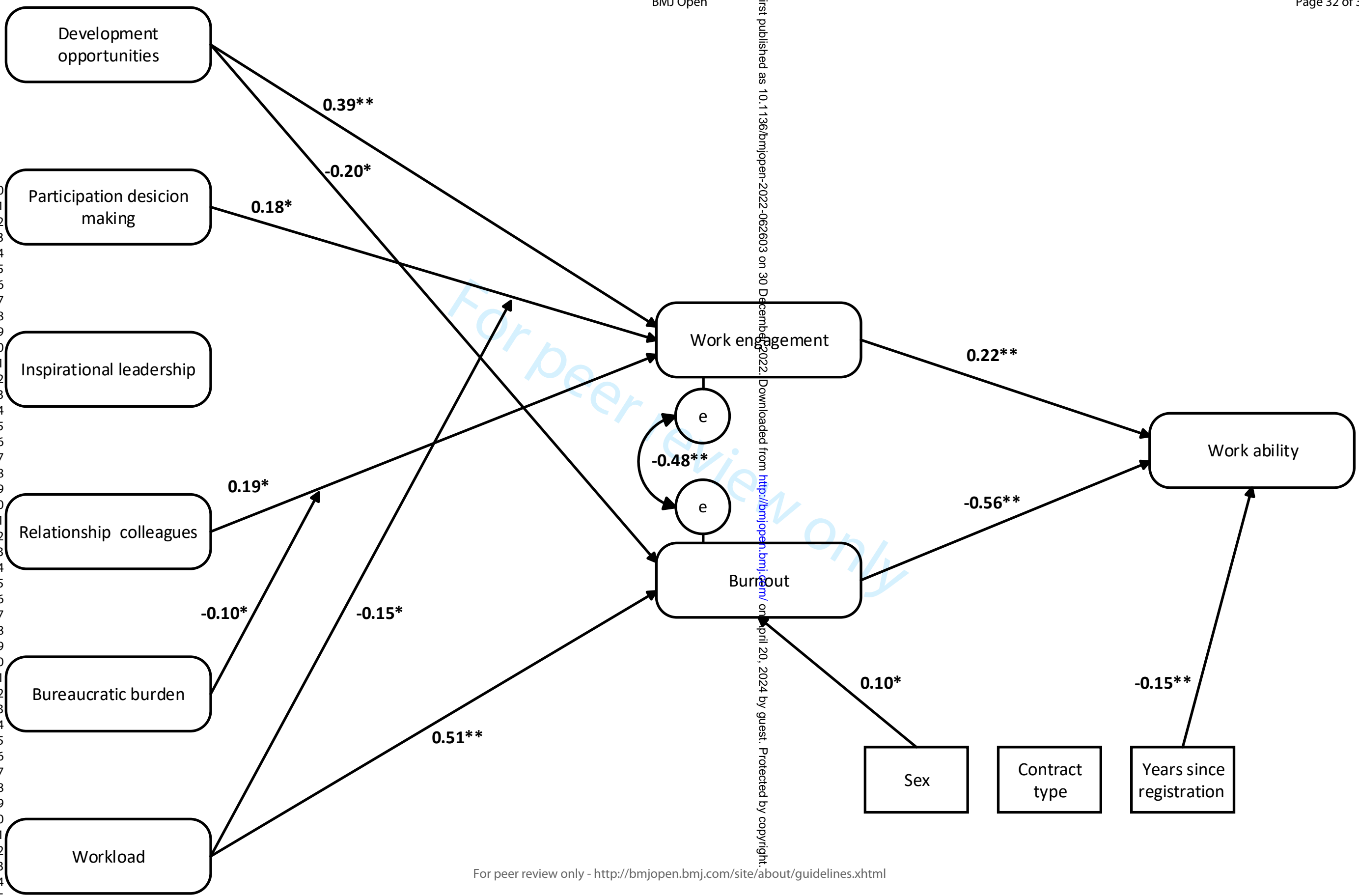
Job resources



Job demands



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Structural Equation Model <- '

#Measurement model, latent variables

Development opportunities (DO) =~ DO1 + DO2 + DO3

Participation decision making (PD) =~ PD1 + PD2 + PD34

Inspirational leadership (IL) =~ IL13 + IL2 + IL4

Relationship colleagues (RC) =~ RC1 + RC24 + RC35

Bureaucratic burden (BB) =~ BB1 + BB2 + BB3

Workload (WL) =~ WL24 + WL36 + WL15

Work engagement (WE) =~ WE125 + WE347 + WE689

Burnout (BO) =~ BO37 + BO248 + BO156

Work ability (WA) =~ WA136 + WA24 + WA78

WL*PD =~ WL24.PD1 + WL24.PD2 + WL24.PD34 + WL36.PD1 + WL36.PD2 + WL36.PD34 + WL15.PD1 + WL15.PD34

BB*RC =~ BB1.RC1 + BB2.RC24 + BB1.RC35 + BB2.RC1 + BB2.RC24 + BB2.RC35 + BB3.RC1 + BB3.RC24 + BB3.RC35

#Regressions

WE ~ a1*DO + a2*PD + IL + a3*RC + WL*PD + BB*RC

BO ~ a4*DO + PD + IL + RC + BB + a5*WL + Sex + Contract type

WA ~ b*WE + b1*BO + Sex + Contract type + Years since registration as medical specialist

Residual (co)variances

BO~~WE

#Indirect effects (independent variable / mediator / dependent variable)

DO/WE/WA := a1*b

PD/WE/WA := a2*b

RC/WE/WA := a3*b

DO/BO/WA := a4*b1

WL/BO/WA := a5*b1'

Latent variables									
Measurement model	Operator	Manif var.	estimate	se	z-value	sig	ci.lower	ci.upper	std.all
Development opp.	=~	DO1	1.000	0.000	NA	NA	1.000	1.000	0.709
Development opp.	=~	DO2	1.427	0.127	11.260	0.000	1.177	1.676	0.878
Development opp.	=~	DO3	1.078	0.106	10.149	0.000	0.866	1.286	0.765
Participation decision	=~	PD1	1.000	0.000	NA	NA	1.000	1.000	0.819
Participation decision	=~	PD2	0.981	0.057	17.164	0.000	0.866	1.093	0.844

bmjopen-2022-062063

Participation decision	=~	PD34	0.703	0.054	13.013	0.000	0.599	0.809	0.718
Inspirational leadership	=~	IL13	1.000	0.000	NA	NA	1.000	1.000	0.930
Inspirational leadership	=~	IL2	0.884	0.039	22.726	0.000	0.809	0.960	0.831
Inspirational leadership	=~	IL4	0.964	0.037	26.001	0.000	0.899	1.036	0.846
Relationship colleagues	=~	RC1	1.000	0.000	NA	NA	1.000	1.000	0.460
Relationship colleagues	=~	RC24	2.006	0.000	7.076	0.000	1.451	2.562	0.872
Relationship colleagues	=~	RC35	1.438	0.226	6.354	0.000	0.999	1.882	0.567
Bureaucratic burden	=~	BB1	1.000	0.000	NA	NA	1.000	1.000	0.626
Bureaucratic burden	=~	BB2	1.108	0.107	10.364	0.000	0.899	1.318	0.773
Bureaucratic burden	=~	BB3	1.084	0.109	9.983	0.000	0.871	1.296	0.769
Workload	=~	WL24	1.000	0.000	NA	NA	1.000	1.000	0.672
Workload	=~	WL36	1.322	0.091	14.573	0.000	1.141	1.500	0.906
Workload	=~	WL15	0.774	0.063	12.372	0.000	0.651	0.896	0.731
Work engagement	=~	WE125	1.000	0.000	NA	NA	1.000	1.000	0.820
Work engagement	=~	WE347	1.022	0.066	15.500	0.000	0.899	1.151	0.856
Work engagement	=~	WE689	0.930	0.061	15.206	0.000	0.811	1.050	0.732
Burnout	=~	BO37	1.000	0.000	NA	NA	1.000	1.000	0.806
Burnout	=~	BO248	1.172	0.055	21.277	0.000	1.061	1.280	0.901
Burnout	=~	BO156	1.028	0.053	19.323	0.000	0.921	1.132	0.867
Work ability	=~	WA136	1.000	0.000	NA	NA	1.000	1.000	0.845
Work ability	=~	WA24	1.087	0.063	17.356	0.000	0.961	1.210	0.803
Work ability	=~	WA78	1.041	0.062	16.753	0.000	0.911	1.162	0.803
Workload*participation d.	=~	WL24*PD1	1.000	0.000	NA	NA	1.000	1.000	0.644
Workload*participation d.	=~	WL24*PD2	0.990	0.069	14.424	0.000	0.851	1.124	0.678
Workload*participation d.	=~	WL24*PD34	0.713	0.084	8.516	0.000	0.541	0.878	0.550
Workload*participation d.	=~	WL36*PD1	1.210	0.110	10.963	0.000	0.994	1.426	0.768
Workload*participation d.	=~	WL36*PD1	1.152	0.119	9.698	0.000	0.911	1.385	0.784
Workload*participation d.	=~	WL36*PD34	0.828	0.126	6.574	0.000	0.581	1.075	0.646
Workload*participation d.	=~	WL15*PD1	0.785	0.099	7.972	0.000	0.591	0.979	0.686
Workload*participation d.	=~	WL15*PD2	0.788	0.103	7.686	0.000	0.581	0.989	0.701
Workload*participation d.	=~	WL15*PD34	0.564	0.099	5.715	0.000	0.371	0.757	0.573
Bureau. bur.*relation. col.	=~	BB1*RC1	1.000	0.000	NA	NA	1.000	1.000	0.378

Bureau. bur.*relation. col.	=~	BB1*RC24	1.726	0.338	5.110	0.000	1.0663	2.389	0.596
Bureau. bur.*relation. col.	=~	BB1*RC35	1.473	0.256	5.758	0.000	0.979	1.974	0.449
Bureau. bur.*relation. col.	=~	BB2*RC1	0.932	0.160	5.817	0.000	0.613	1.247	0.412
Bureau. bur.*relation. col.	=~	BB2*RC24	2.029	0.537	3.777	0.000	0.971	3.082	0.755
Bureau. bur.*relation. col.	=~	BB2*RC35	1.587	0.335	4.743	0.000	0.933	2.243	0.576
Bureau. bur.*relation. col.	=~	BB2*RC1	0.974	0.148	6.590	0.000	0.683	1.264	0.433
Bureau. bur.*relation. col.	=~	BB2*RC24	1.962	0.494	3.971	0.000	0.993	2.930	0.746
Bureau. bur.*relation. col.	=~	BB2*RC35	1.584	0.340	4.662	0.000	0.918	2.250	0.571
Regressions									
Dependent variable	Operator	predictor	estimate	se	z-value	sig	ci.lower	ci.upper	std.all
Work engagement	~	DO	0.561	0.122	4.601	0.000	0.323	0.800	0.387
Work engagement	~	PD	0.168	0.077	2.196	0.028	0.011	0.319	0.175
Work engagement	~	IL	0.044	0.056	0.790	0.430	-0.061	0.153	0.047
Work engagement	~	RC	0.590	0.194	3.039	0.002	0.211	0.971	0.194
Work engagement	~	WL*PD	-0.267	0.095	-2.798	0.005	-0.453	-0.080	-0.145
Work engagement	~	BB*RC	-0.371	0.152	-2.442	0.015	-0.663	-0.073	-0.095
Burnout	~	DO	-0.234	0.080	-2.920	0.004	-0.392	-0.077	-0.198
Burnout	~	PD	-0.088	0.055	-1.594	0.111	-0.197	0.020	-0.112
Burnout	~	IL	-0.042	0.038	-1.094	0.274	-0.119	0.033	-0.054
Burnout	~	RC	-0.274	0.146	-1.885	0.059	-0.560	0.011	-0.110
Burnout	~	BB	0.024	0.047	0.505	0.614	-0.069	0.117	0.023
Burnout	~	WL	0.716	0.083	8.681	0.000	0.553	0.878	0.511
Burnout	~	Sex	0.133	0.058	2.284	0.022	0.011	0.246	0.103
Burnout	~	Contract t.	0.053	0.058	0.919	0.358	-0.051	0.168	0.041
Work ability	~	WE	0.152	0.043	3.532	0.000	0.063	0.237	0.215
Work ability	~	BO	-0.483	0.062	-7.743	0.000	-0.604	-0.360	-0.558
Work ability	~	Sex	-0.015	0.055	-0.270	0.787	-0.181	0.094	-0.013
Work ability	~	Years regis.	0.167	0.050	3.327	0.001	0.063	0.265	0.150
Work ability	~	Contract t.	-0.015	0.058	-0.258	0.796	-0.129	0.099	-0.013
Covariances									
Latent variable (ltv)	Operator	Ltv abbr.	estimate	se	z-value	sig	ci.lower	ci.upper	std.all
Work engagement	~~	BO	-0.126	0.021	-5.883	0.000	-0.168	-0.084	-0.476

bmjopen-2022-062863

Development opp.	~~	PD	0.238	0.036	6.554	0.000	0.16693	0.309	0.537
Development opp.	~~	IL	0.168	0.031	5.473	0.000	0.1088	0.228	0.372
Development opp.	~~	RC	0.048	0.011	4.494	0.000	0.0283	0.069	0.343
Development opp.	~~	BB	-0.091	0.022	-4.123	0.000	-0.1514	-0.048	-0.272
Development opp.	~~	WL	-0.033	0.016	-2.121	0.034	-0.0683	-0.003	-0.133
Development opp.	~~	WL*PD	0.019	0.018	1.021	0.307	-0.0147	0.054	0.080
Development opp.	~~	BB*RC	0.001	0.006	0.232	0.817	-0.0121	0.014	0.013
Participation decision	~~	IL	0.330	0.044	7.494	0.000	0.2488	0.416	0.483
Participation decision	~~	RC	0.086	0.020	4.362	0.000	0.0419	0.125	0.407
Participation decision	~~	BB	-0.218	0.037	-5.853	0.000	-0.2914	-0.145	-0.433
Participation decision	~~	WL*PD	0.022	0.033	0.669	0.503	-0.0442	0.087	0.063
Participation decision	~~	BB*RC	-0.007	0.014	-0.484	0.628	-0.0381	0.020	-0.040
Inspirational leadership	~~	RC	0.069	0.017	3.994	0.000	0.0368	0.103	0.321
Inspirational leadership	~~	BB	-0.134	0.034	-3.979	0.000	-0.2000	-0.068	-0.260
Inspirational leadership	~~	WL	-0.070	0.022	-3.197	0.001	-0.1112	-0.027	-0.182
Inspirational leadership	~~	WL*PD	-0.011	0.023	-0.484	0.629	-0.0519	0.033	-0.031
Inspirational leadership	~~	BB*RC	-0.001	0.013	-0.079	0.937	-0.0127	0.025	-0.006
Relationship colleagues	~~	BB	-0.031	0.011	-2.838	0.005	-0.0513	-0.010	-0.196
Relationship colleagues	~~	WL	-0.023	0.008	-2.723	0.006	-0.0369	-0.006	-0.193
Relationship colleagues	~~	WL*PD	-0.007	0.008	-0.854	0.393	-0.0203	0.009	-0.064
Relationship colleagues	~~	BB*RC	0.005	0.006	0.832	0.405	-0.0067	0.018	0.101
Bureaucratic burden	~~	WL	0.053	0.019	2.794	0.005	0.0149	0.090	0.187
Bureaucratic burden	~~	WL*PD	0.013	0.017	0.737	0.461	-0.0111	0.047	0.049
Bureaucratic burden	~~	BB*RC	0.006	0.015	0.394	0.694	0.0219	-0.035	0.047
Workload	~~	WL*PD	0.011	0.018	0.614	0.539	-0.0212	0.047	0.057
Workload	~~	BB*RC	0.002	0.006	0.301	0.763	-0.0104	0.013	0.019
Workload*participation d.	~~	BB*RC	0.006	0.007	0.898	0.369	-0.0087	0.020	0.072
Variiances									
Variable	Operator	Variable	estimate	se	z-value	sig	ci.lower	ci.upper	std.all
DO1	NA	NA	0.290	0.034	8.508	0.000	0.2225	0.356	0.497
DO2	NA	NA	0.177	0.034	5.136	0.000	0.1088	0.244	0.228
DO3	NA	NA	0.242	0.029	8.224	0.000	0.1859	0.300	0.415

1	PD1	NA	NA	0.327	0.040	8.254	0.000	0.249	0.405	0.329
2	PD2	NA	NA	0.259	0.040	6.457	0.000	0.189	0.338	0.287
3	PD34	NA	NA	0.310	0.033	9.470	0.000	0.249	0.374	0.484
4	IL13	NA	NA	0.109	0.024	4.477	0.000	0.066	0.156	0.135
5	IL2	NA	NA	0.244	0.029	8.402	0.000	0.189	0.301	0.309
6	IL4	NA	NA	0.257	0.030	8.539	0.000	0.199	0.315	0.284
7	RC1	NA	NA	0.249	0.027	9.370	0.000	0.199	0.301	0.789
8	RC24	NA	NA	0.084	0.026	3.224	0.001	0.038	0.135	0.239
9	RC35	NA	NA	0.291	0.036	8.043	0.000	0.229	0.361	0.678
10	BB1	NA	NA	0.590	0.054	10.970	0.000	0.489	0.696	0.608
11	BB2	NA	NA	0.315	0.045	6.966	0.000	0.229	0.404	0.403
12	BB3	NA	NA	0.308	0.052	5.921	0.000	0.209	0.410	0.408
13	WL24	NA	NA	0.255	0.024	10.596	0.000	0.209	0.302	0.549
14	WL36	NA	NA	0.080	0.016	4.859	0.000	0.048	0.112	0.179
15	WL15	NA	NA	0.109	0.009	11.989	0.000	0.099	0.127	0.466
16	WE125	NA	NA	0.300	0.036	8.394	0.000	0.239	0.370	0.327
17	WE347	NA	NA	0.234	0.035	6.679	0.000	0.169	0.303	0.267
18	WE689	NA	NA	0.460	0.049	9.333	0.000	0.369	0.557	0.464
19	BO37	NA	NA	0.223	0.021	10.753	0.000	0.189	0.263	0.351
20	BO248	NA	NA	0.132	0.017	7.954	0.000	0.099	0.164	0.189
21	BO156	NA	NA	0.144	0.017	8.561	0.000	0.119	0.177	0.248
22	WA136	NA	NA	0.124	0.021	5.767	0.000	0.089	0.166	0.286
23	WA24	NA	NA	0.201	0.028	7.132	0.000	0.149	0.256	0.355
24	WA78	NA	NA	0.184	0.025	7.478	0.000	0.139	0.232	0.355
25	WL24*PD1	NA	NA	0.255	0.033	7.856	0.000	0.199	0.319	0.585
26	WL24*PD2	NA	NA	0.209	0.033	6.401	0.000	0.149	0.273	0.540
27	WL24*PD34	NA	NA	0.213	0.031	6.837	0.000	0.159	0.274	0.698
28	WL36*PD1	NA	NA	0.185	0.027	6.789	0.000	0.139	0.238	0.410
29	WL36*PD1	NA	NA	0.151	0.025	5.944	0.000	0.109	0.201	0.385
30	WL36*PD34	NA	NA	0.174	0.028	6.163	0.000	0.119	0.229	0.583
31	WL15*PD1	NA	NA	0.126	0.015	8.153	0.000	0.099	0.156	0.529
32	WL15*PD2	NA	NA	0.117	0.015	7.760	0.000	0.089	0.146	0.508

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WL15*PD34	NA	NA	0.118	0.019	6.067	0.000	0.083	0.156	0.672
BB1*RC1	NA	NA	0.245	0.037	6.674	0.000	0.179	0.317	0.857
BB1*RC24	NA	NA	0.221	0.035	6.320	0.000	0.158	0.290	0.645
BB1*RC35	NA	NA	0.351	0.054	6.531	0.000	0.244	0.457	0.799
BB2*RC1	NA	NA	0.174	0.025	7.033	0.000	0.122	0.222	0.830
BB2*RC24	NA	NA	0.127	0.016	7.861	0.000	0.091	0.158	0.429
BB2*RC35	NA	NA	0.208	0.029	7.274	0.000	0.152	0.264	0.669
BB2*RC1	NA	NA	0.168	0.028	5.897	0.000	0.112	0.224	0.812
BB2*RC24	NA	NA	0.126	0.019	6.470	0.000	0.088	0.164	0.444
BB2*RC35	NA	NA	0.212	0.028	7.547	0.000	0.151	0.267	0.674
Development opp.	NA	NA	0.293	0.054	5.441	0.000	0.182	0.399	1.000
Participation decision	NA	NA	0.668	0.067	10.022	0.000	0.531	0.799	1.000
Inspirational leadership	NA	NA	0.698	0.050	13.975	0.000	0.601	0.796	1.000
Relationship colleagues	NA	NA	0.067	0.019	3.554	0.000	0.031	0.103	1.000
Bureaucratic burden	NA	NA	0.380	0.062	6.088	0.000	0.251	0.503	1.000
Workload	NA	NA	0.210	0.030	6.940	0.000	0.151	0.269	1.000
Work engagement	NA	NA	0.357	0.045	7.862	0.000	0.261	0.446	0.580
Burnout	NA	NA	0.196	0.025	7.956	0.000	0.141	0.244	0.474
Work ability	NA	NA	0.146	0.019	7.858	0.000	0.111	0.182	0.473
Workload*participation d.	NA	NA	0.182	0.032	5.588	0.000	0.111	0.245	1.000
Bureau. bur.*relation. col.	NA	NA	0.041	0.015	2.688	0.007	0.019	0.071	1.000
Indirect effects									
Indp. var / mediator	Dep var	Operator	estimate	se	z-value	sig	ci.lower	ci.upper	std.all
DO / WE	WA	:=	0.085	0.031	2.794	0.005	0.023	0.145	0.083
PD / WE	WA	:=	0.026	0.014	1.872	0.061	-0.061	0.052	0.038
RC / WE	WA	:=	0.090	0.039	2.310	0.021	0.014	0.166	0.042
DO / BO	WA	:=	0.113	0.042	2.701	0.007	0.031	0.195	0.110
WL / BO	WA	:=	-0.346	0.057	-6.073	0.000	-0.457	-0.234	-0.285

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1,2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4,5,6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7,8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7,8
Bias	9	Describe any efforts to address potential sources of bias	9,10
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9,10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	10
		(b) Describe any methods used to examine subgroups and interactions	10
		(c) Explain how missing data were addressed	7,9
		(d) If applicable, describe analytical methods taking account of sampling strategy	NA
		(e) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	11,12
		(b) Give reasons for non-participation at each stage	NR
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11,12
		(b) Indicate number of participants with missing data for each variable of interest	11,12
Outcome data	15*	Report numbers of outcome events or summary measures	13
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	14

		(b) Report category boundaries when continuous variables were categorized	NA
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	18
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15-19
Generalisability	21	Discuss the generalisability (external validity) of the study results	18
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.