

OECD Social, Employment and Migration Working Papers
No. 195

Job quality, health and at-work productivity

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https://dx.doi.org/10.1787/43ff6bdc-en

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Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development

14-Jun-2017

English - Or. English

DIRECTORATE FOR EMPLOYMENT, LABOUR AND SOCIAL AFFAIRS
EMPLOYMENT, LABOUR AND SOCIAL AFFAIRS COMMITTEE

JOB QUALITY, HEALTH AND AT-WORK PRODUCTIVITY

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JEL Codes: I1, J2 and J8

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JT03415985

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ACKNOWLEDGEMENTS

This paper is the first product of a new OECD activity which will explore the link between job quality and productivity and eventually involve country reviews to identify policies that help to improve both, job quality and productivity. The activity will build on two earlier work streams of the OECD, the *Job Quality Framework* and the *Mental Health and Work* review. The authors would like to thank Luke Haywood and Marco Mira D'Ercole for detailed comments to an earlier version of the paper and Alexander Hijzen and Mark Pearson for general comments. The authors are responsible for any remaining shortcomings.

ABSTRACT

Many countries invest considerable resources into promoting employment and the creation of jobs. At the same time, policies and institutions still pay relatively little attention to the quality of jobs although job quality has been found to be a major driver of employee wellbeing and may be an important factor for work productivity. Eventually, job quality might also influence labour supply choices and lead to higher employment. Providing robust evidence for the relationship between job quality and worker productivity could make a strong case for labour market policies directed at the improvement of job quality. This paper reviews existing evidence on the relationship between the quality of the work environment and individual at-work productivity, defined as reduced productivity while at work, and assesses the effect of health on this relationship.

After screening 2 319 studies from various fields and disciplines, including economics and medicine, 48 studies are reviewed. Strong evidence is found for a negative relationship between job stress or job strain and individual at-work productivity and for a positive relationship between job rewards and productivity. Moderate evidence is found for a negative relationship between work-family conflict and at-work productivity and for a positive relationship between fairness at work and social support from co-workers and productivity. Health influences the relationship between the quality of the work environment and productivity. Specifically, the relationship is stronger for people in good health.

Job quality needs a more prominent place in labour market policy. More attention needs to be paid to workers' perceptions of the quality of their work environment and how policies and practices at both the level of the worker and the work environment may influence this. Furthermore, as health-related factors significantly influence the relationship between job quality and productivity, multidisciplinary approaches are needed to support at-work productivity.

RÉSUMÉ

De nombreux pays investissent des ressources considérables dans la promotion de l'emploi et la création d'emplois. Les politiques et les institutions continuent en même temps à accorder relativement peu d'attention à la qualité des emplois, bien que celle-ci soit un facteur majeur du bien-être des employés et peut-être un facteur important pour la productivité du travail. La qualité de l'emploi pourrait finalement influencer également les choix d'offre de main-d'œuvre et conduire à un emploi supérieur. Fournir des preuves solides sur la relation entre la qualité de l'emploi et la productivité des travailleurs pourrait constituer un argument de taille dans les politiques du marché du travail visant à améliorer la qualité de l'emploi. Cet article examine les résultats existants sur la relation entre la qualité de l'environnement professionnel et la productivité individuelle au travail, définie comme une productivité réduite et évalue l'effet de la santé sur cette relation.

Après avoir examiné 2 319 études dans divers domaines et disciplines, y compris l'économie et la médecine, 48 d'entre elles ont été reconsidérées. Des preuves solides ont ainsi pu mettre en évidence une relation négative entre stress ou tension au travail et productivité individuelle au travail, ainsi qu'une relation positive entre récompenses professionnelles et productivité. Un résultat modéré est mis en évidence dans le cas d'une relation négative entre conflit familiale et productivité au travail et dans le cas d'une relation positive entre équité au travail et soutien social des collègues et productivité. La santé influence la relation entre la qualité de l'environnement de professionnel et la productivité. Plus précisément, la relation est plus forte pour les personnes en bonne santé.

La qualité de l'emploi nécessite une place plus importante dans les politiques du marché du travail. Il est nécessaire d'accorder plus d'attention à la perception qu'ont les travailleurs de la qualité de leur environnement professionnel et à la manière dont les politiques et pratiques, tant au niveau du travailleur que de son environnement, peuvent influencer cette situation. De plus, du fait que les facteurs liés à la santé influent de manière significative la relation entre qualité de l'emploi et productivité, des approches multidisciplinaires sont nécessaires pour soutenir la productivité au travail.

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INTRODUCTION

This paper links and contributes to two streams of recent OECD work: i) the work on *Job Quality* which lead to the development of the OECD Job Quality Framework and ii) the work on *Mental Health and Work* which culminated in the release of the Recommendation of the OECD Council on Integrated Mental Health, Skills and Work Policy.

The OECD *Job Quality Framework* has underlined the importance of giving more prominence in policy and practice to the quality of the jobs created in a country to promote job-rich economic growth (Cazes, Hijzen and Saint-Martin, 2015). While countries are more focused on promoting the quantity of jobs and labour force participation, the quality of a job has been found to be a major driver of employee wellbeing and may be an important factor for sustainable work participation and work productivity (Catalina-Romero et al., 2015; Milner, Butterworth, Bentley, Kavanagh and LaMontagne, 2015; Stansfeld and Candy, 2006).

Following this, the OECD *Job Quality Framework* has provided a yardstick for assessing job quality, which allows comparisons over time and across countries and socio-demographic groups. In the Framework, job quality is assessed along three dimensions: earnings quality, labour market security and quality of the work environment. There is ample evidence that these dimensions contribute to employee wellbeing (Schaufeli and Taris, 2014; Stevenson and Wolfers, 2013; Green, 2011; Salvatori, 2010).

While employee wellbeing is an end in its own right, the OECD *Job Quality Framework* emphasises the importance of assessing the impact of job quality on work productivity to provide further justification for incorporating job quality in policy recommendations on labour market performance. Whereas the dimensions of earnings quality and labour market security are quantitative in nature and can be more easily related to work productivity and compared across contexts, the dimension of the quality of the work environment captures many qualitative aspects of employment that are less easily translated in terms of work productivity and less comparable.

The **first goal of this paper** is to review existing evidence on the relationship between the quality of the work environment and work productivity. While productivity is a multidimensional construct and can be operationalized in different ways – e.g. through annual working hours or output per hour worked or the number of sick-leave days –, we chose to specifically focus on *at-work productivity loss* which refers to a worker's reduced productivity, or performance, while at work.

Through the OECD *Mental Health and Work* review (OECD, 2012; OECD, 2015) it has become evident that participating in work and being productive at work is far more challenging for people with health problems compared to their peers without health problems, and even more so for people with *mental* health problems. For example, 70% of people with mild-to-moderate mental health problems report to have experienced reduced at-work productivity or performance compared to 30% of their peers without mental health problems (OECD, 2012). An important question arising is whether and in what way the relationship between the quality of the work environment and individual at-work productivity is influenced by health. The relationship may differ depending on the workers' health status or, workers' health could explain the relationship between the quality of the work environment and at-work productivity (in other words, a poor work environment may lead to reduced health which in turn may reduce the worker's productivity). A **second goal of this paper** is to assess the existing evidence on the effect of health on the relationship between the quality of the work environment and at-work productivity.

DEFINITIONS

The quality of the work environment, individual at-work productivity and also health can be measured and construed in a number of ways. It is not assumed that the particular definitions used in this paper are superior to alternative definitions, but it is important to be aware of the choice made to ensure clarity about the focus of this paper, and its findings.

At-work productivity

In the field of Work and Health, at-work productivity is often seen as one particular aspect of overall work productivity, in addition to absenteeism and work disability. Often, the focus is on assessing at-work productivity loss due to health problems. Examples of definitions of at-work productivity loss used in the literature include 'the inability to adequately perform one's work due to health problems,' 'having gone to work while hindered by health problems,' or 'perceiving difficulties in meeting work demands given one's (physical or mental) health.' In this strand of literature, at-work productivity is usually assessed from the perspective of the individual worker.

Different from that, the organisational psychology, human resource and business literature more frequently interpret at-work productivity as performance at work, with no specific connection to people's health status. Performance could be interpreted as an assessment of overall performance (or productivity), but often it is also further divided into, for example, in-role performance, extra-role performance, task performance, and others. While assessments by the individual worker are most common, in this field, supervisor ratings or team performance ratings are also used.

For this paper, the decision was made to define at-work productivity as either:

1. An assessment of the percentage of time or number of days one has (or has not) been productive or functioning well *while at work*, which could include a specific connection to health (i.e. problems with reduced productivity/functioning due to health problems); or

2. An overall assessment of one's performance or productivity while at work.

This particular choice has two major limitations, or implications. First, the focus in this paper is on a subjective assessment by the individual worker which may be quite remote from the "economic concept" of productivity because workers have no ways of observing firm's value added. Secondly, absenteeism is not included in this definition, i.e. the study only looks at performance or productivity of workers while at work. In other words, the paper is looking at productivity per hour of work whereas, by narrowing the analysis in this way, it omits any possible effects that a bad quality of the work environment might have on lowering productivity per worker for a given level of hourly productivity (by increasing sick leave and other absences from work). This effect could potentially be as large as the one considered in the paper.

Quality of the work environment

Two dominant theories on the quality of the work environment are the Effort-Reward Imbalance (ERI) and the Job Demands-Resources (JD-R) models (Bakker and Demerouti, 2007; Siegrist, 1996). The ERI model postulates reciprocity between effort, consisting of extrinsic job demands and intrinsic motivation to meet these demands, and rewards, consisting of salary, esteem, security and career opportunities. It is hypothesised that an imbalance between effort and rewards results in reduced worker wellbeing. The JD-R model theorises an interaction between job demands and job resources, where job demands refer to physical, psychological, social or organisational aspects that request effort or skills and job resources refer to physical, psychological, social or organisational aspects that help in achieving goals, reduce job demands and/or stimulate personal growth (Bakker and Demerouti, 2007). According to the JD-R model, job demands can

lead to reduced wellbeing and job resources to improved motivation. Adequate job resources may buffer the negative relationship between job demands and wellbeing. This implies that (additional) job demands are more problematic for workers if they do not have the job resources to cope with these demands. Similarly, (additional) job demands may reduce the positive relationship between job resources and motivation. The effort and reward concepts are also included in the JD-R model (as being part of demands and resources, respectively), but the specific trade-off hypothesis is not postulated in the JD-R model.

Many empirical studies have tried to validate the JD-R and ERI models, and there is evidence showing that the mechanisms described in these models are indeed related to worker wellbeing and motivation (e.g. burn-out and organisational commitment). Additionally, there is evidence for a relationship with absenteeism (Arnold B. Bakker & Demerouti, 2007; Catalina-Romero et al., 2015; Milner et al., 2015). However, less is known about studies that have looked at the balance of job demands and job resources and at-work productivity. Lagerveld et al. (2010) reviewed studies on the association between work factors and work functioning (which they defined as the productivity or performance of employees at work) and found only one factor to be associated, namely the type of occupation. However, this finding was based on only one study which was also cross-sectional in design. A more recent review by Miraglia and Johns (2016) combined correlations found in different studies between work factors and presenteeism (defined as "attending work when ill"). This meta-analysis of correlations identified multiple work factors as strongly correlated to presenteeism, including: role demands, workload, understaffing, working hours and physical demands. However, the review only focused on presenteeism as an outcome, while at-work productivity can be assessed in various other ways (for instance, an assessment of work performance or work functioning). An overview of study results on the relationship between the quality of the work environment and at-work productivity (as assessed in different ways) would add to the current literature.

In the OECD Job Quality Framework, quality of the work environment is defined largely along the lines of the JD-R model. The OECD job strain index takes several components and dimensions of the quality of the work environment into account, to identify the extent to which job demands exceed job resources. There is no consensus on a minimal set of ingredients to measure the quality of the work environment and, therefore, a minimal set of questions to be included in surveys that aim to examine the quality of the work environment. The forthcoming OECD *Guidelines on Measuring Quality of the Working Environment* will address conceptualisation and measurement issues.

In this paper, quality of the work environment is defined in the broader JD-R way of physical, psychological, social or organisational job demands and job resources. This includes psychosocial work factors such as psychological job demands, autonomy/job control, social support or job rewards, as well as more contextual work factors like organisational size, type of contract or job type. Notably, the paper is based on what factors and dimensions the studies reviewed have considered. Moreover, the terms quality of the work environment and work factors (which are seen as an operationalization of the quality of the work environment) are used interchangeably.

Health

Since 1948, the World Health Organisation defines health as "a state of complete physical, mental and social wellbeing and not merely the absence of disease of infirmity". This definition has been criticised in the past decades, especially for using the word 'complete' with respect to wellbeing. Probably, the requirement of complete health would render the majority of the population unhealthy. Recently, Huber and colleagues redefined health to a more dynamic concept of 'the ability to adapt and to self-manage, in the face of social, mental and physical challenges in life' (Huber et al., 2011). With this concept of health, people with physical, mental or social challenges who are able and enabled to cope well with these challenges are regarded as healthy. This positive and dynamic concept of health is still underused in research, where health is often assessed through the absence or presence of physical and/or mental health

problems, symptoms or disabilities. As this paper reviews the existing research literature, it defines health in line with the common approach i.e. the presence or absence of physical and/or mental health problems, symptoms or disabilities.

METHODS

Literature search

Scientific articles were searched in the following medical, psychological and economic literature databases: PubMed, PsycInfo, Business Source Elite and Web of Science. The search strategy consisted of search terms related to at-work productivity loss (e.g. presenteeism, job performance, work functioning) combined with terms related to work factors (e.g. work conditions, work stressors, psychosocial factors). No search terms on health were included as the primary goal was to identify research on the relationship between quality of the work environment and at-work productivity, regardless of the effect of health on this relationship. Including search terms related to health would restrict the number of studies that would be identified. Also, no restrictions were used on study type or year of publication, and the search included articles up until April 2016. The search string for each database can be found in the appendix. Additional articles were searched through scanning the reference list of included studies.

Inclusion of studies

One author (IA) screened all titles and abstracts of articles that were found through the literature search. In case of uncertainty of including or excluding an article the full text was retrieved, and if that would not solve the uncertainty discussion took place with a second author (CP or FA). Inclusion criteria for studies were: (1) empirical, quantitative data were presented on the relationship between work factors and at-work productivity; (2) at-work productivity was quantitatively assessed at the individual level by requesting (a) the percentage of time/number of days a worker has (not) been productive/functioning well at work or (b) a worker's overall rating of his/her own performance/productivity/functioning at work; (3) the included work factors had to represent the psychosocial quality of the work environment and could be either (a) objective characteristics (e.g. contract hours, manual/non-manual work) or (b) psychosocial characteristics (e.g. job demands, resources, workplace bullying); (4) the article should be written in English, Dutch or German; and (5) the study should take place in a real-life workplace setting, e.g. not in a simulated/laboratory setting. Articles using measures of work ability or specific aspects of job performance (e.g. in-role, extra-role, task or contextual performance) were excluded, as these do not provide an indication of the amount of time a worker is (not) functioning/being productive at work or an overall performance score. Furthermore, reviews were excluded, but their reference lists were checked for potentially relevant studies.

Data extraction

One author (IA) extracted data from the included studies on study type (cross-sectional, longitudinal), study year, country, study goal, population type, population size, response rate, exposure variables included, covariates controlled for, outcome variable, statistical method and study outcome (i.e. significant relationships between work factors and at-work productivity in final models).

Data synthesis

In order to ensure a degree of homogeneity, additional inclusion and exclusion criteria were formulated. Studies were only included if the relationship between work factors and at-work productivity was investigated through multivariable analyses including more than one work factor and at least two confounders, age and gender. Furthermore, the cut-off for significance in the multivariable model had to be set at $P<.05$. In case results were only presented for subgroups (e.g. age groups, occupational type) and

different outcomes were found across the subgroups, the study was excluded. Similarly, studies were excluded when multiple, different instruments for assessing at-work productivity were used, or when only scores on subscales of an instrument were reported. Finally, when different work factors were grouped together to present a single factor, the study was also excluded.

Effect coefficients (e.g. betas, risk ratios, odds ratios) of the relationship between work factors and at-work productivity were extracted from the final multivariable models (i.e. including all work factors and confounders analysed in the study). No meta-analyses were performed because of the high degree of heterogeneity between studies (e.g. different measures used for assessing work factors and at-work productivity). Instead, the findings were summarised by (a) the number of times similar work factors were assessed in different studies; (b) the number of times a statistically significant relationship with at-work productivity was found at $\alpha<.05$; and (c) the direction of the relationship that was found. Comparable work factors had to be assessed in at least three studies to be included in the quantitative synthesis. *Moderate evidence* for a work factor was defined as 50-74% of the studies finding a significant effect in the same direction, and *strong evidence* was defined as at least 75% of the studies finding a significant effect in the same direction. In these definitions of moderate and strong evidence, no difference was made between cross-sectional and longitudinal studies. However, results from longitudinal studies are described separately in this paper for work factors for which strong or moderate evidence was found, and in case a longitudinal study had found a significant relationship even though there was no strong or moderate evidence based on the combination of studies. This was done as only longitudinal studies are able to provide insight into the direction of relationships.

The second goal of the paper is to summarise the effect of health on the relationship between work factors and at-work productivity. Therefore, data were abstracted from studies that looked at health in one of three ways: (a) as *mediator* of the relationship between work factors and at-work productivity; (b) as *confounder* of the relationship between work factors and at-work productivity; or (c) as *moderator* of the relationship between work factors and at-work productivity. For the studies looking at mediation, information was abstracted on the significant mediation paths that were found between work factors, health and at-work productivity. For studies on confounding, the effect coefficients were compared of (a) the relationship between a work factor and at-work productivity controlling for all other included work factors and confounders except health; and (b) the relationship between a work factor and at-work productivity controlling for all other included work factors and confounders including health. In case no information was available on the separate confounding effect of health, authors were contacted to request this additional information. For studies on moderation, information was abstracted on the difference in the relationship between work factors and at-work productivity for people in good and bad health.

RESULTS

Results of the search

Figure 1 presents a flow diagram of included and excluded studies. The initial search in the databases resulted in 3 140 references and 21 studies were identified through reference checking of included studies. After removing duplicate references, 2 319 references remained. Based on title and abstract screening, 2 249 studies were excluded, mostly because studies did not assess at-work productivity following the inclusion criterion described above. Full-text reading of the 70 remaining studies resulted in a further exclusion of 22 articles. Reasons for exclusion are presented in Figure 1. Thus, finally, 48 studies were included in this paper.

Characteristics of included studies

The main characteristics of the studies included in the analysis are summarised in Table 1. The majority of the studies (79%) were published between 2010 and 2016 and conducted in various countries; e.g. the US, Canada, Australia, Japan, Korea and several European countries. The number of participants included in a study varied greatly, with the smallest study containing only 68 participants and the largest study as many as 78 587 participants. Overall, 62% of the studies had more than 1 000 participants. In the majority of studies, participants were recruited through one or several companies. Three studies used a European survey and 13 studies recruited participants through national surveys or selected a nationally representative sample. In eight studies, participants with a specific health problem were recruited; in three studies this related to mental health problems and in five studies to physical health problems.

Table 1 also provides information on several methodological aspects of the included studies. Most studies (77%) had a cross-sectional as opposed to a longitudinal design, which implies that drawing conclusions on the direction of the relationship (i.e. the causality) between work factors and individual at-work productivity remains difficult. Furthermore, 66% of the studies included four important confounders, i.e. age, gender, health (either physical or mental) and educational level/skill level. Of the 31 studies (66% of all included studies) that reported the response rate, 35% had a response rate below 50%. Finally, the large majority of the studies (85%) had sufficient power for the analyses that were conducted.

Instruments to assess at-work productivity varied across studies. About half of the studies used one self-report question on the number of days (mostly within a timeframe of 12 months) one had been at work despite health problems, which is often referred to as "presenteeism". Six studies assessed the percentage of time people experienced difficulties with executing their work tasks due to health problems measured through either the Work Role Functioning Questionnaire or the Work Limitations Questionnaire. There were nine studies that assessed self-rated performance or productivity at work. Opposed to all other studies, in these nine studies, no specific reference was made to the effect of health on at-work productivity. Table 2 provides an overview of the different instruments to assess at-work productivity that were used, and whether instruments specifically referred to health-related at-work productivity.

Figure 1. Flow diagram of included studies in the review

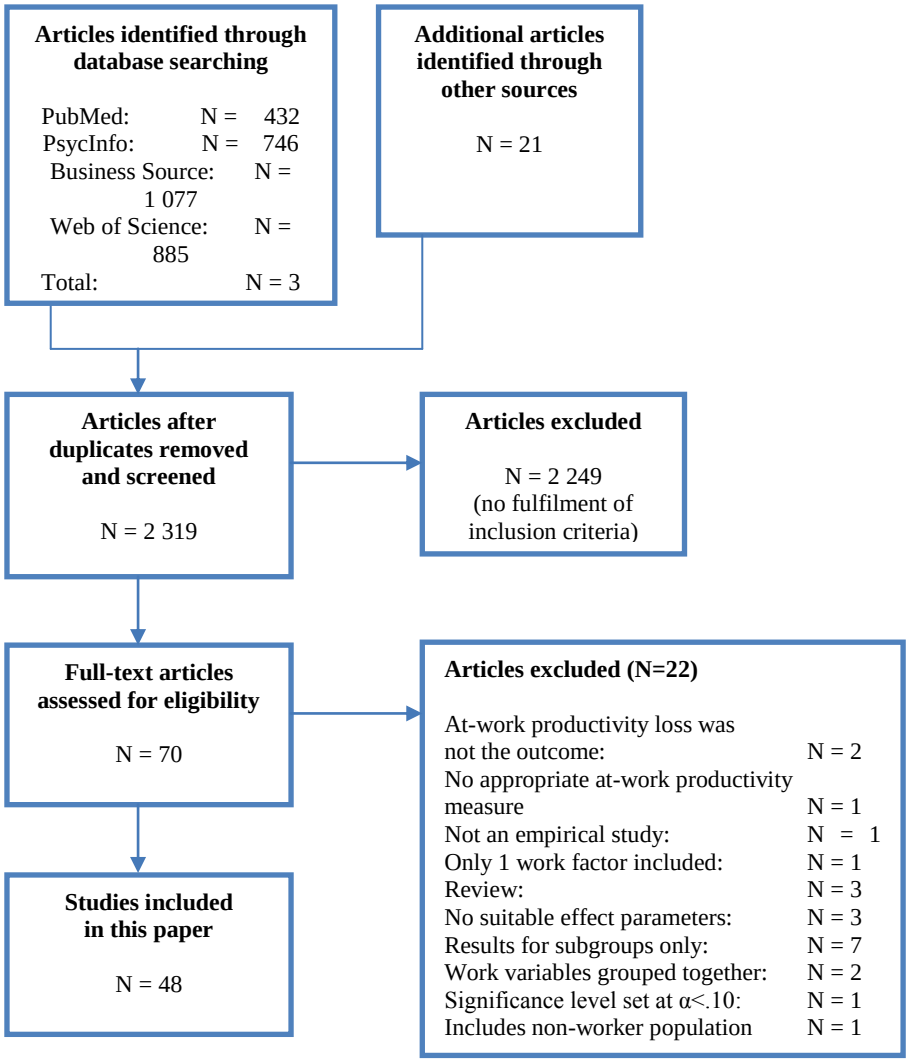


Table 1. Summary of study characteristics

Study #	Study	Country	N	Mean age	% male	Pop. type	Spec. disorder?	Study type	Outcome measure	Number of work variables included	Response rate	Confounders#	Suff. Power*
1	Abma 2014	Netherlands	98	44.6	54%	General working population	No	Longitudinal	Work role functioning questionnaire	7	53%	No	Yes
2	Alavinia 2009	Netherlands	2 252	43.0	69%	Workers in 24 different companies of 15 different branches	No	Cross-sectional	Quantity and Quality Instrument	4	56%	Yes	Yes
3	Amick 2004	US	128	n.r.	n.r.	Patients from community-based physician offices	Carpal tunnel syndrome	Longitudinal	Work role functioning questionnaire	7	n.r.	Yes	Yes
4	Arnold 2016	34 European countries	18 953	n.r.	54%	Participants in a European survey	No	Cross-sectional	One question on working despite illness/injury	15	n.r.	Yes	Yes
5	Aronsson 2005	Sweden	2 897	n.r.	53%	Participants in a supplement to Sweden's regular labor market survey	No	Cross-sectional	One question on working despite illness/injury	5	69%	Yes	Yes
6	Böckerman 2010	Finland	725	n.r.	58%	Member of the Central Organisation of Finnish Trade Unions	No	Cross-sectional	One question on working despite illness/injury	8	70%	No	Yes
7	Boonen 2015	Belgium	80	38.1	50%	Patients in an observational study	Ankylosing spondylitis	Cross-sectional	Work Productivity & Impairment Scale - Ankylosing Spondylitis	12	100%	Yes	Unclear
8	Bubonya 2016	Australia	16 513	n.r.	n.r.	Participants in a national survey	No	Cross-sectional	Self-selected presenteeism questions	4	n.r.	Yes	Yes
9	Chang 2015	Taiwan	816	36.0	63%	Employees from 5 different sectors	No	Cross-sectional	One question on working despite illness/injury	2	55%	Yes	Yes
10	Cho 2016	Korea	29 246	n.r.	61%	Participants in a national work survey	No	Cross-sectional	One question on working despite illness/injury	17	n.r.	No	Yes
11	Cocker 2011	Australia	320	n.r.	47%	Participants in a national survey	Major depression	Cross-sectional	One question on working despite illness/injury	3	n.r.	Yes	Yes
12	Coutu 2015§	Canada	2 261	n.r.	24%	Government employees	No	Cross-sectional	Work role functioning questionnaire	8	48%	Yes	Yes
13	d'Errico 2016	32 European countries	30 279	n.r.	54%	Participants in a European survey	No	Cross-sectional	One question on working despite illness/injury	41	44%	Yes	Yes
14	de Vries 2015	Netherlands	68	43.9	55%	Patients in an intervention study	Major depression	Longitudinal	Work Limitations Questionnaire	7	n.r.	Yes	No
15	de Vries 2013	Netherlands	119	48.3	40%	Patients with chronic non-specific musculoskeletal pain	Chronic non-specific musculoskeletal pain	Cross-sectional	WHO Health & Work Performance Questionnaire Short Form	6	n.r.	Yes	No
16	de Vroome 2010	Netherlands	653	41.1	53%	Survey participants representative for Dutch employees and self-employed	No	Longitudinal	One question on working despite illness/injury	2	45%	Yes	Yes
17	Deery 2014	UK	227	38.9	46%	Staff of emergency call centre	No	Cross-sectional	One question on working despite illness/injury	5	48%	No	Yes
18	Demerouti 2009§	Netherlands	781	37.0	24%	Staff nurses	No	Longitudinal	One question on working despite illness/injury	3	74%	No	Yes
19	Dhaini 2016	Switzerland	3 176	n.r.	8%	Care workers	No	Cross-sectional	One question on working despite illness/injury	11	77%	Yes	Yes
20	Donald 2005	UK	16 001	n.r.	38%	Employees across 15 different organisations	No	Cross-sectional	Self-rated performance score	10	n.r.	n.r.	Yes
21	Elstad 2008	Norway	2 077	n.r.	0%	Lower level care workers in Sweden, Denmark, Norway and Finland	No	Cross-sectional	One question on working despite illness/injury	3	67 - 75%	No	Yes
22	Gerich 2014	Austria	781	43.1	49%	Random sample of employees covered by the Upper Austrian Sickness Fu	No	Cross-sectional	One question on working despite illness/injury	3	31%	Yes	Yes
23	Geuskens 2008	Netherlands	210	45.0	28%	Patients participating in the Rotterdam early arthritis cohort	Inflammatory joint conditions	Longitudinal	Quantity and Quality Instrument	8	n.r.	Yes	Yes
24	Hansen 2008	Denmark	12 935	n.r.	51%	Participants in a national survey	No	Cross-sectional	One question on working despite illness/injury	12	68%	Yes	Yes
25	Holden 2010	Australia	78 587	n.r.	35%	Employees of 58 large companies	No	Cross-sectional	Self-rated performance score	10	25%	Yes	Yes
26	Janssens 2016	Belgium	2 983	43.3	46%	General workforce	No	Cross-sectional	One question on working despite illness/injury	7	30%	Yes	Yes
27	Jeon 2014	Korea	6 220	40.5	49%	Participants in a national survey	No	Cross-sectional	One question on working despite illness/injury	10	n.r.	Yes	Yes
28	Johansson 2015	Sweden	2 397	37.2	46%	National cohort	No	Longitudinal	One question on working despite illness/injury	3	82%	Yes	Yes
29	Johansson 2004	Sweden	4 924	n.r.	44%	Random sample of inhabitants from the county of Stockholm	No	Cross-sectional	One question on working despite illness/injury	2	64-81%	No	Yes
30	Karlsson 2010	Sweden	2 095	43.0	87%	Employees from 4 companies	No	Longitudinal	One question on working despite illness/injury	10	n.r.	Yes	Yes
31	Kennedy 2014	Canada	146	50.5	61%	Patients with Psoriatic Arthritis	Psoriatic Arthritis	Cross-sectional	Work Limitations Questionnaire	5	n.r.	Yes	No
32	Kim 2014	Korea	43 392	n.r.	63%	Participants in a national survey	No	Cross-sectional	One question on working despite illness/injury	13	n.r.	Yes	Yes
33	Leineweber 2011	Sweden	11 793	n.r.	76%	Police officers	No	Cross-sectional	One question on working despite illness/injury	6	n.r.	Yes	Yes
34	McTernan 2013§	Australia	2 790	46.0	50%	General population	No	Longitudinal	WHO Health and Work Performance Questionnaire	2	31%	No	Yes
35	Merrill 2012	US	19 803	n.r.	38%	Employees the insurance and health care industry	No	Cross-sectional	Self-selected presenteeism questions	4	n.r.	Yes	Yes
36	Muckenhuber 2013	34 European countries	43 816	41.2	52%	Random sample of workers in Europe	No	Cross-sectional	One question on working despite illness/injury	3	n.r.	No	Yes
37	Musich 2006	Australia	1 523	40.7	59%	Employees across diverse sectors	No	Cross-sectional	Self-selected presenteeism questions	6	19%	Yes	Yes
38	Nagami 2010	Japan	777	40.6	82%	Employees from an electric device manufacturing company	No	Longitudinal	Self-rated performance score	4	97%	No	Yes
39	Nakagawa 2014	Japan	1 198	36.9	38%	Employees from a manufacturing company	No	Cross-sectional	WHO Health & Work Performance Questionnaire Short Form	5	99%	No	Yes
40	Nakagawa 2015	Japan	1 108	37.0	38%	Employees from a manufacturing company	No	Longitudinal	WHO Health & Work Performance Questionnaire Short Form	4	99%	No	Yes
41	Nyberg 2008	Sweden	5 141	47.7	47%	Participants in a national work survey	No	Cross-sectional	One question on working despite illness/injury	10	64%	Yes	Yes
42	Pit 2016	Australia	92	51.0	55%	General practitioners member of The Northern Rivers General Practice Ne	No	Cross-sectional	One question on working despite illness/injury	4	59%	Yes	No
43	Plaisier 2012	Netherlands	1 522	41.5	35%	Participants in a national survey	Depressive and/or anxiety disorder	Cross-sectional	Health and Labour Questionnaire Short Form	5	88%	Yes	Yes
44	Pohling 2016	Germany	885	42.0	20%	Employees from tax offices	No	Cross-sectional	One question on working despite illness/injury	6	74%	No	Yes
45	Rantanen 2011	Finland	171	40.6	15%	Physicians and nurses	No	Cross-sectional	One question on working despite illness/injury	11	63%	Yes	Yes
46	Robertson 2012§	UK and Europe	6 309	n.r.	27%	Employees from the health, education and government sector	No	Cross-sectional	One question on working despite illness/injury	7	45%	No	Yes
47	van den Berg 2011	Netherlands	10 542	44.0	57%	Workers from different sectors	No	Cross-sectional	Quantity and Quality Instrument	5	58%	No	Yes
48	Wang 2010	Canada	4 302	42.7	54%	Participants in a household survey	No	Cross-sectional	Stanford Presenteeism Scale	11	44%	Yes	Yes

Notes: § These studies were only included in the results on health as a mediator of the relationship between work factors and at-work productivity; # The included relevant confounders are at a minimum: age; gender; educational or skill level or job position; health (physical and/or mental); * Sufficient power is defined as having at least a number of cases in the analyses that is 10 times the number of included independent variables.

Table 2. Instruments used across studies to assess at-work productivity

Study	Instrument to assess at-work productivity	Instrument includes health
Abma 2014; Amick 2004; Coutu 2015	Work Role Functioning Questionnaire (WRFQ) assessing the perceived difficulties in meeting work demands given one's physical health or emotional problems. The total score ranges between 0-100 with higher scores indicating better work functioning.	Yes
Boonen 2015	Work Productivity and Activity Impairment (WPAI) questionnaire assessing the extent to which health affected productivity at work on a scale of 0-10.	Yes
Bubonya 2016	Short Form Health Survey (SF-36) assessing whether, as a result of any emotional problems, one has experienced any of the following: "cutting down the amount of time spent on your work or other activities"; "accomplished less than you would like"; and "didn't do work or other activities as carefully as usual". "Yes" to any of the questions is recorded as presenteeism.	Yes
Arnold 2016; Aronsson 2005; Böckerman 2010; Chang 2015; Cho 2016; D'Errico 2016; de Vroome 2010; Deery 2014; Demerouti 2008; Dhaini 2015; Elstad 2008; Gerich 2014; Hansen 2008; Janssens 2016; Jeon 2014; Johansson 2015; Johansson 2004; Karlsson 2010; Kim 2014; Leineweber 2011; Muckenhuber 2013; Nyberg 2008; Pit 2016; Pohling 2016; Rantanen 2011; Robertson 2012	One question on the number of days one has gone to work despite illness/injury/health problems. E.g.: "Over the past 12 months did you work when you were sick?" "Has it happened over the previous 12 months that you have gone to work despite feeling that you really should have taken sick leave because of your state of health?" "During the past 12 months, have you gone to work despite feeling that you should have taken sick leave?"	Yes
Cocker 2011	One question on the number of days that, in the absence of absenteeism, one was totally unable to work or carry out normal activities because of sadness/discouragement/lack of interest.	Yes
de Vries 2013; Holden 2010; Nagami 2010; Nakagawa 2014; Nakagawa 2015	One item on self-rated performance scored on a 0-10 response scale where 0 represents a total lack of performance/worst performance and 10 no lack of performance/best performance during time of the job.	No
Donald 2005	One item on self-rated productivity scored on a 5-point Likert scale ranging from 1 = 100% productive to 5 = less than 70% productive.	No
de Vries 2015; Kennedy 2014	Work Limitations Questionnaire (WLQ) assessing the impact of health problems on at-work performance and productivity. An overall productivity score is calculated, which expresses the percentage loss in productivity associated with health problems.	Yes
McTernan 2013	Presenteeism was assessed using a question from the HPQ: what is one's overall job performance on a scale from 0 (worst performance anyone could have) to 10 (performance of a top worker). First, performance loss was calculated by deducting this performance score from the maximum score (10). Then, by deducting the mean performance loss scores of participants who reported no depression from the participants who reported depression, a percentage increase in scores of performance loss that was related to depression was derived as an indicator of presenteeism.	Yes
Merril 2012	Twelve selected questions from the HPQ and WPAI. The stem of the question read, ''During the past four weeks (28 days), how often have you been at work but had trouble concentrating or doing your best because of…'' The 12 extensions to the question were (1) your health or physical condition, (2) your responsibilities taking care of someone else, (3) lack of resources (people, material, or information), (4) issues with coworkers, (5) having too much to do and not enough time, (6) issues with supervisor(s), (7) lack of sufficient training, (8) personal problems or worries, (9) depression or anxiety, (10) regulatory or legal requirements, (11) technology issues, or (12) financial stress/concerns. An overall 100-point presenteeism index score is calculated.	Yes
Musich 2006	Five presenteeism questions as follows: In the past 4 weeks how much time did your stress levels, physical or emotional health make it difficult for you to do the following: (1) Work your required number of hours; (2) Use your equipment properly (e.g., keyboard, mouse, tools, or machinery); (3) Concentrate on your work; (4) Work effectively with others; (5) Work to the best of your ability. A summary presenteeism score is calculated on a scale of 0% (no impairment) to 100% (completely impaired).	Yes
Plaisier 2012	Health and Labour Questionnaire Short Form (SF-HLQ), scoring the number of days one has been working while hindered by health problems and how efficient one has been working on these days on a score from 0-1. Work performance was computed by the formula: *# days hindered x (1-efficiency) x # work hours per day / # work hours per week* , in which higher rates indicate more impairment.	Yes
Alavinia 2009; Geuskens 2008; van den Berg 2011	Quantity question of the Quantity and Quality Instrument assessing how much work one has actually performed during regular hours on the most recent regular workday relative to a normal workday on scale from 0 (nothing) to 10 (normal quantity).	No
Wang 2010	6-item Stanford Presenteeism Scale (SPS-6) assessing one's ability to concentrate and accomplish work despite health problems. Higher scores indicate a high likelihood of presenteeism or impaired job performance.	Yes

Relationship between quality of the work environment and at-work productivity

Table 3 summarises the relationships that were identified in the included studies between work factors and at-work productivity. S*trong evidence*[1] was found for a negative relationship between job stress and job strain and at-work productivity and for a positive relationship between job rewards and productivity. *Moderate evidence*[2] was found for a negative relationship between work-family conflict and at-work productivity and for a positive relationship between fairness at work and social support from co-workers and productivity.

Table 3 shows for each work factor the number of studies that had a longitudinal design and whether these studies found a significant relationship between the work factor and individual at-work productivity:

- For job strain, the only longitudinal study included in the analysis (study 16) showed that presenteeism in 2004 was not explained by job strain in 2002.
- The only longitudinal study on fairness at work (study 40) found a significant effect with at-work productivity; participants scoring high on fairness (assessed as procedural justice) in 2009 and 2010 had significantly higher job performance scores in 2010 compared to participants scoring low on fairness at both points in time. ,
- Two out of four longitudinal studies looking at 'social support from co-workers' found a significant relationship with at-work productivity. Low support from colleagues predicted reduced work performance at 6 and 12 months follow-up (study 23); and co-worker support in 2008 was positively related to job performance in 2009 (study 38).
- For psychological job demands, only one out of five longitudinal studies included in the analysis found a significant relationship with productivity; according to this study (study 30), job demands at baseline increased the odds of presenteeism one year later and a change in job demands (from baseline to 1-year follow-up) led to increased odds for presenteeism over time (from 1-year to 2-year follow-up). However, this study did not control for at-work productivity at baseline (the four studies that did not find an effect did control for this).
- Similarly, of the six longitudinal studies that looked at the relationship between job control and at-work productivity, four found no significant relationship between baseline job control and at-work productivity at 2, 3, 6 or 12-month follow-up (study 1, study 3, study 23 and study 28). Again, study 30 found a relationship (job control at baseline decreased the odds of presenteeism one year later and a change in job control decreased the odds of presenteeism over time) and this finding was confirmed by another study, which found that baseline job control predicted job performance one year later (study 38).

For several work factors, different studies found results in the opposite direction. For example, for job rewards four studies found a positive association with productivity and one study a negative association. There might be obvious explanations for such seemingly conflicting findings. Positive work factors such as job rewards, job control and good leadership may on the one hand contribute to employee wellbeing and as such have a positive effect on productivity. On the other hand, a negative effect may be expected if people experience health or other problems that interfere with their productivity, but try to keep going out of loyalty for the good work conditions they experience.

[1] Strong evidence was defined as ≥75% of the studies (that assessed the respective work factor) finding a significant effect in the same direction.

[2] Moderate evidence was defined as 50-74% of the studies (that assessed the respective work factor) finding a significant effect in the same direction.

Table 3. Summary of statistically significant relationships between work factors and at-work productivity loss[a]

Stong evidence **Moderate evidence**

Work factors[b]	No. of studies included[c]	No. of studies that found a relationship[c]	Direction of relationship with productivity[d]	Which studies
Job stress[1]	4	4	All studies: -	8, 10, 21, 33
Job rewards	5	5	1 study: - 4 studies: +	13, 26, 27, 39, 44
Job strain	4 (1)	3	All studies -	10, 13, 16, 48
Work-family conflict[2]	7	5	All studies -	10, 13, 20, 26, 37, 42, 48
Fairness[3]	3 (1)	2 (1)	All studies +	17, 40, 44
Social support from co-workers[4]	14 (4)	7 (2)	All studies +	1, 7, 10, 13-15, 19, 23, 24, 30, 33, 38, 39, 48
Having a supervisory role	7	3	All studies -	4, 7, 13, 23-25, 37
Psychological job demands[5]	17 (5)	7 (1)	All studies -	1-3, 10, 13, 23, 24, 26, 27, 30, 36, 38, 39, 42, 43, 47, 48
Workload	5 (1)	2	All studies -	14, 17, 19, 20, 44
Shift work[6]	6	3	2 studies: - 1 study: +	6, 7, 13, 24, 27, 45,
Physical demands[9]	8 (1)	4	3 studies: - 1 study: +	2, 13, 15, 23, 31, 36, 42, 47
Job control[8]	28 (6)	13 (2)	3 studies: - 10 (2) studies: +	1-5, 8, 10, 13-15, 19, 20, 23-25, 26-30, 33, 36, 38, 39, 43, 44, 47, 48
Work hours[9]	14	5	All studies -	4, 6, 7, 9, 11, 13, 21, 24, 25, 27, 31, 42, 43, 45
Non-standard employment contract[10]	7	3	1 study: - 2 study: +	4, 6, 7, 13, 15, 24, 32
Good leadership	5 (1)	2	1 study: - 1 study: +	19, 30, 33, 37, 41
Job insecurity	11 (1)	4	2 studies: - 1 study: +	3, 4, 8, 10, 13, 14, 20, 24, 25, 27, 48
Company size	6 (1)	1	+	3, 4, 6, 7, 13, 24
Job support[11]	8 (1)	1	+	3, 4, 19, 20, 26, 27, 31, 43
Social support from supervisor[12]	11 (3)	2	1 study: - 1 study: +	1, 10, 13-15, 19, 23, 33, 38, 39, 48

a) The table only includes results from studies in which multivariable regression analyses were performed (with controls).

b) Only work factors that have been assessed in at least three different studies are reported. The ordering of the factors is based on the percentage of studies that found a relationship in the same direction.

c) Number of **longitudinal studies** in brackets; if nothing is reported the number is 0.

d) + = positive relationship; - = negative relationship.

1) This includes feeling under stress while performing work and experiencing the job as stressful.

2) This also includes work-family/work-life imbalance.

3) This also includes procedural, distributive and interactional justice.

4) This also includes relationship with co-workers, collaboration with co-workers, quality of contact with colleagues

5) This also includes work intensity (working at high speed and with strict deadlines).

6) This also includes non-standard work times and irregular working hours.

7) This also includes a physical job and physical load.

8) This includes decision authority, decision latitude, work autonomy, and control over work tasks and over pace of work.

9) This also includes overtime.

10) This includes studies comparing permanent, full-time contracts with other non-standard employment contracts.

11) This includes general job support, support from colleagues and supervisors (as one measure), support from other personnel.

12) This also includes relationship with supervisor, collaboration with supervisor.

Similarly, increased worries on job insecurity could reduce productivity, but they could also stimulate people to work harder to increase their chances of remaining in the organisation. Furthermore, in Table 3 studies are combined that assess at-work productivity in different ways. About half of the studies assess at-work productivity loss by requesting whether people had been at work while they should have stayed at home because of health problems. High physical job demands may make it impossible to do one's work and thus decrease the chances of turning up at work while experiencing health problems (i.e. this was classified as a positive relationship with at-work productivity). On the other hand, in studies where self-assessed performance was used as measure of at-work productivity, it would be more likely that physical demands would lead to a lower assessment of performance (i.e. this was classified as a negative relationship with at-work productivity).This is exactly what was found in the studies that included physical demands (and found an effect) and thus explains the different direction of effects found for this work factor.

For a few work factors, no or only limited evidence was found for the relationship with at-work productivity. This was especially for general job support and supervisor social support. This might seem surprising given that research has shown that the supervisor-worker relationship can impact workers' wellbeing (Nielsen and Daniels, 2016; O'Donnell, Berkman and Subramanian, 2012). Potentially, social support measures do not capture the most relevant aspects of the supervisor-worker relationship for productivity. For example, assessing whether a supervisor is overall 'concerned', 'helpful' or 'encouraging' (as examples of items typically used to measure the supervisor-worker relationship) might be too general to find a significant relationship with at-work productivity; it could be more informative to look in more detail at, for example, whether a supervisor can be approached to discuss potential productivity problems without the fear of being stigmatised and whether a supervisor is willing to change work conditions. The latter aspects are rarely included in supervisor support scales.

Effect of health on the relationship between work factors and at-work productivity

There are three different ways in which the effect of health on the relationship between work factors and at-work productivity are assessed (see Table 4):

- First, five studies analysed whether the relationship between work factors and productivity was *explained* by health, i.e. whether work factors are related to a decrease or increase in health which in turn decreases or increases at-work productivity (also referred to as a mediation effect).For example, low job control may deteriorate a worker's health, and that effect on health may, in turn, reduce at-work productivity.

- Second, eight studies provided information on whether the relationship between work factors and productivity *weakened or disappeared* when controlling for the effect of health (i.e. taking health as a confounder into account in the analysis). For example, a relationship between job strain and at-work productivity might be (partly) due to the fact that people with job strain have poorer health or that people with poor health experience higher job strain. While this seems similar to the above mentioned mediation analyses, there is one important difference. With mediation analysis a specific path is evaluated (in the six studies included it was the path: work factors influence health and health influences productivity), while with confounding it is not investigated in what way health 'interferes' in the relationship, but only whether it does. In five studies, results on the confounding effect of health were already included while in three cases the study authors provided additional information to the authors of the present paper on results after controlling for health (study number 19, 24 and 26).

- Third, there were two studies that investigated whether the effect of work factors on productivity *was different* for people in good or bad health, often referred to as moderation analysis (in some disciplines the terms interaction or effect-modification are more common). Specifically, studies analysed the relationship between work factors and individual productivity separately for people with bad and with good health. This allows identifying whether poor outcomes on work factors are disadvantageous with regards to productivity to both people in bad and people in good health or only to one of these groups.

Table 4. Assessment of health in studies on mediation, confounding and moderation

Study	Assessment of health
Arnold 2016	General health status
Bubonya 2016	Mental health assessed with the Mental Health Inventory 5
Coutu 2015	Psychological distressed assessed with the Psychological Distress Inventory
Demerouti 2008	Burnout assessed with the Maslach Burnout Inventory
Dhaini 2015	• Physical health assessed with five questions from the Swiss Health Survey on back pain, joint pain, tiredness, sleeplessness and headache • Emotional exhaustion assessed with one item "feeling exhausted from work"
Hansen 2008	Health status was assessed by asking respondents whether they suffered from one or more diseases. Also, the Short Form-36 was used to assess mental wellbeing.
Janssens 2016	General health assessed with one question: "How do you generally assess your health?"
Karlsson 2010	General health assessed with the Short Form-12
Leineweber 2011	General health assessed with one question: "How would you describe your general health status?"
McGregor 2014	Health burden score, which was calculated as follows: thirteen health conditions were measured. Each health condition of which the participant indicated they had this was multiplied with the number of absent days due to this condition and with the number of days present at work but affected by the condition. The burden scores for absenteeism and presenteeism were added, resulting in a health burden score for each participant where higher scores indicated more health concerns.
McTernan 2013	Depression assessed with the Patient Health Questionnaire 9
Plaisier 2012	Diagnoses of depressive and anxiety disorders assessed with the CIDI lifetime interview, version 2.1
Pohling 2016	• Mental health assessed with the Well-being Index • Physical health assessed with the Freiburg Complaint List
Robertson 2012	Mental and physical health assessed with the A Shortened Stress Evaluation Tool (ASSET) questionnaire
Wang 2010	Depression level assessed with the Patient Health Questionnaire 9

Results of the mediation, confounding and moderation analyses are presented in Table 5. Due to the limited number of studies, it remains difficult to draw firm conclusions for each individual work factor. For most work factors, only one study was available. However, for job rewards, work-family imbalance and workload two studies evaluated the mediation effect of health and both found an effect in the same direction: poor work conditions are related to poorer health which in turn is related to decreased productivity while at work, while good work conditions are related to good health which in turn leads to increased productivity. Only for job strain and workplace bullying, a longitudinal study was found that showed a significant mediation effect by health (study 34). This study found that baseline job strain and workplace bullying were related to reduced job performance at one-year follow-up through increased depression symptoms (from baseline to one-year follow-up): i.e. job strain and bullying resulted in increased depression symptoms which in turn resulted in reduced job performance.

All eight studies providing information on the confounding effect of health found that health influences the relationship between work factors and productivity. For most work factors (e.g. job demands, job stress, rewards, work-family conflict) the relationship with productivity remained significant but the relationship became weaker (i.e. attenuated) when including health in the equation. For a few factors the relationship with productivity became stronger (e.g. effort, firm size, supervisory role, non-standard work time, working hours) or lost significance completely (e.g. conflict and lack of recognition, cooperation with colleagues, job strain, job support, workload).

Table 5. Summary of mediation, confounding and moderation effects by health as reported in studies on the relationships between work factors and at-work productivity

Health as mediator			
Work factors	*No. of studies that investigated mediation* [a]	*No. of studies that found an effect* [a]	*Pathway* [b]
Community	1	0	-
Effort	1	1	Effort + → health - → productivity -
Emotional labour	1	1	Emotional labour + → health - → productivity -
Fairness	1	0	-
Job control	3	1	Control + → health + → productivity +
Job demands	2 (1)	0	-
Job security	1	0	-
Job strain	1 (1)	1 (1)	Job strain + → health - → productivity -
Organisational commitment	1	0	-
Pay, benefits & job conditions	1	1	Conditions - → health - → productivity -
Job rewards	2	2	Rewards + → health + → productivity +
Resources & communication	1	0	-
Supervisory style	1	1	Supervisory style + → health - → productivity -
Values	1	1	Values + → health + → productivity +
Work-family imbalance	2	2	Imbalance + → health - → productivity -
Workload	2	2	Workload + → health - → productivity -
Workplace bullying	1 (1)	1 (1)	Bullying + → health - → productivity -
Work relationships	1	0	-
Health as confounder[c]			
Work factors	*No. of studies that investigated confounding* [a]	*No. of studies that found an effect* [a]	*Effect on relationship with productivity* [d]
Conflict & lack of recognition	1	1	x
Cooperation with colleagues	1	1	x
Effort	1	1	+
Effort-reward imbalance	1	1	x
Ergonomics	1	1	-
Firm size	1	1	+
Good working conditions	1	1	-
Job control	4 (1)	4 (1)	1 (1) study: x 3 studies: -
Job demands	2 (1)	2 (1)	All studies: -
Job insecurity	3	3	1: study - 2 studies: x
Job strain	1	1	x
Job stress	1	1	-
Job support	2	2	1 study: x 1 study: -
Leadership	2	2	1 study: + 1 study: -
New job	1	1	-
Non-standard work time	2	2	1 study: + 1 study: -
Occupational status	1	1	+
Job rewards	1	1	-
Role compatibility	1 (1)	1 (1)	x
Second job	1	1	-
Social climate	1 (1)	1 (1)	x
Supervisory role	2	2	1 study: + 1 study: -
Support from colleagues	3	3	All studies: -
Support from supervisor[e]			1 study: - 1 study: x
Tenure	1	0	n.a.
Time & resources	3	3	All studies: -
Work-family conflict	2	2	All studies: -
Working hours	2	2	1 study: + 1 study: -
Work interdependence	1	1	x
Workload	1	1	x

Table 5. Summary of mediation, confounding and moderation effects by health as reported in studies on the relationships between work factors and at-work productivity *(cont.)*

Health as moderator			
Work factors	*No. of studies that investigated moderation* [a]	*No. of studies that found an effect*	*Result* [a]
Ergonomics	1	1	Ergonomics - → productivity - is stronger for those in good health
Job complexity	1	1	Job complexity + → productivity + is stronger for those in good health
Job control	2	2	Job control + → productivity + is stronger for those in good health
Job security	1	1	Job security + → productivity + is stronger for those in good health
Job stress	2	2	Job stress + → productivity - is stronger for those in good health
Leadership	1	1	Leadership - → productivity - is stronger for those in good health
Support from colleagues	1	1	Support - → productivity - is stronger for those in good health
Support from supervisor	1	1	Support - → productivity - is stronger for those in good health

a) Number of longitudinal studies in brackets; if nothing is reported than the number is 0.

b) + = increases; - = decreases.

c) Only variables are included that had a significant relationship with at-work productivity (loss) in the analyses excluding health variables.

d) + = the relationship becomes stronger; - = the relationship attenuates but remains significant; x = the relationship becomes non-significant.

e) This also includes collaboration with supervisor.

The two studies that assessed the moderating effect of health on the relationship between work factors and at-work productivity show consistent results. For all work factors included in the two studies, the effect of the work factor on productivity (be it positive or negative) was stronger for people in good health. Thus, for example, increased job control was associated with a reduced risk of productivity loss, but this mattered especially (study 33) or only (study 8) for people in good health.

Taking the latter finding into account, it could be expected that studies focusing on study populations with specific health problems are less likely to find a relationship between work factors and at-work productivity which in turn could have implications for the overall findings presented in this paper. Of the 43 studies that provided the evidence for Table 3 eight studies included a study population with health problems (see also Table 1). Three of the eight studies found no relationship between any of the included work factors and productivity (study 11, study 14 and study 31). The other five studies found an effect for only one or two out of the six to twelve work factors included.

DISCUSSION

This paper investigated the relationship between work factors and at-work productivity loss and the effect of health on this relationship by reviewing research that has been conducted on this topic. Three findings stand out:

1. There is a great diversity in the operationalization of at-work productivity loss;
2. For several work factors there is emergent evidence of a strongly or moderately positive relationship with productivity; and
3. Health is a relevant factor to take into account when looking at the relationship between work factors and productivity.

More consistency is needed in assessing at-work productivity

The relatively broad definition of at-work productivity (loss) allowed the inclusion of studies with varying operationalisations. 'At-work productivity' was defined as either (a) the amount of time a worker was productive or able to function/perform well at work, or (b) the worker's rating of his/her own performance/productivity/functioning at work. Among the 48 included studies, there were 14 different ways in which at-work productivity (loss) was operationalized. This raises the question whether consensus is needed on defining and assessing this outcome, especially when the aim is to design policies and identify practices that influence worker productivity.

The majority of productivity instruments used in the studies tried to identify reduced at-work productivity due to health problems specifically. Most frequently used was a single-item question on the number of days one had gone to work despite health problems. Conceptually, there are two problems with this single-item question when trying to capture at-work productivity. First, it implies that working while experiencing health problems will result in productivity loss, or in other words that ill-health equals inability to work. However, not all people experiencing health problems are unable to function or be productive at work. As such, an item on working despite health problems could result in an overestimation of productivity loss as going to work while experiencing health problems does not necessarily reduce productivity. Second, the item implies that when one experiences ill-health, one should not go to work. In several studies the item even included statements such as 'while you should have stayed at home'. This goes against scientific evidence that work is generally good for health (Dooley, Fielding and Levi, 1996; Thomas, Benzeval and Stansfeld, 2005), and that it can be an important factor in a person's recovery (OECD, 2012). Furthermore, many people with health problems emphasise that participating in work is important to them (Saunders and Nedelec, 2014). Instead of asking people how many days they were at work despite of health problems, an operationalization such as the one used in study 43 by Plaisier et al. (2012), would be preferable. Here it was asked how many working days a respondent experienced hindrance by health problems, followed by an assessment of the person's efficiency on these days. Similarly, questionnaires like the Work Role Functioning Questionnaire and Work Limitations Questionnaire result in an overall score representing the percentage of time one was not able to function well at work specifically due to health problems (according to the respondent). Such multiple-item questionnaires provide more detailed information on specific tasks for which people experienced work functioning problems and can provide more direction for interventions by occupational health providers or employment counsellors.

About one-third of the studies used a single-item instrument inquiring a worker's overall performance or productivity at work, mostly on a scale from 0 to 10, regardless of health problems. These instruments provide a straightforward assessment of one's self-perceived performance or productivity at work but no information on what the specific productivity problems are and where interventions could focus on.

The use of different operationalisations and instruments to assess at-work productivity may influence the relationships one finds between work factors and at-work productivity. In this regard, a study by Johns (2011) which included different instruments to assess at-work productivity loss – a single item on presenteeism days but also the multiple-item Work Limitations Questionnaire (WLQ) and the Stanford Presenteeism Scale (SPS) – has provided interesting insights. While relationships between the work factors and the different outcome measures were in the same direction, differences were found in their strength and statistical significance; for instance, 'pay equity' was significantly associated with the single item on presenteeism days but not with the WLQ and SPS, while 'family and work conflict' was significantly related to the WLQ and SPS but not to the presenteeism item. Based on this one paper, however, it is difficult to provide strong explanations for these different results, highlighting the need for more research to look into this.

To conclude, when choosing an instrument to assess at-work productivity, it is important to take into account what the goal of the analysis is. For example, when assessing how productive people are at work, a single question about the number of days someone went to work despite health problems is not useful as it does not provide information on whether the person was productive. Including an assessment of whether one was also hindered by health problems and an estimation of the amount of hindrance would be essential. When the goal is to measure how to influence productivity, multiple-item measures identifying which types of work tasks are most problematic would be more informative. Consensus about the use of one particular instrument is not essential, but using the same instrument when having a similar goal would improve comparability across settings.

Quality of the work environment influences at-work productivity

A first conclusion that can be drawn from the largely cross-sectional studies reviewed in this paper is that several work factors have shown to be related to productivity. There was strong evidence for a relationship with job stress, job rewards and job strain and moderate evidence for a relationship with work-family conflict, fairness at work and social support from co-workers. The limited number of longitudinal studies and the differing results of these studies (i.e. some did and others did not find a longitudinal relationship between a work factor and at-work productivity) did not allow clear conclusions on the causal pathways. As such, separate look at these longitudinal studies did not change the overall conclusion that there is evidence that several work factors are related to at-work productivity. Second, not for all work factors that have been theoretically linked with worker productivity, following the dominant Job Demands Resources (JD-R) and Effort Reward Imbalance (ERI) models, supportive evidence was found. For example, there was no clear evidence for a unique relationship between job demands or job control (an important job resource in the JD-R model) and at-work productivity, while this is being hypothesized in JD-R theory (Bakker and Demerouti, 2016). However, in line with JD-R theory, job strain, i.e. the combination of high job demands and low job resources, did show a significant relationship with at-work productivity in several cross-sectional studies. Another finding is that for general job support and supervisor support, most studies did not find any relationship. This is surprising as qualitative studies (e.g. interviews with workers) have shown that the supervisor-worker relationship is important for workers' functioning at work, especially for people with health problems (Hjarsbech, Nielsen, Andersen, Rugulies and Christensen, 2015; Andersen, Nielsen and Brinkmann 2012). The question arises whether other ways to assess this relationship are needed.

While more longitudinal research is needed to confirm a causal pathway between the work factors reported in this paper and at-work productivity, an important implication for policy and practice is that more attention is needed for the quality of work and the inherent interplay between the individual and its work context. At this moment, country policies and worker support practices do not take this into account. First, in many OECD countries, workplace policies primarily focus on physical unsafe and unhealthy work conditions. The identification of psychosocial workplace risks from the perspective of the individual worker (e.g. fairness of organisational policies and job stain) is rarely included in workplace legislation and where it is, it generally plays a limited role in practice (OECD, 2015). However, this paper has shown that these factors matter for productivity. Furthermore, there is a body of evidence showing the importance of such factors for workers' health (Bakker and Demerouti, 2016) (Schaufeli and Taris, 2014). Second, while workplace policies are directed at the (physical) works environment, the available interventions for improving worker wellbeing and productivity are often (narrowly) focused on the individual worker, for example by trying to improve resilience, stress management or coping skills (Ebert et al., 2016; Jamieson and Tuckey, 2016). Here, the interaction between the worker and its work environment is missing as well. More attention is needed for how workers perceive the quality of their work environment and how policies and practices at both the level of the worker and the work environment may positively influence this.

When drawing conclusions on the relationship between the quality of the work environment and productivity based on this paper, several limitations need to be taken into account. First, as mentioned, only 11 studies had a longitudinal design, which inhibits conclusions on a causal relationship between work factors and at-work productivity. Also, the direction of causation sometimes remains unclear. For some work factors a reversed causal pathway could be hypothesised. For example, one could imagine that increased productivity may lead to increased job rewards just as well as increased job rewards could lead to increased productivity. Furthermore, the designs of the longitudinal studies that were included had some limitations. For example, most of these studies had quite a short follow-up period of one year. Also, baseline assessments of at-work productivity were not always included, but this is essential to investigate causal pathways between work factors and productivity. In a similar vein, work factors were often only assessed at baseline, while these factors should be repeatedly measured as the experience of quality of the work environment may fluctuate over time.

Second, studies used different instruments to assess productivity and the various work factors, include different study populations and use different covariates in their analyses. This heterogeneity in studies reduces comparability and may explain why for some work factors different studies found opposite results. As discussed above, the study by Johns (2011) showed that relationships between work factors and at-work productivity varied for different measures of at-work productivity. Other studies found that the relationship between work factors and at-work productivity varies for different subgroups of participants, such as workers differing in tenure or type of occupation, or for different countries (Claes, 2011; Jourdain and Vézina, 2014; Jacobs et al. 2007). However, there were too few studies to derive meaningful conclusions when splitting results further for, e.g., similar at-work productivity measures. This is why for this paper it was chosen to combine the results of all studies and to evaluate whether some broad conclusions on the relevance of the quality of the work environment for at-work productivity could be drawn. Third, several work factors were investigated in only a few studies, including those for which strong evidence was found. It is important to have these work factors included in future research, to evaluate whether their relevance for at-work productivity also shows in other settings.

Work policies need to include a health perspective

All 14 studies that investigated the impact of health on the relationship between the quality of the work environment and productivity showed that health indeed matters. Policies must reflect that finding: policies aimed at improving the quality of the work environment so to improve worker productivity must also take workers' health into account.

Especially interesting are the comparable findings of the two studies looking at the moderating effect of health on the relationship between work factors and at-work productivity. These studies show that the relationship between positive work factors (e.g. job control) or negative work factors (e.g. job stress) and productivity is strongest for people in good health. This is an important finding because it suggests that the quality of the work environment matters for reasons that go beyond its negative effects on workers' health.

For some work factors, the relationship with productivity even ceases to exist for people in bad health. The lack of a relationship between the quality of the work environment and productivity for people in bad health has important implications for research and policy. If the relationship between work factors and productivity is solely investigated within study populations dealing with health problems, chances of finding significant associations may be smaller. Of the five studies included in this paper with study populations with health problems, three studies found no effect for any of the work factors. This could one lead to conclude that the quality of the work environment does not matter for productivity. But this would be incorrect, as studies in this paper for general populations show a connection between several work factors and productivity. Furthermore, research has shown that many people with health problems have difficulty in remaining productive at work (Aronsson, Gustafsson and Dallner, 2000; OECD, 2012). Thus, good work conditions alone seem insufficient for workers with health problems to ensure a productive working life.

However, many of the studies included in this paper show that health-related factors (e.g. chronic diseases, general health, or mental distress) were also significantly related to at-work productivity, thereby confirming the need for multidisciplinary approaches to support worker productivity. In line with this, work by the OECD on *Mental Health and Work* has shown that workplace policies for people with mental health problems should not only focus on improving the psychosocial quality of work, but also have a focus on keeping people in work and helping them return to work quickly when they are ill. For both of these aims, integrated health and work support is critical (OECD, 2015). Neither can underlying health issues remain unaddressed, nor can health professionals ignore the underlying workplace issues. An adequate policy response should also include tackling stigma at the workplace associated with health problems to ensure that people feel comfortable discussing potential support measures that could help them remain productive at work.

Conclusion

To improve our understanding of the relationship between the quality of the work environment and at-work productivity and to be able to use the findings to support people (with and without health problems) to remain productive at work, several developments in research and policy are indicated. First, more longitudinal studies that overcome the limitations addressed above are needed to improve the evidence base and to clarify the causal relationship between various factors of the quality of the work environment, health and productivity. Second, when studying productivity, researchers or policy makers need to be clear about what they want to measure, e.g. overall productivity or performance or health-related productivity loss. If the goal is to intervene on reduced productivity, a measurement instrument is needed that can indicate in which areas productivity problems are experienced and picks up change over time. Thirdly, this paper provides direction for the work factors that could be explored further in terms of their effect on productivity and interventions addressing these factors that would improve productivity. Fourthly, attention should be paid to the interaction between the individual and the workplace environment, especially for people with health problems who appear to benefit less from a good quality work environment than people without health problems. For those people, support measures addressing both workplace and health issues are essential.

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STUDIES INCLUDED IN TABLE 5

(Numbering aligns with Table 1)

a. Mediation

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b. Confounding

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c. Moderation

8. Bubonya, M., D. A. Cobb-Clark and M. Wooden (2016), Mental health and productivity at work: Does what you do matter? Melbourne Institute Working Paper Series, Working Paper No. 16/16, Melbourne Institute of Applied Economic and Social Research, University of Melbourne.

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APPENDIX

The search strings used in the different databases are presented below. Words in bold were entered as major subject headings. The separate terms under productivity loss and job characteristics were combined with the Boolean "OR". All terms for productivity loss and all terms for job characteristics were combined with the Boolean "AND".

Medline (Pubmed)

Productivity loss

absenteeism
cutback days
employment outcome
employee performance
employee performance appraisal
job performance
lost productivity
lost workplace productivity
occupational functioning
performance evaluation
presenteeism
production capacity
productivity loss
reduced productivity
reduced workplace productivity
sick leave
sickness absence
vocational functioning
vocational outcome
vocational performance
work cutback
work functioning
work impairment
work limitations
work performance
workplace productivity

Job characteristics

job characteristics
job conditions
job content
job environment
job factors
job quality
occupational characteristics
occupational conditions
occupational factors
psychosocial factors
work characteristics
work conditions
work environment
work factors
work quality
work stressors
working conditions
working environment

PsycInfo (Ebsco)

Productivity loss

Employee absenteeism
Job performance
Employee efficiency
Employee productivity
Absenteeism
Cutback days
Employment outcome
Employee performance
Job performance
Job productivity
Lost workplace productivity
Occupational functioning
Performance evaluation
Presenteeism
Production capacity
Productivity loss
Reduced productivity
Reduced workplace productivity
Sick leave
Sickness absence
Vocational functioning
Vocational outcome
Vocational performance

Work cutback
Work functioning
Work impairment
Work limitations
Work performance
Workplace productivity

Job characteristics

Job characteristics
Job conditions
Job content
Job environment
Job factors
Job quality
Occupational characteristics
Occupational conditions
Occupational factors
Psychosocial factors
Work characteristics
Work conditions
Work environment
Work factors
Work quality
Work stressors
working conditions OR
working environment OR

Business source elite (Ebsco)

Productivity loss

Absenteeism
Sick leave
Job performance
Employees – Rating of
Presenteeism
Absenteeism
Cutback days
Employment outcome
Employee performance
Job performance
Job productivity
Lost workplace productivity
Occupational functioning
Performance evaluation
Presenteeism
Production capacity
Productivity loss
Reduced productivity
Reduced workplace productivity

Sick leave
Sickness absence
Vocational functioning
Vocational outcome
Vocational performance
Work cutback
Work functioning
Work impairment
Work limitations
Work performance
Workplace productivity

Job characteristics

Work environment – psychological aspects
Job characteristics
Job conditions
Job content
Job demands
Job environment
Job factors
Job quality
Occupational characteristics
Occupational conditions
Occupational factors
Psychosocial factors
Work characteristics
Work conditions
Work environment
Work factors
Work quality
Work stressors
Working conditions
Working environment
Workplace risk factor

Web of science

Productivity loss

Absenteeism
Cutback days
Employment outcome
Employee performance
Job performance
Job productivity
Lost workplace productivity
Occupational functioning
Performance evaluation
Presenteeism
Production capacity

Productivity loss
Reduced productivity
Reduced workplace productivity
Sick leave
Sickness absence
Vocational functioning
Vocational outcome
Vocational performance
Work cutback
Work functioning
Work impairment
Work limitations
Work performance
Workplace productivity

Job characteristics

Work environment – psychological aspects
Job characteristics
Job conditions
Job content
Job demands
Job environment
Job factors
Job quality
Occupational characteristics
Occupational conditions
Occupational factors
Psychosocial factors
Work characteristics
Work conditions
Work environment
Work factors
Work quality
Work stressors
Working conditions
Working environment
Workplace risk fact