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# The impact of healthy workplaces on employee satisfaction, productivity and costs

Impact of  
healthy  
workplaces

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## Abstract

**Purpose** – This paper aims to explore the added value of healthy workplaces for employees and organizations, in particular regarding employee satisfaction, labour productivity and facility cost.

**Design/methodology/approach** – The paper is based on a narrative review of journal papers and other sources covering the fields of building research, corporate real estate management, facilities management, environmental psychology and ergonomics.

**Findings** – The review supports the assumption of positive impacts of appropriate building characteristics on health, satisfaction and productivity. Correlations between these impacts are still underexposed. Data on cost and economic benefits of healthy workplace characteristics is limited, and mainly regard reduced sickness absence. The discussed papers indicate that investing in healthy work environments is cost-effective.

**Originality/value** – The findings contribute to a better understanding of the complex relationships between physical characteristics of the environment and health, satisfaction, productivity and costs. These insights can be used to assess work environments on these topics, and to identify appropriate interventions in value-adding management of buildings and facilities.

**Keywords** Well-being, Workplace, Health, Productivity, Satisfaction, Cost, Added value

**Paper type** Literature review

## 1. Introduction

The WHO defines health as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”. As such, a healthy workplace can be defined as a workplace that contributes to the physical, mental and social well-being of its users. Health is the result of a complex interaction between the physiological, psychological, personal and organizational resources available to individuals and the stress placed upon them by their physical and social environment at work and home (Clements-Croome, 2018).

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Well-being reflects one's feelings about oneself in relation to the world, personal feelings about motivation, competence, aspirations and degree of personal control.

### *1.1 Impact of the physical environment on health and well-being*

The past decades show a growing awareness of the impact of the physical environment on peoples' health and well-being, both in academic research and in professional publications. This may be because of the shift from a one-sided focus on cost reduction to a more holistic and integrated value-based approach and an optimal balance between costs and benefits of interventions in buildings, facilities and services (Jensen and Van der Voordt, 2017). Besides, people have become more aware of the impact of health and well-being on our quality of life and the risk of health complaints, illness or – in worst cases – burnout (Appel-Meulenbroek *et al.*, 2020). The relationship between physical workplace characteristics and health and well-being has been explored by a variety of studies, using reviews of the literature (Forooraighi *et al.*, 2020; Van der Voordt, 2021), surveys (Cordero *et al.*, 2020), case studies (Bauer, 2020) and conducting short-term experiments using mobile devices (Nelson and Holzer, 2017).

It appears that in particular a poor indoor climate, noise and distraction have a negative impact on employees' health and well-being, whereas appropriate opportunities to communicate and to concentrate and contact with nature contribute to a healthy workplace. In a survey of 2,000 office workers, occupants reported preferences for lots of natural light, access to outdoor spaces, contemplation spaces, support from colleagues and private as well as collaborative spaces, whereas the main irritants were noise in open-plan areas, lack of natural light, lack of colour, lack of greenery, lack of artwork, lack of fresh air, no personal control of temperature, lack of privacy, clutter and inflexible space (British Council for Offices, 2018).

Another frequently assessed factor is office type. A literature review by Colenberg *et al.* (2020) on the relationship between interior office space (layout, furniture, light, greenery, controls and noise) and employees' physical, psychological and social well-being showed that open-plan offices, shared rooms and higher background noise are negatively related to health. Positive relationships were found between physical well-being and aspects that encourage physical activity; between physical/psychological well-being and (day)light, individual control and real/artificial greenery; and between social well-being and small shared rooms.

Other influencing factors on health and well-being are important as well, such as the context (cultural, social, economic, political), personal characteristics (age, gender, lifestyle), organizational issues (leadership, personal support) and job characteristics (work load, (mis) fit between demands and resources). The European Agency for Safety and Health at Work (2014) warns for a disbalance between high job demands and available job resources. Too little time, too much work and tight deadlines are the most widely recognized risk factors, resulting in sleep disturbance, changes in mood, fatigue, headaches and stomach irritability.

### *1.2 Relationship between healthy workplaces and other values*

Healthy workplaces that support employees' health and well-being can be a goal in itself, but may also have intended or unintended effects on other values, such as employee satisfaction, productivity, costs, corporate image and risk. Vice versa, values such as sustainability may contribute to health and well-being. For instance, green buildings are supposed to be healthier than non-green buildings, because of its focus on the triple P of people, planet and profit. Interrelationships between healthy workplaces and other values are much less studied. This paper aims to reduce this gap in our knowledge, and to answer two research questions: What is the relationship between healthy workplaces and employee satisfaction, productivity and costs? And which evidence is available for these relationships?

These three values turned out to be most frequently prioritized in interviews with corporate real estate and facility managers (Van der Voordt and Jensen, 2014). It is hypothesized that health, satisfaction and productivity go hand in hand. Furthermore, because of the high staff costs compared to facility costs, it is hypothesized that health-supportive interventions are cost-effective. Figure 1 visualizes the key topics of this paper in blue.

## 2. Methods

Because of a limited number of available publications, it was decided to select a number of leading journals in the field and to conduct a narrative review (Green et al., 2006; Ferrari, 2015). In our earlier review of environmental impact factors on healthy workplaces (Jensen and Van der Voordt, 2020), we checked four facilities management and corporate real estate management oriented journals in a 10-year period, covering 2008–2017: *Journal of Corporate Real Estate*, *Corporate Real Estate Journal*, *Facilities* and the *Journal of Facilities Management*. For the current paper, we extended our search to the period 2018–2021 and to other journals, based on paper citations and journal titles. We also screened the last six volumes of *Applied Ergonomics*, *Building and Environment*, *Building Research and Information*, *Environment and Behavior*, *Ergonomics*, *Intelligent Buildings International* and *Journal of Environmental Psychology* on the keywords workplace, health, well-being, satisfaction, productivity and cost.

All papers from the screened journals that discuss health in connection to workplace characteristics and satisfaction, productivity and/or cost were included in this review. This has resulted in a selection of 45 papers on health and satisfaction and/or productivity. Because very few scientific papers related to facility cost were found, we have included relevant industry reports and other publications. Papers that discuss the relationship between the physical environment and either health, satisfaction, productivity or cost, without discussing any interrelationships between these variables, have been excluded.

## 3. Findings on the added value of healthy workplaces

### 3.1 Employee satisfaction

Table 1 summarizes the research topics, methods and findings of eight papers that discuss relationships between physical characteristics of the built environment, health and satisfaction, ranked by year and per year in alphabetical order of the first author. Five out of eight studies investigate the impact of office type and workspaces. The other studies focus

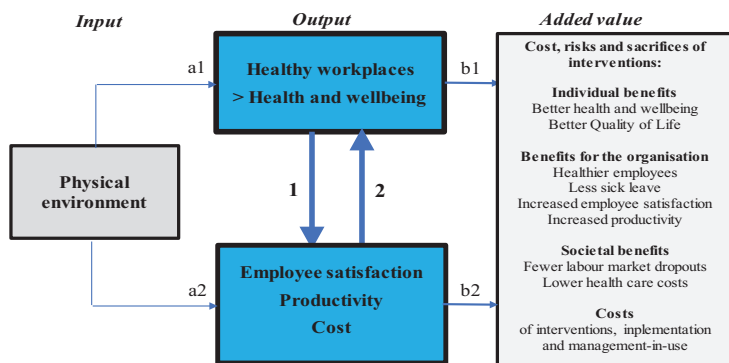


Figure 1.  
Key topics of this  
paper

Study	Methodology	Research topics	Findings
<a href="#">Bodin Danielsson and Bodin (2008)</a>	Questionnaire survey; 469 employees in seven offices from 26 companies in Sweden	Impact of office types on health, well-being and job satisfaction	Highest health status among employees in cell- and flex-offices; lowest health status in medium-sized and small open-plan offices. Highest job satisfaction in cell, flex and shared offices; lowest job satisfaction in combi-offices, followed by medium-sized open-plan
<a href="#">Seddigh et al. (2014)</a>	Questionnaire survey; 1,241 respondents from five organizations in Sweden in six office types	Interaction between the need for concentration, distraction, cognitive stress, emotional exhaustion, depersonalization, personal efficiency and general health	No significant differences in the outcome variables between different types of open-plan. Employees with high need for concentration reported more distraction in all office types, except in cell, and more cognitive stress in all office types except cell and flex-offices
<a href="#">Herbig et al. (2016)</a>	Questionnaire survey in two buildings; 207 office employees in a company in Germany. The older building had small-sized offices with 1–4 employees, and the new building had open-plan	Impact of office space occupation psychosocial work characteristics, and environmental satisfaction on physical and mental health	Effect of office space occupation on employee health was mediated by stressors and environmental satisfaction. More persons per enclosed office space was associated with adverse health effects. Increasing acoustic disturbances and feelings of loss of autonomy and discretion had a negative impact on health
<a href="#">Eichholtz et al. (2019)</a>	Questionnaire surveys before and after a relocation of a municipality in the Netherlands from enclosed office spaces to a new building with open-plan, a strong focus on sustainability and natural ventilation	Impact of environmental conditions in the workplace on health and job satisfaction	Significant improvement in the perceived environmental conditions and health of the relocated workers and a drop in sick building syndrome (SBS) The largest environmental improvements concerned the perceived air quality
<a href="#">Tan et al. (2020)</a>	Questionnaire survey; 195 respondents, including 121 working underground and 74 working above-ground in Singapore	Relationship between mental health, fatigue and satisfaction with workspaces and transitional spaces such as corridors	Lower perceived confinement in transitional spaces was associated with better mental health and lower workload fatigue. Underground workers reported lower levels of physical and emotional fatigue. Among the participants working in above-ground offices, effects were stronger for those with higher levels of claustrophobia
<a href="#">Wijk et al. (2020)</a>	Questionnaire surveys and focus group interviews before relocation from traditional office and after the implementation of activity-based	Relationship between indicators of sense of coherence (SOC) – meaningfulness, manageability and comprehensibility – and health, well-being and work satisfaction	Reduced work satisfaction, unchanged health and well-being. The reduction in satisfaction was smaller among employees with high meaningfulness in the relocation process. All SOC indicators were positively associated with overall health, well-being and satisfaction

**Table 1.** Health and well-being and satisfaction (eight studies)

(continued)

Study	Methodology	Research topics	Findings
<a href="#">Elnaklah et al. (2021)</a>	workplaces (ABW) in Sweden Repeated surveys in an organization with 120 employees before and after moving to a new certified green building (GB)	Effects on occupant perception of indoor environmental quality (IEQ, i.e. ventilation, thermal comfort, lighting and daylighting, noise, acoustics) on thermal comfort and prevalence of SBS	Significant differences in thermal conditions enhanced occupant thermal comfort in the GB. Odour, mental concentration and glare were perceived to be poor in the GB and associated with an increase in the prevalence of SBS symptoms
<a href="#">Hodzic et al. (2021)</a>	Surveys of up to 247 employees before and 2 and 12 months after a relocation to a new headquarters of a large company in Austria	Distractions after moving to an activity-based flexible office	Moving to the flex office had negative effects on distraction, work engagement, job satisfaction and fatigue. The negative effects of distraction were more pronounced in situations of increased time pressure and unpredictability

Table 1.

on environmental conditions, sense of coherence or green buildings. The findings show positive but also contradictory connections between office type; health and well-being; and employee satisfaction. Open-plan seems to have a negative impact, which can be partly compensated by improved environmental conditions. High density and poor acoustics affect health and satisfaction in a negative way. The green building study showed mixed results. Personal characteristics make a difference as well. Employees with high need for concentration report more distraction in all office types, except in cell, and more cognitive stress in all office types except cell and flex-offices. People suffering from claustrophobia perceive stronger effects.

### 3.2 Labour productivity

The findings on relationships between health and well-being and labour productivity are summarized in [Table 2](#). Four studies focus on office type and workplace concept (open-plan, work pattern-office type fit, high-performance hub, variety of workplaces). Five studies investigated the impact of indoor air quality (IAQ) and related issues such as thermal comfort and look-and-feel. Four studies focus on sit-stand/adjustable workstations. The other studies show a variety of research topics, i.e. the influence of a healing office design concept, wind-inducing motion of tall buildings, green buildings, workplace safety, biophilia, plants and time spent in the office. The findings show significant positive but also mixed impacts of IAQ, “green” buildings and sit-stand work on both health and productivity. Health and productivity are usually discussed separately; correlations between health and productivity were only explored in two studies. Interrelationships are affected by job demands and job stress

### 3.3 Satisfaction and productivity

[Table 3](#) summarizes the findings from 17 studies on health and well-being and both satisfaction and productivity. Independent variables include office types, non-territorial workspaces, proximity, impact of break out areas, storage space, adopting the WELL

Study	Methodology	Research topics	Findings
<a href="#">Karakolis and Callaghan (2014)</a>	Literature review	Impact of sit–stand workstations (SSW) on worker discomfort and productivity	SSW are likely effective in reducing perceived discomfort. Eight of the identified 14 studies reported a productivity outcome; three reported an increase in productivity during sit–stand work, four reported no impact on productivity, one reported mixed results
<a href="#">Al Horr <i>et al.</i> (2016)</a>	Literature review	Impact of IEQ, biophilia, views, look and feel (including colour), location and amenities on occupant productivity	Thermal comfort, IAQ, office layout, noise and acoustics were found to be highly significant in affecting occupant productivity. Occupant comfort directly relates to the physical factors of the indoor environment
<a href="#">Lamb and Kwok (2016)</a>	Longitudinal study with questionnaire surveys; 114 participants from 66 different buildings completing 2,261 surveys across a period of eight months	Effects of inadequate IEQ on work performance and well-being in wind-excited tall buildings in New Zealand	Environmental stress not only reduces the cognitive capacity for work, but also the rate of work. Improving IEQ is likely to produce small but pervasive increases in productivity
<a href="#">Jinnett <i>et al.</i> (2017)</a>	Questionnaire surveys; 16,926 employees from 314 companies in the USA	Impact of workplace safety, employee health and job demands on productivity, measured by absenteeism and presenteeism in the past four weeks, in a worksite wellness program	Poor workplace safety and employees' chronic health conditions contributed to absenteeism and job performance. The impact was influenced by the physical and cognitive difficulty of the job
<a href="#">Lamb and Kwok (2017)</a>	Literature review, including own research, simulation studies and surveys	Impact of wind-induced motion of tall buildings ("sopite syndrome") on productivity loss and well-being	Sickness and productivity loss because of wind-induced building motion are highly variable, depending on the local weather climate, but are likely to be significant in the long term and can go up to 30% reduction in work performance
<a href="#">MacNaughton <i>et al.</i> (2017)</a>	Cognitive tests of higher order decision-making performance; 109 participants working in 10 office buildings in the USA. Six building had been renovated and obtained LEED certification; four buildings had no green certification	Impact of working in a green-certified building on cognitive function and health. IEQ parameters were monitored during the tests	Participants in green-certified buildings scored 26% higher on cognitive function tests and had 30% fewer sick building symptoms than those in non-certified buildings. This could partially be explained by IEQ parameters, but the findings indicate that the benefits of green certification go beyond measurable IEQ factors

**Table 2.** Health and well-being and labour productivity (20 studies)

(continued)

Study	Methodology	Research topics	Findings
Garland <i>et al.</i> (2018)	Self-administered questionnaires, and response to repeated micro-polling over one year, in an office building in the USA, with workers having adjustable workstations (AWS) and a control group without AWS	Health impact of adjustable workstations (AWS)	47% of participants with AWS reported decline in upper back, shoulder and neck discomfort; 88% of AWS participants reported convenience to use, 65% reported increased productivity: 65% reported positive impact outside the workplace
Chambers <i>et al.</i> (2019)	Literature review	Effect of sit–stand desks (SSDs) on office workers' behavioural, physical, psychological and health outcomes, work performance, discomfort and posture	SSDs effectively change behaviours, but these changes only mildly affect health outcomes. SSDs seem most effective for discomfort and least for productivity
Isham <i>et al.</i> (2019)	Literature review	Well-being and productivity	Well-being showed to be linked to higher levels of labour productivity. Productivity growth may also have detrimental effects on well-being
Wargocki (2019)	Literature review	Impact of IAQ on health and productivity	Doubling the outdoor air supply rate can reduce illness and sick leave prevalence by roughly 10% and increase the productivity of office work by roughly 1.5%
Bauer (2020)	Before/after study of the adoption of the Healing Offices design concept (ten qualities), based on observations, ten interviews and a survey ( $N_{\text{before}} = 92$ , $N_{\text{after}} = 120$ )	Impact of a Healing Office on perceived health, engagement, comfort and productivity	Increased objective quality of the work environment regarding sustainability, diversity, nature and the possibilities to move and relax. Increased subjective experience regarding feelings of inspiration, comfort and energy, more physical activity and personal contact, increased teamwork and productivity
Hähn <i>et al.</i> (2020)	Survey; 40 occupants in a modern office building with two potted plants per person introduced into individual offices, and eight in break-out spaces	Perceived health, well-being and performance	Plants in offices had significantly positive effects on occupants' perceived attention, creativity, satisfaction and productivity; plants' removal elicited significantly negative effects in perceived attention, productivity, stress and efficiency. Planting had no significant effect on perceived health, tiredness, motivation or well-being
Kaushik <i>et al.</i> (2020)	Post-occupancy evaluation (POE) over 12 months in an office with 40 occupants in	Effects of IEQ on thermal comfort and occupant productivity and establishing	Nine IEQ parameters were ranked according to the degree of effect on occupant thermal comfort and productivity. Temperature had the

(continued)



Study	Methodology	Research topics	Findings
	Quatar using sensors to measure environmental quality as well as online survey every fortnight	mathematical relationships	highest and relative humidity the second highest effect
Lu <i>et al.</i> (2020)	Experimental study with 18 office workers in a closed chamber simulating an ordinary office and different combination of illumination levels and colour temperatures	Effects of illuminance and colour temperature on light comfort and work efficiency	Improving the illumination of the work environment helps to improve the light comfort. Reading efficiency is generally improved using a neutral colour temperature. The physiological evaluation indicated that illumination significantly affects the response of the visual centre
Marsh and French (2020)	Test of 50 employees in a Workplace Performance Hub (WPH) and 20 employees in a control group, across a six-month period	Impact of greater variety in workplaces, circadian lighting and biophilia on employee health, well-being and performance	WPH participants experienced an increase in cognitive performance and a reduction in stress. They were more active and had a lower resting heart rate and saw a rise of 17% in innovation cycles during their stay
Morrison and Smollan (2020)	Longitudinal study with surveys covering 101 respondents and 24 interviews in an Australian law firm six month after moving to an open-plan office with follow-up 14 months later	Impact of open-plan office on performance, well-being and collegial relationships	Positive outcomes relating to aesthetics, collegiality and communication were achieved through good technical design and thoughtful ergonomic assessment of the needs of employees and the requirements of their tasks
Soriano <i>et al.</i> (2020)	Questionnaire and diary study; 83 office workers ( $N = 603$ time points) regarding work patterns, identified by using cluster analysis with Neufert's office-type classification	Well-being and performance	Work pattern–office type (mis)fit moderates the relationship between well-being and performance. The “fit” group shows four out of six positive associations; the “misfit” group shows only one out of six positive associations
Wolkoff (2020)	Literature review	Dry eye symptoms and work performance in offices	Dry eyes are among the most reported acute health symptoms in modern offices Perceived dry air in the work environment negatively affects work performance
Kar and Hedge (2021)	Experimental study in the USA, where 36 participants performed a 60-min computer typing task in two sit–stand workstation configurations	Comparison of musculoskeletal discomfort, productivity, postural risks and perceived fatigue for a sit–stand–walk intervention between two workstation configurations	Musculoskeletal discomfort and perceived fatigue did not vary significantly between configurations. Postural risks for seated and standing work were significantly lower for a customized configuration, while productivity was significantly higher for a self-adjusted configuration

Table 2.

(continued)

Table 2.

Study	Methodology	Research topics	Findings
Rasheed <i>et al.</i> (2021)	Statistical analysis of a dataset with responses from 5,149 workers in 68 commercial and institutional buildings across the globe, collected over 15 years	Impact of time spent in the office building and at workstations on the relationship between IEQ and workers' productivity, comfort and health	Those who spent less time at work were less influenced by IEQ factors. Noise and air quality were predominant in predicting how those who spent more time at work felt about their productivity, comfort and health. The time spent in the office had a greater influence on the relationship between IEQ and workers' comfort than on their productivity and health

criteria, indoor environmental quality (IEQ), shading conditions, sit–stand workstations and plants. Here, too, health, satisfaction and productivity are mainly discussed separately and less regarding possible correlations. In general, activity-based workplaces are perceived to have a positive impact on satisfaction, partly because of better technical qualities regarding IEQ. Searching for a workplace needs time and reduces productivity. Personal control, easiness of interaction and communication, availability of break out areas, windows, sit–stand workstations, comfort of furnishing, attractive IEQ, modern shading systems and applying to the WELL standard show to have a positive impact on both health and satisfaction, whereas distraction and lack of privacy are important predictors of productivity loss.

All presented studies on health in connection to satisfaction and/or productivity originate from Europe, USA, Australia and New Zealand.

### 3.4 Applied research methods to study health and satisfaction and/or productivity

The discussed papers on health and satisfaction and/or productivity show a variety of research designs and research methods (Table 4). Ten studies conducted a before–after study; four studies used an experiment in a lab setting. About 80% of the presented studies used a questionnaire survey, some of them as part of a mixed-methods approach with interviews and observations, identifying healthy or unhealthy office design qualities, scores on the WELL standard and data about toxic substances in the air. Measuring physical conditions such as the heart rate or skin temperature is rather rare.

### 3.5 Financial costs and benefits

Clements-Croome (2018) mentions a return on investment of €5.7 for every euro invested in well-being. However, not much quantitative data was found about the financial impact of changing the spatial layout, supporting new ways of working, providing more contact with nature or the introduction of sit–stand desks. This may be because of the difficulties to quantify the results of healthy workplaces. Various papers discuss the monetary costs and benefits of health-promoting programs such as stop-smoking programs or providing sports facilities and healthier nutrition. However, these topics are not related to physical characteristics of workplaces and are beyond the scope of this paper. Table 5 summarizes the findings from 11 publications. Different research methods are used, such as literature reviews, surveys and analysis of sickness absence data (8 out of 11 studies) and costs. Some studies focus on the impact of stress, without clear links to physical characteristics. Not all

Study	Methodology	Research topics	Findings
<a href="#">Candido et al. (2016)</a>	Surveys covering 5,171 respondents in 30 buildings in Australia	Impact of workspace layout on satisfaction, perceived comfort, health and productivity	Respondents in ABW had the highest degree of satisfaction in terms of overall work area comfort and building satisfaction. Respondents in cell-offices had the highest degree of satisfaction in relation to privacy
<a href="#">Kim et al. (2016)</a>	Reduced dataset of <a href="#">Candido et al. (2016)</a> ; 3,974 respondents in 20 buildings	Effect of non-territorial working versus working in open-plan offices with assigned workplaces and ABW with desk-sharing on health, satisfaction and productivity	Office layout allowing easiness of interaction with colleagues, the ability to adjust/personalize workspace, and the amount of storage space showed to be more important than desk ownership. The comfort of furnishing was identified as the strongest predictor of self-assessed health for shared-desk users
<a href="#">Haapakangas et al. (2018a)</a>	Questionnaire surveys in two offices in Sweden before and after relocations from private to open-plan	Impact of quiet spaces in open-plan offices on stress symptoms	Perceived distractions increased in both organizations after the relocation. Negative effects on environmental satisfaction, perceived collaboration and stress only emerged in the open-plan, where the number of quiet rooms was low
<a href="#">Haapakangas et al. (2018b)</a>	Questionnaire survey with 239 respondents a year after implementation of ABW in four offices in Sweden	Relationships between environmental perceptions and workspace use and self-rated productivity and well-being at work	Satisfaction with the physical environment, privacy and communication had the strongest positive associations with productivity and well-being at work. Increased workspace switching was associated with higher productivity. An increase in time spent searching for a workspace was associated with lower productivity and well-being
<a href="#">Candido et al. (2019)</a>	Questionnaire surveys, spot measurements of IEQ and step-count monitoring in 10 offices before and after relocations from contemporary open-plan to ABW	Satisfaction, productivity and health	ABW had significantly higher satisfaction results on key IEQ dimensions, perceived productivity and health
<a href="#">Groen et al. (2019)</a>	Survey data from 25,947 respondents and 191 organizations in the Netherlands Comparison with findings from a similar study 10 years ago	Relationship between satisfaction with buildings, facilities and services and perceived productivity support. Absence of health complaints was one aspect of productivity support	38% of the variation of office employees' satisfaction with support of productivity could be explained by employee satisfaction with facilities, the organization, current work processes and personal- and job-related characteristics Opportunities to concentrate and to communicate, privacy, level of openness and functionality, comfort and diversity of the workplaces are very important

(continued)

**Table 3.**  
Health and well-being, satisfaction and labour productivity (17 studies)

Study	Methodology	Research topics	Findings
Engelen <i>et al.</i> (2019)	Literature review	Impact of ABW on health, work performance and perceptions	ABW has positive merits in the areas of interaction, communication, control of time and space and satisfaction with the workspace, but it is unfavourable for concentration and privacy
Roskams and Haynes (2019)	Pilot with 15 employees in an open-plan office in the UK to test the effectiveness of an experience sampling approach for measuring employee satisfaction	Impact of environmental comfort on momentary well-being and productivity	The study partially supported a hypothesis that higher levels of environmental comfort are associated with higher levels of well-being and productivity. Distractions had the strongest negative impact on the outcomes
Jamrozik <i>et al.</i> (2019)	Living lab study in the USA, where ten participants worked 14 weeks under three different shading conditions: blackout shade (baseline); manually controlled motorized mesh shades; and windows with automatic, dynamic tinting	Effect of different shading systems on cognitive performance, satisfaction and eyestrain	Eyestrain symptoms were reduced and satisfaction and performance were improved with modern shading systems. There were no statistical differences between the two modern conditions
Davis <i>et al.</i> (2020)	Survey among 406 employees, working in differing office configurations	Impact of physical proximity and breakout areas on ease of communication, job satisfaction and well-being	Limited influence of proximity. Access to breakout areas was strongly related to ease of communication, higher job satisfaction and well-being
Franke and Nadler (2020)	Laboratory test with $N = 180$	Impact of IEQ factors (tangible vs intangible) on workplace satisfaction, health and productivity	Workplace satisfaction, health and productivity are more strongly affected by intangible factors than by tangible ones. Impaired privacy leads to SBS symptoms and less creativity. Personality traits correlate differently with ergonomics and privacy
Ko <i>et al.</i> (2020)	Laboratory experiment in the USA with 86 participants, in spaces with and without windows in office-like test rooms, including subjective evaluations, skin temperature measurements and cognitive performance tests	Assessment of the influence of having a window with a view on thermal and emotional responses as well as on cognitive performance	Participants felt more comfortable with windows in the situation with a slightly warm condition. Positive emotions increased while negative emotions decreased with windows. Working-memory and concentration improved in a space with windows
Nappi <i>et al.</i> (2020)	Questionnaire surveys before and after relocation of a company in France with various	Relationship between stress and workspace attachment, user	After the relocation, the employees experienced greater job stress and less workspace satisfaction and felt less attached to their workspaces. The

(continued)

Table 3.

Study	Methodology	Research topics	Findings
Thatcher <i>et al.</i> (2020)	office types, mostly open-plan and flex Experimental study in a laboratory with student participants, followed by longitudinal studies with surveys in two call-centres in South Africa	satisfaction and productivity Impact of indoor plants on performance and well-being	perceptions of workspace support to labour productivity did not change In the laboratory study, the condition with indoor plants performed statistically better on three measures of work performance. These positive outcomes could not be replicated in two field studies using various proxy measures of performance and well-being
Candido <i>et al.</i> (2021)	Questionnaire surveys with 1,121 respondents from nine offices in Australia, divided into four with open-plan and five with ABW. All buildings held a Green Building certification; two of them also held a WELL certification	Satisfaction, productivity and health Comparison with benchmarks from a research database (Candido <i>et al.</i> , 2016)	The buildings with WELL certification achieved the highest scores for overall satisfaction, workability, perceived productivity and health Offices with ABW had the highest scores on spatial comfort, thermal comfort, noise and privacy, personal control, comfort of furnishing, adjustability of the work area and space to collaborate
Licina and Yildirim (2021)	Online survey among employees in three companies in Switzerland before and after relocation to new office buildings	Occupant satisfaction, productivity and health during a transition to WELL-certified buildings	Significant increase in satisfaction in two out of three WELL buildings. The positive effect was evident for building cleanliness and furniture. WELL buildings usually did not attain the 80% standard satisfaction threshold. SBS symptoms and productivity scores revealed no significant differences, except that symptom of tiredness was lower in WELL buildings
Zerguine <i>et al.</i> (2021)	Mix-method study, including an online survey with 216 respondents from 150 organizations across 18 sectors as well as 17 interviews in Australia	Current use and practices to support the implementation of sit–stand workstations (SSWs)	40% of organizations provided SSWs on request, whereas 41% reported not using them appropriately. SSWs were perceived effective in reducing discomforts and increasing employees' satisfaction and productivity

Table 3.

project data on financial costs and benefits has been tested scientifically on reliability and validity.

#### 4. Discussion and conclusions

The discussed studies show a huge variety in environmental characteristics that influence health and well-being, employee satisfaction and labour productivity, such as office type, proximity, density, IEQ of IAQ, furniture (ergonomics, sit–stand desks), plants and personal control. Some studies focus on specific building types such as certified green buildings, WELL-certified buildings and tall wind-excited building, specific building components such as shading systems or specific interior elements such as sit–stand desks and furniture comfort. Research methods range from questionnaire surveys to before–after studies and laboratory experiments. Measuring physical conditions such as heart rates and skin temperature is still underexposed. Remarkably, most discussed papers present findings on

	Satisfaction (8)	Productivity (20)	Satisfaction + productivity (17)	Total (45)
Literature review		7	1	8
Questionnaire survey	8	12	15	35
Interviews	1	1	1	3
Diary		1		1
Before–after study	4	2	4	10
Longitudinal study		1	1	2
Living lab study		1	4	5
Cognitive tests		1	1	2
Experience sampling			1	1
Polling		1		1
Spot measurements (IEQ)			1	1
Step-count monitoring			1	1
Heart rate		1		1
Skin temperature			1	1

**Table 4.**  
Applied research  
methods in the  
presented studies

**Note:** The total number of methods exceeds the total number of studies, because of the use of mixed methods in various studies

health and satisfaction and/or productivity without discussing correlations between health, satisfaction and productivity.

The reviewed studies indicate positive but also mixed and contradictory effects of healthy workplaces on satisfaction and productivity. Overall, a healthy IAQ, opportunities for communication, concentration and privacy, availability of break-out rooms, an attractive look-and-feel, ergonomic furniture, contact with nature and plants go hand-in-hand with higher employee satisfaction and perceived productivity. Large open-plan offices and centrally controlled air condition show a negative effect on health, satisfaction and productivity. There is some evidence that workplaces in green buildings are healthier than workplaces in conventional buildings. Adjustable workstations with sit–stand desks show to have beneficial effects for comfort and labour productivity. Practitioners should take these findings into account in their design and management activities.

What constitutes a healthy workplace is much dependent on the workstyles and the preferences of the users. The degree to which the workplace has impact on satisfaction is in particular dependent on user preferences in relation to privacy versus social contact. The impact on productivity is in particular dependent on the specific workstyle and how well the workplace supports the work activities. Involving the users in the planning process and change management during implementation is crucial.

Scientific research on monetary cost and benefits of healthy workplaces is limited. Overall, the data indicate a positive impact of healthy workplaces on the reduction of sickness absence.

Because of the impact of many interrelated variables, it is difficult to trace cause–effect relationships between characteristics of healthy work environments and support of other value dimensions. Usually, various interventions are conducted simultaneously. Furthermore, employees' health not only depends on what the workplace does to employees, but also on what workers bring with them to the workplace.

The mixed findings make it hard to provide a sound business case for physical interventions to improve health and well-being. On the one hand, taking care of healthy work environments is a matter of moral responsibility and has in general a positive effect on

Study	Methodology	Research topics	Findings
Burton (2008)	Literature review	Stress, absenteeism, cost	Stress contributes to 19% of absenteeism costs, 30% of disability costs, at least 60% of workplace accidents and 40% of staff turnover costs Positive impact of healthy workplaces on staff turnover and sick leave, resulting in cost reduction Cost–benefit ratio may range from €1.25 to €5 for every Euro invested. Great cost savings can be gained, when health promotion programs are implemented in a supportive work environment
Marsden and Moriconi (2009)	Employee surveys, interviews with managers and data about sickness absence in a multi-site organization in the logistics sector	Absenteeism	Good consultation and communication at the local level, and absence management that emphasizes employee well-being, is associated with lower absenteeism In a case study, absence rates fell from 6.5%–7% to 4%–5%
Elzeyadi (2011)	Qualitative sorting task of employees' preferences and ratings; in-depth interviews with 98 office employees; evaluation of physical office conditions, lighting qualities and quantities by 175 employees; questionnaire survey and physical health screening forms of employees' health conditions	Biophilic relationship between views on nature and daylighting in the workplace and impacts on sick leave	Workers in offices with poor ratings of light quality and poorer views used significantly more sick leave hours. Taken together, the two variables explained 6.5% of the variation in sick leave use, which was statistically significant The combination of view quality, lighting quality and glazing area explained 10% of the variation in sick leave days
Terrapin Bright Green (2012)	Analysis of small investments involving very low or no up-front cost, such as providing employees access to plants, natural views, daylight and other biophilic design elements	Costs and benefit of biophilic design	Integrating quality daylighting schemes can save over €1.65 per employee per year in office costs; over €76m could be saved annually in health-care costs as a result of providing patients with views to nature. Biophilic changes can reduce absenteeism over a long period of time, reduce complaints that drain human resource productivity and help retain employees
European Agency for Safety and Health at Work (2014)	Literature study	Costs of stress and psychosocial risks at work, on national level and per sector	Stress and psychological risks result in increased medical and insurance costs, higher sickness absence, higher staff turnover, early retirement, more accidents

**Table 5.** Financial costs and benefits of healthy workplaces (11 studies)

(continued)

Study	Methodology	Research topics	Findings
			and errors, loss of productivity and lower quality of life. It is estimated that 30% of sickness absence is directly caused by stress. Every €1 of expenditure in promotion and prevention programs generates net economic benefits over a one-year period of up to €13.62
<a href="#">Bodin Danielsson et al. (2014)</a>	Data from 1,852 employees working in Sweden in different office types	Sick leave	Significant higher short sick leave among women in small, medium-sized and large open-plan offices and among men in flex-offices A significantly higher risk on long sick leave was found among women in large open-plan and for the total number of sick days among men in flex offices
<a href="#">Laski (2016)</a>	Analysis of 11 cases	Impact of green features, location and amenities, IAQ, acoustics, look-and-feel on health and well-being benefits, occupant satisfaction and economic benefits	Because of the variety in projects regarding its size, type of organization and interventions, calculated economic benefits showed a wide range with drops in employee sick days of 25%–58%, reductions in staff turnover of 27% and annual savings up to €85,000 per year
<a href="#">Jinnett et al. (2017)</a>	Study of 16,926 employees who participated in a worksite wellness program	Workplace safety, employees' health conditions and absenteeism	Poor workplace safety and employees' chronic health conditions contributed to absenteeism and job performance. Their impact was influenced by the physical and cognitive difficulty of the job
<a href="#">Muldavin et al. (2017/2018)</a>	Property Health and Wellness ROI (Return of Investment)	Financial and health impact of investments in a hypothetical investment in the WELL Building Standard for a 18,500 m <sup>2</sup> office building	Over a period of five years, the Internal Rate of Return from WELL investments is estimated to be almost 300%. Sensitivity analysis around a range of potential cost estimates (e.g. more or less than 0.5% productivity growth, taking into account initial investments to learn new rating systems) results in other figures
<a href="#">Marson (2018)</a>	Analysis of cost data from Investopedia and the International Well Building Institute	Productivity loss and absenteeism	In the USA, the total annual costs of lost productivity because of employee absenteeism counts €69bn. Creating and implementing well-being programs can reduce employee "sick days" by 26%. A real estate agency that achieved a WELL Gold certification mentioned a reduction of four sick

(continued)

Table 5.



Study	Methodology	Research topics	Findings
Measurement (no year)	Literature review and data from internet	Stress, engagement and productivity	days per year per employee and a 27% reduction in staff turnover 57% of employees with high amounts of stress are disengaged in the workplace. Organizations with engaged employees experience increase profitability by more than 20%. Healthy workers are 11% more productive

**Table 5.**

employee satisfaction and labour productivity and on society as a whole. These advantages have to be balanced with the costs of interventions to provide more healthy environments. An obstacle for a more integrated, holistic business case may be that the cost of interventions and its resulting output and outcomes are not always easy to measure in a quantitative way. Another difficulty is that some outcomes might be experienced in the short term and perhaps only temporarily, while others might be sustained, reduced or only experienced in the long term. One solution is to base business cases not only on quantitative data but to take into account well-argued qualitative considerations as well. As such, we plea for a so-called value based business case or “value case”.

*4.1 Suggestions for further research*

Additional research is needed to get a deeper, holistic and evidence-based knowledge of the added value of healthy workplaces and interrelationships between health, satisfaction and productivity and financial impacts that integrate different research topics and research methods. A next step can be to use the research findings as input to follow-up transdisciplinary research by academics from different fields, including corporate real estate management, facilities management, human resource management, environmental psychology and work and organizational psychology. Reflections on data by an interdisciplinary team and experimenting with particular interventions may be helpful as well.

Other topics for future research are extension of this literature review with papers from other journals and databases such as Scopus and PubMed, and to conduct additional empirical research with before–after studies of particular interventions and data-collecting techniques such as workshops, group interviews, pilot projects and self-measurement of health and health-supportive behaviour, e.g. by using wearables and apps. Cost studies should not only focus on data analysis of sickness absence, but extend their scope to self-reported health risks and health conditions, to get a better understanding of what drives health costs and lost productivity (Jinnett *et al.*, 2017). Besides, more studies are needed into the costs of particular interventions and return on investment.

A particular topic for further research is the use and experience of offices in the post Covid-19 period. Increased “infection risk mitigation” will affect the presence in the office, number of people per m<sup>2</sup>, need for fresh air access, etc. The Covid-19 crisis has resulted in a drastic increase in home working and this experience is likely to have profound implications for office work in the future.

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