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Identifying interior design strategies for healthy workplaces – a literature review

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Abstract

Purpose – It is widely recognized that interior office space can affect health in several ways. Strategic and evidence-based design, including explicit design objectives, well-chosen design solutions and evaluation of results, aid realization of desired health effects. Therefore, this paper aims to identify possibly effective interior design strategies and accompanying design solutions and to provide examples of effectiveness measures.

Design/methodology/approach – A literature sample of 59 peer-reviewed papers published across disciplines was used to collect examples of workplace design features that have positively influenced workers' well-being. The papers were grouped by their health objective and design scope successively and their theoretical assumptions, measures and findings were analyzed.

Findings – Four main workplace design strategies were identified. Design for comfort aims at reducing or preventing health complaints, discomfort and stress, following a pathogenic approach. It has the longest tradition and is the most frequently addressed in the included papers. The other three take a salutogenic approach, promoting health by increasing resources for coping with demands through positive design. Design for restoration supports physical and mental recovery through connections with nature. Design for social well-being facilitates social cohesion and feelings of belonging. Design for healthy behavior aims at nudging physical activity in the workplace.

Originality/value – By drawing complementary perspectives and offering examples of design solutions and effectiveness measures, this paper encourages workplace designers, managers and researchers to take a transdisciplinary and evidence-based approach to healthy workplaces. It also serves as a starting point for future empirical research.

Keywords Well-being, Employee health, Office, Interior design, Strategic design, Salutogenic approach

Paper type Literature review

This study re-used data which were collected by Colenberg *et al.* (2020) to provide an overview of the evidence on the relationship between interior office space and health. Previous analysis and a shorter version of this paper were published in the proceedings of the 2020 Transdisciplinary Workplace Research Conference.

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Introduction

A growing body of research is suggesting that workplace design is essential to the successful execution of business strategy (Chan *et al.*, 2007) and to organizational performance (Van de Voorde *et al.*, 2012). The awareness of the possible health impact of building interiors has grown in recent years (Hanc *et al.*, 2019; Jensen and Van der Voordt, 2020; World Green Building Council, 2014) and has become even more urgent during the COVID-19 pandemic (Cirrincione *et al.*, 2020). Yet, a workplace is a complex composition of many different and sometimes conflicting elements. For example, measures to prevent virus spread could be at odds with acoustical comfort due to easy-to-clean yet sound-reflecting surfaces or they could interfere with relatedness due to physical distancing that separates colleagues.

Creating healthy work environments, therefore, requires a wide view of potential health hazards and invigorators. Nevertheless, researchers and practitioners can have a blind spot for workplace factors that are not in the usual scope of their own discipline. For instance, in the field of organizational behavior the influence of the physical work environment has long been ignored (Ayoko and Ashkanasy, 2020) and in facilities and real estate management the research on health and well-being is fairly limited (Jensen and Van der Voordt, 2020). Therefore, the aim of this paper is to draw different perspectives on healthy workplaces and provide leads for strategic and evidence-based workplace design and transdisciplinary workplace research.

Workplace and health

Workplace can refer to the physical or the psychosocial work environment from the perspective of the organization or the individual user, differing from one sector to another. This study focuses on the physical work environment from the perspective of interior design. Interior design directly connects humans and space. It includes form, finish and spatial arrangement of design features such as spatial partitions and transitions, furnishings, lighting fixtures and sources, sound isolation, finish materials, accessories and technologies relating to space (Ching and Binggeli, 2018). It reaches beyond decoration and includes spatial (architectural) elements, but it excludes building construction and engineering. The interior design usually is changed more easily and more frequently than the structural design or air-conditioning layout. Second, as well-being can be considered a primarily individual benefit of healthy workplaces (Jensen and Van der Voordt, 2020), this study refers to the workplace as perceived by the individual user. Finally, this study focuses on office workplaces because office workers are the largest occupational group (U.S. Bureau of Labor Statistics, 2020) and offices are relatively comparable workplaces.

Regarding healthy workplaces, traditionally the emphasis has been on physical health, for instance as a consequence of air quality in office buildings. Polluted air has been identified as a health hazard since the times of the Greek and Roman empires. The sick building syndrome that emerged in the 1980's associated physical complaints of office workers with, for instance, mold and toxic emissions of building materials and machines. However, already in 1948, the World Health Organization defined health as "a complete state of physical, psychological and social well-being" (WHO, 2006), uniting medicine and social science and equating health to well-being. More recently, an even wider perspective is advocated, including the dynamic ability to adapt and to manage one's own well-being (Huber *et al.*, 2011). Designing a healthy workplace can, thus, have different starting points depending on the health perspective. This study takes on the widely accepted WHO definition of health.

Strategic design

Strategic workplace design aligns the design of the work environment with the long-term goals of the organization and might even be used to meet new challenges or create new possibilities (Chan *et al.*, 2007). For example, if a company wants to increase productivity or innovation, it may decide that to achieve this goal the work environment should support employee health as much as possible, believing that healthy workers are more productive and creative. This strategy may include specific health objectives and the use of design solutions that have shown to improve these health aspects directly or by stimulating healthy behavior.

As health has many faces, ideally, the responsible departments of the organization work together to envision and create an optimal workplace. Then they would brief the workplace designer with desired health effects of the new work environment and evaluate results to keep improving and responding to organizational changes, while the designer makes design decisions based on the best available evidence. In addition, researchers from different disciplines ideally work together to increase understanding of the relationship between workplace design and health. However, this is not common practice yet. Apart from segregation between disciplines, another complicating factor is that current research on well-being in office buildings often lacks clarity of design objectives and well-being conceptualizations (Engelen *et al.*, 2019; Forooraghi *et al.*, 2020; Hanc *et al.*, 2019).

More explicit design strategies including well-chosen design solutions can direct workplace design and research toward desired health effects and support organizational goals. Furthermore, examples of scientific outcome measures show how to systematically test assumptions regarding the effects of the applied design, thereby building up evidence to inform future design. Therefore, this study aims to contribute to a transdisciplinary and evidence-based approach to workplace design and design research by answering the following research questions:

RQ1. Which interior design strategies including evidence-based design solutions can be identified based upon scientific research on the relationship between workplace design and health?

RQ2. How can the effectiveness of these interior design strategies be measured?

Method

An existing database from a literature review that synthesized results on the impact of interior office space on employee health (Colenberg *et al.*, 2021) was used to identify the interior strategies. The database offered a way to include a broad sample of empirical workplace research and evidence-based workplace research for a semi-systematic literature review. According to Snyder (2019), semi-systematic literature reviews synthesize topics that are studied by various groups of researchers and contribute to understanding relevant research traditions.

The database was created by a systematic and transparent search procedure, which included entering every combination of six design-related and six health-related search terms (Table 1) into Scopus and Web of Science.

By using general terms for office space and occupational health rather than specific design elements or health complaints, finding studies from different disciplines was supported. The database contained 2,816 papers that were published in peer-reviewed journals between 1995 and 2018.

From the existing database, we extracted 59 papers using the following inclusion criteria:

- studying interior design (as defined by Ching and Binggeli, 2018) of an office environment;
- measuring health (as defined by the WHO, 2006) or healthy behavior;

- reporting a clear and systematic research method; and
- written in English.

Based on these criteria, we excluded papers on employee health that did not relate indoor conditions to interior design features. After subsequently screening title, abstract and full-text, we included 59 research and review papers for analysis.

From each paper in the sample, we extracted data on approach and outcomes (Figure 1) using a template created for this purpose. Next, we applied qualitative content analysis using descriptive and concept coding (Miles *et al.*, 2020). We first grouped papers with a similar health aim and subsequently grouped them by design scope. Studying theoretical assumptions and rationales per health group revealed implicit design goals. Based on the reported findings per design subgroup, we identified which design solutions could help to achieve which goal. By combining these possible goals and solutions that emerged from the papers we distinguished different design strategies. Outcome measures that were applied in each group served as examples of how to determine the strategy's effectiveness. We divided them into self-report measures of perceived well-being and objective measures of actual health and behavior.

Table 1.
Search terms that were used in 6 (interior) × 6 (health) combinations to create the database

Interior office space		Office workers' health
Physical work environment*		Health
Office environment*		Well-being
Office setting*	AND	Well-being
Workplace design*		Musculoskeletal
Office design*		Burnout
Office building*		Stress

Note: The * was used to include singular and plural forms in one search string

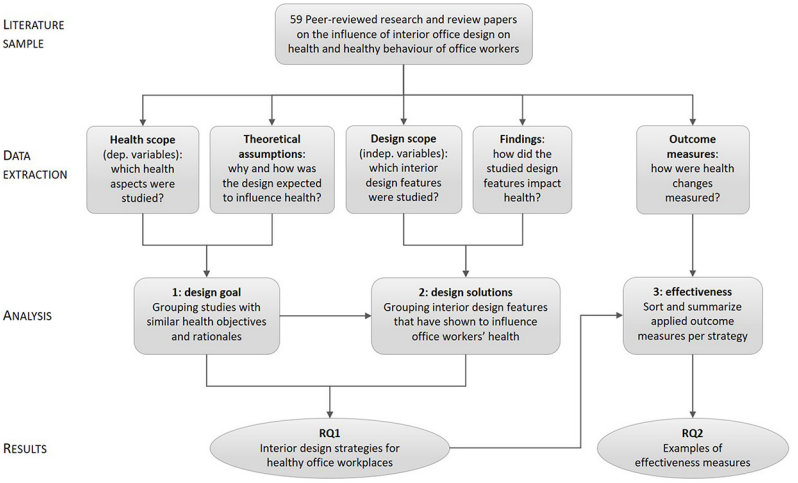

Figure 1.
Approach of literature review to identify interior design strategies for healthy office workplaces and measures of effectiveness

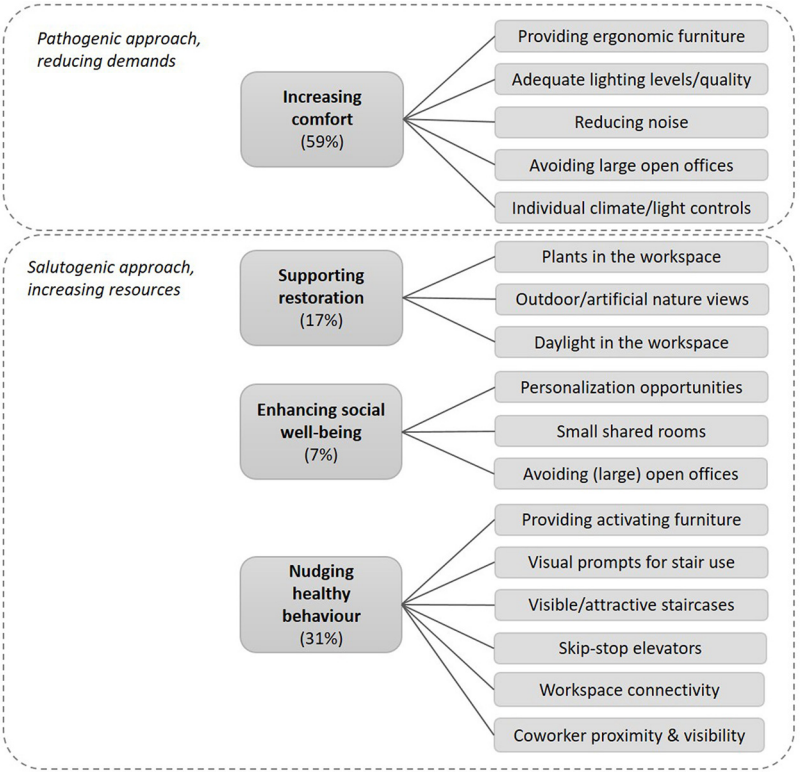

Figure 2.
Identified design strategies (% of the included papers) for healthy office workplaces including examples of evidence-based interior design solutions

Results

We identified four design strategies for healthy office workplaces, aiming at office workers' comfort, restoration and social well-being and stimulating healthy behavior (Figure 2).

The presented design strategies are not mutually exclusive; some papers included elements of different strategies. The most dominant strategy in the considered time-span (59% of the included papers, Figure 2) focuses on reducing environmental demands and decreasing harm and health risk, which refers to a pathogenic approach. The other three take a salutogenic approach (Antonovsky, 1996), aiming for renewal and increase of resources for coping with demands in the workplace. They relate to positive design that is explicitly intended to support human flourishing by, for instance, generating pleasure, personal significance and virtue (Desmet and Pohlmeyer, 2013).

Design for comfort

The most prominent strategy emerging from the selected papers aims to create a comfortable environment that protects users from physical and mental harm and stress. It has the longest tradition and can be considered the foundation of healthy workplaces, rooted in disciplines such as occupational health and safety, health psychology, ergonomics, building technology and medical science. The majority of the selected papers in this review were predominantly directed toward the office worker's physical or psychological comfort. They frame the research within knowledge on medical conditions such as cardiovascular

diseases and musculoskeletal issues or take the psychological stress perspective: support of employee functioning (Vischer, 2008), the balance between environmental resources and demands (Demerouti *et al.*, 2001) and privacy theory (Altman, 1975).

Ten papers investigated the health risks of different office types, comparing physical health conditions, environmental stress, mood or sickness absence between occupants of workspaces varying in architectural openness and number of workstations (Bodin Danielsson *et al.*, 2014, 2015; Jaakkola and Heinonen, 1995; Lindberg *et al.*, 2018; Pejtersen *et al.*, 2006, 2011) or before and after implementation of a different office concept (Brennan *et al.*, 2002; Foley *et al.*, 2016; Haapakangas *et al.*, 2018; Meijer *et al.*, 2009). These studies showed that workspaces for a larger number of people were related to increased health complaints and distractions, especially in open-plan offices without the backup spaces provided by an activity-based working concept. Seven studies aimed at reduction of musculoskeletal discomfort by providing ergonomic furniture designed to fit the user's body (Amick *et al.*, 2012; Van Niekerk *et al.*, 2012; Robertson *et al.*, 2009) or stimulate alternating working positions (Grooten *et al.*, 2017; Karakolis and Callaghan, 2014; Robertson *et al.*, 2013; Roossien *et al.*, 2017). Adjustable chairs were found to reduce discomfort, although it was not clear how much of this could be attributed to accompanying training. A smart chair and sit-stand desks showed mixed results regarding physical comfort.

Eight studies aimed at increasing visual or eye comfort, reducing physiological stress or headaches or improving mood and alertness by more light on the work surface (Van Duijnhoven *et al.*, 2018; Lamb and Kwok, 2016; Thayer *et al.*, 2010), applying different lighting concepts or systems (Fostervold and Nersveen, 2008; Joines *et al.*, 2015; De Kort and Smolders, 2010; Viola *et al.*, 2008) or increasing perceived lighting quality (Veitch *et al.*, 2008). Their findings indicate that adequate light levels and quality improve physical well-being and mood, but do not affect alertness.

A well-known source of discomfort and stress in offices is noise. A high level of background noise was found to increase physiological stress, yawning and psychological discomfort (Jahncke *et al.*, 2011; Lamb and Kwok, 2016; Schlittmeier and Liebl, 2015; Shafiee Motlagh *et al.*, 2018; Thayer *et al.*, 2010). Better sound absorption was related to a lower level of perceived disturbances and cognitive stress (Seddigh *et al.*, 2015).

Increasing comfort by offering possibilities to control indoor climate, for example, by being able to open a window, temperature or lighting in the workspace, had mixed results. Self-control was preferred by office workers although actual effects on musculoskeletal, visual or overall comfort or on headaches varied (Bluyssen *et al.*, 2011; Boerstra *et al.*, 2015; Knight and Haslam, 2010; Toftum, 2010). None of the included papers connected interior design to indoor air quality and health, although it was argued that building materials and plants could influence air quality (Fjeld, 2000).

Design for restoration

A second design strategy for healthy workplaces aims at providing a restorative work environment that supports recovery from physical and mental strain, grounded in environmental psychology and human biology. This strategy takes a step forward from minimizing stressors and misfits. It aims at supporting recovery by implementing principles of biophilic design (Kellert, 2008) to create beneficial connections with nature. Papers in this category refer to attention restoration theory (Kaplan, 1995), stress recovery theory (Ulrich *et al.*, 1991) and the biophilia hypothesis of Wilson (1984).

Seven studies relating to this strategy assessed the influence on fatigue and physiological stress of plants in the workspace (Bjørnstad *et al.*, 2016; Evensen *et al.*, 2015; Fjeld, 2000; Qin *et al.*, 2014) and of real or artificial outdoor nature views

(Bjørnstad *et al.*, 2016; Kahn *et al.*, 2008; Kweon *et al.*, 2008; Xue *et al.*, 2016). Most of these studies were lab experiments. The results varied from positive health effects to no effect at all, but at least the participants enjoyed the greenery. Other studies, including cross-sectional research designs and field experiments, focused on improving vitality, alertness and sleep quality through increased daylight in the workspace (Bjørnstad *et al.*, 2016; Boubekri *et al.*, 2014) or mimicry of daylight (De Kort and Smolders, 2010; Viola *et al.*, 2008), also with either little or positive results for well-being.

Design for social well-being

A less explicit design strategy emerging from the selected papers aims at supporting social relationships at work and expression of identity and is grounded in social, organizational and environmental psychology. This strategy differs from the other three by focusing on the outer-directed dimension of well-being that depends on interactions with other people (Fisher, 2014). Studies within this strategy refer to theory on personalization of space (Sommer, 1974), territoriality (Brown *et al.*, 2005) and regulation of social interactions (Altman, 1975) and to the Job Demands-Resources Theory (Demerouti *et al.*, 2001) in which social support serves as a buffer against burnout.

Morrison and Macky (2017) investigated a wide array of social demands and resources in the office and found that small shared rooms are best for friendships at work and that large open-plan offices undermine cooperative behavior and trust and increase negative interpersonal relationships. Wells (2000) studied workspace personalization as a means of increasing well-being. She found that allowance for personalization and the actual display of objects indeed were related to better well-being, mediated by satisfaction with the physical work environment and job satisfaction. Others addressed conflicts or satisfaction with team relations in studies on the effects of office type (Bodin Danielsson *et al.*, 2015; Brennan *et al.*, 2002) or furniture use (Torbeyns *et al.*, 2016), finding that open-plan offices were negatively associated with quality of relationships at work.

Design for healthy behavior

The fourth, relatively young strategy emerging from the selected papers aims to stimulate health-supporting behavior, namely, physical activity at work. These studies are framed by medical risks of prolonged sitting and theory on behavioral motivation and habits (Aarts and Dijksterhuis, 2000) and implicitly lean on the concept of nudging (Thaler and Sunstein, 2008) comes from behavioral economics and consumer psychology. Currently, nudging is often promoted as a seemingly easy and possibly effective means to influence human behavior and there are several ways to apply it in the physical work environment (Venema and van Gestel, 2021).

The studies within this design strategy all targeted the employees' sedentary behavior or amount of walking in the office. Among furniture offered to decrease sitting time (Barbieri *et al.*, 2017; Carr *et al.*, 2016; Graves *et al.*, 2015; Healy *et al.*, 2013; Torbeyns *et al.*, 2016), sit-stand desks generally reduced sitting and increased standing time (while they were less effective in reducing discomfort, as explained before). Having more sedentary breaks was related to greater local connectivity (available routes) and co-worker proximity and visibility (Duncan *et al.*, 2015; Wilkerson *et al.*, 2018). After relocating to an activity-based work environment office workers sat less than before (Foley *et al.*, 2016). An attractive and accessible staircase, as well as breakout spaces and centralized facilities, did reduce sitting time but did not increase moderate or vigorous activity (Jancey *et al.*, 2016). Larger distances

to the bathroom and kitchen were supposed to increase walking, but this was not confirmed after relocating to the new office buildings (Engelen *et al.*, 2016, 2017).

Other studies focused on increased physical activity by nudging stair use. Signs outside the staircase and an interactive artwork featuring inside doubled the stair use compared to a control group and this effect lasted for at least six weeks (Swenson and Siegel, 2013). However, posters, floor stickers and stair banners had mixed effects. Point-of-choice prompts did work, motivational posters inside elevators did not (Lewis and Eves, 2012). Or posters did increase stair use but after removal, this dropped back to baseline (Kwak *et al.*, 2007). In one case the nudging even lead to *reduced* stair use because it annoyed the office occupants (Åvitsland *et al.*, 2017). A review by Nocon *et al.* (2010) also reported contradictory or non-significant results. This shows that prompts might be an effective design solution only in the right form and place and when the nudging is accepted by the target group. Another design solution implemented to increase stair use was making stairs visible and implementing a skip-stop elevator that stops only at every third floor (Nicoll and Zimring, 2009). In other office buildings, open central staircases did not lead to more walking (Engelen *et al.*, 2016, 2017).

Measures for effectiveness

The outcome measures that were applied in the research papers (Figure 3) serve as examples of how to estimate the effectiveness of a design strategy in achieving health improvement or consolidation.

Comfort

Self-report measures
- Perceived comfort (general/ thermal)
- Musculoskeletal discomfort
- Eyestrain/ visual discomfort
- Perceived lighting quality
- Noise annoyance
- Disturbance
- Satisfaction with privacy
- Perception of cramped space
- Unpleasant odour
- Percieved air quality

Objective measures
- Observed sitting postures, upper body movements
- Lighting level (lux)
- Background sound level (dBA)
- Speech transmission index
- Radius of acoustic comfort

Restoration

Self-report measures
- Alertness, sleepiness, fatigue, feeling 'off'
- Mood, irritability, anger
- Need for recovery
- Experienced restoration
- Vitality / energy
- Perceived sleep quality
- Reported physical or social function
- Perceived fascination

Objective measures
- Heart rate recovery
- Observed yawning
- Directed attention capacity test
- Observed fascination (e.g. viewing time)

Social well-being

Self-report measures
- Satisfaction with team member relations
- Co-worker friendships
- Supervisor support
- Organizational support
- Frequency of conflicts, distractions
- Negative relationships
- Cooperative atmosphere, trust
- Possibilities for personalization

Objective measures
- Manually observed workspace personalization

Healthy behaviour

Self-report measures
- Reported sitting/ standing/ walking time at work
- Frequency of breaks in sitting time
- Reported stair/ lift use
- Level of physical activity

Objective measures
- Step count
- Observed sitting/standing time, sit-stand transitions
- Observed stair/ lift use

General health/well-being of office workers

Self-report measures (surveys)
- General physical/ mental health (rating), health concerns
- Mood, anxiety, depression, tiredness, feelings of stress (physical/ cognitive)
- Sick building symptoms: headache, eye/ ear/ nose/ throat/ skin irritation, nausea, feeling heavy headed, fatigue
- Musculoskeletal complaints (e.g. lower-back pain)
- Visual symptoms (e.g. blurred vision, difficulty focusing)
- Reported sickness absence, number of common colds
- Reported use of pain killers or sleep medication

Objective measures (e.g. by medical equipment)
- Physiological stress: saliva cortisol, skin conductance, heart rate variability, EEG, ECG, respiration rate, fingertip blood flow, oxyhaemoglobin saturation, urine catecholamines
- Cardio-metabolic biomarkers: systolic blood pressure, cholesterol, triglycerides, blood glucose level
- Anthropometrics: waist cricumference, body mass index, fat percentage, spinal shrinkage
- Aerobic fitness: peak VO_2, resting heart rate
- Tracked sleeping time and fragmentation
- Registered/certified sick leave days

Figure 3.
Effectiveness measures regarding health outcomes as applied in the included research papers

As well-being primarily is a subjective experience, many of the studies applied self-report measures, either by using previously validated scales, such as the perceived stress scale (Cohen *et al.*, 1983) and the perceived restorativeness scale (Hartig *et al.*, 1997) or –more often – newly created questionnaires. They address, for example, health complaints, sickness leave, environmental stress, interpersonal relationships and estimated physical activity and usually are created for one study only with limited testing of validity and reliability.

Objective health measures included examination of bodily fluids, heart rate recordings and measurements of the body weight and shape (Figure 3). They were used in experimental settings to compare health conditions before and after an intervention or to compare groups in different environments. Many of these measures are obtrusive to the participants, sensitive to privacy issues and require medical equipment and expertise, which explains their limited use in field studies. Objective measures for design improvement included, for example, sound and light levels. Objective measures for behavior change were mostly applied by automatic observation using wearables, such as activity trackers and sleep timers, sensors (for example, in chairs or under handrails) and cameras.

Discussion

Future research

This study has identified four workplace design strategies based on a sample of peer-reviewed papers on interior office space and health. Because of its wide scope and large time span, it is likely that this sample covers most of the approaches in workplace health research and an update would not lead to the identification of different strategies. However, additional strategies and design solutions may emerge from research using different search strings and search engines, including grey literature (books, dissertations) and studying publications on virtual work environments and design of communication technology, phenomena that have increased rapidly during the COVID-19 pandemic.

More design strategies for healthy workplaces may also be identified by analysis of well-being theories in the work context. For example, Forooraghi (2020) and Roskams and Haynes (2019) applied the sense of coherence theory onto office environments and argued that a comprehensible, manageable and meaningful workplace will ease health. This implies that next to interventions to support the restoration, enhance social well-being and stimulate physical activity, workplace design strategies could also aim for creating a sense of control, ownership and empowerment or providing clear rules about the use of workspaces. Strategies for empowerment match the positive health definition of Huber *et al.* (2011), which includes self-management and adaptation. Similarly, the combination of Person-environment fit and Self-determination theory may suggest a strategy of adjustable design, as needs-supply fit depends on individual, group and job characteristics (Appel-Meulenbroek *et al.*, 2020).

Additionally, analysis of design projects that were carried out in practice to improve workers' health may reveal new design strategies by studying their approach, applied design solutions and achieved improvements. We recommend studying projects across different work environments because the effectiveness of design solutions may differ strongly across work environments and work processes. Furthermore, studying the interior design of other environments, for example, health care (healing environment), educational settings (learning environment) and retail (consumer behavior) might reveal design solutions that could be applied to offices. Because design is not deterministic and design changes alone often will not be able to improve health, analyzing practices could also reveal important contextual factors.

Within the strategies, more evidence-based design solutions could be generated by a larger amount and variety of systematic research on healthy workplaces. Conducting field experiments would generate more knowledge of the designs' effectiveness in real-life settings whereas studies that rely on lab experiments provide a limited simulation of office settings. Longitudinal studies are required to generate insights into the long-term effects of changes in the work environment. For example, the effectiveness of nudges could be tested in field experiments taking measures before implementation and several times during the intervention to track how long its effect lasts in real life. Measuring after the intervention has ended and the stimulus has been taken away will show if the nudging has been able to establish healthy habits. Qualitative research can contribute to the understanding of why applied design solutions do or do not have the desired effect, for example, by conducting spatial walkthroughs, card sorting or experience mapping (Chafi and Cobaleda-Cordero, 2021).

Measurement of well-being in offices could also be improved by further operationalization of well-being concepts and developing measurement scales appropriate to the work context and office environment. General mental health measures may not cover all issues that are relevant to office workers' well-being. For example, social well-being may be context-sensitive and not yet been operationalized accordingly (Colenberg *et al.*, 2020). However, there may be appropriate well-being scales available in psychology that just did not find their way to workplace research.

In addition to contextualized and validated well-being measures, a more fine-grained taxonomy and measurement of actual workplace design features are required to improve measures of effectiveness. The work of, for example, Cobaleda Cordero *et al.* (2019) on identifying spatial attributes of the office landscape and the work of Kwon *et al.* (2019), Laurence *et al.* (2013), Sailer and Thomas (2020), Yıldırım *et al.* (2019) and Zerella *et al.* (2017) on classifying office furniture, layout characteristics and degrees of enclosure could serve as a basis for further development of design measures.

Practical implications

The current study offers workplace designers (interior architects and product designers), workplace managers (corporate real estate, facilities and human resources) and their consultants a source of design approaches. The identified strategies and explanation of their mutual relationships could support a wider perspective to healthy workplaces that reach beyond comfort, merging pathogenic and salutogenic approaches to achieve a complete state of health (Keyes, 2014).

This study also shows promising directions for further development of design strategies for healthy workplaces. Obviously, the youngest strategy, nudging healthy behavior, could be explored to a much greater extent. First of all, the targeted behavior could be extended from decreasing sitting time or increasing stair use to, for instance, stimulating a healthy diet, following hygiene measures, taking regular breaks, having walking meetings, cycling to work and any other activity that fits a healthy lifestyle, reduces health risk and generates positive experiences. For instance, nudging could also be applied to engage people in social interactions that enhance their social well-being. Furthermore, additional types of nudges could be developed. In the analyzed studies, most nudges were limited to graphs and warnings while they can take many other forms too. Translating Sunstein's (2014) top 10 nudges into workplace design, one could think of simplifying the use of tools or furniture, access to healthy options (staircase, healthy food) by default and to less-healthy options (elevator, snacks) by request or rewarding desired behavior in several ways, making healthy options more visible, easy and fun.

Also, the least developed strategy that was identified, called workplace design for social well-being, has potential. Deliberately creating social affordances (Spreitzer *et al.*, 2020), such as coffee bars and opportunities for playful interaction and using technologies to enhance face-to-face interactions at work (Olsson *et al.*, 2020) can increase the frequency or quality of positive interactions and thereby support relationship building. Offering opportunities for privacy regulation is important to facilitate private conversations and to prevent undesired interactions. Identity affordances (Spreitzer *et al.*, 2020), such as incorporating possibilities for personalization and workplace branding into the workplace design, can further increase feelings of belonging and place attachment.

To create restorative environments at work many more aspects of the biophilic design could be applied. The reviewed papers mainly focused on the direct experience of nature in the office through natural light and indoor and outdoor nature views, while (Kellert, 2008) distinguishes six main biophilic design elements and over 70 design attributes. He argues that apart from multi-sensory environmental features, such as plants, color, water and natural materials, the biophilic design could include the use of natural shapes, forms, patterns, processes, light and spatial attributes, as well as the support of place-based and human-nature relationships.

Regarding design for comfort, more design solutions could be developed and tested that reduce environmental stressors and solutions that go beyond ergonomics and instrumental control by further increasing psychological comfort. Vischer (2008) states that psychological comfort results from feelings of belonging, ownership and control over a workspace. Additional means to reduce environmental stress could aim for privacy regulation, for example, items that communicate someone does not want to be disturbed or flexible partitions that could be controlled by the employee. Or they could aim for decreasing fear of contamination by, for example, applying easy-to-clean materials, communicating cleanliness and nudging office users to take protection measures and follow hygiene rules.

Conclusions

In summary, four interior design strategies that aim to support or increase comfort, restoration, social well-being and healthy behavior, were identified based on a broad literature sample. These strategies invite workplace designers, managers and researchers to take a transdisciplinary view of healthy workplaces and look beyond physical well-being. Although the COVID-19 pandemic initially has forced the attention to hygiene and physical distance, in the longer term the lockdowns and social restrictions made us aware of the human need to connect with each other in person and to get inspired by the environment. Salutogenic design could support people's resilience by replenishing resources for coping with demands. The presented examples of evidence-based design solutions and effectiveness measures could aid in making design decisions explicit and testing assumptions. For academics, this study provides directions for future transdisciplinary workplace research by outlining workplace design features and possibly related well-being aspects, indicating which ones are underexposed and proposing additional research topics and methods.

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