

The Role of Healthcare Facility Design on the Mental Health of Healthcare Professionals: A Literature Review

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Abstract

Objective: This study aims to review and synthesize the empirical evidence about the connection between healthcare facility design and the mental health of healthcare professionals by reviewing the relevant literature. **Background:** Mental exhaustion of healthcare professionals is becoming a critical issue in healthcare, especially during the pandemic. The physical design of healthcare facilities has significant potential to reduce and prevent the mental exhaustion of healthcare professionals by removing environmental stressors and providing restorative experiences. However, the built environment is not fully utilized as an intervention to support healthcare professionals. **Methods:** Relevant articles were identified from the Medline, PsycINFO, PubMed, and Web of Science databases using a combination of search terms representing environmental design factors and health outcomes. Identified articles were reviewed by their titles, abstracts, and full texts using the inclusion and exclusion criteria. **Results:** The search yielded 27 empirical articles investigating the relationships between environmental design factors and staff mental health outcomes, including stress, fatigue, job satisfaction, burnout, and well-being. Healthcare design aspects that were investigated in the identified articles include overall facility and perception (e.g., aesthetic appeal and impression, belonging to the surroundings, safety), specific spaces (e.g., patient area, staff workspace), intangible elements (e.g., exterior view, light, sound), and interior space and ergonomics (e.g., material finishes, furniture). **Conclusions:** Through the synthesis of the current literature regarding the relationships between healthcare facility design and the mental health of healthcare professionals, this study provides implications for supporting healthcare professionals through the design of the healthcare facility.

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Keywords

mental health, burnout, stress, healthcare professionals, facility design, staff safety

Healthcare facilities can be stressful work environments (Nejati et al., 2016). Healthcare professionals experience high levels of stress, job dissatisfaction, mental fatigue, burnout, and mental exhaustion, which worsened during the COVID-19 pandemic (Adams & Walls, 2020; Gregory et al., 2022; Lai et al., 2020; Sasangohar et al., 2020; Valipoor & Bosch, 2021). Burnout—a syndrome driven by work-related stressors (Shanafelt & Noseworthy, 2017)—is nearly twice as prevalent among healthcare professionals as among U.S. workers in other fields (Shanafelt et al., 2012; Shanafelt et al., 2015). Before the COVID-19 pandemic, 35%–54% of nurses and physicians reported burnout (National Academies of Sciences, Engineering, and Medicine, 2019), and this value increased to 70.5% among nurses after the COVID-19 pandemic (Wei et al., 2022). Healthcare professionals suffering from burnout may develop physical and psychological symptoms, including post-traumatic stress disorder, insomnia, and even suicidal ideation, resulting in poor performance and excessive turnover rates (Moss et al., 2016; Shanafelt et al., 2011).

Healthcare professionals experience high levels of stress, job dissatisfaction, mental fatigue, burnout, and mental exhaustion, which worsened during the COVID-19 pandemic.

Furthermore, healthcare professionals' mental exhaustion endangers not only themselves but also their patients. Healthcare professional burnout has been associated with increased rates of medical error (Shanafelt et al., 2010; Shanafelt et al., 2002; West et al., 2006; West et al., 2009), hospital-associated infections (Cimiotti et al., 2012), and higher patient mortality (Aiken et al., 2002; Welp et al., 2015).

Recognizing the need to support healthcare professionals' well-being and mental health, various initiatives have been launched in the United States, including the Healthy Nurse Healthy Nation (American Nurses Association, NA) and the

Well-Being Initiative (American Nurses Association, 2022). However, such initiatives are mostly centered on assessment, training, and/or consultation (American Nurses Association, 2022; American Nurses Association, NA) and do not fully utilize the built environments of healthcare facilities as a tool to improve the well-being and mental health of healthcare professionals yet.

The physical environments of healthcare facilities have immense potential to be an effective intervention for reducing and preventing the mental exhaustion of healthcare professionals. Physical environments may work as environmental stressors (Nejati et al., 2016; Valipoor & Bosch, 2021) or provide restorative spaces that positively contribute to staff mental health (Gregory et al., 2022; Nejati et al., 2016). The physical environments of healthcare facilities can not only lessen stressful conditions but also provide restorative conditions for healthcare professionals (Valipoor & Bosch, 2021).

The physical environments of healthcare facilities have immense potential to be an effective intervention for reducing and preventing the mental exhaustion of healthcare professionals.

To address the need to support healthcare professionals' mental health through the design of healthcare facilities, we aim to provide a synthesis of the current research investigating relationships between healthcare facility design and the mental health of healthcare professionals. This article reviews peer-reviewed empirical studies, identifying design factors associated with healthcare professionals' mental health symptoms, including stress, fatigue, job satisfaction, burnout, and well-being.

Method

Identification of Relevant Literature

Articles from 1990 to 2020 (2019 in the initial search) were searched in the following databases: Medline, PsycINFO, PubMed, and Web of

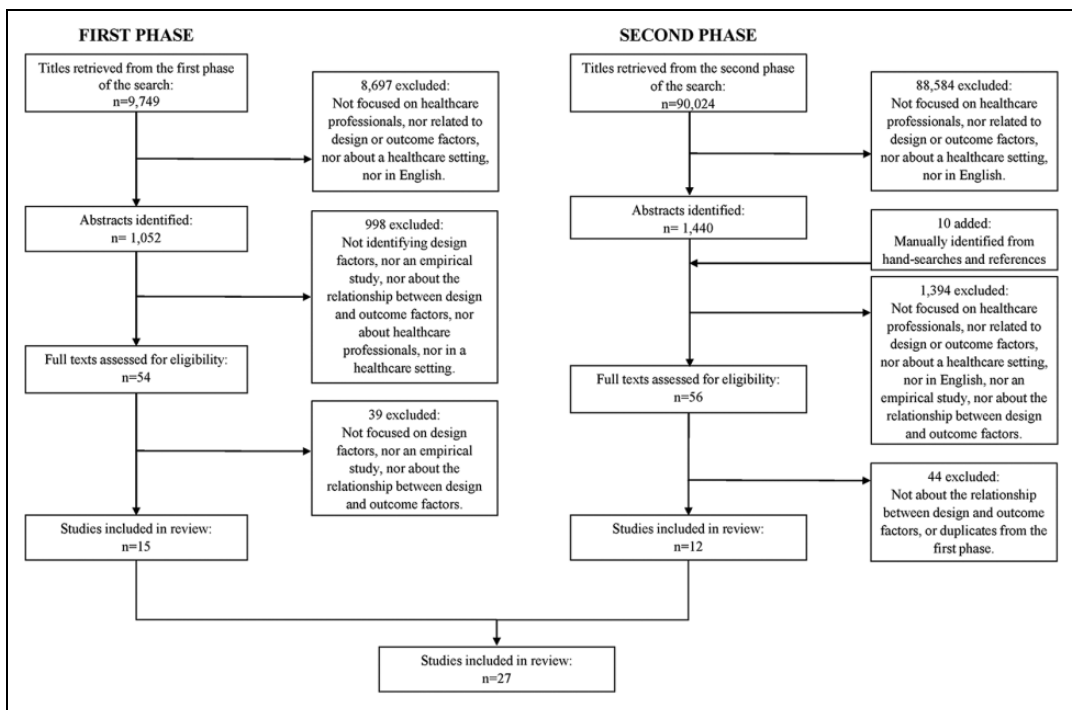


Figure 1. The search process of literature investigating relationships between facility design and staff mental health outcomes.

Science. This review was performed to identify design factors associated with the mental health outcomes of healthcare professionals. The examined mental health outcomes included burnout, stress, fatigue, and job (dis)satisfaction, which were identified as influencing factors in the high turnover rate of the healthcare profession (McHugh et al., 2011; Nejati et al., 2016), as well as well-being, which was found to be associated with burnout (Hall et al., 2016).

We conducted two key word searches, using AND in the query, to identify relevant articles (Figure 1). During the initial search conducted from February to March 2019, we used a combination of three factors (i.e., design, mental health outcomes, and population). We used “Built Environment,” “Design,” “Ergonomics,” and “Facility” to represent environmental design factors, “Burnout,” “Satisfaction,” “Stress,” “Wellbeing/Well-being,” and “Joy in Practice” as mental health outcomes, and “Caregiver,” “Nurse,” “Physician,” “Provider,” and “Staff” for the population.

After the first search, we conducted a second round to expand the scope of the search from June to July 2020. For the second search, we used the combination of only two factors, design and mental health outcomes with slightly adjusted search terms. The following search terms were used: “Environment,” “Built Environment,” “Physical Environment,” “Space,” “Prevention,” “Design,” “Ergonomics,” “Facility,” and “Intervention” for environmental design factors and “Stress,” “Fatigue,” “Burnout,” “Inefficacy,” “Exhaustion,” “Depersonalization,” “Cynicism,” and “Satisfaction” for health outcomes. Searches were performed for every combination of built and outcome factors.

Inclusion and Exclusion Criteria

Articles that were (1) primary studies published in peer-reviewed journals, (2) related to healthcare design with a focus on health professionals’ work environments, and (3) relevant to mental health were included for further review.

Furthermore, articles that were (1) not written in English, (2) not about a healthcare setting, (3) not an empirical study, (4) not focused on healthcare professionals, (5) not related to design or outcome factors, and (6) not about the relationship between design and outcome factors were excluded from further review.

Literature Review Process

The review was conducted by a team of researchers with architecture backgrounds. The researchers were trained before the search, and exclusion criteria were used to ensure consistency between team members. Articles were excluded only when they fell under at least one exclusion criterion. The articles that did not meet any exclusion criteria were forwarded for further review.

In the first phase, the titles of each of 9,749 sources were reviewed, which was followed by a review of the abstract and full text using the inclusion and exclusion criteria. In the second phase, which expanded the search using additional terms, a total of 90,024 articles were identified and reviewed by their titles, abstracts, and full texts using the same inclusion and exclusion criteria. During the second phase, additional articles manually identified from hand searches and references, including recently published articles (after 2020), were added to the abstract review process. Duplicates between the two phases were excluded.

Results

A total of 27 studies were identified and included in the review. The summary descriptions of the identified articles are illustrated in Table 1.

The staff health outcomes of the identified articles were categorized into stress, fatigue, burnout, job satisfaction, and well-being. The majority of the included articles reported the role of facility design aspects on stress and job satisfaction. Table 2 and the following sections illustrate the relationships between design factors (in multiple scales from overall facility design to interior design) and staff health outcomes in the literature. The following sections were organized according to the four groups of design factors:

design of the overall facility and perception (i.e., the design consideration of the overall situation and context of the facility that affects the user's perception), design of the specific space (i.e., the layout and architectural properties of the specific area or space in the facility), design of intangible elements (i.e., intangible or ambient aspects of a space that affect the user's senses and experiences), and design of the interior space and ergonomics (i.e., design elements of interior spaces closely related to the user's body).

Overall Facility Design and Staff Health Outcomes

Age/aesthetic appeal and impression. Four studies examined the effects of facility age and/or aesthetic appeal on staff health outcomes, mostly staff satisfaction levels. Before and after studies of a hospital moving to a new facility found a significant increase in satisfaction among staff members who moved to the new facility. The factors of the new facility included higher scores of pleasantness defined as "the ambience of the facility design due to specific design features such as natural light, views of nature, and 'off-stage' areas" (Berry & Parish, 2008, p. 7) and favorable impressions of the hospital for dimensions, such as wellness, connection to the neighborhood, nature, and the city; comforting; and overall impressions (Alvaro et al., 2016). A cross-sectional study utilized surveys to test for links between the physical work environment and satisfaction (Djukic et al., 2014; Djukic et al., 2010). One of the surveyed components of the physical work environment was aesthetic appeal, and there was no effect of aesthetic appeal on job satisfaction based on a multivariate regression analysis (Djukic et al., 2010). Furthermore, a path analysis of the variables was conducted, which showed a positive indirect influence of the physical environment on job satisfaction through structural, personality, and economic variables (Djukic et al., 2014). In addition to job satisfaction, a positive impression of the healthcare facility (e.g., pleasantness, favorable impressions of the building) was associated with lower staff stress (Berry & Parish, 2008), lower burnout, and enhanced well-being (Alvaro et al., 2016).

Table 1. Summary Descriptions of the Identified Empirical Studies.

Sources	Setting	Population	Location	Related Staff Health Outcomes
Alvaro et al. (2016)	IP	Staff	Canada	Burnout, job satisfaction, and well-being
Applebaum et al. (2010)	IP	Nurses	United States	Job satisfaction and stress
Berry et al. (2008)	IP	Nurses	United States	Job satisfaction and stress
Bosch et al. (2012)	NICU	Staff (doctors and nurse practitioners)	United States	Stress, job satisfaction, and fatigue
Cone et al. (2010)	NICU	Staff (physicians, nurses, respiratory therapists, and support service personnel)	United States	Stress
Copeland et al. (2017)	IP	Nurses	United States	Job satisfaction
Cordoza et al. (2018)	IP	Nurses	United States	Burnout
de Matos et al. (2020)	ICU	Staff doctors, nurses, and respiratory therapists)	Brazil	Burnout and stress
Djukic et al. (2010)	IP	Nurses	United States	Job satisfaction
Djukic et al. (2014)	IP/OP	Nurses	United States	Job satisfaction
Gola et al. (2021)	NA	Staff (doctors, nurses, unlicensed assistive personnel, and others)	Italy	Fatigue
Harris et al. (2006)	NICU	Staff (mainly nursing staff)	United States	Stress
Hogan et al. (2016)	NICU	Nurses and midwives	Australia	Job satisfaction and burnout
Hua et al. (2012)	IP	Nurses	United States	Job satisfaction and stress
Maguire et al. (2013)	NICU	Staff (nurses, social work services, nutritionists, respiratory therapists, child life and rehabilitation therapists, and pharmacists)	United States	Stress
Milhandoust et al. (2021)	ICU/TU/ED	Nurses	United States	Burnout
Nejati et al. (2016)	NA	Nurses	United States	Stress
Okcu et al. (2011)	ICU	Nurses	United States	Stress
Pati et al. (2008)	IP	Nurses	United States	Stress
Pati et al. (2015)	IP	Staff (physicians, nurses, and support staff)	United States	Stress
Shepley et al. (2008)	NICU	Staff (physicians, nurses, and respiratory therapists)	NA	Stress and job satisfaction
Sundberg et al. (2017)	ICU	Nurses	Sweden	Well-being and stress
Wang et al. (2013)	ICU	Staff (registered nurses, patient care technicians, and patient care liaisons)	United States	Stress and satisfaction

(continued)

Table 1. (continued)

Sources	Setting	Population	Location	Related Staff Health Outcomes
Watson et al. (2014)	NICU	Staff (physicians, nurses, nurse practitioners, and allied health)	Canada	Job satisfaction
Wingler et al. (2015)	OP	Staff	United States	Well-being
Wingler et al. (2019)	IP/OP/LT	Nurses	United States	Fatigue
Zamani et al. (2019)	ED	Staff (ED staff)	United States	Job satisfaction

Note. IP = inpatient; OP = outpatient; ED = emergency department; (N)ICU = (neonatal) intensive care unit; TU = telemetry unit; LT = long-term care; NA = not applicable.

Table 2. Relationships Between Design Factors and Staff Health Outcomes in the Literature.

Design Factors	Stress	Fatigue	Burnout	Job Satisfaction	Well-Being
Design of the overall facility and perception ^a	Age/aesthetic appeal and impression		Alvaro (2016) ^b	Alvaro (2016) ^b Berry (2008) ^b Djukic (2010) Djukic (2014) ^b Alvaro (2016) ^b	Alvaro (2016) ^b
	Belonging to the surrounding (e.g., neighborhood, city, nature) Crowding Privacy Safety	Berry (2008) ^b	Alvaro (2016) ^b	Djukic (2010) Djukic (2014) ^b Zamani (2019) ^b Berry (2008) ^b Zamani (2019) ^b Zamani (2019) Wang (2013) ^b Copeland (2017) Berry (2008) ^b Bosch (2012) ^b Hogan (2016) Shepley (2008) ^b Watson (2014) ^b	Alvaro (2016) ^b
Design of the specific space ^a	Wayfinding Floor/unit layout	Wingler (2019) ^b Wingler (2019) ^b			
	Patient area	Wang (2013) ^b Berry (2008) ^b Bosch (2012) ^b Cone (2010) ^b de Matos (2020) ^b Harris (2006) ^b Maguire (2013) ^b Shepley (2008) ^b Berry (2008) ^b Hua (2012) Pati (2015) Berry (2008) ^b Nejati (2016) ^b	de Matos (2020) Hogan (2016)	Bosch (2012) ^b Wingler (2019) ^b Bosch (2012) ^b Wingler (2019) ^b de Matos (2020) Hogan (2016)	Sundberg (2017) ^b Wingler (2015) ^b
	Staff workspace			Wingler (2019) ^b	Wingler (2015) ^b
	Break area Outdoor space		Cordoza (2018) Cordoza (2018) ^b	Berry (2008) ^b Hua (2012) Zamani (2019) ^b Berry (2008) ^b	

(continued)

Table 2. (continued)

Design Factors	Stress	Fatigue	Burnout	Job Satisfaction	Well-Being	
Design of intangible elements ^a	Exterior view Light	Pati (2008) ^b Applebaum (2010) Berry (2008) ^b Pati (2008) ^b	Wingler (2019) ^b	Mihandoust (2021) ^b	Applebaum (2010) Berry (2008) ^b Djukic (2010) Djukic (2014) ^b	Wingler (2015) ^b
	Odor Sound/Noise	Applebaum (2010) Applebaum (2010) ^b Okcu (2011) ^b Pati (2008) ^b Sundberg (2017) ^b Pati (2008) ^b	Wingler (2019) ^b Wingler (2019) ^b		Zamani (2019)	Wingler (2015) ^b
	Temperature Ventilation/air quality		Wingler (2019) ^b		Djukic (2010) Djukic (2014) ^b Djukic (2010) Djukic (2014) ^b Zamani (2019) ^b	Wingler (2015) ^b
Design of the interior space and ergonomics ^a	Visibility Material finishes/color	Applebaum (2010)	Wingler (2019) ^b		Djukic (2010) Djukic (2014) ^b Djukic (2010) Djukic (2014) ^b Djukic (2010) Djukic (2014) ^b	Wingler (2015) ^b
	Furniture		Wingler (2019) ^b			
	Ergonomic	Pati (2008) ^b	Wingler (2019) ^b			

^a Design of the overall facility and perception refers to the design consideration of the overall situation and context of the facility that affects the user's perception, design of the specific space refers to the layout and architectural properties of the specific area or space in the facility, design of intangible elements means intangible or ambient aspects of a space that affect the user's senses and experiences, and design of the interior space and ergonomics refers to design elements of interior spaces and closely related to the user's body.

^b Indicates that the association(s) between the environmental design factor(s) and staff health outcome(s) are reported by the author(s).

Belonging to the surrounding. Alvaro et al. (2016) investigated how the location and context of the facility would predict staff health outcomes. The results of this before-and-after study found that a greater sense of belonging to the neighborhood, nature, and the city was associated with increased staff satisfaction (Alvaro et al., 2016). Similarly, lower burnout was found to be associated with a greater sense of belonging to the neighborhood but not with a sense of belonging to nature or the city (Alvaro et al., 2016). Additionally, no significant association was found between the sense of belonging to the surroundings (neighborhood, nature, or city) and staff well-being (Alvaro et al., 2016).

Crowding. Two articles by Djukic and colleagues investigated the link between crowded facilities and staff spaces with staff health outcomes. Crowded space, as a physical work environment factor, had a positive indirect effect on job satisfaction according to the path analysis results (Djukic et al., 2014), although crowded space did not affect job satisfaction based on the multivariate regression analysis (Djukic et al., 2010).

Privacy. Only one study conducted by Zamani (2019) investigated the relationship between privacy and staff health outcomes. The findings of the study reported that higher levels of privacy, measured as the “ease of private interaction with patients and with team members,” enhanced staff satisfaction (Zamani, 2019).

Safety. Zamani (2019) also investigated the relationship between staff safety perception regarding the built environment and job satisfaction. The perception of emergency department (ED) safety accounted for 34% of the variance in the perception of work satisfaction (Zamani, 2019). Similarly, nurses working in the new wing who perceived that the hospital emphasized patient and staff safety felt the hospital was safe and reported positive job stress and satisfaction scores (Berry & Parish, 2008).

Wayfinding. Zamani (2019) reported no significant relationship between wayfinding perception and staff satisfaction. However, from the content analysis of the in-depth focus group data, the

authors identified wayfinding as one of the sensory design elements that contributes to nurse fatigue, although the directions of the relationships between the identified design elements and nurse fatigue were not specified (Wingler & Keys, 2019).

Design of Specific Space and Staff Health Outcomes

Floor/unit layout. Wang et al. (2013) reported that a dedicated service corridor in the ICU compared to shared corridors adjacent to patient rooms was associated with lower staff stress. The authors explained that the dedicated service corridor improved the noise level and provided a quieter environment for the staff, which in turn reduced staff stress (Wang et al., 2013). Furthermore, from the in-depth focus group, Wingler and Keys (2019) identified unit configuration that determines spatial adjacencies and spatial/visual relationships as one of the environmental factors contributing to nurse fatigue. In addition, two studies investigated the relationships between unit configuration and staff job satisfaction (Copeland & Chambers, 2017; Wang et al., 2013). While Wang et al. (2013) reported an association between a dedicated service corridor and improved satisfaction of the staff (i.e., feeling hopeful about work), Copeland and Chambers (2017) did not find a significant association between staff job satisfaction and overall layout changes (e.g., change from centralized to decentralized nursing stations, location of support spaces, and corridor passageways).

Patient area. Patient rooms are also one of most studied design areas in relation to healthcare professionals' health. A total of 12 studies reported the impact of patient area design on staff health outcomes. One of the main topics that was investigated is the comparison between open bay layout and single-patient rooms, and a couple of studies reported higher stress levels in single-patient rooms (de Matos et al., 2020; Maguire et al., 2013). One study demonstrated that the perceived stress was significantly higher after the move into a new unit with 61 private rooms (Maguire et al., 2013). Another study also found

that the stress of ICU staff was higher among ICU staff who worked in single-patient rooms (de Matos et al., 2020).

The comparison between open bay and single bay designs was further investigated in the neonatal intensive care unit (NICU). In the NICU, studies reported positive effects of a single-bay design on staff health outcomes. A single-family room, compared to an open bay design, was associated with a lower level of staff stress (Bosch et al., 2012; Cone et al., 2010; Harris et al., 2006; Shepley et al., 2008), improved satisfaction (Bosch et al., 2012; Shepley et al., 2008; Watson et al., 2014), and fatigue (Bosch et al., 2012). However, there is also one study that reported no significant association between single-family rooms (compared to open bay design) and staff job satisfaction or burnout levels (Hogan et al., 2016).

Furthermore, the design attributes of patient rooms, such as patient room size, acoustic environment, and room standardization, were investigated. A study conducted in a hospital moving to a new wing that included larger patient rooms with more natural light found significant improvement in staff satisfaction, as well as a significant reduction in staff stress levels (Berry & Parish, 2008). Another study in an ICU setting reported that a refurbished patient room with improved acoustic wall and ceiling panels, cyclic lighting, and a private door leading to a patient garden was considered to promote the wellbeing of nurses: The participants noted that they felt relaxed and calm in the room (Sundberg et al., 2017). In addition, a study found that satisfaction with space for patient care as the design category was relevant to staff well-being (Wingler & Hector, 2015). Furthermore, the patient room size and the degree to which the patient room is standardized with the location of furniture, equipment, and other supplies were identified as design factors that affect staff fatigue (Wingler & Keys, 2019).

Staff workspace. While a total of six studies investigated the role of staff workspace on staff health outcomes, staff workspace has received relatively less attention compared to that of patient areas. The design aspects of the staff workspace that

were investigated in the identified articles include the perception of workspace quality (Berry & Parish, 2008), nurse station layout (Hua et al., 2012; Pati et al., 2015), support for staff interaction and individual work (Wingler & Hector, 2015), and spatial adjacencies between workspaces, including supply rooms (Wingler & Keys, 2019; Zamani, 2019).

Berry and Parish (2008) measured the perception of the workspace quality using items, such as necessary features for workstations, sufficient meeting spaces, conveniently located supplies, storage areas, a convenient parking area, and ability to easily find equipment. The authors reported that nurses perceived the quality of staff workspace of the newly constructed hospital more positively, and the nurses in the new hospital also reported lower job stress and higher job satisfaction (Berry & Parish, 2008).

Two studies compared centralized and decentralized/multihub nurse station layouts and investigated their effects on staff stress (Pati et al., 2015) and satisfaction (Hua et al., 2012), but the two studies did not report statistically significant differences in staff stress and staff satisfaction between different types of nurse stations. However, in further analysis, Hua et al. (2012) reported that the staff members showed distinct results according to the length of time working on the unit. The job satisfaction scores of the nurses who had worked longer (i.e., 3 or more years) improved, while those of the newer nurses (i.e., less than 3 years) decreased, after the move from the centralized nurse station to multiple hubs with decentralized nurse stations (Hua et al., 2012).

In addition, study sites that implemented design innovations with a workspace environment that enabled ease of interaction and individual work were associated with statistically significant higher well-being scores among staff members (Wingler & Hector, 2015). Furthermore, adjacencies between and accessibility to multiple work areas, including supplies, medications, equipment, and workstations, were identified as design factors affecting physical, cognitive, and psychosocial dimensions of fatigue (Wingler & Keys, 2019) and were associated with staff job satisfaction (Zamani, 2019).

Break area. While important for staff restoration, there are only three identified studies that investigated the relationship between staff break area and staff health outcomes. A study reported that staff members of the new wing that included staff break rooms reported higher levels of satisfaction and lower levels of stress (Berry & Parish, 2008). Likewise, restorative design factors such as access to break areas, aesthetics of break areas, and access to private areas enabling between-shift recovery and providing personal privacy were identified as environmental factors that affect staff fatigue (Wingler & Keys, 2019).

An indoor break room with good accessibility, comfortable seating, and privacy from patients had low psychological improvement among staff when compared to an outdoor garden (Cordoza et al., 2018). Significant improvement was found in burnout inventory scores for the garden breaks compared with indoor-only breaks for emotional exhaustion and depersonalization (Cordoza et al., 2018).

Outdoor space. Outdoor spaces, such as balconies or green spaces, were associated with improved staff mental health. As mentioned, Cordoza et al. (2018) found a significant decrease in burnout among staff members who took their breaks outside in the hospital garden when compared to those who took their breaks inside (Cordoza et al., 2018).

Nejati et al. (2016) reported that having access to private outdoor spaces such as porches or balconies was associated with significantly greater restoration perception compared to window views or artwork. Likewise, a short break in green spaces was associated with improved mental and psychophysical well-being (mood), including fatigue (Gola et al., 2021). Furthermore, connection to the outdoors was identified as one of the design elements that has an impact on staff fatigue (Wingler & Keys, 2019).

Design of Intangible Elements and Staff Health Outcomes

Exterior view. Two studies examined the effects of exterior views on staff health outcomes, and both found significant links. One study showed a

significant correlation between both exterior view duration and exterior view content, with decreased levels of stress among staff members (Pati et al., 2008). Another study confirmed that the content of the view, whether staff can see nature or not, matters to staff health (Mihandoust et al., 2021). Mihandoust et al. (2021) found that less exposure to exterior nature views was associated with higher burnout, especially emotional exhaustion (defined as “the depletion of emotional resources and workers’ inability to focus on their patients at a psychological level”) and depersonalization (referring to “negative feelings toward patients”; Mihandoust et al., 2021, p. 259).

Light. Eight studies investigated the relationships between daylight or lighting design and staff health outcomes. In particular, natural light was found to have a positive impact on staff health outcomes. A study conducted in a hospital before and after renovations that provided increased natural lighting (along with single occupancy rooms, hand-washing stations, and break rooms) reported significant improvements in staff satisfaction and lower stress levels (Berry & Parish, 2008). A cross-sectional study using a Quality of Well-being Scale found a significant correlation between natural light and staff well-being (Wingler & Hector, 2015).

Furthermore, study sites that implemented design innovations with both natural and electric light environments were associated with statistically significantly higher staff well-being scores (Wingler & Hector, 2015), and staff members considered lighting (e.g., ambient light, daylight) as a design sensory factor related to nurse fatigue (Wingler & Keys, 2019). However, in another study, the level of light (as a combination of daylight and electric light sources) did not indicate a significant association with staff job satisfaction (Applebaum et al., 2010).

Two studies measured lighting as a variable of the physical work environment on job satisfaction (Djukic et al., 2014; Djukic et al., 2010). In both studies, lighting did not (directly) affect job satisfaction; however, the latter study conducted a path analysis and identified that lighting has a positive indirect effect on job satisfaction through

structural and economic variables (Djukic et al., 2014; Djukic et al., 2010). Pati et al. (2008) considered inappropriate lighting as a major environmental stressor, along with auditory, thermal, and ergonomic elements and investigated their relationship with acute stress. The results showed that the combined environmental stressors had a significant relationship with acute stress.

Odor. Odor has received less attention than other environmental design factors. One study identified odor as one of the design sensory factors related to nurse fatigue (Wingler & Keys, 2019). However, another study examined the impact of odor as an environmental factor on staff stress, but no significant correlation was found (Applebaum et al., 2010).

Sound/noise. Seven studies included examinations of the impact of noise (or sound) levels on staff health outcomes, especially regarding staff stress (Applebaum et al., 2010; Okcu et al., 2011; Pati et al., 2008; Sundberg et al., 2017). One study among nurses found noise level to be a significant predictor of reported staff stress (Applebaum et al., 2010). A before-and-after study of two hospitals found environmental stressors, including noise levels, to significantly impact staff members' stress (Pati et al., 2008). Another study examined an ICU patient room, which was refurbished with acoustic wall panels to reduce the noise from neighboring patient rooms, creating an environment in which staff members reported a lower level of stress (Sundberg et al., 2017). A comparative study of two ICUs showed that nurses in the centralized ICU, which produced higher objective sound pressure levels, had significantly higher levels of annoyance (Okcu et al., 2011).

Moreover, a cross-sectional study in three healthcare centers similarly found that noise level was also associated with quality of well-being scores (Wingler & Hector, 2015). Noise was identified as a physical health design element that contributes to health professionals' fatigue (Wingler & Keys, 2019). However, in a study centered on EDs, noise level was not significantly associated with the perception of staff satisfaction (Zamani, 2019).

Temperature. A total of five studies investigated the role of temperature on staff outcomes. A study of two children's hospitals found that environmental stressors, including temperature levels, significantly impacted both efficacy and stress levels; however, the variable of temperature was not specifically isolated in the analysis (Pati et al., 2008). In addition, community health centers that implemented design innovations with improved temperature environments were associated with statistically significantly higher well-being scores (Wingler & Hector, 2015). Another study reported that participants considered temperature that provides thermal comfort to be an element that impacts nurses' fatigue (Wingler & Keys, 2019).

Furthermore, two studies measured temperature as a variable of the physical work environment on job satisfaction (Djukic et al., 2014; Djukic et al., 2010). However, temperature did not affect job satisfaction according to the regression analysis but instead was analyzed as a positive indirect effect, such as lighting and noise according to the path analysis results (Djukic et al., 2014; Djukic et al., 2010).

Ventilation/air quality. Three studies investigated the relationships between air quality and staff health experiences, and only one study reported an association between the two. Wingler and Keys (2019) identified access to fresh air as one of the sensory design elements that impact the physical, cognitive, emotional, and psychosocial dimensions of staff fatigue. A cross-sectional study found, through a path analysis, that ventilation had an indirect effect on nurse satisfaction (Djukic et al., 2014), although ventilation had no effect on satisfaction in the regression analysis (Djukic et al., 2010).

Visibility. While it has received less attention than other design factors, visibility has been identified as a design aspect that affects staff satisfaction (Zamani, 2019) and fatigue (Wingler & Keys, 2019). Surveys revealed that staff members' ability to surveil patients and to see each other had significant effects on staff satisfaction (Zamani, 2019). Similarly, Wingler and Keys (2019) reported that peer-to-peer visibility and visual

connection to the patients within the unit are design dimensions that affect both cognitive and psychosocial fatigue.

Interior Design and Its Effects on Staff Health Outcomes

Material finishes and color. While a total of four studies included an investigation regarding the relationships between material finishes/color and staff health outcomes, only one study confirmed the association between the two. One study that examined satisfaction with colors and textures on finishes and furniture in the facility revealed that color and textures were significantly associated with higher staff well-being scores (Wingler & Hector, 2015).

In contrast, another study analyzed color (e.g., warm stimulating colors, soft soothing colors) as a major environmental variable but found no significant effect on staff stress (Applebaum et al., 2010). A study that analyzed colors and other decorative elements found an indirect effect on nurse satisfaction through a path analysis and no effect of color on job satisfaction in the regression analysis (Djukic et al., 2014; Djukic et al., 2010).

Furniture. Two studies examined the links between the quality of furniture as one of the physical work environmental factors and satisfaction among nurses (Djukic et al., 2014; Djukic et al., 2010). The research found that furniture as an interior design feature had a positive indirect effect on job satisfaction according to the path analysis (Djukic et al., 2014), although furniture had no effect on job satisfaction according to the regression analysis (Djukic et al., 2010).

Ergonomic. Two studies reported ergonomics as the design aspect that is associated with staff stress (Pati et al., 2008) and fatigue (Wingler & Keys, 2019). Wingler and Keys (2019) identified ergonomic design elements, such as travel distance, seating options, movable equipment, lift load, and reach distance, as design factors that are related to physical fatigue among staff. Such ergonomic design elements were considered to affect fatigue by placing forces on staff members while they performed certain patient care

activities, such as reaching, walking, and lifting (Wingler & Keys, 2019). From the point of view that improper ergonomics can be a physical constraint in healthcare facilities, one study identified ergonomics as a major environmental factor (Pati et al., 2008). It was integrated as environmental stress along with the rest of the environmental factor variables. The analysis found that this factor had a significant relationship with acute stress (Pati et al., 2008).

Discussion

Healthcare facility design plays a significant role in the mental health of healthcare professionals, as demonstrated in the identified literature. In this study, we reviewed previous literature and synthesized the relationships between healthcare design factors, categorized as the design of the overall facility and perception, design of the specific space, design of intangible elements, and design of the interior space and ergonomics, and the mental health outcomes including stress, fatigue, burnout, job satisfaction, and well-being.

Healthcare facility design plays a significant role in the mental health of healthcare professionals, as demonstrated in the identified literature.

Among the various design factors, the design of the patient area, staff workspace, light, and sound were frequently studied in the literature. Previous studies illustrated that the design of the patient area was associated with all five mental health outcomes, and staff workspace, light, and sound were associated with stress, fatigue, job satisfaction, and well-being. The relationships between staff workspace, light, and sound and staff burnout have not been investigated.

Among the five categories of health outcomes, stress and job satisfaction were utilized as major mental health outcomes. However, there are few studies on burnout and well-being as mental health outcomes related to healthcare design. Considering the recent challenges of healthcare professionals' burnout, future research investigating the role of the built environment on burnout and positive health outcomes, such as well-being

and joy at work, would provide significant insight in creating healthy work environments for healthcare professionals.

While this study provides insights for designing healthy work environments for healthcare professionals, it has several limitations. First, there could be relevant literature that was not included in this review due to the criteria used to select articles. We included literature written in English, and relevant literature written in other languages was not included. In addition, this review included studies that were conducted in various departments, such as intensive care units and outpatient settings. The results of a specific study may not be applicable depending on the type of healthcare settings and departments.

Furthermore, this review article is focused on the relationships between design factors and mental health outcomes. It does not illustrate the relationships between mental health outcomes or the relationships between patient outcomes and healthcare professionals. Considering that the design of a healthcare facility affects both patients and healthcare professionals and that health outcomes are related to each other, future studies expanding the synthesis of this article that describe the relationships between various factors could provide a holistic view of the role of facility design in user experiences.

Through the synthesis of the current literature, this study provides a means of supporting healthcare professionals through the design of healthcare facilities. This review article is expected to guide healthcare designers and facility managers to identify negative environmental stressors and positive design factors of their healthcare facility. We urge healthcare designers and facility managers to remove negative environmental stressors and provide positive design factors for healthcare professionals' mental health.

During the design process, along with other important (and potentially conflicting) factors, such as the efficiency of the spaces and patient safety, this study would help visualize the potential effects of healthcare facility design on the mental health of healthcare professionals. While the decision will be made by the relevant stakeholders, we hope this study will facilitate communication between stakeholders and eventually

provide healthier work environments for healthcare professionals.

Implications for Practice

- Researchers can identify design factors and health outcomes of healthcare professionals that need further investigation.
- Designers can confirm design factors that positively affect the mental health of healthcare professionals and implement them in their designs.
- Facility managers can evaluate their current built environments with respect to the mental health of healthcare professionals.

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