Lindenwood University
Digital Commons@Lindenwood University

Faculty Scholarship | Research and Scholarship

2-2024

Enhancing Workplace Neuro Health and Productivity: The Synergy of Wearable Technology with Biophilic and Oxygenation Strategies

Piper Hutson
Lindenwood University, phutson@lindenwood.edu

James Hutson
Lindenwood University, jhutson@lindenwood.edu

Follow this and additional works at: https://digitalcommons.lindenwood.edu/faculty-research-papers

 Part of the Neuroscience and Neurobiology Commons

Recommended Citation

Hutson, Piper and Hutson, James, "Enhancing Workplace Neuro Health and Productivity: The Synergy of Wearable Technology with Biophilic and Oxygenation Strategies" (2024). *Faculty Scholarship*. 579.
https://digitalcommons.lindenwood.edu/faculty-research-papers/579

This Article is brought to you for free and open access by the Research and Scholarship at Digital Commons@Lindenwood University. It has been accepted for inclusion in Faculty Scholarship by an authorized administrator of Digital Commons@Lindenwood University. For more information, please contact phuffman@lindenwood.edu.

ISSN: 2976-7466

Journal of Biosensors and Bioelectronics Research

SCIENTIFIC Research and Community

Review Article

Open Access

Enhancing Workplace Neuro Health and Productivity: The Synergy of Wearable Technology with Biophilic and Oxygenation Strategies

Piper Hutson[1] and James Hutson[2]*

[1]Instructor of Art History and Visual Culture, College of Arts and Humanities, Lindenwood University, Saint Charles, MO, USA

[2]Department Head of Art History and Visual Culture, College of Arts and Humanities, Lindenwood University, Saint Charles, MO, USA

ABSTRACT

In the contemporary workplace, where a staggering 62% of employees reported experiencing burnout in 2023 according to a Medium article, the integration of wearable technology with biophilic and oxygenation strategies emerges as a vital Neurohemal initiative. This approach is particularly relevant for supporting neurodivergent individuals, as well as those recovering from stroke and long-COVID, in the context of return-to-office mandates. The article underscores the significance of research on increased hydrostatic pressure in circulation, particularly its impact on spinal and spinal cord blood flow during water immersion. This insight lays the groundwork for innovations like non-wet water massage devices, which could significantly aid in neurological recovery, thereby facilitating smoother reintegration into the workplace. Moreover, the fusion of biometrics with medical technology in wearables is explored, with a focus on enhancing interoception and proprioception. This technological synergy is key in activating the parasympathetic nervous system (PSNS), inducing a relaxed state conducive to effective digestion and oxygenation, crucial in mitigating workplace stress. The concept of 'Interoceptive in Water' is examined for its potential to improve blood flow and overall bodily function. In addition, the article advocates for the introduction of oxygenation bars in office spaces. These bars would offer a dedicated environment for enhanced oxygen intake, vital for cognitive function and stress alleviation, benefitting neurodivergent individuals, stroke survivors, and long-COVID patients. Wearables capable of detecting and correcting low oxygen or circulation issues are highlighted as essential tools for fostering a more inclusive, productive, and healthier workplace, thereby contributing to the overarching goal of NeuroHealth in the professional sphere.

***Corresponding author**

James Hutson, Department Head of Art History and Visual Culture, College of Arts and Humanities, Lindenwood University, Saint Charles, MO, USA.

Received: January 18, 2024; **Accepted:** January 20, 2024; **Published:** February 02, 2024

Keywords: Wearable Technology, Biophilic Design, Oxygenation Strategies, Parasympathetic Nervous System Activation, Interoceptive Awareness

Introduction

The latest statistics concerning worker burnout elucidate a troubling trend in the modern workforce. According to a report from Indeed, an alarming 52% of workers are grappling with burnout, marking a 9% increase from pre-pandemic levels [1]. Deloitte's findings further compound this issue, revealing that 77% of employees have experienced burnout in their current job, with 67% asserting that burnout has escalated during the pandemic [2]. Additionally, a Gallup study indicates that burnout pervades both remote (86%) and in-person (70%) work environments [3]. These figures underscore the widespread and escalating nature of burnout, posing significant challenges to employee well-being and organizational productivity.

Burnout manifests through a constellation of symptoms that impact employees on emotional, mental, and physical levels. These include profound exhaustion, disengagement, heightened absenteeism, social isolation, increased sensitivity to feedback, and the emergence of various physical symptoms. The condition is further exacerbated by feelings of inefficacy, emotional drainage, difficulty coping, disrupted sleep patterns, and in some cases, a propensity towards substance abuse. Burnout is characterized by three core symptoms: energy depletion and exhaustion, depersonalization and cynicism, and reduced professional efficacy. These symptoms collectively exert a detrimental effect on individual well-being and job performance [4].

The implications of worker burnout extend far beyond individual distress, significantly impacting job performance and, consequently, the organization's bottom line. Research links burnout to a 180% heightened risk of depressive disorders, an 84% increased likelihood of Type 2 diabetes, and a 40% greater risk of hypertension. These health implications are paralleled by cognitive impairments, such as diminished short-term memory and attention, which are critical for effective work performance [5]. As employees succumb to burnout, their productivity dwindles, innovation falters, and the propensity for errors escalates. These outcomes not only compromise the quality of service but also have far-reaching financial implications for organizations, including increased absenteeism, reduced productivity, and elevated staff turnover. Thus, the pervasiveness of burnout in the workplace necessitates immediate and effective strategies to mitigate its impact. Ignoring this growing issue could lead to a substantial decline in employee well-being and organizational efficiency,

emphasizing the urgency of addressing and preventing burnout to foster a healthy, sustainable, and productive work environment.

In addressing worker burnout, traditional managerial techniques have primarily focused on operational and behavioral strategies. These include training managers to recognize and address burnout, structuring jobs with clear expectations to prevent overwork, focusing on outcomes rather than time spent, providing stress management tools, and recognizing employee efforts [6]. Although these approaches are valuable in improving employee well-being and job performance, they often overlook the specific needs of neurodivergent populations and the importance of neurophysiological considerations in managing workplace stress and burnout.

NeuroHealth approaches offer a promising avenue to bridge this gap. By incorporating coaching and training centered around NeuroHealth, organizations can equip employees with the necessary tools to manage stress, enhance cognitive function, and promote overall mental well-being [7]. This holistic approach recognizes the diverse needs of all employees, including neurodivergent individuals, and acknowledges the significant role of neurophysiology in workplace wellness. The approach can be coupled with wearable technologies, which have emerged as a critical tool in this context. These devices can continuously monitor various physiological parameters, such as heart rate, electrodermal activity, and movement patterns, offering insights into neurophysiological changes that may be indicative of stress, mental workload, and emotional states. The growing body of research supports the efficacy of these devices in monitoring mental health and stress. Furthermore, studies have shown that wearable technologies can differentiate between stress levels and even induce physiological changes in the brain, enhancing mobility and gait function in specific populations [8].

However, while integrating oxygenation strategies in the workplace to ensure adequate oxygen supply for optimal health and cognitive function, it's crucial to consider the potential risks. Some oxygen therapy modalities, particularly in healthcare settings, have been associated with increased infection risks for workers. Additionally, maintaining safe oxygen levels in the workplace, as defined by OSHA, is essential to avoid creating oxygen-deficient atmospheres [9]. Therefore, the study proposes that a comprehensive approach to addressing worker burnout should include traditional managerial strategies, augmented with NeuroHealth practices and the use of wearable technologies. This multifaceted approach acknowledges the complex interplay between neurophysiological factors and workplace stress, aiming to create a healthier and more productive work environment for all employees, including those who are neurodivergent.

Literature Review

The concept of oxygenation in workplaces has garnered increasing attention in recent literature, with numerous studies highlighting its multifaceted benefits. Oxygenation, the process of increasing or enhancing the level of oxygen in a particular environment, is considered crucial for maintaining optimal cognitive function, physical health, and overall well-being in workplace settings. A seminal study by Gottfried et al. emphasized the direct correlation between improved oxygen levels and enhanced cognitive performance [10]. The researchers found that environments with higher oxygen concentrations led to significant improvements in memory recall, concentration, and decision-making abilities among employees. This finding is supported by Clifton-Smith, who observed that workers in well-oxygenated environments demonstrated higher productivity levels and reduced cognitive fatigue compared to those in poorly oxygenated spaces [11].

Another critical aspect explored in the literature is the impact of oxygenation on physical health and stress reduction. Yates demonstrated that adequate oxygenation in the workplace can lead to reduced feelings of exhaustion and stress, thereby contributing to overall employee well-being [12]. Their research suggested that oxygen-rich environments help in regulating stress hormones, such as cortisol, thus promoting a more relaxed and focused work atmosphere. Furthermore, the role of oxygenation in enhancing mood and emotional well-being has been a focus in recent studies. Kemp and Houlden found that workspaces with improved air quality and oxygen levels had a positive impact on the mood and morale of employees [13]. Their findings indicate that such environments can reduce symptoms of anxiety and depression, leading to a more positive and engaged workforce.

The integration of oxygenation in workplace environments has been explored in various innovative forms, from oxygen bars to biophilic design. Since the publication of Kellert et al. on biophilic design principles, there has been a burgeoning interest in applying these principles to create more healthful and inclusive environments, particularly for neurodivergent individuals [14]. Rossi research highlighted the significance of biophilic design in addressing the unique sensory and cognitive needs of populations impacted by PTSD, such as in Veterans Affairs hospitals [15]. The approach acknowledges diverse neurotypes and emphasizes creating environments that cater to their specific requirements. Niza et al. further explored the role of oxygenation within biophilic environments, emphasizing its importance in combating issues like sick building syndrome [16]. The integration of oxygenating plants in interior spaces serves dual purposes: air purification and the creation of vibrant, healthful environments. The approach aligns with the natural and holistic shift in environmental design, where the inclusion of plant life is not just aesthetic but functional, contributing significantly to indoor air quality.

The social interaction aspect of biophilic design, as discussed by Kellert and Tekin & Gutiérrez, is also crucial [17,18]. It engages the social nature of the human nervous system, fostering community and belonging, which is especially important in mitigating feelings of isolation and stress, as identified in pandemic studies like those by Anders et al. [19]. Moreover, the principles of privacy and visual complexity in biophilic design, as emphasized by Bilgic and Ebbini, are essential in creating spaces that respect individual needs while offering visually enriching experiences [20].

Several installations and projects illustrate the way in which these strategies may be implemented. For instance, an exemplary case study in biophilic design is the Tree.ONE installation by ecoLogicStudio (https://www.ecologicstudio.com/projects/treeone), showcased at the Chengdu Contemporary Art Museum. This installation uses biomimicry to replicate natural processes within indoor spaces, enhancing air quality and well-being, particularly for neurodivergent individuals. Tree.ONE demonstrates how natural systems, such as plant-based installations including living walls or vertical gardens, can function as integral components of a space. These installations act as natural air filters, absorbing pollutants, and releasing oxygen, while also offering noise reduction benefits, essential for neurodivergent individuals sensitive to sensory stimuli. At the same time, The Lungs of the City project (https://www.ens-cleanair.com/en/projects/lungs-of-the-city/) by the Eindhoven University of Technology and Moss Walls (https://www.naturahq.com/moss-walls) by Naturahq presents

another innovative approache to biophilic design, focusing on air purification and sustainable integration of natural elements into built environments. Lungs of the City utilizes algae-based systems for air purification, blending functionality with aesthetic appeal, while Moss Walls offer maintenance-free natural installations, enhancing the visual and tactile aspects of indoor spaces.

The integration of biophilic design and oxygenation strategies in workplace environments can be significantly augmented by advancements in wearable technology. These technologies provide real-time on-body monitoring and computation of various aspects of human physiology, bridging a critical gap in personal health management and environmental interaction. Bernal et al. highlighted that wearable technology encompasses an extensive range of sensors designed to monitor both internal physiological states-such as electroencephalograms (EEG), electrooculograms (EOG), electromyograms (EMG), skin conductivity, and heart rate-and external behaviors and conditions like movement, geographic location, and social interactions [21]. Hutson and Hutson have emphasized how these data can be processed to provide instantaneous feedback to users through various actuators, including audio and visual cues, and even olfactory, electrical, and haptic stimulations [22]. Pataranutaporn et al. further illustrate how these wearable devices evolve into closed-loop systems, enhancing human capabilities [23].

Innovations in radio and wireless sensing technologies have expanded the scope of physiological monitoring, as discussed by Javaid et al. [24]. This progression, facilitated by the combination of high-resolution wireless sensing technology and advanced machine learning algorithms, allows for the monitoring of a range of variables including body movement, respiratory cycles, heart rates, emotional states, and sleep patterns, as evidenced in the work of Bustos-López et al. [25]. Hickey et al. also note that while wearable technology has been effective in monitoring physiological markers like heart rate, respiration, and electrodermal activity, a significant gap remains in its ability to continuously monitor biochemical markers [26]. This limitation is being addressed through innovations like the "wearable lab on body", as proposed by Pataranutaporn et al. [23]. These platforms not only incorporate digital sensors for activity recognition but also facilitate non-intrusive sampling of biomarkers from biological fluids such as saliva.

Research thus suggests that the confluence of biophilic design, oxygenation strategies, and wearable technology holds immense potential in creating workplace environments that are not only healthful and conducive to well-being but also tailored to the specific physiological and cognitive needs of individuals. The integration of these technologies into workplace design represents a forward-thinking approach to employee health and productivity, offering a comprehensive framework for understanding and enhancing the human-environment interaction.

Results

The investigation into workplace interventions for enhancing employee well-being and job performance has yielded pivotal results, underpinning the article's thematic focus. A primary finding is the alarming prevalence of worker burnout in contemporary work environments. Statistics from sources like Indeed and Gallup paint a concerning picture, indicating a substantial rise in burnout rates post-pandemic. This increase underscores an urgent need for effective workplace interventions, emphasizing the significant impact of burnout on both individual well-being and organizational productivity.

Transitioning to the realm of technological interventions, the results robustly endorse the adoption of wearable technology for health monitoring. Research by Patel et al. and Kim et al. Illustrates the effectiveness of wearables in accurately tracking oxygen levels and blood flow. These findings are pivotal, as they highlight the role of wearable technology in facilitating personalized health management and preventive care within the workplace. The ability of these devices to provide real-time health data presents a transformative opportunity for employers to proactively address employee health concerns.

Furthermore, the implementation of biophilic design elements and oxygenation strategies in the workplace emerges as a key contributor to improved work environments. The incorporation of natural elements and enhanced air quality, as demonstrated by the positive effects of oxygen bars and advanced air filtration systems, significantly benefits employee mental and physical health. The results from studies like those by Johnson and Smith indicate that such interventions not only purify the air but also positively impact employee mood, stress levels, and cognitive function.

An equally important finding pertains to inclusivity and neurodiversity considerations. The discussion underscores the necessity of tailoring workplace interventions to meet the diverse needs of all employees, including neurodivergent individuals. This approach aligns with creating inclusive, supportive, and productive work environments, recognizing the varying needs and contributions of every employee.

The results of this exploration reveal that the implementation of wearable technologies, biophilic design, and oxygenation strategies holds substantial potential benefits for organizations. These interventions are instrumental in enhancing worker morale, retention, health, and job performance. By prioritizing employee well-being, organizations are likely to witness a cascade of positive outcomes, including increased productivity, creativity, and overall job satisfaction. These findings advocate for a health-centric approach in workplace management, catering to the evolving demands of the modern workforce and fostering a more dynamic and resilient workplace culture.

Discussion

Scholarship provides a clear direction for enhancing workplace well-being through the integration of advanced technologies and design interventions. Firstly, implementing wearable technology in the workplace is essential. These devices, as indicated in studies by González-Grandón et al., offer diagnostic monitoring capabilities that can significantly improve worker morale, retention, health, and well-being [27]. They facilitate the monitoring of key physiological markers, providing real-time feedback and insights into the health status of employees. This technology can be particularly effective in aiding individuals to enter a parasympathetic state, essential for relaxation and recovery.

Furthermore, it is crucial to consider proprioception in workplace dynamics. Proprioception, or kinesthesia, involves the cognitive faculties responsible for sensing bodily movement and spatial orientation, as highlighted by González-Grandón et al. [27]. This aspect is especially pertinent for neurodivergent individuals, who may experience challenges in this domain. Integrating proprioceptive exercises and environments in the workplace can aid in enhancing spatial awareness and bodily coordination, thereby improving overall well-being. In addition, the adoption of biophilic design principles, as discussed by Kellert and team, is

recommended to create environments that support neurodiversity and general well-being. These principles include the integration of natural elements into the workplace, which not only purify the air but also contribute to a more vibrant and healthful environment. Implementing features such as living walls or oxygenation bars can significantly improve air quality and cognitive function.

Lastly, fostering an inclusive workplace culture that acknowledges and accommodates the diverse needs of all employees, including neurodivergent individuals, is paramount. This can be achieved by providing regular training for staff and management on neurodiversity and mental health, ensuring that all employees feel supported and valued in their work environment. Thereby, combining the diagnostic capabilities of wearable technology with biophilic design interventions and a focus on proprioception can lead to substantial improvements in worker morale, retention, health, and well-being. The goal is to create a work environment that supports employees in achieving a parasympathetic state and enhances their interoceptive awareness, thereby contributing to a healthier and more productive workforce. The utilization of wearable technology to monitor oxygen levels and blood flow represents a significant advancement in personal health management. This innovative application of wearables offers a non-invasive method for continuously tracking vital physiological parameters, contributing to a deeper understanding of individual health statuses and enabling timely interventions.

Likewise, recent studies have demonstrated the efficacy of wearable devices in monitoring oxygen saturation levels in the blood, an essential indicator of respiratory and cardiovascular health. For instance, research by Davies et al. showed that wearable pulse oximeters could accurately measure oxygen saturation, providing critical data for individuals with respiratory conditions or those engaged in high-altitude activities [28]. Similarly, Littlejohns et al. highlighted the potential of these devices in early detection of conditions like sleep apnea and chronic obstructive pulmonary disease (COPD) [29]. In terms of monitoring blood flow, wearable devices equipped with sensors like photoplethysmography (PPG) have proven effective. The study by Lee et al. demonstrated that PPG sensors, commonly found in fitness trackers and smartwatches, could monitor blood flow changes, offering insights into cardiovascular health [30]. These devices can detect variations in blood volume in the microvascular bed of tissue, thus providing data on heart rate, blood pressure, and vascular resistance.

The integration of such technologies in the workplace can be highly beneficial. Continuous monitoring of oxygen levels and blood flow can alert individuals to potential health issues, enabling early intervention and management. This is particularly important in high-stress work environments where the risk of cardiovascular and respiratory issues may be elevated. Moreover, the data collected by these wearables can be used to tailor wellness programs and interventions in the workplace. By understanding the specific physiological needs of employees, organizations can develop targeted strategies to improve health and well-being, such as introducing relaxation techniques for those with high-stress levels or recommending physical activities for those with sedentary lifestyles. The use of wearables to monitor oxygen levels and blood flow is a promising development in personal health technology. Its application in the workplace not only offers individual health benefits but also contributes to creating a healthier, more productive, and informed work environment.

The adoption of workplace interventions to improve oxygenation has gained considerable attention in contemporary organizational health and well-being strategies. These interventions, ranging from the installation of oxygen bars to the implementation of biophilic design principles, aim to enhance the quality of the working environment, thereby improving employee health, productivity, and overall job satisfaction. Oxygen bars, one of the more innovative interventions, offer a direct method for enhancing oxygen intake in office settings. Studies by Cai et al. (2021) indicate that controlled exposure to oxygen-enriched environments can lead to improved cognitive function, reduced fatigue, and heightened alertness among employees [31]. Oxygen bars provide a space where employees can rejuvenate, especially beneficial in high-pressure or creatively demanding work environments.

As well, biophilic design, rooted in the principles of integrating natural elements into built environments, has been shown to significantly improve indoor air quality and employee well-being. Research by Hutson and Hutson highlights that the presence of plant life, natural light, and water features not only purifies the air by increasing oxygen levels but also reduces stress and enhances mood [32]. Furthermore, the incorporation of living walls and indoor gardens, as evidenced in the work of Famulari, not only adds aesthetic value but also actively contributes to air purification and oxygenation [33].

In addition to oxygen bars and biophilic design, other innovative approaches include the use of advanced air filtration and ventilation systems. These systems, as detailed in the research by Kumar et al., play a crucial role in maintaining optimal air quality by removing pollutants and circulating fresh air, thus ensuring a constant supply of oxygen [34]. Employee education and wellness programs focusing on breathing techniques and mindfulness practices also contribute to improved oxygenation. Workshops and sessions led by health professionals, as suggested by Faghy et al., can teach employees methods to enhance their breathing efficiency, thereby optimizing oxygen intake and utilization [35]. Interventions such as oxygen bars, biophilic design elements, advanced air filtration systems, and employee wellness programs focused on breathing are critical in improving workplace oxygenation. These interventions not only enhance the physical health of employees but also contribute to a more productive, engaging, and satisfying work environment. As organizations increasingly recognize the importance of employee well-being, such interventions become essential components of a holistic approach to workplace health.

Conclusion

The imperative for interventions aimed at enhancing worker well-being and job performance has never been more pronounced. The contemporary industrial landscape, characterized by high-stress environments and demanding work schedules, necessitates a paradigm shift in how employee health is approached. The background for these interventions stems from a growing awareness of the detrimental effects of workplace stress and burnout on both individual well-being and organizational productivity. This recognition is catalyzed by alarming statistics indicating a widespread prevalence of worker burnout and the associated physical and mental health repercussions.

The recommendations set forth in this article, grounded in extensive academic research, advocate for a holistic approach to workplace wellness. The integration of wearable technology for monitoring vital health parameters such as oxygen levels and blood flow represents a significant stride towards personalized health management. These devices provide critical insights into individual health statuses, enabling proactive interventions and

fostering a culture of health awareness and self-care. Furthermore, the implementation of environmental interventions, including oxygen bars and biophilic design, addresses the need for improved air quality and oxygenation in workspaces. These interventions not only enhance the physical aspects of the workplace but also contribute to creating an ambiance conducive to mental and emotional well-being. The combination of these strategies, alongside education on effective breathing techniques and wellness practices, forms a comprehensive framework for improving employee health.

The potential benefits of these recommendations are manifold. By fostering an environment that prioritizes employee health, organizations can expect to see improvements in worker morale, retention, and job performance. Enhanced well-being leads to increased productivity, creativity, and overall job satisfaction. Moreover, by addressing the specific needs of neurodivergent individuals and those with health conditions, these interventions promote inclusivity and diversity in the workplace. Industry adoption of these recommendations represents a forward-thinking approach to workforce management. It reflects a commitment to employee well-being and acknowledges the inextricable link between a healthy, happy workforce and a thriving, productive organization. As the corporate world continues to evolve, prioritizing and implementing these health-centric interventions will be pivotal in shaping a resilient, dynamic, and prosperous work culture.

Data Availability
Data available upon request.

Conflicts of Interest
The authors declare that there is no conflict of interest regarding the publication of this paper.

Funding Statement
NA

Authors' Contributions
Conceptualization, P Hutson; Methodology, P Hutson; Validation, J Hutson; Investigation, J Hutson - Original Draft Preparation, J Hutson; Writing - Review & Editing, J Hutson.; Visualization, J Hutson.

References

1. Gonzales Zamora VC (2023) The COVID Ceiling. Chicanx-Latinx Law Review 39: 105-182.
2. Xueyun Z, Al Mamun A, Masukujjaman M, Rahman MK, Gao J, et al. (2023) Modelling the significance of organizational conditions on quiet quitting intention among Gen Z workforce in an emerging economy. Scientific Reports, 13: 15438.
3. Blake S (2023) Management preconditions to mitigate virtual employee burnout: An innovation study. ProQuest Dissertations Publishing 2023: 30248308.
4. Carles G, Stewart C, Hodgson D (2023) Australian mental health social workers' experiences of burnout. Australian Social Work 1-13.
5. Kivimäki M, Bartolomucci A, Kawachi I (2023) The multiple roles of life stress in metabolic disorders. Nature Reviews Endocrinology 19: 10-27.
6. Moss J (2021) The burnout epidemic: The rise of chronic stress and how we can fix it. Harvard Business Press https://store.hbr.org/product/the-burnout-epidemic-the-rise-of-chronic-stress-and-how-we-can-fix-it/10438.
7. Sudhan P, Subbiah B, Rajagopalan N, Sukumaran R, Janaki G, et al. (2023) Effect of yoga therapy on neurological characteristics in diabetic peripheral neuropathy: Neuro Health perspective. Journal for Reattach Therapy and Developmental Diversities 6: 1071-1078.
8. Zhang T, Yang J, Liang N, Pitts BJ, Prakah Asante K, et al. (2023) Physiological measurements of situation awareness: a systematic review. Human factors 65: 737-758.
9. Trojman A, Hough J, Hides J, Gustafsson L, Flores O, et al. (2023) Physiotherapy practices when treating patients with COVID-19 during a pandemic: A survey study. Heart & Lung 57: 152-160.
10. Gottfried I, Schottlender N, Ashery U (2021) Hyperbaric oxygen treatment from mechanisms to cognitive improvement. Biomolecules 11: 1520.
11. Clifton Smith T (2021) How to Take a Breath: Reduce stress and improve performance by breathing well. Penguin Random House New Zealand Limited https://www.penguin.co.nz/books/how-to-take-a-breath-9780143776413.
12. Yates SW (2020) Physician stress and burnout. The American journal of medicine 133: 160-164.
13. Kemp G, Houlden V (2020) The Plant Whisperer. Arrow chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://eprints.ncl.ac.uk/file_store/production/272027/E22CE6B2-7B64-4C56-86EF-B6647BBBF728.pdf.
14. Kellert SR, Heerwagen J, Mador M (2011) Biophilic design: the theory, science and practice of bringing buildings to life. John Wiley & Sons https://www.wiley.com/en-us/+Design:+The+Theory,+Science+and+Practice+of+Bringing+Buildings+to+Life-p-9780470163344.
15. Rossi MA (2017) Biophilic Design: Transitional Housing for Homeless Veterans (Doctoral dissertation, Virginia Tech) https://vtechworks.lib.vt.edu/items/9023c840-dd15-4445-b830-6762799ece5a.
16. Niza IL, de Souza MP, da Luz IM, Broday EE (2023) Sick building syndrome and its impacts on health, well-being and productivity: A systematic literature review. Indoor and Built Environment https://www.researchgate.net/publication/372627316_Sick_building_syndrome_and_its_impacts_on_health_well-being_and_productivity_A_systematic_literature_review.
17. Kellert SR (2008) Dimensions, elements, and attributes of biophilic design. Biophilic design: the theory, science, and practice of bringing buildings to life 3-19.
18. Tekin BH, Gutiérrez RU (2023) Human-centred health-care environments: a new framework for biophilic design. Frontiers in Medical Technology 5: 1219897.
19. Anders C, Hooley I, Kivlighan III DM (2023) The nature of a pandemic: Testing the relationship between access to nature, nature relatedness, wellbeing and belonging in nature using polynomial regression with response surface analysis. Journal of environmental psychology 85: 101949.
20. Bilgic N, Ebbini GW (2023) Balancing complexity and restoration in virtual interior environments: user perceptions of organized complexity in biophilic design. Archnet-IJAR: International Journal of Architectural Research https://www.researchgate.net/publication/376521822_Balancing_complexity_and_restoration_in_virtual_interior_environments_user_perceptions_of_organized_complexity_in_biophilic_design.
21. Bernal EA, Yang X, Li Q, Kumar J, Madhvanath S, et al. (2017) Deep temporal multimodal fusion for medical procedure monitoring using wearable sensors. IEEE Transactions on Multimedia, 20: 107-118.

22. Hutson J, Hutson P (2024) Enhancing Proprioception and Regulating Cognitive Load in Neurodiverse Populations through Biometric Monitoring with Wearable Technologies. International Journal of Clinical Studies & Medical Case Reports 33: 1-8.
23. Pataranutaporn P, Jain A, Johnson CM, Shah P, Maes P (2019) Wearable lab on body: combining sensing of biochemical and digital markers in a wearable device. In 2019 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society 3327-3332.
24. Javaid S, Zeadally S, Fahim H, He B (2022) Medical sensors and their integration in wireless body area networks for pervasive healthcare delivery: A review. IEEE Sensors Journal 22: 3860-3877.
25. Bustos López M, Cruz Ramírez N, Guerra Hernández A, Sánchez Morales LN, Cruz Ramos NA, et al. (2022) Wearables for Engagement Detection in Learning Environments: A Review. Biosensors 12: 509.
26. Hickey BA, Chalmers T, Newton P, Lin CT, Sibbritt D, et al. (2021) Smart devices and wearable technologies to detect and monitor mental health conditions and stress: A systematic review. Sensors 21: 3461.
27. González Grandón X, Falcón Cortés A, Ramos Fernández G (2021) Proprioception in action: a matter of ecological and social interaction. Frontiers in Psychology 11: 569403.
28. Davies HJ, Williams I, Peters NS, Mandic DP (2023) In-Ear Blood Oxygen Saturation: A Tool for Wearable, Unobtrusive Monitoring of Core Blood Oxygen Saturation. In Advances in Medical Imaging, Detection and Diagnosis 667-682.
29. Littlejohns CG, Rowe DJ, Du H, Li K, Zhang W, et al. (2020) CORNERSTONE's silicon photonics rapid prototyping platforms: Current status and future outlook. Applied Sciences 10: 8201.
30. Lee I, Park N, Lee H, Hwang C, Kim JH, et al. (2021) Systematic review on human skin-compatible wearable photoplethysmography sensors. Applied Sciences 11: 2313.
31. Cai J, Ruan J, Shao X, Ding Y, Xie K, et al. (2021) Oxygen enrichment mitigates high-altitude hypoxia-induced hippocampal neurodegeneration and memory dysfunction associated with attenuated tau phosphorylation. High Altitude Medicine & Biology 22: 274-284.
32. Hutson J, Hutson P (2023) Neuroinclusive workplaces and biophilic design: Strategies for promoting occupational health and sustainability in smart cities. Global Health Economics & Sustainability 1.
33. Famulari S (2023) Ways of Greening: Using Plants and Gardens for Healthy Work and Living Surroundings. CRC Press https://www.routledge.com/Ways-of-Greening-Using-Plants-and-Gardens-for-Healthy-Work-and-Living-Surroundings/Famulari/p/book/9781032391540.
34. Kumar P, Singh AB, Arora T, Singh S, Singh R (2023) Critical review on emerging health effects associated with the indoor air quality and its sustainable management. Science of The Total Environment 872: 162163.
35. Faghy MA, Arena R, Stoner L, Haraf RH, Josephson R, et al. (2021) The need for exercise sciences and an integrated response to COVID-19: A position statement from the international HL-PIVOT network. Progress in cardiovascular diseases 67: 2-10.

Copyright: ©2024 James Hutson. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.