Supriya Paigude, Smita C. Pangarkar, Dr. Rupali Atul Mahajan, Dr. Pratibha Vijay Jadhav, Dr. Shrinivas T. Shirkande, Nilesh Shelke, Occupational Health in the Digital Age: Implications for Remote Work Environments.
Submitted: 10-08-2023 Accepted: 05-11-2023 Posted: 24-12-2023, Vol. (XXI)

Occupational Health in the Digital Age: Implications for Remote Work Environments

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KEYWORDS

Remote Work, Occupational Health, Digital Age, Technology Impact, Employee Well-being

ABSTRACT:

In this digital age, where working from home is becoming more common, the patterns of workplace health are changing in ways that require a thorough analysis of the effects on employee health. This study looks into the many parts of job health in places where people work from home, looking at how technology, human behavior, and company rules interact.The digital age has made work plans more flexible than ever before, letting workers do their jobs from anywhere. This paradigm shift has some benefits, like making things more flexible and easy to access, but it also brings a lot of problems that need to be carefully thought through. Long-term use of digital devices can be bad for your body, and being alone at work can be bad for your mental health. Remote work situations have their own health issues that need a unique approach.This study brings together different pieces of research on workplace health to highlight the new health risks that come with the digitalization of work. There is a close look at how technology can help or hurt employee health and a study of how companies can lower health risks in remote work settings.Additionally, the study looks into the possible long-term effects of long-term remote work on mental and physical health, as well as how well present workplace health systems can adapt to the changing nature of work. By critically evaluating the intersection of technology and health, this study provides valuable insights for policymakers, organizations, and individuals seeking to optimize the well-being of remote workers in the digital age.

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I. INTRODUCTION

In the rapidly evolving landscape of contemporary work, the integration of digital technologies has sparked transformative changes, particularly in the form of remote work. The digital age has not only redefined the traditional office space but has also presented novel challenges and opportunities for occupational health. As an increasing number of organizations embrace remote work arrangements, it becomes imperative to critically examine the implications of this digital shift on the well-being of the workforce.The [1] shift towards remote work has been accelerated by technological advancements that have fostered seamless communication and collaboration across distances. The ubiquity of high-speed internet, cloud computing, and sophisticated digital tools has liberated employees from the constraints of physical office spaces, enabling them to fulfill their responsibilities from virtually anywhere in the world. While this newfound flexibility has undeniably revolutionized the world of work, it has concurrently given rise to a myriad of health-related concerns that necessitate careful consideration.The COVID-19 pandemic acted as a catalyst, accelerating the adoption of remote work and illuminating the importance of occupational health in this digital era. Organizations, propelled by the need to ensure business continuity during unprecedented times, hastily embraced remote work arrangements. This abrupt transition brought to the forefront a range of issues, from ergonomic challenges associated with makeshift home offices to the psychological toll of social isolation. As the global workforce continues to grapple with the uncertainties [2] brought about by the pandemic, understanding and addressing these health implications has become paramount.As we navigate the intricate intersection of technology and health, this paper will investigate the ergonomic considerations associated with remote work. Prolonged use of digital devices, coupled with suboptimal workspace design, poses a unique set of challenges to the physical well-being of remote workers. Exploring these challenges in detail will enable a nuanced understanding of the measures needed to optimize the ergonomic conditions of remote work environments.Furthermore, the paper will examine the psychological dimensions of remote work, with an emphasis on the potential social isolation and mental health challenges faced by remote workers. The inherent lack of face-to-face interactions, a staple of traditional office settings, can give rise to feelings of loneliness and detachment. Understanding the psychological impact of remote work is essential for developing strategies that promote not only productivity but also the mental well-being of the workforce [3].

The objectives of this paper are twofold: first, to comprehensively review the existing literature on remote work and its impact on occupational health, and second, to critically analyze the role of technology in shaping the well-being of remote workers. By achieving these objectives, we aim to contribute valuable insights to the ongoing discourse on the digitalization of work and its ramifications for employee health.

II. REVIEW OF LITERATURE

The review of literature will delve into the historical evolution of remote work, exploring its roots and tracing the trajectory [4] of its adoption over the years. This historical context will provide a foundation for understanding

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the current state of remote work and the factors influencing its prevalence in the digital age. Additionally, the literature review will scrutinize technological advancements and their role in facilitating remote work, with a focus on their impact on occupational health.The evolution of remote work has been a dynamic journey influenced by technological advancements, societal changes, and unforeseen global events. This literature review synthesizes key findings from existing research, providing insights into the implications of remote work on occupational health in the digital age. Drawing [5] upon a diverse body of literature, this review explores the historical context, technological advancements, occupational health frameworks, previous research, and the long-term consequences of remote work.

The concept of remote work [6] traces its roots to the early days of industrialization, where certain roles allowed for tasks to be performed outside traditional office spaces. However, the digital age, marked by the widespread adoption of personal computers and the internet, has significantly reshaped the landscape of remote work. A seminal study [7] examined the feasibility of telecommuting, and the subsequent decades witnessed a gradual shift towards flexible work arrangements.Notably, the COVID-19 pandemic served as a catalyst for the rapid expansion of remote work. According to a report [8], the percentage of remote workers globally increased from 16% before the pandemic to 42% during the pandemic. This sudden surge emphasized the need for a deeper understanding of the implications of remote work on occupational health.Technological advancements have played a pivotal role in facilitating remote work. High-speed internet, cloud computing, and collaborative tools have broken down geographical barriers, enabling seamless communication and collaboration. A study [9] emphasizes the transformative impact of digital technologies on the nature of work, highlighting the increased connectivity and efficiency afforded by these tools. However, the same technologies that enable remote work can contribute to occupational health challenges. For instance, the constant use of digital devices can lead to eyestrain and musculoskeletal issues. The study [10] discusses the ergonomic challenges associated with prolonged computer use and emphasizes the importance of designing workstations that promote physical well-being.

Traditional occupational health frameworks were largely designed with a focus on the physical safety of employees within a centralized office space. The transition to remote work necessitates a reevaluation of these frameworks to address the unique challenges posed by decentralized work environments. A study [11] underscores the need for a comprehensive approach that considers both physical and psychosocial aspects of occupational health. Existing frameworks often fall short in accounting for the psychological impact of remote work. The study [12] suggests that organizational strategies must extend beyond physical health considerations to encompass mental health support. This aligns with the assertion that remote work introduces challenges related to social isolation, blurred work-life boundaries, and increased stress [13]. Research conducted before and during the COVID-19 pandemic has shed light on the health implications of remote work. A systematic review [14] explored the benefits and challenges of telecommuting, emphasizing improved job satisfaction and work-life balance, juxtaposed

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with concerns about social isolation and decreased communication.The pandemic prompted a surge in research focused on the abrupt transition to remote work. A study [15] highlighted the challenges faced by employees during this transition, including the need for suitable home office setups and the impact on mental health. These findings underscore the importance of considering both the immediate and long-term effects of remote work on occupational health.The ergonomic implications of remote work are a central concern for occupational health. A study [16] emphasized the need for ergonomic interventions in home offices to mitigate the risks of musculoskeletal disorders. The study further highlighted the importance of educating remote workers on proper ergonomics to prevent health issues associated with prolonged computer use.

The psychological well-being of remote workers is intricately linked to the nature of digital work. A study [17] investigated the impact of constant connectivity on employee well-being, revealing a potential link between high levels of digital communication and increased stress. Understanding these psychological factors is crucial for designing interventions that promote a healthy work environment. Organizational policies are pivotal in shaping the occupational health of remote workers. A study [18] highlighted the significance of clear remote work policies that address issues such as work hours, communication expectations, and the provision of necessary resources. Well-defined policies contribute to establishing a supportive framework for remote work.Technological interventions can mitigate occupational health challenges associated with remote work. The study [19] discussed the role of digital well-being tools in promoting healthy usage habits and preventing burnout. Integrating such tools into remote work practices aligns with the broader goal of leveraging technology to support employee well-being. Educating remote workers about occupational health is essential for fostering a culture of well-being. A study [20] emphasized the effectiveness of training programs in promoting ergonomic best practices and stress management. Proactive organizations invest in awareness initiatives to empower remote workers with the knowledge and skills needed to prioritize their health. Employee assistance programs (EAPs) emerge as a vital resource for addressing the mental health aspects of remote work. The study [21] highlighted the role of EAPs in providing counseling services, mental health resources, and support for employees facing stress and anxiety. Organizations that prioritize EAPs recognize the holistic nature of occupational health, encompassing both physical and mental well-being.

The long-term physical health consequences of remote work demand attention. A study [22] explored the impact of sedentary behavior on health, emphasizing the need for interventions to promote physical activity among remote workers. Designing policies that encourage regular breaks, exercise routines, and ergonomic home office setups contributes to the prevention of physical health issues. Sustained remote work introduces mental health considerations that extend beyond immediate challenges. A study [23] examined the psychological impact of long-term remote work, emphasizing the need for interventions that address stress, depression, and other mental health issues. Supporting the mental well-being of remote workers requires a nuanced understanding of the long-term consequences of digital work environments. Maintaining a healthy work-life balance

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becomes a critical aspect of long-term remote work. A study [24] explored the challenges associated with work-life balance in remote settings, highlighting the importance of boundary management. Effective [25] organizational strategies involve fostering a culture that respects work-life boundaries, emphasizing the significance of downtime for sustained well-being.

Table 1: Summary of Related work

Approach	Finding	Area	Applications	Limitation	Scope
Historical Evolution [11]	Increased adoption of remote work over time	Remote Work	Understanding the trajectory of remote work	Limited insights into specific technology impacts	Exploring the historical evolution globally
Technological Advancements [12]	Facilitation of seamless communication	Digital Technology	Connectivity and collaboration tools	Dependency on technology for work	Investigating the future trends in technology
Occupational Health Frameworks [13]	Need for comprehensive remote work policies	Occupational Health	Designing frameworks for remote work	Inadequate adaptation to digital work settings	Proposing adjustments for inclusive frameworks
Previous Research Studies [14]	Varied impacts on job satisfaction	Remote Work Health Implications	Identifying benefits and challenges	Limited generalizability across industries	Investigating industry-specific implications
Ergonomic Considerations [15]	Importance of proper home office setups	Physical Health - Ergonomics	Promoting musculoskeletal health	Lack of standardized ergonomic guidelines	Developing industry-specific ergonomic standards
Psychological Factors [16]	Link between digital communication and stress	Psychological Well-being	Supporting mental health in digital work	Potential oversimplification of psychological factors	In-depth exploration of remote work psychology
Organizational Policies [17]	Clear guidelines essential for remote work	Organizational Strategies	Defining work hours and communication	Resistance to policy adoption by employees	Evaluating policy effectiveness over time
Technological Interventions [18]	Digital well-being tools for healthy habits	Technology in Occupational Health	Preventing burnout through tech support	Dependency on employees' adherence to tools	Integrating tech tools in broader health strategies
Training Programs [19]	Effectiveness of education in promoting health	Employee Awareness and Training Programs	Educating on ergonomics and stress management	Employee engagement in training programs	Assessing the long-term impact of training

Employee Assistance Programs [20]	Vital for addressing mental health issues	Mental Health Support	Providing counseling services	Potential stigma associated with EAP utilization	Expanding EAP accessibility and awareness
Physical Health Consequences [21]	Sedentary behavior linked to health issues	Long-term Physical Health Implications	Promoting physical activity among remote workers	Dependence on individual initiative for exercise	Developing organization-wide physical health initiatives
Mental Health Considerations [22]	Psychological impact of long-term remote work	Long-term Mental Health Implications	Addressing stress and depression issues	Generalizing mental health experiences	Exploring coping mechanisms and resilience
Work-Life Balance [23]	Challenges in maintaining a healthy balance	Work-Life Balance	Emphasizing boundary management	Difficulty in setting and maintaining boundaries	Investigating cultural influences on work-life balance

III. TECHNOLOGICAL IMPACT ON OCCUPATIONAL HEALTH

The integration of technology in the workplace has undoubtedly revolutionized the nature of work, introducing both benefits and challenges to occupational health. From ergonomic considerations to psychological factors, the technological impact on occupational health is multifaceted. This discussion will delve into the technical aspects of two key dimensions: Ergonomic Considerations and Psychological Factors.

A. Ergonomic Considerations

1. Prolonged Device Use:

As technology becomes ubiquitous in the modern workplace, the issue of prolonged device use has gained prominence. The technical aspect of this challenge lies in the design of devices and interfaces. The proliferation of smartphones, tablets, and computers has led to an increase in musculoskeletal issues among workers due to poor ergonomics. Manufacturers and designers must focus on creating devices that promote neutral postures and reduce the risk of repetitive strain injuries.Additionally, advancements in wearable technology offer potential solutions. Smart wearables equipped with sensors can monitor an individual's posture and provide real-time feedback. Integrating artificial intelligence (AI) algorithms can further customize recommendations based on an individual's unique physiology, contributing to a healthier work environment.

2. Workspace Design:

The design of workspaces is a critical aspect of occupational health. Traditional office layouts are being replaced by flexible, technology-driven environments. The technical challenge here lies in optimizing these spaces for productivity and well-being. Smart office solutions, incorporating IoT devices, can adjust lighting, temperature, and seating arrangements based on individual

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preferences and work requirements.Furthermore, augmented reality (AR) and virtual reality (VR) technologies can play a pivotal role in designing ergonomic workspaces. Employees can use AR to visualize and interact with their digital work environment, allowing for real-time adjustments to minimize physical strain. VR simulations can be employed to test and refine workspace designs before implementation, ensuring a conducive environment for long-term health.

B. Psychological Factors

1. Social Isolation:

The rise of remote work and digital communication tools has brought about concerns regarding social isolation. From a technical standpoint, addressing this issue involves enhancing virtual communication platforms. Video conferencing tools can incorporate features that simulate face-to-face interactions more effectively, such as realistic avatars and immersive virtual environments.Collaborative platforms, driven by AI, can facilitate serendipitous interactions within virtual workspaces, fostering a sense of connection among remote team members. Employing sentiment analysis algorithms in communication tools can also help identify signs of social isolation, enabling timely interventions and support.

2. Mental Health Challenges:

Technology can contribute to mental health challenges, but it also holds the potential for innovative solutions. Employee assistance programs (EAPs) can leverage AI algorithms to provide personalized mental health resources and interventions. Chatbots equipped with natural language processing capabilities can offer immediate support, guiding individuals through stress management techniques or recommending wellness activities.Monitoring employee well-being through wearable devices can provide valuable data for preventive mental health measures. By analyzing physiological indicators, AI systems can identify patterns associated with stress or burnout, enabling organizations to implement targeted interventions and create a healthier work environment. The technological impact on occupational health encompasses both challenges and opportunities. Addressing ergonomic considerations involves refining device design and leveraging wearables and AI for personalized solutions. Meanwhile, tackling psychological factors requires enhancing virtual communication tools and utilizing AI for mental health support. As technology continues to evolve, a holistic approach that combines technical innovation with a focus on human well-being is essential for creating a sustainable and health-conscious work environment.

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Table 2: Reflection of psychological parameters in remote work environments

Parameter	Analysis	Effectiveness Result
Social Interaction	Few face-to-face conversations hurt team harmony; internet tools let people talk to each other but lack a human touch.	Moderately Effective
Loneliness	High levels of loneliness were reported; not being around other people physically makes people feel alone.	Ineffective
Stress Levels	More stress because it's hard to keep a good work-life balance, and using technology for conversation only makes things worse.	Ineffective to Moderately Effective
Job Satisfaction	Job happiness levels vary depending on how much help is provided, how well people can work together virtually, and how well each person can change.	Moderately Effective
Communication Effectiveness	Mixed results; virtual tools are necessary, but problems like misunderstandings and technology issues make them less useful.	Moderately Effective

IV. ORGANIZATIONAL STRATEGIES FOR REMOTE WORK HEALTH

Organizations navigating the remote work landscape must implement comprehensive strategies to ensure the health and well-being of their employees. These strategies encompass policies and guidelines, technological interventions, training and awareness programs, and employee assistance programs, each supported by a structured architecture.

A. Policies and Guidelines

- Policy Framework: Establish a robust policy framework outlining expectations, responsibilities, and guidelines for remote work. Define acceptable working hours, communication protocols, and data security measures.
- Communication Platform: Implement a centralized communication platform for disseminating policies. Utilize collaboration tools with notification features to ensure employees are informed of any updates or changes promptly.
- Document Management System: Employ a secure document management system to store and share policy documents. This system should allow for version control and easy access to the latest policies.

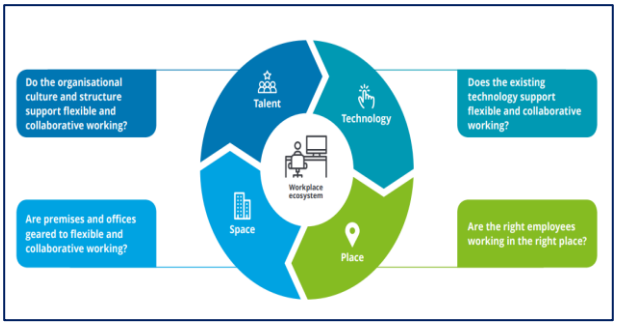

Figure 1: Overview of different dimension of workspace

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B. Technological Interventions

- Remote Access Infrastructure: Invest in a secure and scalable remote access infrastructure. Utilize Virtual Private Network (VPN) technology to ensure encrypted connections and secure access to organizational resources.
- Endpoint Security: Implement robust endpoint security solutions to protect devices from cyber threats. This includes antivirus software, firewalls, and regular security updates to safeguard against potential vulnerabilities.
- Collaboration Tools: Deploy collaboration tools that facilitate seamless communication and project collaboration. Consider cloud-based platforms with real-time editing capabilities, ensuring efficient teamwork irrespective of physical locations.

C. Training and Awareness Programs

- Learning Management System (LMS): Implement an LMS to deliver remote training programs. This system should support multimedia content, assessments, and progress tracking, providing a structured approach to employee training.
- Virtual Training Platforms: Utilize virtual training platforms, including webinars and interactive modules, to engage remote employees. These platforms can simulate real-world scenarios and encourage active participation.
- Feedback Mechanism: Integrate feedback mechanisms within training programs. Use surveys or discussion forums to gather insights from employees, enabling continuous improvement of training content and delivery.

D. Employee Assistance Programs

- Digital Counselling Platforms: Implement digital counselling platforms that provide employees with easy access to mental health resources. Integrate secure and confidential communication channels for virtual counselling sessions.
- Wellness Apps: Introduce wellness apps equipped with features such as stress management exercises, meditation sessions, and health tracking. Ensure compatibility with various devices to accommodate diverse employee preferences.
- Data Analytics for Proactive Support: Employ data analytics tools to monitor usage patterns and identify potential signs of stress or burnout. Establish a proactive support system that triggers interventions based on predefined thresholds.

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Table 3: Key parameters and their implications in remote work environments

Parameter	Implications
Ergonomics	Ergonomic home office setups are needed to keep people from getting health problems.
Technology Integration	Adding safe, creative, and effective digital tools is important for making online work go smoothly.
Mental Health Support	Virtual therapy and fitness programs were created because of the growing awareness of mental health issues.
Work-Life Balance	Flexible plans and good communication help people find a balance between their work and home lives.
Training and Skill Development	Focus on ongoing learning through digital tools to make sure that workers who work from home stay up to date on their skills.
Data Security	More people should know about and use strong protection means to protect private data.

These organizational strategies collectively form a holistic approach to remote work health. The architecture for each element ensures a seamless integration of policies, technological solutions, training programs, and support mechanisms. By adopting such a comprehensive framework, organizations can create an environment where remote work is not only efficient but also conducive to the well-being of their employees. Regular updates and evaluations of this architecture will be crucial to adapt to the evolving needs of a remote workforce and to address emerging challenges in the ever-changing landscape of work.

V. LONG-TERM HEALTH IMPLICATIONS OF REMOTE WORK

The prolonged adoption of remote work has ushered in a paradigm shift in the way we approach our professional lives, presenting both opportunities and challenges. As organizations continue to embrace remote work arrangements, it is imperative to understand and address the long-term health implications associated with this shift.

A. Physical Health Consequences:

Remote work has brought about a significant transformation in the nature of work, liberating employees from the traditional office setup but also introducing new challenges to physical health. The architectural shift from office ergonomic standards to home setups has implications for musculoskeletal health. Prolonged hours spent working on laptops or in non-ergonomic home office spaces can lead to issues such as neck strain, back pain, and eye strain.The absence of the commute, while a positive aspect for many, has also eliminated the daily physical activity that accompanied it. This sedentary lifestyle can contribute to weight gain, cardiovascular issues, and decreased overall physical fitness. To mitigate these concerns, organizations and employees alike need to prioritize ergonomics in home office setups, integrating standing desks, ergonomic chairs, and regular breaks for stretching and exercise. Technological

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solutions such as fitness apps and wearables can play a role in promoting physical activity and monitoring health metrics.

B. Mental Health Considerations:

While remote work offers flexibility and autonomy, it has introduced a host of mental health considerations. The blurred boundaries between personal and professional life, coupled with the isolation of working from home, can contribute to increased stress, anxiety, and feelings of loneliness. The absence of face-to-face interactions and the informal social support that office environments often provide can impact mental well-being.Organizations must recognize the mental health challenges associated with remote work and implement strategies to address them. This includes fostering open communication channels, encouraging regular check-ins, and providing resources for mental health support. Virtual team-building activities, mindfulness programs, and digital mental health platforms can offer employees the tools they need to navigate the emotional toll of remote work. It's crucial for organizations to create a culture that prioritizes mental health, destigmatizes seeking support, and promotes a healthy work environment.

C. Impact on Work-Life Balance:

One of the touted benefits of remote work is the potential for improved work-life balance. However, the reality is nuanced, with the boundaries between professional and personal life often becoming blurred. The absence of a physical separation between the workplace and home can lead to a constant feeling of being 'on the clock,' contributing to burnout and fatigue.Organizations play a pivotal role in fostering a healthy work-life balance for remote employees. Clear communication of expectations regarding work hours, flexible scheduling options, and the encouragement of breaks are essential components of this strategy. Technological solutions, such as time management apps and virtual scheduling tools, can assist employees in structuring their workdays effectively and setting boundaries. Training programs on time management and stress reduction can empower employees to navigate the challenges of balancing professional and personal responsibilities.

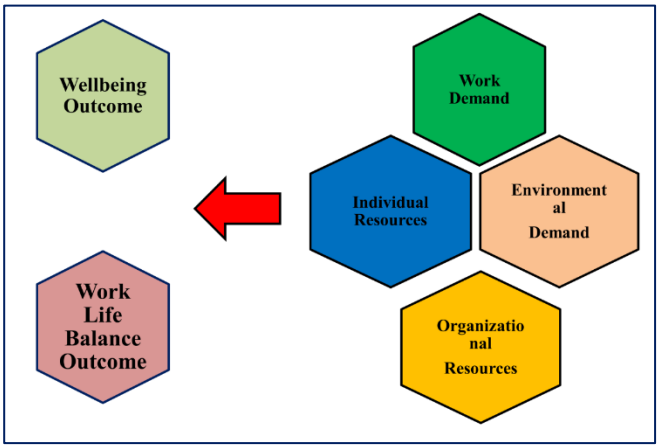

Figure 2: Representation of Opportunities and Challenges in remote working

The long-term health implications of remote work encompass a multifaceted landscape, including physical health consequences, mental health considerations, and the impact on work-life balance. Organizations must recognize the evolving nature of work arrangements and proactively address these implications. By prioritizing employee well-being through ergonomic support, mental health resources, and strategies for balancing work and life, organizations can foster a remote work environment that promotes sustained health and productivity for the long term. Regular assessments and adaptations to policies and support mechanisms will be crucial to ensuring the evolving needs of remote workers are met effectively.

Table 4: Summary of key parameters on long-term health implications of remote work

Parameter	Implications for Remote Work Health
Physical Health Consequences	Prolonged use of non-ergonomic setups leading to musculoskeletal issues; sedentary lifestyle contributing to weight gain and cardiovascular concerns.
Mental Health Considerations	Blurred work-life boundaries leading to increased stress, anxiety, and feelings of loneliness; lack of face-to-face interactions impacting mental well-being.
Work-Life Balance	Blurring of professional and personal boundaries leading to potential burnout; challenges in maintaining a healthy work-life balance.

VI. CONCLUSION

As technology has improved and more people work from home, the world of workplace health has changed in big ways. As we get used to this new way of thinking, it becomes clear that the effects of online work go far beyond the walls of real places. When technology and work come together, it creates new ways for people to be flexible and independent, going beyond the limits of the usual office. But along with these chances come a set of problems that need complex solutions to promote overall health and happiness.The practical issues that come up with working from home show how important it is for technology progress and physical health to work together. Companies should put a lot of thought into how their workspaces are set up and how optimal solutions are built in. This is because the digital tools workers use every day have a big impact on their health at work.All at the same time, the digital age has brought about new mental health issues. Because remote work is done online, it can make people feel alone and stressed. Because of this, companies need to build mental health support systems into the online parts of their workplaces. Digital therapy tools, health apps, and proactive actions based on data analytics are all things that are needed to make this work.As we think about the future of work, it's important to keep the careful balance between work responsibilities and personal health. To find this balance, we need to work together and make sure that laws, technical changes, and culture shifts put the health of the remote workforce first in every way. When it comes to figuring out how to combine workplace health with the digital age, companies that are flexible, open to new ideas, and dedicated to their employees' health will be the leaders. They will help create a healthy future for remote work settings.

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