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Biomechanical Wellness: A Human-Centered Framework Integrating Biomechanics, Ergonomics, Neurophysiology, and Organizational Design for Sustainable Workplace Wellbeing

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ABSTRACT

Workplace wellbeing has become a strategic organizational priority that extends beyond individual health to encompass the interaction between employees, work environments, and organizational systems. Although numerous workplace wellness initiatives have focused on stress management and individual behavioural interventions, increasing evidence suggests that many determinants of employee health and performance originate from organizational design, ergonomic conditions, movement behaviour, and cognitive workload.

This conceptual paper introduces Biomechanical Wellness as an interdisciplinary framework integrating biomechanics, ergonomics, physiology, neuroergonomics, occupational health, and organizational science. Drawing on evidence from occupational health, human factors, neuroscience, and workplace wellbeing research, the paper examines how workplace systems influence posture, movement, physiological regulation, cognitive function, stress responses, and musculoskeletal health. It argues that fatigue, burnout, reduced concentration, and declining work performance should be understood not merely as individual limitations but as biological and biomechanical responses to workplace environments and organizational conditions.

The proposed framework advocates a shift from employee-centred wellness initiatives toward organizational strategies that prioritize healthy work design, movement opportunities, ergonomic optimization, recovery, and leadership practices that support sustainable human functioning. By positioning wellbeing as a shared organizational responsibility, the Biomechanical Wellness framework provides an integrated theoretical foundation for future research, workplace policy, and evidence-based interventions aimed at improving employee health, organizational resilience, and long-term performance.

Keywords: Biomechanical wellness; workplace wellbeing; ergonomics; neuroergonomics; occupational health; movement behaviour; organizational health; sustainable performance.

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عافية البيوميكانيكية: إطار متكامل يجمع بين الميكانيكا الحيوية، و ergonamic، والفيزيولوجيا العصبية، والتصميم التنظيمي لتحقيق العافية المستدامة في بيئة العمل

في هذه الورقة يُستخدم مصطلح "العافية "(Wellness) للدلالة على نهج وقائي وتكاملي يهدف إلى تعزيز الصحة والأداء وجودة الحياة، بينما يُستخدم مصطلح "الرفاه "(Wellbeing) للإشارة إلى الحالة أو النتيجة المتحققة من هذا النهج.

الملخص

أصبحت العافية في بيئة العمل تمثل أولوية استراتيجية للمؤسسات، ولم تعد تقتصر على كونها قضية تتعلق بصحة الفرد فحسب، بل أصبحت ترتبط بالتفاعل بين العاملين وبيئة العمل والأنظمة التنظيمية. وعلى الرغم من أن العديد من مبادرات العافية المؤسسية ركزت على إدارة الضغوط النفسية والتدخلات السلوكية الموجهة للأفراد، إلا أن الأدلة العلمية المتزايدة تشير إلى أن العديد من محددات صحة الموظفين وأدائهم تنبع من تصميم العمل، والظروف الإرغونومية، وأنماط الحركة، والأحمال المعرفية داخل بيئة العمل.

تقدم هذه الورقة مفهوم العافية البيوميكانيكية (Biomechanical Wellness) بوصفه إطارًا متعدد التخصصات يدمج بين علم الميكانيكا الحيوية، و ergonamic، وعلم وظائف الأعضاء، و ergonamic العصبية، والصحة المهنية، والعلوم التنظيمية. واستنادًا إلى الأدبيات العلمية في مجالات الصحة المهنية، والعوامل البشرية، وعلوم الأعصاب، والعافية في بيئة العمل، تستعرض الورقة الكيفية التي تؤثر بها الأنظمة التنظيمية في القوام والحركة، والتنظيم الفسيولوجي، والوظائف المعرفية، والاستجابة للضغوط، وصحة الجهاز العضلي الهيكلي. كما تجادل بأن الإرهاق والاحتراق الوظيفي وضعف التركيز وتراجع الأداء الوظيفي لا ينبغي النظر إليها باعتبارها قصورًا فرديًا فحسب، بل باعتبارها استجابات بيولوجية وبيوميكانيكية تتشكل بفعل بيئة العمل والأنظمة التنظيمية.

ويقترح الإطار مفهومًا جديدًا ينتقل بالرفاهية المؤسسية من التركيز على تدخلات تستهدف الفرد إلى استراتيجيات تنظيمية شاملة تعتمد على تصميم بيئات عمل صحية، وتعزيز الحركة، وتحسين الجوانب الإرغونومية، وتوفير فرص التعافي، وتبني ممارسات قيادية داعمة للأداء البشري المستدام. ومن هذا المنطلق، توفر الرفاهية البيوميكانيكية أساسًا نظريًا متكاملًا يمكن أن يسهم في توجيه البحوث المستقبلية، وصياغة السياسات المؤسسية، وتطوير تدخلات قائمة على الأدلة لتعزيز صحة العاملين، ومرونة المؤسسات، واستدامة الأداء.

الكلمات المفتاحية : العافية البيوميكانيكية؛ الرفاهية في بيئة العمل؛ ergonamic؛ ergonamic العصبية؛ الصحة المهنية؛ السلوك الحركي؛ الصحة التنظيمية؛ الأداء المستدام.

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1. INTRODUCTION

Workplace wellbeing has emerged as a major organizational challenge in contemporary work environments characterized by increasing cognitive demands, prolonged sedentary behavior, digital overload, and constant connectivity. Modern employees are frequently exposed to excessive workload, continuous information processing, multitasking demands, and limited opportunities for recovery, all of which contribute to rising levels of stress, burnout, fatigue, and disengagement (World Health Organization [WHO], 2019; Van der Lippe & Lippényi, 2020). Despite substantial organizational investment in employee wellness and engagement initiatives, global workforce reports continue to demonstrate declining wellbeing and increasing psychological strain across occupational sectors (Gallup, 2023). Previous research has further demonstrated that healthy lifestyle behaviours—including regular physical activity, adequate sleep, and healthy nutrition—are major predictors of mental wellbeing, emphasizing that employee wellbeing is influenced by interconnected behavioural and environmental factors rather than isolated psychological interventions (Kilani et al., 2020).

The World Health Organization defines burnout as an occupational phenomenon resulting from chronic workplace stress that has not been successfully managed and is characterized by emotional exhaustion, mental distance from work, and reduced professional efficacy (WHO, 2019). Burnout has been consistently associated with reduced productivity, absenteeism, disengagement, turnover intentions, impaired cognitive functioning, and long-term physical and psychological health complications (Maslach & Leiter, 2016). Increasing evidence further suggests that workplace wellbeing is closely linked not only to psychological satisfaction, but also to organizational sustainability, workforce resilience, and long-term operational performance (Bakker & Demerouti, 2017).

Traditional workplace wellbeing initiatives have primarily focused on employee-centered interventions such as stress-management workshops, mindfulness programs, motivational training, and resilience-building strategies. Although these approaches may provide temporary psychological support, research increasingly indicates that many workplace wellbeing challenges originate from organizational structures and work design rather than from individual behavior alone (Harvard Business Review, 2019). Excessive workload, prolonged sitting, repetitive posture, poor workstation ergonomics, digital overstimulation, limited movement, and inadequate recovery opportunities exert measurable physiological, neurological, biomechanical, and psychological effects on employees (Thorp et al., 2011; Parasuraman & Rizzo, 2008).

Research in occupational health, ergonomics, neuroscience, and organizational psychology demonstrates that workplace conditions directly influence musculoskeletal health, nervous system regulation, concentration, cognitive performance, fatigue development, and emotional functioning (Aghazadeh, 2001; Safe Work Australia, 2021). Prolonged sedentary behavior has been associated with musculoskeletal discomfort, metabolic

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dysfunction, impaired circulation, and reduced cognitive performance, while excessive cognitive load contributes to attentional fatigue, emotional exhaustion, and impaired decision-making (Thorp et al., 2011; Parasuraman & Rizzo, 2008). Similarly, healthy lifestyle behaviours have been shown to play an important role in maintaining psychological wellbeing and resilience, reinforcing the importance of integrating movement, recovery, and health-promoting behaviours into workplace systems (Kilani et al., 2020). These findings suggest that fatigue, burnout, reduced concentration, and declining performance should not be understood solely as personal weaknesses or motivational failures, but rather as biological and biomechanical responses to workplace systems and environmental conditions.

Against this backdrop, the present paper introduces Biomechanical Wellness as an interdisciplinary organizational framework integrating biomechanics, ergonomics, physiology, neuroergonomics, occupational health, and workplace wellbeing. The framework proposes that employee wellbeing and performance are continuously shaped by organizational systems influencing posture, movement, cognitive load, stress regulation, recovery opportunities, and physiological functioning throughout the workday.

The purpose of this paper is to examine how workplace systems influence human physiological, biomechanical, cognitive, and psychological functioning and to propose Biomechanical Wellness as a human-centered organizational framework for sustainable workplace wellbeing and performance. By integrating evidence from occupational health, ergonomics, neuroscience, organizational psychology, and workplace wellbeing research, this paper argues for a shift from employee-focused wellness initiatives toward systemic organizational strategies that support sustainable human functioning and long-term organizational performance.

2. Workplace Wellbeing and Organizational Performance

Workplace wellbeing is increasingly recognized as a critical determinant of organizational sustainability, employee engagement, operational efficiency, and long-term business performance. Contemporary organizational research consistently demonstrates that employee wellbeing is strongly associated with productivity, innovation, resilience, absenteeism, turnover intentions, and organizational commitment (Bakker & Demerouti, 2017; Harter et al., 2020). Meta-analytic evidence further indicates that employees with higher levels of psychological wellbeing and work engagement demonstrate superior job performance, stronger organizational attachment, and lower rates of burnout and occupational withdrawal (Christian et al., 2011; Hooley et al., 2022).

Large-scale workforce analyses conducted by Gallup (2023) have shown that employees reporting higher wellbeing and engagement exhibit greater productivity, lower absenteeism, and stronger organizational loyalty, whereas disengagement is associated with substantial economic losses and reduced organizational performance worldwide.

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Similarly, systematic reviews in organizational psychology suggest that workplace environments characterized by supportive leadership, psychological safety, manageable workload, autonomy, and adequate recovery opportunities are associated with improved employee wellbeing and sustainable work performance (Arnold, 2017; Inceoglu et al., 2018).

Conversely, excessive workload, prolonged working hours, high emotional demands, and continuous digital responsiveness have been consistently linked to emotional exhaustion, cognitive fatigue, stress-related disorders, and burnout (Maslach & Leiter, 2016). The World Health Organization (2019) recognizes burnout as an occupational phenomenon resulting from chronic workplace stress that has not been successfully managed. Burnout is characterized by emotional exhaustion, depersonalization, and reduced professional efficacy and has been associated with reduced productivity, disengagement, absenteeism, impaired cognitive functioning, and long-term physical and psychological health consequences (Salvagioni et al., 2017).

Evidence from occupational health research further highlights the biological consequences of excessive occupational demands. A joint systematic review and meta-analysis conducted by the World Health Organization and the International Labour Organization demonstrated that employees working 55 hours or more per week face significantly higher risks of stroke and ischemic heart disease compared with individuals working standard hours (Pega et al., 2021). Similar findings from occupational stress and psychophysiology research indicate that chronic workplace stress contributes to autonomic nervous system dysregulation, elevated cortisol secretion, sleep disturbance, cardiovascular strain, impaired recovery, and reduced cognitive performance (Ganster & Rosen, 2013).

Recent evidence also suggests that workplace wellbeing extends beyond psychological satisfaction and should be viewed as a multidimensional construct involving physiological, cognitive, biomechanical, and organizational factors. Research in ergonomics, occupational biomechanics, and neuroergonomics demonstrates that prolonged sitting, repetitive posture, restricted movement, excessive screen exposure, and sustained cognitive load negatively affect musculoskeletal health, concentration, fatigue regulation, and overall work performance (Thorp et al., 2011; Parasuraman & Rizzo, 2008). Meta-analytic findings have further shown that sedentary occupational behavior is associated with increased musculoskeletal discomfort, metabolic dysfunction, and reduced physical and psychological wellbeing (Shrestha et al., 2018).

Collectively, these findings indicate that workplace wellbeing should not be conceptualized solely as an employee support initiative, but rather as a strategic organizational responsibility closely tied to sustainable human functioning and long-term organizational performance. Organizations that fail to address workplace stressors, workload intensity, environmental conditions, and recovery opportunities may gradually create systems that biologically and psychologically deplete employees over time. In

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contrast, organizations that integrate wellbeing into leadership practices, ergonomic systems, work design, communication structures, and recovery-oriented cultures are more likely to support employee resilience, sustainable performance, and organizational success.

3. Biomechanical Effects of Workplace Conditions

Contemporary workplace environments are increasingly characterized by prolonged sitting, repetitive movements, excessive screen exposure, high cognitive demands, and reduced opportunities for physical activity. Growing evidence from occupational health, ergonomics, biomechanics, neurophysiology, and human factors research demonstrates that these workplace conditions exert measurable biomechanical, physiological, neurological, and psychological effects on human functioning (Punnett & Wegman, 2004; Thorp et al., 2011). Modern organizational systems frequently expose employees to sustained postural loading, restricted movement patterns, repetitive motor tasks, and chronic cognitive demands that contribute to musculoskeletal strain, fatigue development, impaired recovery, and reduced cognitive performance (Waersted et al., 2010).

Biomechanics refers to the study of the mechanical forces acting on the human body during movement, posture, and physical activity. Within occupational settings, biomechanical factors include posture, movement variability, workstation configuration, repetitive motion, muscular loading, force production, physical strain, and environmental conditions that influence physiological and musculoskeletal functioning (Chaffin et al., 2006). Research increasingly suggests that workplace wellbeing is closely associated with biomechanical and physiological conditions rather than solely psychological or motivational factors.

3.1 Sedentary Behavior and Prolonged Sitting

One of the most extensively studied biomechanical risks in modern workplaces is prolonged sedentary behavior. The increasing digitalization of work has substantially expanded screen-based occupational activities, resulting in prolonged sitting durations across professional sectors (Owen et al., 2010). Systematic reviews and meta-analyses consistently demonstrate that uninterrupted sitting is associated with increased musculoskeletal discomfort, particularly in the lower back, cervical region, shoulders, and spinal stabilizing musculature (Shrestha et al., 2018; Thorp et al., 2011). Sedentary occupational behavior has also been linked to impaired circulation, reduced muscle activation, metabolic dysfunction, cardiovascular risk, and decreased cognitive functioning (Biswas et al., 2015).

Experimental research indicates that even relatively short periods of uninterrupted sitting may significantly increase discomfort and postural fatigue across multiple body regions (Waongenngarm et al., 2020). Prolonged sitting contributes to altered neuromuscular activation patterns, spinal compression, reduced joint mobility, and muscular

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deconditioning, particularly in the lumbar and cervical regions (Callaghan & McGill, 2001). In addition to musculoskeletal effects, sedentary behavior has been associated with attentional fatigue, reduced working memory performance, impaired executive functioning, and decreased psychomotor efficiency (Voss et al., 2014).

Conversely, evidence suggests that brief movement interruptions and postural variation throughout the workday may improve circulation, neuromuscular activation, cognitive performance, perceived energy, and psychological wellbeing (Dunstan et al., 2012). Meta-analytic evidence indicates that workplace movement interventions and active-break strategies may reduce musculoskeletal discomfort and improve both physical and cognitive functioning among office workers (Shrestha et al., 2018).

3.2 Physiological and Psychological Strain

Restricted movement, excessive workload, chronic occupational stress, and prolonged cognitive demands contribute to substantial physiological and psychological strain. Occupational stress research consistently demonstrates that excessive work demands and inadequate recovery opportunities activate stress-response systems and disrupt physiological regulation (Ganster & Rosen, 2013). Chronic activation of the sympathetic nervous system and hypothalamic–pituitary–adrenal (HPA) axis contributes to elevated cortisol secretion, sleep disturbance, fatigue, cardiovascular strain, emotional exhaustion, and impaired cognitive functioning (McEwen, 2007).

A joint systematic review and meta-analysis conducted by the World Health Organization and the International Labour Organization reported that employees working 55 hours or more per week face a significantly increased risk of stroke and ischemic heart disease compared with employees working standard working hours (Pega et al., 2021). Similar findings have been reported in occupational medicine and psychophysiology research linking chronic workplace stress to autonomic nervous system dysregulation, inflammatory responses, metabolic dysfunction, burnout, and long-term health complications (Salvagioni et al., 2017).

Work-related stress has also been associated with reduced attentional capacity, impaired decision-making, decreased working memory efficiency, and cognitive fatigue (Sonnentag & Fritz, 2015). Neuroergonomic research further demonstrates that sustained cognitive overload, multitasking demands, excessive digital stimulation, and continuous responsiveness impair neurological recovery and contribute to mental fatigue and reduced performance efficiency (Parasuraman & Rizzo, 2008). These findings suggest that many workplace wellbeing challenges are closely linked to biological stress mechanisms and physiological dysregulation rather than solely psychological dissatisfaction.

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3.3 Workstation Ergonomics

Workstation ergonomics represents a central component of biomechanical wellbeing within occupational environments. Poor workstation configuration, repetitive posture, inadequate seating support, improper monitor placement, and limited opportunities for movement substantially increase strain on the musculoskeletal and nervous systems (Robertson et al., 2013). Ergonomic risk factors such as static posture, repetitive movement, awkward joint positioning, and insufficient lumbar support have been consistently associated with work-related musculoskeletal disorders among office workers (Punnett & Wegman, 2004).

Recent ergonomic research demonstrates that inadequate desk height, prolonged laptop use, poor keyboard positioning, and limited arm support significantly increase muscular strain in the cervical, trapezius, shoulder, and lumbar regions (Waersted et al., 2010). Cross-sectional studies further report high prevalence rates of neck pain, lower back pain, shoulder discomfort, and upper-extremity musculoskeletal disorders among employees engaged in prolonged computer-based work (Janwantanakul et al., 2008).

Systematic reviews and intervention studies indicate that ergonomic modifications, including adjustable workstations, posture correction, movement integration, monitor repositioning, ergonomic seating systems, and workstation redesign, may significantly reduce musculoskeletal symptoms, visual strain, fatigue, and physical discomfort while improving productivity and occupational performance (Robertson et al., 2013). Emerging evidence also suggests that ergonomically supportive environments positively influence concentration, cognitive functioning, and employee wellbeing, highlighting the close interaction between biomechanical conditions and organizational performance outcomes.

Jordanian Workplace and Ergonomics Context

Emerging occupational health and ergonomics research in Jordan further supports the relationship between workplace conditions, biomechanical stressors, and employee wellbeing. As workplaces in Jordan increasingly experience digitalization, sedentary work patterns, prolonged computer use, and greater cognitive demands, concerns regarding occupational health and work-related musculoskeletal disorders have become more prominent across multiple sectors (Jordan Social Security Corporation, 2023). Recent evidence suggests that workplace ergonomics, posture, repetitive movement, and organizational working conditions significantly influence both physical and psychological wellbeing among Jordanian employees.

Research conducted among office employees in Jordanian universities reported that poorly designed computer workstations were significantly associated with musculoskeletal discomfort and visual symptoms, highlighting the importance of ergonomic workstation design for employee health and occupational performance (Al-Ali et al., 2021). Similar

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findings have been observed in healthcare environments. A cross-sectional study involving dentists in Amman demonstrated high prevalence rates of work-related musculoskeletal disorders, particularly in the neck, shoulders, lower back, and wrists, primarily associated with prolonged static posture, repetitive movements, awkward positioning, and inadequate ergonomic practices (Al-Mohrej et al., 2023). The study further indicated that ergonomic education, posture awareness, and workplace modifications contributed to reductions in musculoskeletal symptoms over time.

These findings are consistent with broader international evidence linking prolonged sedentary behavior, repetitive occupational movements, and poor ergonomic environments to increased biomechanical strain and musculoskeletal dysfunction (Punnett & Wegman, 2004; Waersted et al., 2010). Occupational ergonomics research has consistently demonstrated that inadequate workstation design and prolonged static posture contribute to increased spinal loading, muscular fatigue, neck and shoulder strain, and reduced physical functioning (Robertson et al., 2013).

At the national level, Jordan's Occupational Safety and Health Strategy (2023–2027) emphasizes the growing importance of workplace safety, ergonomic awareness, occupational health education, and organizational responsibility in reducing work-related injuries and improving employee wellbeing across sectors (Jordan Social Security Corporation, 2023). The strategy highlights the need for stronger ergonomic standards, improved workplace health policies, and broader institutional awareness regarding occupational risk factors and employee safety.

Collectively, these findings suggest that the biomechanical and physiological workplace challenges discussed throughout this paper are increasingly relevant within Jordanian organizational environments. As occupational systems continue to evolve toward more technology-dependent and cognitively demanding work structures, organizations may need to adopt more comprehensive ergonomic and human-centered approaches to support sustainable employee wellbeing and performance.

3.4 Cognitive Ergonomics and Neuroergonomics

Beyond physical ergonomics, growing evidence from cognitive ergonomics and neuroergonomics demonstrates that workplace environments strongly influence cognitive, neurological, and emotional functioning. Modern employees are increasingly exposed to excessive digital stimulation, sustained attentional demands, multitasking, frequent interruptions, long virtual meetings, and expectations of continuous responsiveness, all of which contribute to cognitive fatigue and impaired mental performance (Parasuraman & Rizzo, 2008).

Research in neuroergonomics suggests that sustained cognitive overload places continuous demands on attentional and executive-control systems, impairing working memory,

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concentration, decision-making, emotional regulation, and recovery capacity (Hancock & Szalma, 2008). Excessive information processing and prolonged screen exposure have also been associated with mental exhaustion, reduced attentional efficiency, increased stress responses, and impaired psychomotor functioning (Sonnentag & Fritz, 2015). Cognitive overload may further contribute to nervous system dysregulation, fatigue accumulation, and reduced adaptive functioning during prolonged occupational tasks.

Meta-analytic and occupational stress research additionally indicates that chronic cognitive demands and excessive workload are associated with increased emotional exhaustion, burnout symptoms, sleep disturbance, and reduced occupational performance (Salvagioni et al., 2017). Neurophysiological evidence suggests that sustained activation of stress-response systems may impair neural recovery processes and reduce employees' ability to maintain concentration, cognitive flexibility, and emotional stability over time (McEwen, 2007).

Together, these findings demonstrate that workplace wellbeing is strongly shaped not only by psychological and organizational factors, but also by biomechanical, physiological, and neurological conditions. Fatigue, reduced concentration, physical discomfort, cognitive exhaustion, and burnout should therefore be understood not merely as individual weaknesses or motivational failures, but as biological and neurophysiological responses to workplace systems and environmental demands.

4. Limitations of Traditional Workplace Wellness Programs

Over the past two decades, organizations have increasingly invested in workplace wellness initiatives aimed at improving employee health, engagement, productivity, and organizational performance. Common interventions include mindfulness programs, stress-management workshops, resilience training, motivational seminars, fitness initiatives, and employee assistance services. Although such interventions may provide short-term psychological support, growing evidence suggests that traditional workplace wellness programs often fail to address the underlying organizational and environmental conditions contributing to stress, fatigue, burnout, and declining wellbeing (Baxter et al., 2014).

A major limitation of many wellness initiatives is their strong emphasis on individual responsibility. Employees are frequently encouraged to improve resilience, manage stress more effectively, exercise regularly, or maintain positive attitudes while broader organizational factors—including excessive workload, prolonged working hours, poor ergonomics, cognitive overload, sedentary systems, and insufficient recovery opportunities—remain insufficiently addressed (Maslach & Leiter, 2016). This individual-centered approach may inadvertently frame burnout and fatigue as personal failures rather than consequences of unhealthy organizational structures and working conditions.

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Organizational psychology and occupational health research increasingly argue that burnout should be understood primarily as a systemic organizational issue rooted in work design, leadership practices, workload expectations, and psychosocial environments (Bakker & Demerouti, 2017). Excessive workload, continuous digital responsiveness, high emotional demands, and inadequate recovery opportunities contribute to measurable physiological, neurological, and psychological strain, including chronic stress activation, emotional exhaustion, impaired concentration, and reduced occupational functioning (Ganster & Rosen, 2013).

Another limitation of traditional wellness programs is the discrepancy between organizational wellbeing messaging and actual workplace conditions. Many organizations publicly promote employee wellbeing while simultaneously maintaining cultures characterized by excessive workload, constant availability, long meetings, high performance pressure, and limited recovery opportunities. This contradiction may reduce wellness initiatives to symbolic or performative interventions rather than integrated organizational strategies capable of supporting sustainable employee functioning.

Traditional wellness approaches also tend to focus predominantly on psychological wellbeing while giving comparatively limited attention to biomechanical, physiological, and neuroergonomic workplace conditions. Prolonged sitting, repetitive posture, restricted movement, poor workstation ergonomics, cognitive overload, and nervous system strain remain underrepresented within many organizational wellbeing models despite growing evidence regarding their biological and performance-related consequences (Thorp et al., 2011; Parasuraman & Rizzo, 2008).

Furthermore, many wellness initiatives are implemented as isolated or short-term interventions rather than sustained organizational systems integrated into workplace design and operational structures. One-time workshops, temporary awareness campaigns, and isolated wellbeing activities rarely address the chronic environmental and systemic conditions shaping employee health, recovery, and performance on a daily basis.

Although previous research has extensively examined workplace wellbeing, occupational stress, burnout, ergonomics, and employee engagement independently, fewer studies have integrated biomechanics, neuroergonomics, physiology, occupational health, and organizational systems into a unified conceptual framework. This gap highlights the need for more interdisciplinary approaches capable of linking workplace systems with human biological, cognitive, and biomechanical functioning.

5. Biomechanical Wellness Framework

The proposed Biomechanical Wellness Framework comprises six interdependent organizational dimensions: (1) movement behavior, (2) ergonomics and posture, (3) physiological regulation, (4) cognitive ergonomics, (5) stress-recovery systems, and (6)

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organizational design. These dimensions interact dynamically to influence employee wellbeing and organizational performance. In response to the limitations of traditional workplace wellness approaches, the present paper proposes Biomechanical Wellness as an interdisciplinary framework for organizational wellbeing integrating biomechanics, ergonomics, physiology, neuroergonomics, occupational health, movement science, and organizational design. The framework is grounded in emerging evidence demonstrating that workplace systems continuously influence physiological regulation, cognitive functioning, musculoskeletal health, nervous system activity, fatigue development, and occupational performance (Parasuraman & Rizzo, 2008; Robertson et al., 2013). Based on the evidence presented in the preceding sections, we propose the Biomechanical Wellness Framework as an integrative model linking human movement, ergonomics, neurophysiology, and organizational design (Figure 1).

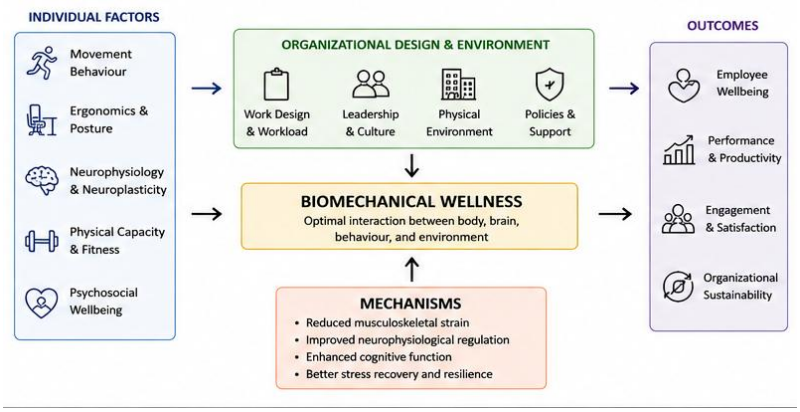

Figure 1. Conceptual Framework of Biomechanical Wellness.

The proposed Biomechanical Wellness Framework illustrates the multidimensional interactions among biomechanics, ergonomics, neurophysiology, movement behaviour, physical capacity, psychosocial wellbeing, and organizational design. The framework proposes that sustainable employee wellbeing emerges from the integration of individual biological systems with workplace environmental and organizational factors, ultimately influencing health, productivity, engagement, and organizational performance. The framework proposes that employee wellbeing and performance are continuously shaped by organizational systems influencing posture, movement, cognitive load, stress regulation, recovery opportunities, and physiological functioning throughout the workday. This systems perspective is consistent with evidence demonstrating that lifestyle behaviours and movement-related factors are closely associated with psychological wellbeing and overall health outcomes (Kilani et al., 2020).

The principal components of the proposed Biomechanical Wellness Framework and their workplace implications are summarized in Table 1.

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Table 1. Core Components of the Biomechanical Wellness Framework and Their Workplace Applications.

Component	Scientific Basis	Workplace Applications	Expected Outcomes
Movement Behaviour	Regular movement, motor control, physical activity	Office micro-exercises, active workstations, movement breaks	Reduced musculoskeletal disorders, improved energy
Ergonomics	Posture, workstation design, biomechanical loading	Ergonomic assessments and workstation optimization	Reduced injury risk and physical discomfort
Neurophysiology	Neuroplasticity, motor learning, cognitive regulation	Movement variation, cognitive–motor activities	Improved attention, learning, and cognitive performance
Physical Capacity	Strength, flexibility, endurance, balance	Exercise and conditioning programmes	Enhanced physical function and resilience
Psychosocial Wellbeing	Stress regulation, motivation, resilience	Coaching, wellbeing programmes, social support	Improved mental wellbeing and reduced burnout
Organizational Design	Leadership, culture, policies, work environment	Wellbeing policies, supportive leadership	Increased engagement, productivity, and retention
Lifespan Perspective	Prevention, adaptation, healthy ageing	Continuous wellbeing strategies across the working lifespan	Sustainable health and organizational performance

The table summarizes the principal dimensions of the proposed Biomechanical Wellness Framework, including their scientific basis, practical workplace applications, and expected health and organizational outcomes.

Unlike conventional wellness models that primarily emphasize individual resilience and behavioral modification, the Biomechanical Wellness framework conceptualizes employee wellbeing as a dynamic biological and organizational process shaped by environmental conditions, work design, movement opportunities, cognitive demands, recovery systems, and leadership practices. The framework argues that fatigue, burnout, reduced concentration, disengagement, and declining performance should not be viewed solely as individual weaknesses or motivational failures, but rather as biological and biomechanical responses to unhealthy organizational systems and chronic occupational strain (Maslach &

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Leiter, 2016; McEwen, 2007).

This perspective aligns with contemporary systems-based approaches in occupational health and organizational psychology, which emphasize that employee functioning emerges from continuous interactions between physiological capacity, environmental demands, and organizational structures (Bakker & Demerouti, 2017). Research in neurophysiology and psychophysiology further suggests that prolonged stress exposure, cognitive overload, repetitive posture, and insufficient recovery contribute to autonomic nervous system dysregulation, elevated cortisol levels, impaired cognitive performance, musculoskeletal strain, and fatigue accumulation over time (Ganster & Rosen, 2013).

The proposed framework is organized around several interconnected dimensions that collectively influence workplace wellbeing and sustainable human functioning.

Movement and Physical Activity

The first dimension concerns the extent to which workplace systems encourage or restrict movement throughout the workday. Sedentary occupational behavior has been consistently associated with musculoskeletal discomfort, cardiovascular risk, metabolic dysfunction, fatigue, and reduced cognitive performance (Biswas et al., 2015; Thorp et al., 2011). Evidence from ergonomics and occupational health research suggests that movement variability, postural changes, and regular activity interruptions improve circulation, neuromuscular activation, attentional functioning, and perceived energy (Dunstan et al., 2012). Accordingly, organizations that integrate movement opportunities into workflow systems may better support employee wellbeing and physiological recovery. The proposed Actness Lifespan Biomechanical Wellness Model summarizes the temporal relationship between movement behaviour, physical capacity, neuroplasticity, and healthy ageing (Figure 2).

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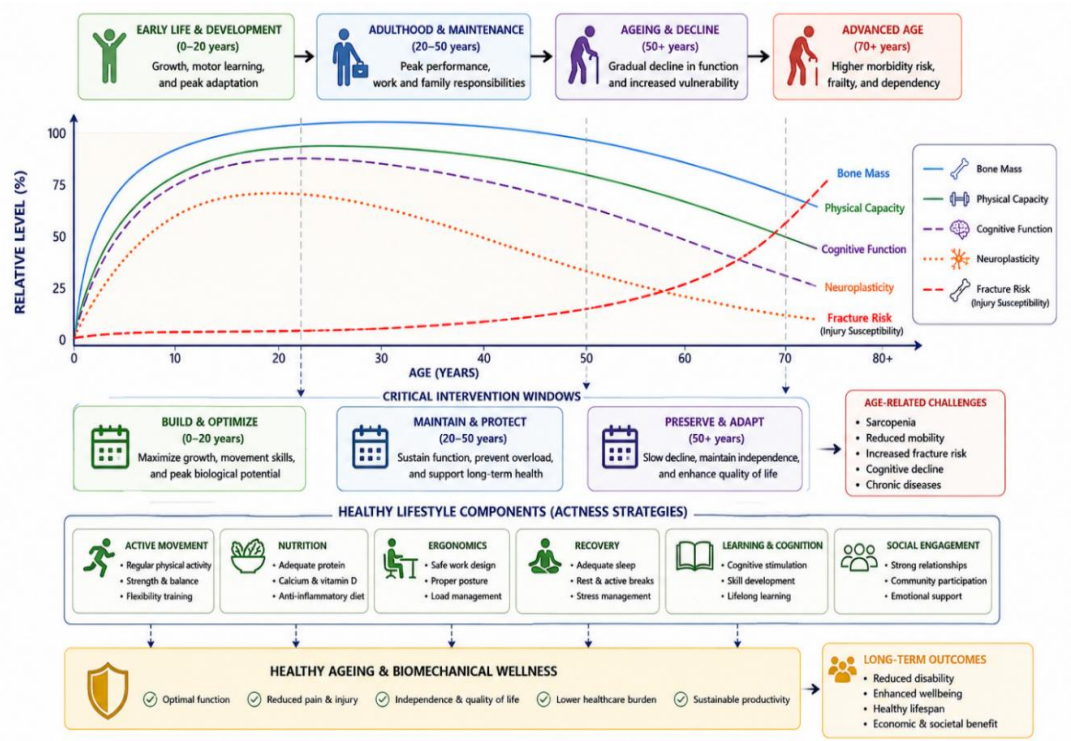

Figure 2. Proposed Actness Lifespan Biomechanical Wellness Model.

The Actness Lifespan Biomechanical Wellness Model illustrates the interaction between bone mass, physical fitness, cognitive function, and neuroplasticity across the human lifespan. The model highlights three major phases: (1) attainment of peak bone mass and physical fitness during growth and early adulthood, (2) consolidation and maintenance during adulthood, and (3) progressive age-related decline characterized by reduced physical capacity, sarcopenia, diminished neuroplasticity, and increased fracture risk. The model emphasizes that lifelong movement, ergonomics, physical activity, and healthy lifestyle practices may delay functional decline and promote healthy ageing.

Regular movement throughout the working day is increasingly recognized as a fundamental determinant of health and wellbeing. Recent evidence demonstrates that physical activity patterns vary considerably across occupational and demographic groups, highlighting the need for individualized and context-specific workplace interventions (Takruri et al., 2026).

Posture and Ergonomics

The second dimension involves posture, workstation ergonomics, and repetitive occupational movement patterns. Poor ergonomic design, prolonged static posture, repetitive movement, and inadequate workstation support increase musculoskeletal loading and contribute to work-related musculoskeletal disorders, particularly in the cervical spine, shoulders, lower back, and upper extremities (Punnett & Wegman, 2004). Systematic reviews further indicate that ergonomic interventions, including adjustable workstations,

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posture optimization, and workstation redesign, may significantly reduce physical discomfort and improve occupational functioning (Robertson et al., 2013). Within the Biomechanical Wellness framework, ergonomics is therefore viewed as a central organizational determinant of both physical and cognitive wellbeing.

Breathing and Physiological Regulation

Another important dimension concerns physiological regulation and the influence of workplace stressors on breathing patterns, nervous system activity, and recovery processes. Chronic occupational stress and sustained cognitive demands activate stress-response systems and contribute to dysregulation of the hypothalamic–pituitary–adrenal (HPA) axis and autonomic nervous system functioning (McEwen, 2007). Research in psychophysiology demonstrates that chronic stress exposure is associated with elevated cortisol secretion, sleep disturbance, fatigue accumulation, cardiovascular strain, and impaired emotional regulation (Ganster & Rosen, 2013). Sedentary behavior and restricted movement may further impair respiratory efficiency and physiological recovery. Consequently, organizational systems that promote recovery opportunities and reduce excessive physiological strain may contribute to healthier occupational functioning.

Cognitive Load and Neuroergonomics

The framework also incorporates cognitive ergonomics and neuroergonomics, emphasizing the neurological effects of excessive meetings, multitasking, digital overload, prolonged attentional demands, and continuous responsiveness. Modern occupational environments increasingly expose employees to sustained information processing and cognitive overload, which impair working memory, attentional control, decision-making, and emotional regulation (Parasuraman & Rizzo, 2008). Neuroergonomic research further indicates that excessive cognitive demands contribute to mental fatigue, reduced neural recovery, and diminished occupational performance efficiency (Hancock & Szalma, 2008). These findings highlight the importance of cognitive recovery and workload regulation within organizational wellbeing strategies.

Stress and Recovery Systems

Another core component of the framework concerns the balance between occupational demands and recovery opportunities. Occupational stress models consistently demonstrate that chronic imbalance between workload demands and recovery capacity contributes to burnout, emotional exhaustion, and long-term health complications (Sonnentag & Fritz, 2015). Recovery processes—including movement, sleep, psychological detachment, and physiological restoration—are therefore essential for maintaining sustainable cognitive and physical functioning. Organizations that fail to provide adequate recovery opportunities may gradually contribute to cumulative physiological depletion and reduced workforce resilience.

Environmental and Organizational Design

The final dimension emphasizes the role of organizational culture, leadership practices,

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communication systems, workload structures, environmental conditions, and operational expectations in shaping employee wellbeing. Research in organizational psychology consistently demonstrates that leadership behavior, psychological safety, workload management, and autonomy strongly influence occupational stress, engagement, resilience, and burnout risk (Arnold, 2017). From a biomechanical wellness perspective, organizational systems should therefore be designed not only for productivity, but also for sustainable human functioning.

Collectively, the Biomechanical Wellness framework conceptualizes workplace wellbeing as a multidimensional biological and organizational process continuously shaped by interactions between physiological systems, workplace environments, movement behavior, cognitive demands, and organizational structures. The framework further proposes that organizations adopting human-centered and physiologically supportive systems may improve concentration, engagement, resilience, creativity, decision-making quality, and long-term organizational sustainability.

6. Organizational Implications and Practical Applications

The Biomechanical Wellness framework has important implications for organizational leadership, workplace design, workload management, cognitive recovery, and employee wellbeing strategies. Contemporary evidence increasingly suggests that sustainable organizational performance depends on systems that support long-term physiological, cognitive, and biomechanical functioning rather than solely maximizing short-term productivity (Bakker & Demerouti, 2017).

6.1 Leadership and Organizational Responsibility

Leadership plays a central role in workplace wellbeing because it shapes workload expectations, communication norms, psychological safety, recovery opportunities, and organizational culture. Occupational stress research consistently links workplace burnout and emotional exhaustion to excessive demands, limited autonomy, inadequate managerial support, and unhealthy organizational climates (Maslach & Leiter, 2016). From a biomechanical wellness perspective, leadership extends beyond maintaining employee morale and includes designing operational systems aligned with human physiological and cognitive capacity.

This includes establishing realistic workload expectations, encouraging recovery periods, reducing unnecessary cognitive overload, creating opportunities for movement and postural variation, and promoting healthy communication boundaries. Research further indicates that supportive leadership and psychologically safe environments are associated with lower burnout rates, greater engagement, and improved occupational performance (Arnold, 2017).

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6.2 Workplace Design and Ergonomic Systems

Physical work environments substantially influence movement behavior, concentration, musculoskeletal health, fatigue development, and cognitive functioning. Ergonomic research consistently demonstrates that poorly designed workstations, prolonged sitting, repetitive posture, inadequate lighting, and restricted movement contribute to increased physical strain, musculoskeletal discomfort, and productivity loss (Punnett & Wegman, 2004). Ergonomically optimized environments, by contrast, may improve comfort, reduce physiological strain, and support sustained occupational performance (Robertson et al., 2013).

Organizations applying biomechanical wellness principles should therefore prioritize workplace systems that encourage movement variability, ergonomic flexibility, postural support, and recovery opportunities throughout the workday.

6.3 Digital Overload and Cognitive Recovery

Contemporary work environments increasingly expose employees to continuous digital stimulation, frequent notifications, prolonged virtual meetings, multitasking demands, and expectations of constant availability. Research in cognitive ergonomics and neuroergonomics demonstrates that sustained cognitive overload contributes to mental fatigue, reduced attentional efficiency, impaired working memory, and nervous system strain (Parasuraman & Rizzo, 2008). Excessive digital demands may also impair psychological recovery and increase emotional exhaustion over time.

From a biomechanical wellness perspective, cognitive recovery should therefore be considered an essential component of sustainable occupational performance. Organizational strategies aimed at reducing unnecessary digital interruptions, optimizing meeting structures, and supporting attentional recovery may contribute to healthier cognitive functioning and improved work performance.

6.4 Biomechanical Wellness Interventions

The Biomechanical Wellness framework shifts workplace wellbeing from isolated wellness activities toward integrated organizational interventions addressing workplace systems directly. Such interventions may include integrating movement opportunities into workflow structures, encouraging microbreaks and postural variation, redesigning meetings to reduce cognitive fatigue, improving workstation ergonomics, supporting recovery practices during high-stress periods, implementing workload-management systems, and promoting organizational cultures that balance performance expectations with physiological recovery capacity.

Collectively, these interventions align workplace systems more closely with human physiological, cognitive, and biomechanical functioning, potentially improving employee wellbeing, resilience, productivity, and long-term organizational sustainability.

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6.5 Future of Workplace Wellbeing

As organizations continue to adapt to digital transformation, artificial intelligence, hybrid work systems, automation, and increasingly complex occupational environments, workplace wellbeing is becoming progressively more interconnected with organizational sustainability, workforce resilience, and long-term human performance. Emerging evidence suggests that future workplaces will be characterized by intensified cognitive demands, greater digital dependency, continuous connectivity, and more complex interactions between humans, technology, and organizational systems (Parasuraman & Rizzo, 2008). Consequently, organizational success may increasingly depend on the ability to design work environments that support sustainable physiological, cognitive, and biomechanical functioning rather than relying solely on productivity-driven operational models.

Research in occupational health and organizational psychology consistently demonstrates that chronic occupational stress, excessive workload, cognitive overload, sedentary behavior, and inadequate recovery contribute to burnout, fatigue accumulation, impaired concentration, reduced engagement, and declining organizational performance (Maslach & Leiter, 2016; Salvagioni et al., 2017). Similarly, evidence from neuroergonomics and psychophysiology suggests that excessive attentional demands, prolonged digital exposure, multitasking, and constant responsiveness may impair nervous system regulation, cognitive recovery, and adaptive functioning over time (Hancock & Szalma, 2008).

The Biomechanical Wellness framework proposed in this paper argues that sustainable organizational performance depends fundamentally on sustainable human functioning. Organizations operating within systems characterized by chronic stress exposure, excessive cognitive demands, prolonged sedentary behavior, limited movement opportunities, and insufficient recovery capacity may gradually experience reductions in employee resilience, innovation, engagement, creativity, and long-term workforce sustainability. In contrast, organizations adopting human-centered systems that integrate ergonomics, movement, cognitive recovery, physiological regulation, and supportive leadership practices may be better positioned to promote sustainable occupational performance and organizational adaptability.

Biomechanical Wellness offers a scientific framework that repositions workplace wellbeing as a measurable biological and organizational outcome rather than solely an individual responsibility. This perspective may guide future research, organizational policy, leadership practice, and workplace design toward more sustainable human performance. Such approaches recognize that employee wellbeing is not merely an individual responsibility, but rather a dynamic organizational outcome continuously shaped by workplace systems, environmental conditions, and physiological demands.

The conceptual framework presented in this review has informed the development of practical workplace wellbeing interventions implemented through corporate wellbeing initiatives, including office micro-exercise programs, organizational wellbeing assessments, and leadership development models.

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7. Conclusion

Workplace wellbeing can no longer be viewed solely as an individual health concern or a supplementary organizational initiative. Contemporary evidence from occupational health, ergonomics, organizational psychology, neuroergonomics, and physiology demonstrates that employee wellbeing is profoundly shaped by workplace systems, workload structures, ergonomic conditions, cognitive demands, leadership practices, and organizational environments (Bakker & Demerouti, 2017; Maslach & Leiter, 2016). The evidence reviewed throughout this paper indicates that prolonged sitting, repetitive posture, excessive workload, cognitive overload, insufficient recovery, and poorly designed occupational systems contribute to measurable physiological, neurological, biomechanical, and psychological strain.

This paper introduced *Biomechanical Wellness* as an interdisciplinary framework integrating biomechanics, ergonomics, physiology, neuroergonomics, movement science, occupational health, and organizational design into a unified model of workplace wellbeing. The framework proposes that fatigue, burnout, reduced concentration, physical discomfort, disengagement, and declining performance should not be interpreted merely as individual weaknesses or motivational failures, but rather as biological and biomechanical responses to unhealthy workplace systems and chronic occupational strain.

The findings synthesized in this review further suggest that organizational systems continuously influence nervous system regulation, musculoskeletal functioning, cognitive performance, stress recovery, attentional capacity, and long-term workforce resilience. Accordingly, organizations that integrate wellbeing into leadership practices, ergonomic systems, movement opportunities, workload management, communication structures, and recovery-oriented cultures may be better positioned to support sustainable human functioning, employee engagement, occupational performance, and long-term organizational success.

The Biomechanical Wellness framework therefore calls for a fundamental shift from employee-focused wellness interventions toward systemic organizational strategies grounded in human physiological, cognitive, and biomechanical functioning. Rather than asking employees to adapt to unhealthy systems through greater resilience alone, organizations may need to redesign workplace environments in ways that align operational demands with biological capacity and sustainable human performance.

As occupational environments continue to evolve through digitalization, hybrid work models, artificial intelligence, and increasing cognitive demands, the importance of human-centered organizational systems will likely become even more critical. Sustainable organizational performance cannot ultimately be separated from sustainable human functioning. Future workplace wellbeing strategies should therefore move beyond symbolic wellness initiatives toward integrated organizational approaches that support physiological regulation, cognitive recovery, movement variability, ergonomic health, and long-term workforce sustainability.

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