

Navigating the Sustainable Metaverse: Leveraging HRIS for Green and Responsible Innovation in India's Virtual Work Environments

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RESEARCH ARTICLE

Open Access

ARTICLE INFORMATION

Received: January 31, 2026
 Accepted: August 11, 2026
 Published Online: August 23, 2026

Keywords:

HRIS integration, Sustainable metaverse, Virtual work environments, Responsible innovation, Cybersecurity threats, Inclusive governance frameworks, Green human resource management

ABSTRACT

Purpose: This study examines how Human Resource Information Systems (HRIS) can be strategically deployed to promote, monitor, and institutionalise sustainable and socially responsible practices within India's emerging metaverse-enabled work environments.

Method: The study adopts a five-phase, mixed-methods design comprising a structured review of the literature on HRIS, green human resource management, and metaverse technologies; 45-minute semi-structured interviews with 17 senior HR, sustainability, and technology leaders; a 30-item survey administered to 347 professionals; two illustrative organisational case studies; and the development of a Green HR Metaverse Strategy Framework validated by 21 subject matter experts.

Findings: Technological readiness for metaverse-enabled HRIS has outpaced cultural readiness, evidenced by resistance among middle management and unresolved budgeting concerns. Generational differences shape perceptions of Web 3.0 technologies, with younger employees more optimistic than experienced professionals, who place greater emphasis on scientific validity and social implications. Privacy and continuity risks, together with cybersecurity concerns linked to decentralised architecture, were identified as significant barriers, while customisable climate simulations and biofeedback-enabled accessibility tools emerged as promising opportunities, provided their implementation is guided by inclusive governance.

Implications: The study offers practical and social implications by guiding organisations in adopting sustainable, privacy-conscious metaverse-enabled HR practices while promoting trust and inclusion. However, its focus on Indian enterprises, qualitative subjectivity, and the rapidly evolving metaverse ecosystem may limit generalisability and the longevity of some findings.

Originality: This is among the first empirical studies to integrate HRIS, green HRM, and metaverse adoption within a single strategic framework, offering both theoretical grounding and a practitioner-orientated roadmap for sustainable virtual workplace transformation.


 DOI: [10.15415/jtmge/2026.171005](https://doi.org/10.15415/jtmge/2026.171005)

1. Introduction

The advent of the metaverse — a persistent virtual environment that uses extended reality technologies to enable immersive interaction — has added a new dimension to how individuals connect, collaborate, and work. As organisations increasingly experiment with virtual environments for training, meetings, and collaboration, questions have emerged about how environmental sustainability can be embedded into the design and operation of these spaces, rather than treated as an afterthought. This concern is particularly pressing as companies migrate a growing share of their work activity to metaverse platforms. The present study examines the relationship between the “green metaverse” and Human Resource Information Systems (HRIS), investigating how

HRIS tools can help organisations promote, measure, and govern sustainable practices as they adopt immersive virtual work environments.

1.1. Background

The concept of the metaverse originates in Neal Stephenson's 1992 science-fiction novel *Snow Crash*, in which humans interact through virtual identities in an immersive three-dimensional world (Stephenson, 1992). While the metaverse remains a work in progress, it is now generally understood as an ecosystem of virtual worlds that supports community, creativity, commerce, and other forms of interaction through extended reality technologies. The “green metaverse” refers to how sustainability principles can be embedded in the design

of these virtual worlds and to how the metaverse itself might become a vehicle for sustainable practice (World Economic Forum, 2022). Virtual environments can reduce the resource footprint of activities that would otherwise occur physically — for example, holding meetings and conferences virtually can reduce transportation-related energy consumption (Dumont *et al.*, 2017). At the same time, the metaverse carries sustainability costs of its own, including the energy consumed by data centres and extended-reality hardware and the e-waste generated as devices are upgraded (Dwivedi *et al.*, 2022; De Giovanni, 2023).

Human Resource Information Systems (HRIS) provide the digital infrastructure organisations use to manage employee data and human capital processes (Lengnick-Hall *et al.*, 2009). As sustainability has become embedded in organisational culture, green HRM has emerged as a distinct field concerned with directing HRM policies and practices toward sustainable resource use (Renwick *et al.*, 2013). HRIS platforms are a natural tool for tracking and advancing green HRM initiatives—from environmental work practices to sustainability training and CSR participation—yet very little is known about how HRIS functions within metaverse-based work environments (Zhang *et al.*, 2023; Chaudhary *et al.*, 2025).

1.2. Problem Statement

Despite growing scholarly attention to sustainability and to the metaverse individually, comparatively little research has examined how organisations might use HRIS to monitor and implement green practices specifically within metaverse spaces (Reniati *et al.*, 2023). Prior work has documented the difficulty of embedding sustainability into virtual environments, given concerns about the energy intensity of metaverse infrastructure and the e-waste generated through hardware turnover (Dwivedi *et al.*, 2022). A clear gap remains in how the green HRM framework, and the HRIS systems that operationalise it, might be adapted for virtual workspaces. This gap poses a practical challenge for organisations seeking to preserve their sustainability commitments while expanding their presence in the metaverse: without adapted frameworks, firms risk being unable to monitor the environmental impact of their virtual operations, encourage sustainable behaviour among a virtual workforce, or evidence progress on their metaverse-related sustainability commitments (Chen & Huang, 2023).

1.3. Purpose and Objectives of the Study

The purpose of this study is to address this knowledge gap by examining how HRIS can be used to advance green organisational practice within metaverse platforms and, in doing so, to develop an evidence-based framework that

organisations can apply in practice. Correspondingly, the study is guided by five specific objectives: to determine the efficiency of HRIS in supporting green practices within the metaverse; to identify the needs and expectations of users of green metaverse HRIS solutions; to examine how inclusive design principles can be incorporated into such solutions; to study the socio-technical dimensions — cultural, generational, and organisational — of green metaverse HRIS adoption; and to assess the scalability of green metaverse HRIS solutions across organisational contexts.

Guiding these objectives is the working proposition that integrating HRIS features for green organisational practice within metaverse platforms will positively influence sustainability key performance indicators—including emissions reduction, renewable energy use, and green engagement—and that engaging diverse stakeholders, including disadvantaged populations, in the design process will produce more socially responsible and user-centred outcomes. To this end, the study combines a review of the literature, qualitative interviews and case studies, and a quantitative survey, culminating in a strategy framework; the full research design is set out in Section 3.

1.4. Research Questions

- RQ1: How are metaverse platforms utilising sustainable design and practices?
- RQ2: Which green HRM measurement tools associated with HRIS are useful for monitoring sustainability in both physical and digital workplaces?
- RQ3: How should HRIS systems evolve to better manage green policies and initiatives tied to corporate metaverse implementation?
- RQ4: What do current HR and IT perceptions indicate about the contribution of HRIS to sustainable behaviour in metaverse workplace environments?

1.5. Significance of the Study

As the metaverse ecosystem matures, the way organisations deploy virtual-world technologies will increasingly shape user experience and organisational dynamics, making sustainable models of practice a growing priority. The World Economic Forum (2022) estimates that metaverse ecosystems could generate more than \$1 trillion in additional global GDP by 2028, raising the question of how this new digital economy can be harnessed responsibly and without generating unaddressed externalities. HRIS has the potential to serve as the information infrastructure that supports this responsible growth. This study contributes to the small but growing body of empirical research on HRIS in the context of green organisational activity and metaverse adoption, offering insights that can help start-ups and established organisations

alike understand how HRIS features can make their virtual work offerings more sustainable while also helping establish baseline standards for evaluating the maturity of a “green metaverse” (Cao *et al.*, 2023; De Giovanni, 2023).

2. Literature Review

Against the backdrop of the current global environment, sustainability has become more important than ever, owing to the escalating dangers of climate change, resource depletion, and environmental degradation. In response, firms have increasingly integrated sustainable practices into their operations, and the adoption of green human resource management (HRM) has gained popularity as a means of embedding environmental sustainability into organisational policy (Chaudhary *et al.*, 2025). At the same time, the emergence of the metaverse — a persistent virtual environment enabled through extended reality — is poised to reshape how organisations interact and operate. As businesses explore the potential of metaverse platforms, the environmental sustainability concerns associated with their use cannot be overlooked (World Economic Forum, 2022). Against this backdrop, one area requiring urgent investigation is the role of Human Resource Information Systems (HRIS) in promoting and monitoring green organisational practice. With the support of data analytics, digital platforms, and information systems, organisations can potentially strengthen their sustainability initiatives, track progress, and encourage environmentally responsible behaviour among employees. This review synthesises the current academic literature on the interconnection between HRIS and the green metaverse.

2.1. Metaverse and Sustainability

The term ‘metaverse’ was first coined by Neal Stephenson in *Snow Crash*, where it is described as the internet’s successor, built on virtual reality (Stephenson, 1992). Since then, both technology companies and researchers have proposed a range of definitions. The World Economic Forum (2022) describes the metaverse as a three-dimensional evolution of the internet that integrates augmented and virtual reality, social media, online gaming, and cryptocurrency into a single immersive environment. Alongside the enthusiasm the metaverse has generated, researchers have also documented its environmental costs. De Giovanni (2023) and Jauhiainen *et al.* (2023) highlight the high energy consumption associated with running data centres, extended-reality equipment, and the computing hardware required to sustain immersive experiences, while Dwivedi *et al.* (2022) further note the growing volume of e-waste generated as such hardware is upgraded.

2.2. HRIS and Green HRM

The emergence of the metaverse has sharpened attention to the role HRIS can play in advancing green HRM (Chaudhary *et al.*, 2025). Evidence suggests that HRIS supports sustainability through improved data acquisition, analysis, and reporting; HRIS-enabled green HRM interventions, for instance, have been linked to positive employee green behaviour and stronger environmental performance, although such findings are often limited by reliance on employee self-report and single-organisation samples (Dumont *et al.*, 2017). The literature is not uniformly positive, however. Scholars have raised concerns about the risk of “greenwashing” and about the practical difficulty of measuring environmental impact through HRIS (Ren *et al.*, 2018), as well as about the potential for such systems to widen existing inequalities where access and digital literacy are unevenly distributed (Bondarouk & Brewster, 2016). Existing empirical studies on the environmental dimension of metaverse technologies also tend to be industry-specific or based on qualitative data alone, which limits how far their conclusions can be generalised (Dwivedi *et al.*, 2022; Jauhiainen *et al.*, 2023).

2.3. Integrating HRIS and the Green Metaverse

Although research on HRIS and green HRM individually has matured considerably, empirical work that integrates HRIS, sustainability, and metaverse technologies together remains limited. Existing studies tend to focus on technological architecture, immersive collaboration, digital transformation, and sustainable digital ecosystems, rather than on human resource management applications specifically (Dwivedi *et al.*, 2022; Zhang *et al.*, 2023; Chen & Huang, 2023). As a result, limited evidence exists on how HRIS can monitor sustainability indicators, support employee engagement, and underpin governance mechanisms within metaverse-enabled organisations.

2.4. Gap Analysis

Despite the considerable interest surrounding the metaverse, sustainability, and HRIS, several important gaps remain. The most significant is the near-total absence of empirical validation: there is an urgent need for experiments and pilot studies that test the impact of HRIS, carbon dashboards, and virtual green teams on sustainability performance. Relatedly, user-centred and inclusive approaches — incorporating feedback from employees, HR professionals, and other stakeholders — are needed to design solutions that are both relevant and sustainable. It is equally important to examine the socio-technical dimensions of HRIS-enabled metaverse adoption, including organisational culture and resistance to

change. HRIS-enabled metaverse solutions hold real promise for measuring sustainability performance and encouraging environmentally responsible behaviour through immersive learning and collaboration, but realising this promise will require organisations to address technological, governance, and change-management barriers concurrently. These gaps directly inform the objectives and methodology of the present study, outlined in Sections 1.3 and 3.

3. Research Methodology

3.1. Research Design

The background and rationale set out in Sections 1 and 2 establish why the relationship between immersive digital workplaces, the capacity of HRIS to manage and monitor green policy implementation, and the resulting sustainability outcomes warrants further investigation. As more companies embrace virtual worlds and augmented reality for collaboration and training, their ecological impact needs to be studied and effectively governed. This informed the study's primary lines of inquiry: the current state of metaverse-based work and its HRIS integration; the benefits and challenges involved; the extent to which sustainable HRM can be measured in a digital environment; the cultural features that distinguish this era from earlier ones; and how professionals in strategy and technology roles perceive these issues. To address these questions, the study followed a five-phase, mixed-methods design.

3.2. Phase 1 – Literature Review

The systematic literature review examined more than 150 scholarly papers published across over 200 information-systems, management, sustainable-development, and technology-adoption journals. Supplementary case data from leading metaverse companies, sustainability analytics providers, and HR software vendors provided additional insight into industry practice, emerging integration strategies, and pilot initiatives. The review uncovered notable disparities between the conceptual frameworks proposed by academics and the practical solutions offered by existing green metaverse HRIS applications.

3.3. Phase 2 – Leadership Interviews

To capture the perspectives of influential decision-makers, 45-minute interviews were conducted with 17 directors and vice-presidents responsible for metaverse rollout, sustainability strategy, or HR systems transformation. Snowball sampling was used to identify participants from professional networks spanning consumer goods, higher education, hospitality, biopharmaceuticals, and e-commerce.

Sampling justification: The leadership interviews targeted a purposive sample of strategic decision-makers and subject-matter experts actively engaged in metaverse, sustainability, or HR transformation initiatives, with the aim of capturing insight from stakeholders directly shaping change at the intersection of these domains. Key themes emerging from the interviews included friction in budgeting and forecasting returns on investment for prototyping virtual environments aligned with sustainability goals and an expectation among most leaders of continued resistance from middle-management teams accustomed to physical-world monitoring, notwithstanding advances in augmented reality technology.

3.4. Phase 3 – Methods Survey

A 30-item survey, incorporating multiple-choice, sliding-scale, ranking, and open-ended questions, was distributed to 347 professionals whose roles involved sustainability practice or immersive-platform implementation. Cluster analysis identified six respondent categories—including “Techno-Optimists” and “Climate Cynics”—reflecting differing levels of acceptance of Web 3.0 dynamics depending on respondents' broader outlook on technological progress. Text analysis of open-ended responses revealed a mixture of enthusiasm and apprehension regarding the privacy and continuity implications of integrating sustainability initiatives into virtual environments through employee avatars.

Sampling justification: The survey was designed to reach a broader cross-section of professionals engaged in sustainability-related projects or immersive-platform development in order to capture a wider range of opinions and to support the derivation of archetypal profiles and generational distinctions.

Data analysis transparency: Qualitative data collected through interviews and open-ended survey items were analyzed using iterative coding—descriptive, pattern, and value coding—supported by VOSviewer for keyword and thematic mapping.

3.5. Phase 4 – Case Study Examples

Two organisational case studies illustrate real-world instances in which HRIS and sustainability tools have evolved alongside augmented-reality platforms.

- **TerraVerda:** An Italian agricultural sciences firm that has built a photorealistic digital twin of a metaverse environment for simulating crop growth and climate resilience under varying weather patterns. TerraVerda enables farmers to customise simulations to the characteristics of their specific micro-regions, isolating soil samples from different locations and modifying seasonal conditions within minutes. Its embedded HRIS

module tracks individual employees' sustainability micro-credentials and associated carbon savings, although concerns around data decentralisation have raised biopiracy-related risks that the organisation is still working to address.

- JustTransit: A Singapore-based urban mobility analytics provider that has developed a virtual command centre equipped with bio-sensors, enabling engineers to simulate public transit journeys from the perspective of senior citizens and people with disabilities, using avatar-based restrictions on vision, hearing, and movement. Its HRIS module measures relevant sustainability skills and allocates personnel to initiatives aimed at improving accessibility. Together, these cases point to both the possibilities and the challenges at the intersection of digital-workplace sustainability and the cultural shifts associated with augmented reality adoption.

3.6. Phase 5 – Green HR Metaverse Strategy Framework

Drawing on the literature review, executive interviews, survey analytics, and organisational case studies, the study developed a Green HR Metaverse Strategy Framework comprising modules that guide practitioners through the critical steps of alignment, needs assessment, design parameters, change sequencing, data integration, dashboard development, and impact evaluation when embedding HRIS sustainability functionality within augmented-reality environments. Modular flowcharts illustrate the framework's core phases across strategy, implementation, and governance. The resulting 70-page, evidence-based framework was reviewed by 21 HR, IT, and sustainability experts drawn from Global 1000 organisations and metaverse-focused start-ups, leading to refinements in personalisation-algorithm safeguards, carbon-calculation transparency, and ecosystem-partner accountability guidance.

3.7. Framework Limitations

While the Green HR Metaverse Strategy Framework aims to provide a comprehensive guide, its applicability may be more relevant to organisations and sectors actively pursuing metaverse adoption alongside sustainability integration. Its utility may be more limited in sectors with lower technological maturity or where regulatory constraints hinder immersive-platform implementation, and the rapid pace of technological change may necessitate periodic updates to address emerging challenges and advancements.

4. Findings

This study, conducted across multiple phases, generated valuable insight into the emergent integration of HRIS

with sustainability reporting and metaverse platform implementation in Indian organisations. Qualitative exploration using virtual ethnography illuminated cultural considerations shaping end-user adoption. Leadership interviews emphasised organisational resistance from mid-level management and the difficulty of forecasting budgets for virtual work practices aligned with green initiatives. Focus groups with employees raised concerns about privacy in augmented-reality settings and about the sustainability implications of virtual environments more broadly. Quantitative survey data revealed generational differences in how employees engage with the possibilities HRIS and the metaverse offer beyond physical boundaries. Comparative organisational case studies contributed further insight into the intersection of HRIS, sustainability, and the metaverse across sectors such as agriculture, mobility, and education, while scenario simulations illustrated the potential benefits of transferring sustainability credentials into digital environments — tempered by legitimate cybersecurity concerns associated with decentralised metaverse systems. Augmented biofeedback dashboards demonstrated further possibilities for accessibility and inclusivity. The resulting Green HR Metaverse Strategic Evaluation Model reflects best practices validated by participants across needs assessment, data-integration parameters, change-management processes, dashboard-building criteria, and impact-auditing guidelines; variance-based clustering helped chart maturation pathways suited to different organisational archetypes, while participants stressed that continual iteration remains essential given the pace of change in this space.

The study identified several vital findings regarding the use of metaverse platforms as instruments for tracking HRIS and sustainability data. Technological readiness emerged as a factor that has achieved considerable improvement, as virtual environments and augmented reality tools continue to develop. Cultural readiness, however, has not kept pace: the views of employees, particularly middle managers, and of leaders indicate that resistance to change persists and that traditional control mechanisms continue to prevail, with budget forecasting playing a critical constraining role. Generational disparities in the perception of Web 3.0 technologies were also evident: younger, digitally native employees expressed greater confidence in metaverse opportunities than more experienced professionals, who placed greater weight on the scientific validity of new technologies and on their potential social implications and inequalities.

Privacy and continuity emerged as critical considerations for HRIS implementation within metaverse architecture. The transition to metaverse platforms raises privacy concerns even where anonymised avatars are used, and difficulties persist in transferring sustainability outcomes from physical to virtual settings. Despite these challenges, the study also

revealed genuine opportunities. Customisable features of metaverse platforms can support climate resilience through tailored simulations, particularly within digital-twin ecosystems, while biofeedback systems built on sensor technology and biometric data can improve accessibility and empathy, offering inclusive solutions for older adults and people with disabilities, especially in public-service contexts. The study nonetheless stresses the need to integrate such advances with ongoing stakeholder participation, so as to prevent the marginalisation of the very groups these tools are intended to serve. Governance frameworks that represent stakeholder interests are essential to ensuring the fair and equitable use of metaverse technology.

5. Discussion

Taken together, these findings offer several important conclusions about metaverse usage in HRIS and sustainability monitoring through mixed methods. First, a gap exists whereby technological preparedness has outpaced cultural preparedness (RQ2), reflecting improvements in virtual-world development alongside persistent barriers such as resistance among middle management and financial uncertainty. Second, generational differences shape the perception of Web 3.0 technologies (RQ3): younger employees display greater optimism, while experienced professionals focus more heavily on scientific and ethical considerations that constitute a distinct cultural gap. Third, privacy and continuity risks require attention (RQ2), given the challenges of transferring sustainability-related information between HRIS systems and metaverse platforms. Fourth, decentralised technology architecture introduces cybersecurity risks (RQ1) related to potential data leakage and intellectual-property concerns that may constrain the adoption of metaverse technology within HRIS systems. On a more positive note, customisation increases climate resilience (RQ1) by enabling digital twins that support sustainability simulations, while biofeedback technologies improve accessibility and empathy (RQ2) through inclusive design for vulnerable populations. Finally, sustained stakeholder engagement remains essential to ensuring inclusivity and avoiding extractive outcomes (RQ3).

These findings should be read in light of the study's broader implications. For practitioners, they suggest that closing the gap between technological and cultural readiness will require deliberate change-management investment rather than technology deployment alone. For researchers, they point to a need for longitudinal and cross-national studies that can test whether the patterns observed here — particularly generational divergence in technology perception — hold across different regulatory and cultural contexts. For policymakers, the privacy, continuity, and cybersecurity risks identified here underscore the importance

of governance frameworks that keep pace with the rapid evolution of metaverse infrastructure.

6. Conclusion

This study set out to examine how HRIS can be used to advance green organisational practice within metaverse platforms, and its findings point to significant shortcomings in organisational readiness for these technologies across cultural, generational, ethical, and security dimensions. At the same time, the results highlight genuine opportunities to improve sustainability outcomes in the metaverse through customisation, inclusivity, and participatory assessment. The evidence gathered across the study's five phases indicates that technological capability alone is insufficient: sustainable and socially responsible metaverse adoption depends equally on organisational culture, governance, and the meaningful inclusion of diverse stakeholders in the design process. In addressing its stated objectives, the study confirms that HRIS can meaningfully support sustainability monitoring and engagement within metaverse environments while also identifying the socio-technical conditions — cultural readiness, inclusive design, and scalable governance — that determine whether this potential is realised in practice.

7. Limitations

This study is subject to several limitations. First, its scope is confined to Indian enterprises, which may limit the generalisability of the findings to other geographic or cultural settings. Second, the rapid pace of technological advancement within the metaverse ecosystem may render some findings and recommendations outdated or may require them to be revisited as the technology matures. Third, some of the qualitative methods employed, including virtual ethnography and leadership interviews, are inherently subject to the subjectivity and personal perspectives of participants; although the researchers took care to mitigate such bias, participants' opinions and experiences may nonetheless have shaped their responses and the interpretations drawn from them.

8. Future Research Directions

Building on the findings and limitations above, three directions for future research appear particularly valuable. First, longitudinal studies could track the progression and development of metaverse platforms and their influence on sustainability indicators as adoption and technology mature. Second, further research is needed into how emerging technologies such as blockchain, artificial intelligence, and extended reality interact with HRIS

systems to support or hinder sustainability practices within metaverse environments. Third, future work should develop frameworks that address privacy and equity concerns associated with immersive platforms, both within the workplace and beyond it.

9. Recommendations

Based on the study's findings, several recommendations follow. Organisations should prioritise addressing cultural-adjustment challenges and resistance to change among middle-level managerial staff, including through training programmes designed to bridge the differences between physical and virtual working environments. They should also work to recognise and address the differing degrees of confidence that younger and more experienced employees place in Web 3.0 and metaverse technologies, using mentoring schemes and cross-generational learning networks to build mutual understanding and respect. Privacy and continuity risks should be managed through robust governance systems, including clear data-management practices, privacy-protection rules, and credential-transfer protocols that ensure safety across both physical and digital domains. Finally, organisations should foster ongoing collaboration among subject-matter experts, technologists, and end users so that innovations remain tailored to specific organisational needs; aligning technological investment with cultural and governance considerations in this way is critical to sustaining responsible growth within the metaverse.

Acknowledgement

The author sincerely thanks all the respondents who participated in this study and provided valuable insights. The author also expresses gratitude to colleagues, mentors, and the concerned institutions for their continuous guidance, encouragement, and support throughout the research process.

Authorship Contribution

The author solely contributed to the conceptualization and design of the study, data collection, data analysis, interpretation of results, and preparation of the manuscript. The author has read and approved the final version of the manuscript.

Conflict of Interest

The author declares that there is no conflict of interest regarding the publication of this paper.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical Approval

The study was conducted in accordance with accepted ethical standards. Participation was voluntary, and informed consent was obtained from all respondents prior to data collection. The confidentiality and anonymity of participants were strictly maintained throughout the research process.

Declarations

The author confirms that this manuscript is original, has not been published previously, and is not under consideration for publication elsewhere. All sources of information have been properly acknowledged, and ethical research standards have been followed.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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AI Disclosure Statement

During the preparation of this manuscript, the author did not use any artificial intelligence or AI-assisted technologies in the writing, analysis, or interpretation of data. All content presented in this manuscript is the original work of the author.

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