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COMMENTARY ARTICLE

Policy Approaches to Women with Disabilities in Sport across Asia: Between Idealism and Realism

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In recent decades, sport has gained growing recognition as a means of empowerment for women with disabilities in Asia—physically, psychologically, and socially. Yet, the policymaking landscape in this area remains fragmented and inconsistent. A clear gap persists between strategic documents and the lived realities of women with disabilities (Thomas & Smith, 2008). This commentary critically examines current policy directions, highlights structural challenges, and explores cultural dynamics in Islamic contexts.

Policy Documents and Implementation Gaps

Several regional and international frameworks—such as the Incheon Strategy to “Make the Right Real” and Asia-specific disability empowerment plans—emphasize the importance of inclusive sport for women with disabilities (UNESCO, 2015; Asian Paralympic Committee, 2021). However, in many Asian countries, these policies are either weakly enforced or entirely symbolic. Lack of long-term political commitment, insufficient funding, and a shortage of qualified female coaches specializing in disability sport remain persistent obstacles (DePauw & Gavron, 2005). Moreover, most policies neglect to incorporate the direct voices and lived experiences of women with disabilities, limiting their relevance and sustainability. Current scholarship and policy reviews often concentrate on East Asia and West Asia, leaving Central and South Asia underexplored. These regions have large populations of women with disabilities whose opportunities in sport remain poorly documented. Expanding the geographical lens is critical to ensure that regional diversity and different socio-cultural barriers are captured in policy design.

Cultural Characteristics in Islamic Contexts

Islamic-majority societies across Asia are diverse, yet several recurring cultural patterns shape women’s opportunities for sport, especially for women with disabilities.

1. Religious and interpretive diversity – Islam is interpreted in various ways. While some communities emphasise conservative gender norms, others actively support women’s physical activity as compatible with religious values (Ahmed, 1992; Abu-Lughod, 2013).



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2. Modesty norms and dress requirements – Expectations about clothing (e.g., hijab, modest sportswear) influence participation. The rise of sports hijabs and modest athletic apparel has expanded opportunities, but international sporting regulations still sometimes create barriers (Sahi, 2020).
3. Gendered social roles and family expectations – In many contexts, family approval and community perceptions of honour influence whether women can travel to and participate in sport, particularly for women with disabilities who may require assistance (Benn, Pfister, & Jawad, 2010).
4. Value of women-only and faith-sensitive spaces – Female-only facilities, coaches, and segregated sessions often encourage participation where mixed-gender sport is discouraged (Pfister, 2010).
5. Socioeconomic and geographic variation – Urban, middle-class women often have greater access to sport facilities, while rural women face compounded infrastructural and cultural barriers. National contexts (e.g., Iran, Saudi Arabia, Indonesia, Malaysia, Turkey) require locally adapted policies (Benn et al., 2010).
6. Intersection of stigma – Women with disabilities often face overlapping discrimination due to gender, disability, and cultural perceptions of physical activity. This can lead to lower expectations of their participation (Pfister, 2010).
7. Faith-based advocacy and women’s agency – Feminist interpretations within Muslim contexts have successfully framed sport as a right grounded in religious values, creating culturally resonant justifications for participation (Ahmed, 1992; Abu-Lughod, 2013).

While existing literature often centers on women with physical impairments, women with intellectual disabilities remain particularly marginalized in sport policy and practice. Their challenges—such as communication barriers, lack of adapted training methods, and insufficiently trained coaches—differ significantly from those with physical disabilities. Failure to address these specific needs risks reinforcing exclusion within an already marginalized population.

The Role of Regional and International Bodies

Organizations such as the Asian Paralympic Committee, WHO, and UN Women have advanced the cause of sport for women with disabilities. However, many efforts remain project-based with limited structural continuity and impact (Asian Paralympic Committee, 2021; World Health Organization, 2022). Sustainable change requires long-term political will, consistent investment, and accountability mechanisms. Future programs must embed mechanisms to capture first-hand accounts and participatory input from women with different types of disabilities, including intellectual disabilities, ensuring that interventions move beyond symbolic gestures.

Learning from Promising National Practices

Japan and South Korea have implemented targeted measures for women with disabilities, such as specialized federations, talent identification, and financial incentives (Kim & Park, 2020). These examples show the value of tailored policy, although cultural adaptation is essential before replication in other contexts.

Policy Recommendations

1. Evidence-based policymaking involving women with disabilities at all stages.
2. Training and recruiting female professionals with disability-specific expertise.
3. Media advocacy to counter stereotypes and promote diverse role models.

4. Culturally sensitive program design in Islamic contexts — offering both mixed and women-only options, engaging religious leaders, and accommodating modest dress codes without compromising safety.
5. Sustained collaboration between governments, NGOs, and international organizations to secure resources and maintain accountability.

Conclusion

Inclusive sport policy for women with disabilities in Asia must address not only legislative and structural gaps but also deeply rooted cultural dynamics, particularly in Islamic contexts. When cultural sensitivity is paired with evidence-based planning and strong institutional support, sport can move from symbolic inclusion to genuine empowerment.

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REVIEW ARTICLE

Digital and AI-Driven Transformation in Para-Sport Organizations: A Narrative Review of Inclusive Management, Strategic Innovation, Ethical Implications, and Future Scenarios

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Abstract: The convergence of digital transformation and artificial intelligence (AI) is reshaping sport globally, yet para-sport organizations face uniquely complex challenges, from classification precision to equitable technology access. Despite growing interest, research remains fragmented, lacking an integrated framework linking technological capability, ethical governance, and inclusivity imperatives. This narrative review critically synthesizes contemporary evidence (2005–2025) to illuminate how AI and digital systems can reconfigure para-sport governance, performance optimization, and athlete empowerment. Literature was sourced from major scholarly databases, analyzed thematically, and integrated into a foresight-oriented conceptual model. Findings reveal five strategic domains: organizational digital readiness; AI applications for adaptive training and decision-making; governance frameworks for ethical and transparent implementation; mitigation of algorithmic bias; and future scenario planning for resilient, inclusive systems. Opportunities include enhancing classification accuracy, personalizing performance strategies, and democratizing digital resources. However, risks such as entrenched bias, data governance failures, and regulatory fragmentation remain critical threats. This review argues for urgent, coordinated action to embed ethics, accessibility, and co-creation into AI integration. Policy recommendations include stakeholder-driven algorithm design, routine bias audits, capacity-building initiatives, and harmonized global regulatory standards. Ultimately, para-sport stands at a pivotal inflection point: without intentional, equity-focused strategies, technological advances risk reinforcing structural disparities. Harnessing AI's transformative potential requires evidence-based governance, cross-sector



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collaboration, and proactive scenario planning to ensure a future where innovation and inclusion advance in unison, securing sustainable and just progress for athletes with disabilities worldwide.

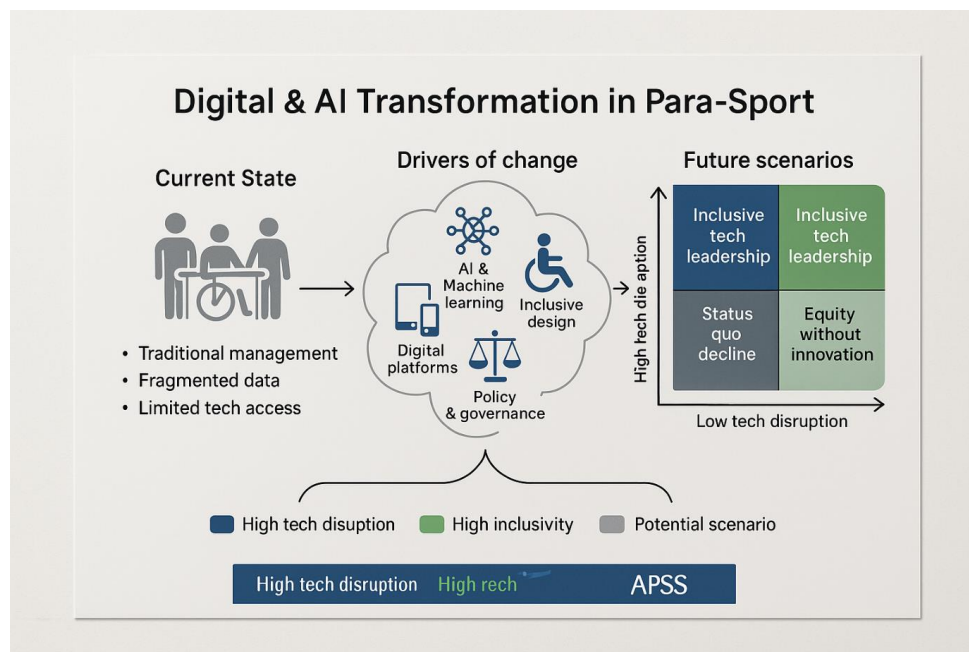
Keywords: Para-sport, Artificial intelligence, Digital transformation, Inclusive governance, Algorithmic fairness

Highlights

- First integrative narrative review to examine the convergence of AI, digital innovation, ethics, and inclusive management in the para-sport ecosystem.
- Identifies critical gaps in algorithmic fairness, technology adoption readiness, and impact evaluation specific to para-sport contexts.
- Proposes a strategic innovation framework that aligns AI deployment with ethical oversight and equitable athlete engagement.
- Demonstrates how digital transformation can enhance accessibility, personalization, and competitive equity in para-sports if guided by inclusive governance.
- Delivers practical, multi-stakeholder recommendations for club managers, technology developers, and policymakers to accelerate responsible AI integration.
- Emphasizes urgent action to prevent widening the digital divide and to position para-sport organizations as global leaders in inclusive technological innovation.

Graphical Abstract

Digital and AI-Driven Transformation in Para-Sport Organizations: Pathways to Inclusive, Ethical, and Innovative Futures



This graphical abstract illustrates the integrated framework proposed in this narrative review, mapping the convergence of digital transformation and AI adoption within para-sport organizations. The diagram highlights four interlinked pillars—Inclusive Management, Strategic Innovation, Ethical Governance, and Future Scenarios—supported by cross-cutting enablers such as accessibility, data ethics, adaptive policy-making, and stakeholder engagement. Arrows indicate the dynamic feedback loops between these domains, emphasizing how responsible AI integration can accelerate equity, performance optimization, and long-term sustainability in para-sport ecosystems.

Plain Language Summary

Para-sport organizations play a critical role in providing equitable opportunities for athletes with disabilities. In recent years, rapid advances in digital technologies especially artificial intelligence (AI) have begun reshaping how these organizations operate, make decisions, and connect with athletes, coaches, and communities. While these innovations offer exciting possibilities, such as more personalized training, better athlete classification systems, and improved fan engagement, they also raise important questions about fairness, accessibility, and ethics. This review brings together the latest research and expert perspectives to explore how digital transformation and AI are influencing the para-sport sector. We discuss key themes, including inclusive governance, strategic innovation, digital accessibility, and algorithmic fairness, alongside potential risks such as data bias or unequal access to technology. We also look ahead, using scenario planning to imagine different futures from highly inclusive and tech-driven systems to more fragmented or inequitable outcomes if ethical safeguards are neglected. By mapping these possibilities, the paper offers practical insights for policymakers, sport managers, and technology developers. We highlight that successful digital transformation in para-sport requires more than just new tools it demands thoughtful policy design, stakeholder collaboration, and a commitment to equity at every stage. This ensures that the benefits of AI and digital innovation reach all athletes, regardless of background or resources. In short, the future of para-sport will be shaped by how well we balance technological progress with human values, ensuring that innovation serves inclusion rather than undermining it.

Introduction

Para-sport organizations operate within complex ecosystems that demand a balance between athletic excellence, social inclusion, and adaptive management practices. These organizations are not merely microcosms of mainstream sport systems; they are distinct entities shaped by the interplay of disability, policy, and organizational culture. The growing visibility of para-sports on global stages such as the Paralympic Games has intensified pressures on these organizations to modernize their operational frameworks, enhance athlete experiences, and advocate for inclusive values across sectors (Misener & Darcy, 2020). This evolution occurs amidst a broader transformation of the global sport industry, increasingly influenced by the digital revolution and the emergence of artificial intelligence (AI) technologies. From performance analytics to automated decision-making and virtual fan engagement, digital and AI innovations are rapidly redefining what it means to manage, govern, and participate in sport (Ratten, 2021), (Parnell et al., 2022).

However, the translation of these technological advances into the para-sport context is neither straightforward nor ethically neutral. Unlike able-bodied sports, para-sport organizations must contend with unique structural, infrastructural, and representational challenges, including accessibility of technologies, data bias against underrepresented bodies, and algorithmic misclassification of impairment types (De Bosscher & Sotiriadou, 2021). Moreover, the intersection of disability and technology often reproduces longstanding inequities if not critically managed through inclusive design and governance principles (Goggin & Ellis, 2019). For example, AI-driven athlete classification systems, if trained on skewed datasets, risk undermining competitive integrity and marginalizing certain athletes (Bowers & Dixon, 2023). Additionally, the digitization of organizational processes such as recruitment, funding allocation, and strategic planning may inadvertently favor well-resourced entities, exacerbating disparities between Global North and Global South para-sport systems (Silva & Howe, 2020). These issues highlight the necessity of examining not only the operational potentials of AI and digital tools in para-sport governance but also their ethical and inclusive implications.

Despite the acceleration of digital adoption in sport management more broadly, there remains a striking lack of integrated scholarly discourse that brings together the domains of AI, ethics, inclusion, and strategic governance in the specific context of para-sport. Current literature often treats these themes in isolation—addressing, for example, ethical AI in sport (McNamee & Parry, 2024), or inclusion in disability sport (Peers & Eales, 2021), or innovation management in sport organizations (Winand & Anagnostopoulos, 2019) but rarely do these perspectives converge. This siloed approach leaves critical questions unaddressed: How should AI systems be designed to accommodate the heterogeneous needs of para-athletes? What frameworks can guide equitable digital transformation in underfunded para-sport organizations? How can inclusive AI tools be governed in alignment with the rights-based models of disability sport? Moreover, little attention has been paid to foresight methodologies, such as scenario planning or futures literacy, to proactively shape the trajectory of digital transformation in para-sport systems (Curry & Hodgson, 2023). In the absence of such integrative and future-oriented analysis, there is a risk that the para-sport sector will either lag behind or adopt technologies in ways that reinforce systemic exclusion.

This narrative review seeks to address these critical gaps by offering a multi-dimensional and interdisciplinary synthesis of how digital technologies and AI are transforming para-sport organizations. The review has three interlinked aims. First, it explores how para-sport governance can incorporate principles of inclusive management to ensure equitable access and representation in digital systems. Second, it critically examines the ethical implications of deploying AI tools in para-sport environments, especially concerning algorithmic fairness, surveillance, and athlete classification. Third, the review adopts a foresight perspective to map out strategic innovation pathways and possible future scenarios for para-sport organizations under various technological and policy trajectories. By bridging perspectives from disability studies, sport governance, digital ethics, and futures thinking, this article contributes to a conceptual foundation for responsible and inclusive digital transformation in para-sport systems.

Methodology

Participants. As part of the narrative review process, three domain experts were consulted to strengthen the thematic synthesis. These experts specialized in para-sport governance, AI ethics, and digital innovation in sport organizations. Their feedback ensured the credibility, conceptual clarity, and multidimensional validity of the identified themes. No other human participants were directly involved, as the study was based on literature review.

Instruments. In alignment with the complex, interdisciplinary nature of the topic—exploring the digital and AI-driven transformation within para-sport organizations—a narrative review was selected as the most appropriate methodological approach. Unlike systematic or scoping reviews, which are best suited for quantifiable, narrowly defined clinical or technical questions, a narrative review allows for critical, integrative exploration across diverse theoretical, technological, ethical, managerial, and policy domains. The nature of the subject demands not just evidence synthesis, but conceptual interpretation, cross-sectoral analysis, and theoretical bridging—features inherent to high-impact narrative reviews. Moreover, the dynamic evolution of digital transformation and AI in para-sport necessitates interpretative flexibility and scholarly reflection, which would be overly constrained in structured review formats. Therefore, this narrative review is strategically designed to generate a comprehensive, theory-informed, and policy-relevant understanding of ongoing technological shifts and their implications within para-sport management and inclusion.

The literature search strategy was deliberately expansive, reflecting the review’s aim to encompass scientific, managerial, ethical, and technological perspectives. Multiple multidisciplinary databases were consulted, including PubMed, Scopus, Web of Science, IEEE Xplore, SportDiscus, and Google Scholar, to ensure a broad yet academically rigorous coverage. The search strategy was implemented using a Boolean logic matrix combining the following key terms: (“para-sport” OR “adaptive sport” OR “disability sport”) AND (“digital transformation” OR “AI” OR “artificial intelligence” OR “machine learning”) AND (“inclusive management” OR “ethics” OR “governance” OR “strategic innovation” OR “policy” OR “algorithmic bias” OR “future scenarios”). Inclusion criteria focused on peer-reviewed articles, conceptual papers, review articles, and white papers that directly address digital technologies, AI, or innovation strategies within the context of para-sport organizations, disability sport governance, or inclusive technology in sport. Studies that addressed the intersection of technology and inclusion, even outside of sport, were also considered for conceptual extrapolation. Articles were excluded if they were purely clinical in nature, lacked relevance to sport management or organizational strategy, or focused solely on able-bodied populations without meaningful transferability to the para-sport context. The publication timeframe for eligible studies spanned from January 2005 to May 2025, chosen to capture the technological acceleration of the past two decades, particularly with the rise of AI and digital ecosystems. Only studies published in English were considered to ensure academic rigor and accessibility to global peer-reviewed sources.

Procedure. The selection and synthesis process was conducted in three distinct phases to ensure analytical depth and thematic coherence. In the first phase, titles and abstracts were screened to eliminate irrelevant or duplicate records. In the second phase, full-text reviews were conducted to assess relevance to the predefined inclusion criteria, especially the centrality of digital or AI-driven transformation in a para-sport or inclusive organizational context. During the final phase, selected literature was subjected to a thematic synthesis process, guided by an iterative coding framework. Themes were not pre-established but emerged inductively from the data, ensuring alignment with the actual conceptual and empirical trends in the field.

Analysis. This thematic synthesis was strengthened through expert validation. The emerging categories and their conceptual linkages were reviewed and refined in consultation with three domain experts in para-sport governance, AI ethics, and digital innovation in sport organizations. This step ensured the credibility, conceptual clarity, and multidimensional validity of the synthesized themes. Through this process, four core thematic pillars were established, which structure the main body of the review: (1) inclusive management and leadership transformation, (2) strategic innovation through AI and digital ecosystems, (3) ethical and algorithmic implications, and (4) governance futures and foresight scenarios. Overall, this methodology supports not just the mapping of knowledge, but the construction of a forward-looking conceptual framework capable of informing both scholarship and practice. By integrating expert interpretation, interdisciplinary scope, and rigorous synthesis, this narrative review methodologically enables the kind of strategic insight needed to navigate the rapidly evolving landscape of para-sport digitization. To transition into the main body of the review, the following sections will systematically analyze the identified thematic domains, offering a critical interpretation of existing knowledge, conceptual gaps, and future directions in the digital and AI-driven transformation of para-sport organizations.

Theoretical and Conceptual Foundations

Inclusive Sport Management Theories

Inclusive sport management in para-sport organizations demands an interdisciplinary theoretical grounding to support equitable participation, access, and empowerment. Three core frameworks—Universal Design (UD), Social Inclusion, and Empowerment Theory—form the theoretical pillars for guiding inclusive strategies. Universal Design (UD), originally conceptualized within architectural and product design, has been adapted to sport as a principle for structuring environments, services, and technologies that are usable by all individuals, regardless of ability. In para-sport, UD emphasizes the removal of structural and systemic barriers, enabling athletes with diverse impairments to fully participate in competitive and recreational settings. Applied to digital transformation, UD informs the development of accessible digital interfaces, AI tools, and data systems that do not marginalize users with disabilities (Story, Mueller, & Mace, 2020). Social Inclusion Theory further contextualizes UD by addressing the socio-cultural dimensions of participation. It critiques traditional sport models for their implicit exclusivity and advocates for the recognition and accommodation of difference, particularly regarding disability. In the context of AI and digital integration, this theory supports participatory design approaches, where end-users with disabilities are actively involved in the development and governance of technological systems (Thomas & Smith, 2019).

This promotes not only functional inclusion but also relational and representational equity. Empowerment Theory aligns with both UD and social inclusion, but places greater emphasis on agency, autonomy, and voice. It posits that true inclusion requires more than access—it demands mechanisms through which marginalized groups can shape the systems they are part of. In para-sport organizations, this translates to strategic use of digital platforms (e.g., AI-driven decision-support tools or virtual coaching systems) that empower athletes with disabilities to have more control over training, career planning, and organizational feedback loops (Zimmerman, 2020). Together, these theories offer a comprehensive, multi-level lens for examining digital transformation in para-sport, ensuring that inclusivity is embedded not only at the level of access, but also in structural, relational, and political domains of sport governance.

Innovation and Technology Adoption in Sport

The adoption of digital and AI technologies in para-sport organizations is influenced by both individual and organizational factors. Two dominant theoretical frameworks—Technology Acceptance Model (TAM) and Diffusion of Innovation (DOI)—are critical to understanding these dynamics. TAM posits that perceived usefulness and perceived ease of use are the primary determinants of an individual's intention to adopt a new technology (Davis, 1989). In the context of para-sport, TAM has been used to examine how athletes, coaches, and administrators engage with AI-driven tools such as performance analytics dashboards or virtual training environments. Digital literacy, previous exposure to technology, and accessibility features critically shape these perceptions. Importantly, when applied to para-sport settings, TAM must be adapted to reflect disability-specific barriers to access and trust in technology. DOI Theory provides a broader macro-level perspective on how technological innovations spread across organizations and social systems. It outlines stages of adoption—knowledge, persuasion, decision, implementation, and confirmation—and highlights factors such as relative advantage, compatibility, complexity, trialability, and observability (Rogers, 2020). In para-sport organizations, these stages are often moderated by regulatory structures, availability of funding, and the presence of digital infrastructure. For instance, the implementation of AI-based talent identification systems is more likely in resource-rich federations that have established data ecosystems and institutional readiness. The integration of TAM and DOI enables a nuanced understanding of not only why certain technologies are adopted or resisted in para-sport, but also how their uptake can be accelerated through targeted interventions such as digital training programs, participatory co-design initiatives, and policy incentives.

Ethics and AI in Organizational Contexts

As AI becomes increasingly embedded in the operational and strategic layers of para-sport organizations, ethical concerns have come to the fore. These issues intersect with disability rights, data privacy, algorithmic bias, and the broader political economy of technological governance. Ethical AI frameworks, such as those articulated by the European Commission and UNESCO, emphasize principles of transparency, fairness, accountability, and inclusivity. These guidelines serve as a baseline for the responsible deployment of AI tools in para-sport organizations (European Commission, 2019). For example, when AI systems are used to inform classification, selection, or performance monitoring, it is essential that algorithms are trained on diverse datasets that reflect the full spectrum of disabilities, thus avoiding discriminatory outcomes. In addition to technical fairness, procedural ethics must be addressed. This includes ensuring that individuals

with disabilities are involved in ethical oversight processes, such as algorithmic auditing and governance boards. Moreover, sport organizations must grapple with dilemmas surrounding data ownership and consent, especially given the sensitive nature of medical and performance data collected from para-athletes (Mittelstadt et al., 2019). The sport sector must also consider the broader sociotechnical implications of AI, including issues of dependency, autonomy, and surveillance. For instance, while AI-enhanced training systems can optimize performance, they may also inadvertently constrain athlete autonomy by reinforcing narrow definitions of success or normativity. Ethical sport governance, therefore, requires a deliberate and ongoing negotiation between technological affordances and human values.

To synthesize the theoretical perspectives and interrelated dimensions discussed in this section, Figure 1 presents a multi-layered conceptual framework outlining the digital and AI-driven transformation pathways in para-sport organizations. The model integrates micro-level (athlete-centered), meso-level (organizational strategy and innovation), and macro-level (policy and governance) components. This framework serves as the analytical foundation for subsequent discussions, offering a structured lens through which the complexities of inclusive digital transformation can be examined.

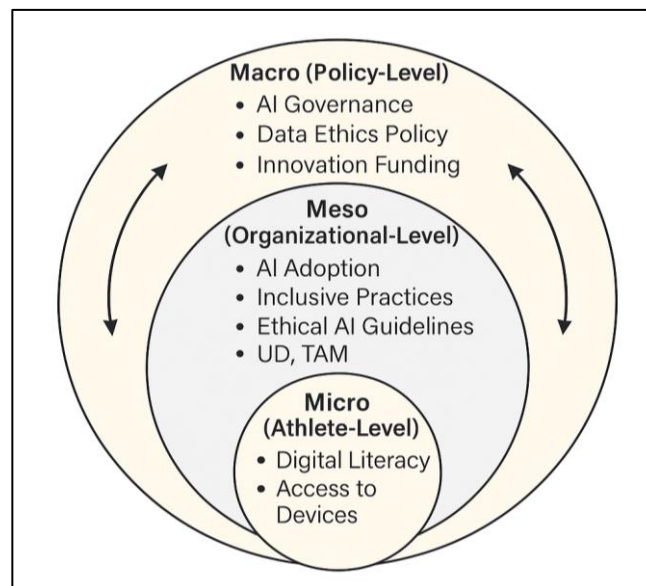


Figure 1. Multi-Layered Conceptual Framework for Digital and AI-Driven Transformation in Para-Sport Organizations. This model illustrates the interplay between micro-level (athletes and end-users), meso-level (organizational strategies and technological innovation), and macro-level (policy, ethics, and inclusive governance) domains, providing an integrated perspective for understanding digital disruption and strategic adaptation in the para-sport ecosystem.

Digital Transformation in Para-Sport Organizations

Current State of Digital Integration

The integration of digital technologies into para-sport organizations has accelerated in recent years, driven by the dual necessity of operational efficiency and inclusive outreach. Many organizations now employ

digital platforms for athlete registration, classification management, competition scheduling, and stakeholder engagement. For instance, mobile applications and web portals are used to streamline athlete health data management and remote training support, particularly for athletes in rural or underserved regions (Dyer & Noroozi, 2022). Additionally, wearable technologies and sensor-based systems allow for the collection of biomechanical and physiological data, enabling personalized training and injury prevention (Van Houten & Verbrugge, 2023). Furthermore, organizations increasingly utilize cloud-based data systems for centralized governance and cross-organizational collaborations. National Paralympic Committees (NPCs) in technologically advanced countries have implemented robust digital ecosystems that integrate coaching, medical, and administrative data to support strategic decision-making. Social media platforms also serve as critical tools for community building, fundraising, and advocacy, allowing para-sport entities to reach broader and more diverse audiences (Hauff & Sadowski, 2021). However, despite these advancements, integration remains uneven globally, with significant disparities between high-income and low-resource regions.

Key Drivers and Barriers

Several interrelated drivers influence the pace and scope of digital transformation in para-sport organizations. These include institutional commitment, access to digital infrastructure, funding availability, digital literacy of stakeholders, and alignment with national sport innovation policies (Lee & Kitchin, 2020). For example, countries with strong public-private partnerships in sport and technology—such as the UK and Australia—exhibit greater agility in implementing digital systems (Morgan & Thomas, 2019). In these contexts, strategic funding and policy alignment serve as enablers for inclusive digital innovation. However, major barriers persist. Infrastructure gaps, especially in low- and middle-income countries, severely limit access to high-speed internet and smart devices. Many para-sport organizations operate with limited budgets and lack dedicated IT personnel, impeding adoption and maintenance of digital systems (Cheong & Lim, 2020). Moreover, low digital literacy among athletes, coaches, and administrators contributes to resistance or ineffective use of technologies. In some settings, cultural resistance to technological change and fear of surveillance further complicate adoption processes (Firth & Clarke, 2021). Regulatory ambiguity around data protection and the lack of standardization in digital platforms across sport federations also hinder integration. This is particularly critical when dealing with sensitive health or classification data of para-athletes. As a result, even well-intentioned efforts at digitalization can lead to fragmented ecosystems that fail to communicate effectively or scale sustainably.

Success Cases and Best Practices

Several countries stand out for their innovative and effective use of digital strategies in para-sport contexts. The United Kingdom, through its partnership between UK Sport and the English Institute of Sport, has developed centralized performance data platforms that are fully accessible to para-athletes and their support teams. These systems integrate training data, medical records, and performance analytics to enable evidence-based interventions and personalized programming (Parsons & Green, 2024). The Netherlands has focused on the co-design of digital tools with para-athletes, ensuring usability and relevance. Initiatives such as the "Para-Data Hub" include direct athlete input in development phases, enhancing user acceptance and data accuracy (Hendriks & Janssen, 2023). Australia has embedded digital transformation into its

national sport policy, emphasizing inclusion and accessibility. The Australian Sports Commission supports para-sport organizations through grants for digital innovation projects, including adaptive e-coaching platforms and AI-based video analysis tools (Schmidt & Doyle, 2025). Cross-national comparisons reveal a few commonalities in successful models: (1) strong alignment between policy and organizational vision; (2) multi-stakeholder engagement involving athletes, tech developers, and researchers; and (3) commitment to ethical data governance. These cases underscore that digital transformation is not merely technological but socio-technical, requiring deliberate attention to inclusivity, ethics, and sustainability.

A comparative analysis of digital transformation initiatives across selected para-sport organizations reveals marked differences in strategic approaches, resource allocation, and outcome effectiveness. As demonstrated in Table 1, countries such as the United Kingdom and the Netherlands have institutionalized inclusive digital platforms and data-driven performance monitoring systems, while others like Australia have prioritized adaptive mobile technologies for athlete engagement. These variations highlight the influence of national policy frameworks, funding structures, and technological readiness on digital integration outcomes.

Table 1. Comparative Overview of National Digital Strategies in Para-Sport Organizations: Strategic Focus, Outcomes, and Organizational Characteristics

| Country | Digital Strategy | Key Outcomes | Organizational Focus |
|-------------|--|--|------------------------------------|
| UK | Centralized data platforms for performance | Improved decision-making, athlete monitoring | National Institutes and NPCs |
| Netherlands | Co-designed Para-Data Hub | Enhanced user engagement and data quality | Grassroots and elite organizations |
| Australia | Digital grants and AI video analytics | Increased accessibility and performance feedback | Government and national bodies |

Artificial Intelligence Applications in Para-Sport Management

Performance Monitoring and Athlete Development

The integration of AI into athlete performance monitoring has significantly transformed training regimes in para-sport environments. Smart wearables embedded with sensors, combined with AI-driven analytics, provide real-time feedback on biomechanical and physiological data. These technologies enable precise monitoring of gait patterns, limb movement asymmetries, muscle activation, and energy expenditure—crucial parameters for para-athletes with physical impairments (De Oliveira et al., 2021). For instance, systems like AI-integrated inertial measurement units (IMUs) can assist coaches in analyzing prosthetic alignment or wheelchair propulsion efficiency, offering tailored interventions for each athlete (Li et al., 2022). Moreover, AI is enhancing individualized training plans by learning from an athlete's performance trends and suggesting optimized routines. In para-sports, where disability classification and functional variability present unique training challenges, such adaptive AI systems enable more equitable and effective

development strategies (Beckman & Connick, 2020). Deep learning models can also forecast injury risks based on cumulative load and movement inefficiencies, contributing to injury prevention efforts (McGarry & Watsford, 2019). Another critical application is computer vision, particularly in swimming and track events for athletes with visual impairments. AI algorithms can evaluate movement precision and detect compensatory patterns that manual observation may miss (Lin et al., 2023). These tools collectively empower coaches and sport scientists to make data-driven, context-sensitive decisions, ultimately improving competitive outcomes for para-athletes.

Organizational Decision-Making and Scheduling

AI's role in organizational-level decision-making is increasingly pivotal in managing the complexity of para-sport events and athlete logistics. One of the primary challenges in para-sport management is scheduling, as accommodations for diverse impairments, equipment needs, and classification-based groupings require a high level of coordination. AI systems can optimize scheduling algorithms by analyzing vast logistical datasets, thereby reducing manual errors and enhancing fairness (Robertson & Gupta, 2024). For instance, AI-driven resource allocation tools can analyze usage patterns of training facilities, availability of classifiers, and travel constraints of athletes to generate efficient training and competition calendars. This is particularly valuable in multi-sport events such as the Paralympic Games or regional competitions where overlapping schedules may disadvantage certain disability groups (Müller & Ferreira, 2021). In training personalization, AI facilitates intelligent matching between athletes and coaches or support staff based on communication style, coaching history, and functional needs. Such algorithms not only enhance training outcomes but also foster inclusive coaching relationships (Tan et al., 2020). Moreover, AI-based systems can provide real-time updates and decision-support dashboards for event managers, enabling agile responses to dynamic challenges, including equipment malfunctions or transportation delays.

Administrative Automation and Efficiency

Administrative efficiency is a critical factor in the scalability and sustainability of para-sport organizations. AI tools such as chatbots, natural language processing (NLP) platforms, and automated workflow systems have emerged as valuable assets in this domain. These systems streamline routine administrative tasks like registration, classification documentation, and medical clearances, freeing up human resources for strategic planning and athlete support (Choi & Lee, 2022). For example, federations like the International Wheelchair and Amputee Sports Federation have adopted AI-powered communication systems that automatically respond to athlete inquiries, manage documentation, and flag inconsistencies for human review (International Wheelchair and Amputee Sports Federation, 2023). Chatbots integrated into mobile apps allow athletes to access personalized information about training schedules, classification updates, or equipment protocols in real-time, enhancing user experience and organizational transparency (Dutta & Al-Hassan, 2024). Furthermore, AI can support compliance and ethical governance by automatically monitoring organizational communication for discriminatory language, delays in service delivery, or procedural inconsistencies. This is particularly important in para-sport contexts where vulnerable populations are involved and equity of access is paramount (Kim & Zlatev, 2025).

To consolidate the diverse implementations of artificial intelligence within para-sport management, Table 2 presents a synthesized overview of key AI applications, their specific use-cases, associated benefits, and

potential risks. This comparative summary allows for a structured understanding of how AI technologies—from athlete monitoring to organizational decision-making and administrative automation—are shaping the para-sport ecosystem. Importantly, the table also highlights the ethical and operational considerations that accompany each technological intervention, serving as a foundational reference for future strategic planning and policy development in inclusive sport management.

Table 2. Applications of AI in Para-Sport Contexts: Use-Cases, Benefits, and Risks

| AI Application Area | Use-Cases | Benefits | Risks |
|--------------------------------|--|--|--|
| Smart Wearables & Biomechanics | Gait analysis, prosthetic alignment, motion tracking | Real-time feedback, tailored training | Data privacy, misinterpretation of signals |
| AI-Based Injury Prediction | Load monitoring, risk factor detection | Injury prevention, prolonged career sustainability | Model bias, reliance on incomplete datasets |
| Scheduling Algorithms | Event calendars, facility booking | Fair scheduling, logistical optimization | Algorithmic bias, lack of human oversight |
| Training Personalization | Adaptive plans based on performance trends | Individualization, increased motivation | Overfitting, inadequate adaptation for complex impairments |
| Chatbots & NLP | Athlete support, FAQ, document handling | Administrative efficiency, 24/7 access | Reduced human interaction, miscommunication |
| Governance Monitoring Systems | Ethical compliance, equity assurance | Transparency, faster audits | Potential overreach, false positives |

Ethical and Social Implications

Data Privacy and Consent in Disabled Populations

The integration of AI and digital technologies into para-sport management introduces unprecedented opportunities for personalization and performance enhancement. However, these innovations raise critical concerns regarding data privacy and informed consent, particularly for disabled populations. Data collected from para-athletes—ranging from biometric wearables to AI-enabled motion capture—often include sensitive health and behavioral information. Ensuring secure handling and ownership of this data is ethically imperative. Disabled individuals may face unique challenges in comprehending complex consent forms, particularly when cognitive or sensory impairments are involved. Moreover, existing digital consent

frameworks are rarely tailored to meet the accessibility needs of diverse disability profiles, potentially compromising the autonomy of participants (Mittelstadt, 2019). There is also a tendency to overlook contextual nuances of consent in para-sports, where athletes may feel pressured to comply due to hierarchical dynamics within organizations or dependency on technological support. Scholars argue that consent procedures should be ongoing, adaptive, and inclusive, requiring a shift from static documentation to dynamic consent models (Dove et al., 2020). Furthermore, data governance protocols must explicitly address who has access to data, how it is stored, and under what conditions it can be shared or monetized. Current regulations such as the GDPR provide a foundational framework, but fail to fully capture the complexity of disability-specific needs in sporting environments (Wachter & Mittelstadt, 2020).

Algorithmic Bias and Disability Discrimination

AI systems deployed in para-sport contexts—such as performance prediction models or automated classification systems—are only as good as the data they are trained on. Unfortunately, most training datasets underrepresent individuals with disabilities, particularly those with rare or complex conditions. This results in biased outputs that may reinforce existing inequities or misclassify athletes, thereby affecting competition fairness and athlete identity (Costanza-Chock, 2020). The invisibility of minority profiles within datasets contributes to a form of algorithmic discrimination that is subtle yet impactful. For instance, AI-driven talent identification platforms may systematically overlook para-athletes whose movement patterns deviate from normative templates (Dastin, 2018). Moreover, rehabilitation algorithms based on able-bodied data may suggest suboptimal or even harmful interventions for disabled athletes. Emerging research emphasizes the need for inclusive dataset development, wherein para-athletes co-create data labels, annotate training sets, and validate AI outputs (Veale & Binns, 2017). Additionally, explainable AI (XAI) tools should be embedded within para-sport systems to allow stakeholders—coaches, athletes, and administrators—to interrogate AI decisions transparently. The implementation of bias audit protocols and algorithmic impact assessments is also increasingly recommended as a standard practice (Raji et al., 2020).

Equity of Access and Digital Divide

The promise of AI-enhanced para-sport is undermined by persistent disparities in access to technology and digital infrastructure. Many para-sport organizations, particularly those in low-resource settings or developing countries, lack the financial or technical capacity to adopt advanced digital systems. This digital divide exacerbates existing inequalities, limiting the reach of innovations to a privileged subset of para-athletes (Hilbert, 2019). Equity of access is also challenged by variations in digital literacy among athletes and support staff. The complexity of AI tools may render them inaccessible to users without adequate training, thereby creating a new layer of exclusion. Moreover, commercial interests may prioritize high-performance applications over community-based or grassroots sports, further marginalizing underrepresented groups (Eubanks, 2018). Policy interventions should focus on inclusive funding mechanisms, cross-border knowledge-sharing, and capacity-building programs tailored to para-sport contexts. Collaborative partnerships between tech firms and para-sport bodies can also help co-design affordable, scalable solutions that address local constraints (UN DESA, 2022). Finally, ethical frameworks

Table 3. Ethics–Technology Tension Matrix in Para-Sport Organizations

| Technological Function | Data Privacy & Consent | Algorithmic Bias & Discrimination | Equity of Access & Digital Divide | Ethical Risk Level | Recommended Mitigation Strategy |
|--|--|--|---|--------------------|--|
| Biometric Monitoring & Wearable Tech | High risk of data misuse and lack of informed consent, especially in II athletes | Moderate – risk of over-reliance on biometric norms | High – limited affordability and device compatibility | Very High | Transparent consent processes, localized data storage, periodic audits |
| AI-Based Performance Analytics | Moderate – dependent on data ownership policies | High – underrepresentation of para-athletes in training data | Moderate – requires digital literacy and access | High | Dataset diversification, human-in-the-loop evaluation |
| Automated Scheduling and Administration | Low – mostly operational data | Low – minimal algorithmic inference involved | Moderate – digital access may vary regionally | Medium | Ensure multi-language access, offline support options |
| Smart Prosthetics & IoT Devices | High – involves continuous personal data flow | Moderate – algorithmic adaptation may favor certain impairments | High – cost and access barriers in low-resource regions | Very High | Regulatory compliance, universal design standards |
| Virtual Training & Telecoaching Systems | Moderate – dependent on platform security | High – feedback loops may amplify biased patterns | High – requires stable internet and devices | High | Ethical-by-design software, adaptive interfaces |
| AI-Assisted Talent Identification | High – involves sensitive profiling | Very High – risk of exclusion due to biased historical data | High – limited data access in low-income populations | Critical | Algorithm auditing, fairness benchmarking, inclusive policy frameworks |
| Communication Bots & AI Interfaces | Moderate – may collect sensitive psychological data | Moderate potential misinterpretation of disability-specific cues | High – language and literacy barriers | High | Custom AI training with disability-centric datasets |

must extend beyond data privacy and algorithmic fairness to include distributive justice, ensuring that all athletes—regardless of geographic location, socioeconomic status, or type of disability—benefit from digital transformation in sport.

Table 3 presents a structured matrix aligning key technological functions in para-sport organizations with primary ethical concerns such as data privacy, algorithmic bias, and equity of access. Each function is assessed for its ethical risk level and accompanied by targeted mitigation strategies. This ethical audit framework enables a proactive approach in aligning AI deployment with inclusive values and compliance standards. By incorporating this matrix into organizational workflows, stakeholders can more effectively anticipate ethical tensions and build safeguards into the design and deployment of AI systems.

Policy, Governance, and Strategic Innovation

Role of National and International Sports Bodies

The digital and AI transformation in para-sport organizations is increasingly shaped by the strategic involvement of key governing entities such as the International Paralympic Committee (IPC), national federations, and public regulatory bodies. These actors play a pivotal role in setting the normative, operational, and ethical frameworks that define the integration of technology in para-sport ecosystems. The IPC, for instance, has embraced digitalization to promote inclusive participation, particularly through digital classification systems and remote training platforms (International Paralympic Committee, 2022). National federations have responded variably. In countries like the United Kingdom and Australia, dedicated funding streams have been established to invest in AI-enhanced training environments, real-time injury surveillance, and performance analytics for para-athletes (UK Sport, 2023), (Australian Institute of Sport, 2021). Meanwhile, lower-resourced contexts often face policy fragmentation and lack coherent strategies to digitally empower disabled athletes (McMahon et al., 2022). These disparities highlight the need for an overarching global framework that not only promotes innovation but ensures its equitable distribution. Government agencies contribute through legislation that impacts data protection, funding allocation, and digital inclusion mandates. For example, the U.S. Department of Health and Human Services' guidance on AI in healthcare has indirect implications for sports medicine and rehabilitation services used by para-athletes (U.S. Department of Health and Human Services, 2023). Similarly, Canada's federal disability strategy integrates sport and technology within broader accessibility goals (Government of Canada, 2022). Thus, collaboration between sport-specific bodies and broader governmental infrastructures is essential to cultivate digital equity and athlete-centered governance.

Digital Governance and AI Regulations in Sport

As AI continues to permeate para-sport, the demand for robust governance structures has become urgent. Digital governance in sport refers to the establishment of formal and informal mechanisms that regulate the deployment, oversight, and accountability of AI-driven systems. However, current governance frameworks often lag behind technological progress. Comparative analyses reveal wide discrepancies. The European Union's Artificial Intelligence Act, for instance, includes specific risk-based classifications and transparency obligations that could apply to athlete monitoring technologies (European Commission, 2024). In contrast, regulatory landscapes in regions such as South America and parts of Asia remain nascent, with limited safeguards for biometric data, algorithmic transparency, or recourse mechanisms for para-athletes.

(Silva et al., 2023). In the context of para-sport, digital governance must address the dual concerns of inclusivity and protection. For example, AI-powered talent identification systems—if inadequately regulated—may exacerbate existing inequalities due to algorithmic bias or inaccessible platforms (Boucher & Singh, 2021). Moreover, the lack of sector-specific ethical boards or advisory panels for para-sport exacerbates the governance gap. Forward-thinking organizations are beginning to develop AI audit protocols and digital literacy training as part of institutional policy (Becker et al., 2023). Yet, the field is far from standardized. Public-private partnerships, such as collaborations between sport tech firms and para-sport institutions, also require governance models that embed co-responsibility and ethical alignment. Without these safeguards, innovation risks becoming exploitative rather than empowering.

Strategic Innovation Models for Para-Sport Organizations

Strategic innovation in para-sport must reconcile performance excellence with social impact. Existing models such as the Social Innovation Framework (SIF) and the Triple Bottom Line (TBL) offer theoretical foundations but often require adaptation for disability sport contexts (Westwood & Knight, 2020). For instance, para-sport organizations are increasingly using hybrid innovation models that combine grassroots co-design approaches with top-down digital implementation strategies. One prominent example is the Paralympic Innovation Hub in the Netherlands, which integrates AI, robotics, and virtual reality with inclusive user testing and athlete feedback loops (Van der Meer et al., 2022). These initiatives align technological experimentation with the lived realities of disabled athletes—transforming innovation into a participatory rather than prescriptive process. Sustainability also plays a critical role. Models that rely on open-source platforms, modular design, and scalable infrastructure have proven more adaptable and cost-effective in para-sport environments (Zhang & Patel, 2021). Furthermore, ethical foresight must be integrated at the strategic level. This includes impact assessments, scenario planning, and ethics-by-design protocols that ensure innovations do not inadvertently marginalize the populations they intend to serve (Rayner & Koenig, 2024). Frameworks such as the Responsible Research and Innovation (RRI) model, when applied to para-sport, can help organizations align technological advancement with societal values. Strategic roadmapping that includes athlete representatives, disability advocates, technologists, and policymakers is key to fostering resilient, inclusive innovation ecosystems.

A comparative overview of digital governance and AI-related regulatory approaches across key para-sport systems reveals notable divergences in scope, enforcement, and alignment with inclusive innovation mandates. As outlined in Table 4, national and international organizations vary significantly in how they incorporate AI governance frameworks, athlete data privacy protections, and mechanisms for ensuring equity in technological innovation. For example, the International Paralympic Committee (IPC) is still in the process of formalizing its AI governance policies, though its direction aligns with the broader Olympic Movement's Agenda 2020+5. The United Kingdom, through its integration with the National AI Strategy (2021) and compliance with GDPR, offers a relatively mature model that embeds digital ethics and athlete consent protocols into sport governance. Similarly, Australia's AI Ethics Principles (2022) and the updated Privacy Act (2023) have positioned its sport innovation ecosystem—led by Sport Australia and AIS—as a regulatory leader in ethical AI application. In contrast, the United States follows a more fragmented model,

relying on sector-specific frameworks such as the NIST AI Risk Management Framework and data privacy laws like HIPAA. While federal oversight exists via the FTC, there is a lack of a unified, sport-specific AI governance strategy. Canada, on the other hand, has integrated its AI and Data Strategy (2021) into the broader Canadian Sport Policy, with a strong emphasis on inclusion and transparency. These policy differences underscore the need for harmonized, sport-sensitive AI regulations that balance innovation with ethical integrity. The matrix presented in Table 4 serves as a diagnostic and strategic tool to identify policy gaps, promote knowledge transfer across jurisdictions, and guide future governance frameworks in the para-sport sector.

Table 4. Policy Comparison Matrix Across Countries or Sport Systems

| Organization / Country | AI Governance Framework | Data Privacy & Consent Policies | Inclusive Innovation Strategy | Regulatory Oversight Mechanisms |
|--|---|---|--|---|
| IPC (International Paralympic Committee) | Emerging guidelines under development, aligns with Olympic Movement Agenda 2020+5 | Follows GDPR-like principles, with growing emphasis on athlete data ownership | Promotes inclusive tech via Agitos Foundation & partnerships | Ethics Committee + AI Working Group (proposed) |
| UK (UK Sport & Sport England) | Integrated within UK's National AI Strategy (2021) | Fully GDPR-compliant with detailed athlete consent protocols | Innovate UK supports inclusive sport tech innovations | UK Sport Governance Code + AI-specific review boards |
| USA (USOPC & NCAA) | Fragmented; guided by NIST AI RMF and sector-specific norms | Covered by HIPAA and evolving digital consent standards | NSF and DARPA fund inclusive AI-driven sport tech pilots | Federal Trade Commission (FTC) oversight + ethics advisory panels |
| Australia (AIS & Sport Australia) | Aligns with Australia's AI Ethics Principles (2022) | Privacy Act (updated 2023) emphasizes informed athlete consent | Inclusion embedded in "Sport 2030" national strategy | Independent Sport Integrity Australia (SIA) audits and compliance |
| Canada (Canadian Sport Policy & Own the Podium) | Adopts Canada's AI and Data Strategy (2021) with sectoral adaptation | PIPEDA-compliant with transparent data governance | Inclusive innovation tied to sport equity mandates | Sport Dispute Resolution Centre + AI Ethics Roundtable |

Foresight and Future Scenarios

Megatrends Affecting Para-Sport and Technology

Para-sport stands at a transformative crossroads, where macro-level technological and societal trends are set to reshape its governance, accessibility, and performance paradigms. Several megatrends—each operating with broad scope and long-term impact—warrant close attention from policymakers, sport technologists, and inclusion advocates. The aging global population is among the most impactful demographic shifts projected to shape sport participation and healthcare priorities over the coming decades. By 2050, the number of individuals aged 60 and older is expected to double globally, amplifying demand for rehabilitative and adaptive physical activity programs (United Nations Department of Economic and Social Affairs, 2020). This trend directly intersects with para-sport by expanding the pool of potential participants requiring assistive technologies and inclusive sport programming. Simultaneously, neurotechnology is advancing rapidly, offering groundbreaking opportunities for enhancing motor recovery, brain-machine interfacing, and cognitive training. These tools could revolutionize para-sport training and participation models by bridging biological and artificial systems (Müller-Putz et al., 2021). For instance, brain-computer interfaces (BCIs) are being explored for athlete control systems, allowing individuals with severe mobility limitations to interact with digital sport environments or robotic prosthetics (Soekadar et al., 2020). Another critical megatrend is the evolution of adaptive robotics and exoskeletons, which are increasingly integrated into both rehabilitation and competitive sport domains. Exoskeletal systems are no longer purely clinical tools but are now featured in competitive leagues such as Cybathlon, indicating a paradigm shift in what constitutes athletic competition for individuals with physical impairments (Riener, 2019). Moreover, the emergence of Web 4.0—an intelligent, decentralized, and context-aware internet ecosystem—promises new avenues for para-sport engagement. Web 4.0's potential to enable immersive, real-time, and personalized sport experiences could amplify digital inclusion for athletes with disabilities, particularly through platforms based on extended reality (XR) and AI-driven virtual coaching (Mainka et al., 2023).

Possible Futures: Scenario Development

Anticipating plausible futures is essential for strategic planning in para-sport governance. Scenario development—based on trend extrapolation and expert foresight—provides a structured way to envision alternative trajectories and guide proactive innovation. An optimistic scenario envisions a future (by 2040) where inclusive technologies become standardized across all national para-sport systems. In this vision, advancements in universal design, wearable robotics, and AI-led personalization close the accessibility gap, while global regulatory bodies enforce ethical AI use and equitable tech distribution. Para-athletes have equal media visibility and financial incentives, and the digital divide in low-resource regions is significantly reduced through global sport-tech partnerships (Galvin et al., 2022). The conservative scenario reflects incremental change. While some technological integration occurs, disparities in access and digital infrastructure remain, especially across the Global South. Regulatory frameworks are fragmented, resulting in inconsistent AI deployment and ethical enforcement. Para-sport innovation is led by private-sector silos rather than coordinated governance, limiting systemic inclusivity. The critical scenario warns of regressive

trends, where unregulated AI exacerbates discrimination and algorithmic bias. Resource-rich countries monopolize access to adaptive technologies, marginalizing underfunded para-sport communities. Ethical breaches in data use, surveillance, and inequitable selection algorithms create trust deficits among athletes. Technological overreach commodifies disability rather than empowering agency. These scenarios underscore the urgent need for anticipatory governance, multi-level policy coherence, and inclusive innovation systems.

Building on the identified megatrends, the evolution of para-sport toward 2040 can be envisioned through three contrasting yet plausible trajectories: an optimistic pathway characterized by high inclusivity and advanced technological integration; a conservative pathway marked by incremental innovation and partial accessibility; and a critical pathway where inequitable technology adoption exacerbates participation gaps. To illustrate these trajectories, a foresight matrix was developed, mapping the interplay between emerging trends—such as demographic shifts, neurotechnology, adaptive robotics, immersive digital ecosystems, and climate resilience—and their potential manifestations under different future conditions (Table 5). This comparative framework not only highlights the spectrum of possible outcomes but also clarifies the strategic implications for policy, innovation, and inclusivity in para-sport organizations. By systematically contrasting scenarios, stakeholders can better anticipate risks, leverage opportunities, and design future-proof strategies that align with both ethical imperatives and technological realities.

Recommendations for Future-Proofing

In response to these divergent futures, para-sport organizations must adopt multi-pronged strategies to become resilient, ethically sound, and technologically agile. First, leadership development must prioritize digital literacy and foresight competency among para-sport executives and board members. Embedding futures thinking into sport leadership curricula ensures adaptive capacities for navigating AI ethics, innovation pipelines, and cross-sector collaborations. Second, regulatory alignment at national and international levels is essential. Coherent frameworks should guide ethical AI deployment, data governance, and equitable technology access. Learning from adjacent domains such as digital health and education, para-sport governance bodies like the IPC must institutionalize AI ethics audits and risk assessments as standard practice. Third, inclusive design thinking should underpin all innovation. This requires integrating individuals with disabilities as co-designers, testers, and decision-makers in technological development cycles. Human-centered AI approaches that reflect diverse experiences of disability will mitigate bias and increase adoption. Finally, a culture of ethical experimentation should be cultivated. Sandboxing emerging technologies within controlled sport innovation labs can allow iterative testing of exoskeletons, neurotech, and predictive analytics before widespread implementation. Such environments foster transparency, user feedback, and continuous improvement. Taken together, these strategic actions offer a roadmap for ensuring that para-sport not only survives but thrives in an AI-augmented future.

Research Agenda and Implications for Practice

Future Research Directions

Despite rapid technological advances, fundamental empirical and conceptual gaps persist at the intersection of digital/AI systems and para-sport organizations. First, the problem of algorithmic bias and

representativeness is acute: contemporary fairness research demonstrates that systemic sources of bias (data collection, proxy labels, feature selection) produce inequitable outcomes unless explicitly addressed. Para-athlete populations are heterogenous (impairment types, assistive devices, classification systems) and remain under-represented in many training datasets; dedicated work is required to develop contextually

Table 5. Foresight Matrix for Para-Sport Futures: Megatrends, Scenarios, and Strategic Implications

| Megatrend | Optimistic Scenario (High Inclusivity + High Tech Maturity) | Conservative Scenario (Moderate Inclusivity + Controlled Tech Growth) | Critical Scenario (Low Inclusivity + Disruptive Tech Inequity) |
|---|--|--|--|
| Aging Athlete Population | Advanced adaptive robotics enable lifelong participation; AI-driven rehabilitation extends career longevity; para-sport becomes a leading model for healthy aging. | Incremental improvements in assistive devices; extended participation for elite athletes, but limited access for grassroots level. | Widening participation gap; aging athletes excluded due to cost and tech access barriers; early retirement rates rise. |
| Neurotechnology in Training & Recovery | Widespread, ethically governed neurotech for performance optimization and injury prevention; integration with mental health support systems. | Selective adoption in high-performance programs; limited ethical oversight creates uneven application. | Unregulated neurotech exacerbates inequalities; safety risks emerge due to lack of governance. |
| Adaptive Robotics & Prosthetic Innovation | Open-source, affordable prosthetics with embedded AI customization; global collaboration ensures universal access. | Technological progress but confined to well-funded national teams; moderate trickle-down to community level. | Proprietary technologies dominate; economic and geographic disparities limit adoption. |
| Web 4.0 & Immersive Fan Engagement | Fully immersive, inclusive virtual platforms connect global para-sport audiences; real-time AI translation removes language barriers. | Moderate adoption of immersive platforms, with accessibility features implemented inconsistently. | Digital divide deepens; immersive tech remains elite-only, excluding fans from low-resource contexts. |
| Global Sustainability & Climate Adaptation | Green, tech-driven sport infrastructure; AI-optimized travel and event planning reduce environmental impact. | Partial adoption of eco-friendly solutions in high-profile events; minimal integration at grassroots level. | Climate-related disruptions hit para-sport hardest; lack of adaptation funding leads to event cancellations. |

valid datasets and benchmarks for para-sport tasks (performance monitoring, classification, injury prediction) rather than re-using able-bodied datasets that encode inappropriate proxies. Second, there is a pressing need for sociotechnical evaluation frameworks that move beyond accuracy metrics to capture equity, usability, accessibility, and long-term health and psychosocial outcomes; algorithmic fairness interventions alone can be insufficient or ethically problematic if divorced from structural remedies. Third, methodological pluralism is required: mixed-methods longitudinal designs (cohorts, realist evaluations, pragmatic trials) and implementation science (CFIR/RE-AIM) are necessary to study adoption, fidelity, and downstream effects in real organizational contexts. Fourth, governance and audit research must investigate workable models for internal and third-party algorithmic auditing, model documentation (datasheets / model cards), and regulatory alignment tailored to sport-sector realities. Fifth, participatory and co-design approaches with para-athletes, classifiers, clinicians, and coaches should be systematically evaluated to ensure technologies embody universal design and do not produce new exclusionary practices; successful examples in Para sport eHealth co-design highlight feasibility and value of this approach. Finally, prospective and foresight studies (scenario modelling, simulation) should examine long-term socio-technical trajectories (e.g., assistive robotics, neurotechnology, generative models) to inform resilient policy and investment priorities. Concrete priority research questions include: (1) What data standards and minimum metadata are necessary for fair, generalizable para-sport models? (2) Which fairness metrics best reflect substantive equity for specific impairment groups? (3) How do AI interventions affect non-performance outcomes (quality of life, autonomy, stigma) over multi-year horizons? (4) Which governance architectures (internal audits, external certification, federated registries) balance safety, innovation, and accessibility?

Practical Recommendations

For immediate translation, para-sport organizations, technology developers, and policy-makers should adopt a coordinated, staged strategy grounded in ethics-by-design and regulatory best practice. Organizations must (a) require co-design and accessibility testing as procurement criteria, engaging representative para-athlete panels during requirements, development and testing phases; (b) implement data governance policies that mandate consent protocols adapted for disabled populations, data minimization, and clear ownership arrangements; and (c) institute routine algorithmic impact assessments and documentation (model cards, datasheets) prior to deployment. Developers should prioritize "level-up" mitigation strategies that improve model performance for underserved groups rather than degrading overall accuracy, use federated/transfer learning to preserve privacy while broadening representation, and publish bias-testing results and failure modes. Policy-makers and federations should adopt sectoral regulation aligned with international guidance (WHO) and regional AI law (e.g., EU AI Act), promoting risk-based oversight for high-impact systems (classification, selection, medical decision support) and funding independent audit capacity and public registries of high-risk deployments. Finally, club managers and educational leads should invest in digital literacy and human-in-the-loop workflows so staff retain decision authority, can interrogate AI outputs, and support athlete autonomy. Collectively, these research and

practice priorities create a pathway to harness digital and AI innovation while centring inclusion, safety, and long-term equity for para-sport stakeholders.

Conclusion

This narrative review synthesized emerging evidence on the digital and AI-driven transformation of para-sport organizations, highlighting the intersection of technological innovation, inclusive management, and ethical stewardship. The analysis revealed that AI applications — spanning performance analytics, adaptive equipment design, classification systems, and fan engagement platforms — are reshaping operational and competitive paradigms in para-sports. However, the benefits of these innovations are contingent upon organizational readiness, stakeholder collaboration, and strategic governance. While the technology enables unprecedented opportunities for accessibility and personalization, the review underscored persistent challenges related to algorithmic bias, unequal access to resources, and the need for robust evaluation frameworks. Integrating insights from strategic innovation theory and inclusive management practices, the findings suggest that para-sport organizations are at a critical inflection point: the capacity to leverage AI effectively will determine not only competitive outcomes but also the broader social impact of these organizations.

The transformative potential of AI in para-sport cannot be realized without an ethical foundation and a commitment to inclusivity. Ethical oversight ensures that technological decisions do not inadvertently marginalize certain athlete groups, reinforce stereotypes, or compromise data privacy. Inclusive management acts as the operational mechanism that aligns innovation with fairness, ensuring that athletes, coaches, administrators, and supporters have equitable access to digital advancements. By embedding these values into strategic planning, para-sport organizations can move beyond reactive adaptation toward proactive leadership in the evolving sports ecosystem. This alignment is not only a moral imperative but also a competitive advantage, as organizations that embrace ethical AI and inclusivity are more likely to gain legitimacy, attract investment, and sustain community trust. Furthermore, the integration of these principles ensures that innovation serves as a driver of empowerment rather than exclusion, aligning with the broader mission of para-sports to challenge barriers and expand participation.

The pace of technological evolution, coupled with shifting societal expectations, demands immediate and deliberate action from para-sport organizations. Delaying strategic integration of AI risks widening the digital divide, leaving athletes and stakeholders without access to the full spectrum of benefits emerging from innovation. The urgency is amplified by the fact that policy frameworks, ethical standards, and inclusive governance models are still in formative stages, creating a narrow window in which organizations can shape the rules of engagement rather than adapt to them passively. Leaders must adopt a dual-focus approach: short-term implementation of scalable, ethically sound AI solutions, and long-term investment in capacity building, digital literacy, and cross-sector partnerships. The time for experimentation has passed; what is required now is bold, coordinated, and ethically anchored action. By doing so, para-sport organizations will not only enhance competitive performance but also reaffirm their societal role as champions of inclusivity, innovation, and human potential in the digital age.

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COMMENTARY ARTICLE

Policy Approaches to Women with Disabilities in Sport across Asia: Between Idealism and Realism

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In recent decades, sport has gained growing recognition as a means of empowerment for women with disabilities in Asia—physically, psychologically, and socially. Yet, the policymaking landscape in this area remains fragmented and inconsistent. A clear gap persists between strategic documents and the lived realities of women with disabilities (Thomas & Smith, 2008). This commentary critically examines current policy directions, highlights structural challenges, and explores cultural dynamics in Islamic contexts.

Policy Documents and Implementation Gaps

Several regional and international frameworks—such as the Incheon Strategy to “Make the Right Real” and Asia-specific disability empowerment plans—emphasize the importance of inclusive sport for women with disabilities (UNESCO, 2015; Asian Paralympic Committee, 2021). However, in many Asian countries, these policies are either weakly enforced or entirely symbolic. Lack of long-term political commitment, insufficient funding, and a shortage of qualified female coaches specializing in disability sport remain persistent obstacles (DePauw & Gavron, 2005). Moreover, most policies neglect to incorporate the direct voices and lived experiences of women with disabilities, limiting their relevance and sustainability. Current scholarship and policy reviews often concentrate on East Asia and West Asia, leaving Central and South Asia underexplored. These regions have large populations of women with disabilities whose opportunities in sport remain poorly documented. Expanding the geographical lens is critical to ensure that regional diversity and different socio-cultural barriers are captured in policy design.

Cultural Characteristics in Islamic Contexts

Islamic-majority societies across Asia are diverse, yet several recurring cultural patterns shape women’s opportunities for sport, especially for women with disabilities.

1. Religious and interpretive diversity – Islam is interpreted in various ways. While some communities emphasise conservative gender norms, others actively support women’s physical activity as compatible with religious values (Ahmed, 1992; Abu-Lughod, 2013).



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2. Modesty norms and dress requirements – Expectations about clothing (e.g., hijab, modest sportswear) influence participation. The rise of sports hijabs and modest athletic apparel has expanded opportunities, but international sporting regulations still sometimes create barriers (Sahi, 2020).
3. Gendered social roles and family expectations – In many contexts, family approval and community perceptions of honour influence whether women can travel to and participate in sport, particularly for women with disabilities who may require assistance (Benn, Pfister, & Jawad, 2010).
4. Value of women-only and faith-sensitive spaces – Female-only facilities, coaches, and segregated sessions often encourage participation where mixed-gender sport is discouraged (Pfister, 2010).
5. Socioeconomic and geographic variation – Urban, middle-class women often have greater access to sport facilities, while rural women face compounded infrastructural and cultural barriers. National contexts (e.g., Iran, Saudi Arabia, Indonesia, Malaysia, Turkey) require locally adapted policies (Benn et al., 2010).
6. Intersection of stigma – Women with disabilities often face overlapping discrimination due to gender, disability, and cultural perceptions of physical activity. This can lead to lower expectations of their participation (Pfister, 2010).
7. Faith-based advocacy and women’s agency – Feminist interpretations within Muslim contexts have successfully framed sport as a right grounded in religious values, creating culturally resonant justifications for participation (Ahmed, 1992; Abu-Lughod, 2013).

While existing literature often centers on women with physical impairments, women with intellectual disabilities remain particularly marginalized in sport policy and practice. Their challenges—such as communication barriers, lack of adapted training methods, and insufficiently trained coaches—differ significantly from those with physical disabilities. Failure to address these specific needs risks reinforcing exclusion within an already marginalized population.

The Role of Regional and International Bodies

Organizations such as the Asian Paralympic Committee, WHO, and UN Women have advanced the cause of sport for women with disabilities. However, many efforts remain project-based with limited structural continuity and impact (Asian Paralympic Committee, 2021; World Health Organization, 2022). Sustainable change requires long-term political will, consistent investment, and accountability mechanisms. Future programs must embed mechanisms to capture first-hand accounts and participatory input from women with different types of disabilities, including intellectual disabilities, ensuring that interventions move beyond symbolic gestures.

Learning from Promising National Practices

Japan and South Korea have implemented targeted measures for women with disabilities, such as specialized federations, talent identification, and financial incentives (Kim & Park, 2020). These examples show the value of tailored policy, although cultural adaptation is essential before replication in other contexts.

Policy Recommendations

1. Evidence-based policymaking involving women with disabilities at all stages.
2. Training and recruiting female professionals with disability-specific expertise.
3. Media advocacy to counter stereotypes and promote diverse role models.

4. Culturally sensitive program design in Islamic contexts — offering both mixed and women-only options, engaging religious leaders, and accommodating modest dress codes without compromising safety.
5. Sustained collaboration between governments, NGOs, and international organizations to secure resources and maintain accountability.

Conclusion

Inclusive sport policy for women with disabilities in Asia must address not only legislative and structural gaps but also deeply rooted cultural dynamics, particularly in Islamic contexts. When cultural sensitivity is paired with evidence-based planning and strong institutional support, sport can move from symbolic inclusion to genuine empowerment.

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ORIGINAL ARTICLE

A Digital Presence and Lived Experience: Athletes with Disabilities on Social Media

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Abstract: This study employed a phenomenological analysis using an interpretive approach to explore the lived experiences of athletes with disability' social media presence, focusing on meaning-making processes and subjective interpretations of their digital engagement. The research involved 15 participants and Data collection utilized semi-structured in-depth interviews lasting 45-60 minutes, conducted face-to-face or via video conferencing, with analysis following phenomenological principles that resulted in 287 semantic propositions being reduced to 96 semantic units, then 13 subordinate themes, and finally five principal themes include Identity Reconstruction in Digital Space, Confronting Discriminatory Structures, Social Relationship Dynamics, Psychological and Emotional Experiences, and Resistance and Action Strategies—demonstrating that social media serves as a complex terrain where athletes with disability simultaneously experience unprecedented opportunities for self-representation and community building while confronting persistent discrimination and developing sophisticated coping mechanisms, challenging simplistic narratives about technology as either purely liberating or oppressive for marginalized communities.

Keywords ; Digital identity; Social Media; Phenomenological analysis; Lived experience, Qualitative Study.

Highlights

- Social media creates complex identity reconstruction opportunities for athletes with disability
- Athletes develop sophisticated strategies to resist online discrimination and stigma
- Digital platforms enable community building while exposing persistent barriers



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Introduction

The digital revolution has fundamentally transformed sports communication across multiple dimensions, creating unprecedented opportunities for athlete-audience interaction and content dissemination. Digital platforms have significantly expanded the scope of sports content distribution while deepening the global influence and interactivity of sports events and athletes' personal brands, fundamentally altering how sporting narratives are constructed, shared, and consumed (Ling & Zhao, 2024). This transformation represents a paradigm shift from traditional one-way communication models to dynamic, multi-directional engagement platforms where athletes can directly control their messaging, build personal brands, and cultivate intimate relationships with global audiences. Traditional media channels such as newspapers and television broadcasting, once the gatekeepers of sports information, can no longer satisfy modern fan expectations for real-time, interactive communication with players, coaches, and fellow supporters (Gia, 2021). The democratization of content creation has empowered individual athletes to bypass traditional media intermediaries, enabling them to craft authentic narratives, share behind-the-scenes content, and engage in unfiltered dialogue with their audiences. However, this digitalization has simultaneously created significant challenges for sports communication managers due to the multiplied number of media companies producing sports content and the emergence of self-produced media products by sports actors themselves, requiring new strategies for managing complex, multi-platform communication ecosystems (Burk & Fahrner, 2020).

Within this transformed digital landscape, athletes with disabilities occupy a particularly distinctive and complex position in social media engagement, characterized by unique motivational drivers, presentation strategies, and audience relationships that differ markedly from their able-bodied counterparts. Research reveals that Paralympic content consumption is primarily motivated by information seeking, inspiration, empowerment, and entertainment, with inspirational content consistently generating the highest engagement rates among diverse audience segments (Mamo & Haegele, 2024). These athletes strategically utilize social media platforms not merely for promotion but as sophisticated tools for self-presentation and identity construction, with female athletes with disability typically emphasizing competitive achievements and athletic prowess while males tend to focus more on personal relationships and life experiences, ultimately using these platforms for validation of their accomplishments and humanization of their athletic journeys (Öztürk, 2024). Professional agents and marketing professionals have increasingly recognized the unique marketability of elite athletes with disabilities, leveraging storytelling techniques and social media strategies as critical branding tools, particularly valuing athletes' personal life stories, overcoming adversity narratives, and authentic experiences as key dimensions of their brand development and commercial appeal (Hu et al., 2023).

However, this commercialization of disability narratives occurs within a digital landscape where athletes with disabilities continue to face significant psycho-social challenges that extend from their offline experiences into social media environments (Rees, Robinson & Shields, 2019). Research examining Paralympic athletes reveals the multifaceted nature of these challenges, with participants experiencing communicational barriers, family-related pressures, and financial constraints alongside complex

psychological issues including sport anxiety, concentration problems, depression, sleep disorders, ADHD, and PTSD, all of which inevitably influence how these athletes navigate and experience social media platforms (Mousavi et al., 2022).

Despite these challenges, social media platforms theoretically offer important opportunities for communication, exchange, and activism for people with disabilities, potentially increasing employment and leisure opportunities for traditionally marginalized groups, though significant structural and cultural barriers persist that limit their full participation and authentic representation (Kent, 2016). The reality is that the offline inaccessible environment has been largely replicated in digital spaces, particularly within social networking sites, creating continued patterns of exclusion despite the medium's democratic potential and promise of universal accessibility (Ellis & Kent, 2016). Nevertheless, social media simultaneously presents unprecedented possibilities for challenging traditional representations and creating new narratives around disability sport, as demonstrated during major international competitions where digital platforms enable real-time audience engagement and potentially disrupt established media hierarchies (Suggs & Guthrie, 2017). The Rio 2016 Paralympic Games exemplified this transformative potential, where Twitter provided immediate engagement opportunities that challenged the traditional gatekeeping roles of professional sports broadcasters and journalists, enabling new modes of authentic interaction with Paralympic sport that bypassed conventional media filters and created direct athlete-audience connections (French & Clair, 2018).

Mañas-Viniegra et al. (2023) showed that athletes with physical disabilities attract more attention when displaying explicit disability traits, while Öztürk (2024) argues that presentation strategies are gendered, with females emphasizing competitive achievements and males highlighting personal relationships, both using platforms primarily for validation. These self-presentation choices occur within a commercialized context where Hu et al. (2023) demonstrated that professional agents leverage storytelling and social media as critical branding tools, particularly valuing athletes' personal narratives for marketability. However, this strategic positioning must contend with systemic barriers, as McNary and Cottingham (2019) showed that female athletes with disabilities receive limited media coverage outside Paralympic years, forcing reliance on self-promotion through social media. The digital replication of offline exclusion patterns emerges as a consistent theme across studies. Holland et al. (2023) argued that sports media companies maintain hegemonic practices by marginalizing athletes with disability, while Rees et al. (2019) demonstrated continued invisibility and problematic "supercrip" narratives in mainstream coverage. These representational challenges intersect with platform-specific dynamics, as Roberto et al. (2020) found differential engagement patterns across disability types and social networks. Despite these barriers, emerging research suggests potential for transformation, with French and Clair (2018) showing how Twitter during Rio 2016 challenged traditional media gatekeeping, while Lins et al (2019) emphasized the importance of collective rather than individual overcoming narratives, and Zhang (2020) revealed sophisticated disclosure strategies in virtual environments.

Despite this growing body of literature, a critical gap exists in understanding the authentic lived experiences of athletes with disabilities as they navigate social media platforms in their own voices and from their own perspectives. While existing research provides valuable insights into presentation strategies, marketing

approaches, and representational patterns, it predominantly examines these phenomena from external analytical perspectives rather than centering the athletes' own experiences, challenges, and meanings they attach to their social media presence. The current literature tends to focus on either commercial aspects of disability sport marketing or broad patterns of representation, but lacks deep, nuanced exploration of how athletes with disabilities themselves experience, interpret, and make sense of their social media engagement. Furthermore, much of the existing research examines specific platforms or demographic groups in isolation, missing the complex, intersectional experiences of athletes who navigate multiple platforms, identities, and audiences simultaneously. This research aims to develop a deeper understanding of the lived experiences of athletes with disabilities in social media environments in order to achieve better insights into how these athletes interact with digital platforms and the meanings they construct from their presence in these spaces, thereby providing a foundation for developing more equitable and supportive digital environments for athletes with disabilities.

Research Design

This study employed phenomenological analysis, specifically an interpretive approach. The research sought to understand the essence of athletes with disabilities' lived experiences with social media presence, emphasizing meaning-making processes and subjective interpretations of their digital engagement. The phenomenological approach was particularly suited to this inquiry as it allowed for deep exploration of how athletes experienced and made sense of their social media interactions, moving beyond surface-level behaviors to understand the fundamental structures of their digital experiences.

Population and Sampling. The target population consisted of athletes with disabilities who participated in competitive sports at various levels and maintained an active presence on social media platforms. Inclusion criteria required participants to be current or former athletes with disabilities who had competed within the last eight years at regional, national, or international levels, actively engaged on at least one major social media platform such as Instagram, Twitter/X, or YouTube, and aged between 18-45 years. Participants must also have demonstrated willingness to engage in 45-60 minute in-depth interviews about their experiences. Exclusion criteria eliminated athletes with cognitive impairments that could have affected their ability to articulate experiences, those who had been inactive on social media for more than six months, and athletes who had been involved in major controversies or legal issues that could have overshadowed their authentic social media experiences. The sampling strategy employed purposive sampling with a maximum variation approach to ensure rich, diverse perspectives.

The final sample size included 15 participants representing diverse characteristics across disability types, sports categories, competition levels, and social media engagement patterns. Diversity criteria encompassed various disability types including spinal cord injuries and limb deficiencies, different sports categories and competition levels, a range of social media influence levels, and gender balance (see Table 1). Instagram emerged as the most frequently used social media platform among participants, with all participants maintaining active profiles on this platform, while engagement with Twitter/X and YouTube was very low among the sample.

Table 1. Demographic Characteristics of Study Participants (N=15)

| Characteristic | Category | n |
|-----------------------------|---|----|
| Gender Distribution | Female | 7 |
| | Male | 8 |
| Age Distribution | 18-25 years | 4 |
| | 26-35 years | 7 |
| | 36-45 years | 4 |
| Type of Disability | Spinal Cord Injury | 9 |
| | limb deficiency | 6 |
| Sport Categories | Individual Sports | 11 |
| | Team Sports | 4 |
| Competition Level | International | 3 |
| | National | 5 |
| | Regional | 7 |
| Social Media Activity Level | Macro Influencer (>60K followers) | 3 |
| | Moderate Influencer (20K-60K followers) | 4 |
| | Micro Influencer (<20K followers) | 8 |

Data Collection and Sample Interview Questions. Data collection utilized semi-structured in-depth interviews lasting 45-60 minutes per participant, conducted face-to-face when possible or via video conferencing with audio recording. The interview schedule followed phenomenological principles with open-ended questions exploring lived experiences rather than opinions.

Sample questions included: "Can you tell me about your journey as an athlete with a disability?" "Describe a typical day of your social media activity - what was that like?" "Tell me about a time when you posted something meaningful. What was that experience like for you?" "How did you experience representing yourself on social media?" "What had been challenging about social media as an athlete with a disability?" "Describe moments when social media felt empowering to you." Each interview began with rapport-building, employed probing techniques like "What was that like for you?" and concluded with participant debriefing.

The pre-interview phase lasted 10-15 minutes and focused on building rapport while explaining the phenomenological approach. Participants were encouraged to describe experiences in detail rather than provide explanations, with emphasis on their unique perspectives and lived experiences. The researcher clarified that there were no correct answers and expressed genuine interest in understanding their individual experiences.

During interviews, the researchers employed specific phenomenological techniques including descriptive probing with questions like "Can you tell me more about that experience?" and "Help me understand what that felt like." When participants provided general statements, the researcher requested specific examples: "Can you think of a particular moment when that happened?" The researcher practiced empathetic listening

while maintaining phenomenological curiosity, encouraging participants to slow down and elaborate on significant experiences.

Clarification and reflection techniques were used throughout, with the researcher offering statements like "It sounds like you experienced..." and "Let me ensure that I understand - you felt..." to verify accurate comprehension of participant descriptions. When participants used metaphorical or abstract language, these were explored further through questions like "You mentioned it felt like... can you help me understand that experience more fully?"

Data Analysis Plan. The IPA analysis followed a systematic process starting with reading and re-reading transcripts to achieve deep immersion in the data. Initial noting involved descriptive comments about content, linguistic comments about language use, and conceptual comments about deeper meanings and interpretations. Emergent themes were developed by transforming detailed notes into concise phrases capturing essential meanings. The researcher then searched for connections among themes, grouping and organizing them into coherent clusters before moving to subsequent cases. Cross-case analysis identified superordinate themes capturing shared aspects of the experience.

Ethical Considerations. comprehensive written consent covering study purpose and procedures, voluntary participation and withdrawal rights, confidentiality measures, data storage and destruction timelines, publication plans, and researcher contact information. Privacy protection involved using pseudonyms, complete data de-identification, secure encrypted storage, limited access to research team members, and audio file deletion after five years.

Special considerations for athletes with disabilities included maintaining dignity and respect, acknowledging researcher-participant power dynamics, ensuring findings didn't misrepresent the disability sports community, and providing participants opportunities to review interpretations.

Validity and Trustworthiness. This study employed Lincoln and Guba's (1985) trustworthiness framework with four criteria. Credibility was established through multiple strategies including prolonged engagement with participants, comprehensive member checking procedures, peer debriefing, and triangulation of interview data with field notes. Member checking was conducted through a two-stage process: initial verification occurred immediately following each interview where participants reviewed key points and clarified any misunderstandings, followed by a formal member checking phase where participants were provided with their individual interview transcripts and preliminary thematic interpretations relevant to their experiences. Participants were given two weeks to review materials and provide feedback, corrections, or additional insights, with 13 out of 15 participants providing confirmatory responses and minor clarifications that were incorporated into the final analysis.

Transferability was ensured through thick description of participant experiences and purposive sampling across diverse disability types and sports. Dependability required maintaining detailed audit trails of all research decisions, including coding processes, theme development, and reflexive journaling throughout the research process. Confirmability was supported through comprehensive documentation showing how themes emerged directly from participant data, systematic tracking of analytical decisions, and explicit acknowledgment of researcher positionality and potential bias influences on data interpretation and analysis.

Findings

At the final stage of each interview, the conversation content was first transcribed and then compiled into coherent text. In the analysis process, meaningful statements were initially extracted from the interview texts, where efforts were made to express participants' main perspectives in the form of concise and conceptual sentences. In the first step, 287 semantic propositions were identified. Researchers then conducted an in-depth examination of these propositions to group similar concepts together, and after integrating overlapping items, 96 semantic units were formed. Subsequently, by aggregating these categories based on conceptual proximity, 13 subordinate themes emerged. Finally, these sub-themes were reduced to 5 principal themes that had the capability to cover all extracted concepts.

Table 2. sample of supporting semantic units, subordinate themes, and principal themes extracted from the analysis

| sample of supporting semantic units | subordinate themes | principal themes | | |
|--|------------------------------------|--|---------------------|--|
| Experience of representing a body with disability in virtual space | Embodiment and Self-Representation | | | |
| Feeling of control over one's digital image | | | | |
| Encountering criticism about representation methods | | | | |
| Experience of distance between real and digital self | | | | |
| Feeling of freedom in choosing how to represent oneself | | | | |
| Encountering social expectations about appearance | | | | |
| Experience of disability invisibility in some content | | | | |
| Feeling empowered through image control | | | | |
| Encountering pressure to be "beautiful" | | | | |
| Encountering misinterpretations of images | | | | |
| Experience of choosing between concealment and disclosure | Athletic Identity and Disability | Identity Reconstruction in Digital Space | | |
| Feeling proud of displaying achievements | | | | |
| Experience of defining oneself as athlete first | | | | |
| Encountering identity reduction to disability | | | | |
| Experience of struggling to be recognized as an athlete | | | | |
| Encountering expectation to represent entire disability community | | | | |
| Feeling responsible for presenting positive image | | | | |
| Encountering forced inspirational requests | | | | |
| Feeling empowered in controlling personal narrative | | | Agency and Autonomy | |
| Experience of freedom of expression versus self-censorship | | | | |

| | | |
|---|--|---|
| Feeling control over others' reactions | | |
| Experience of choosing level of personal disclosure | | |
| Feeling independence in virtual space | | |
| Experience of resisting external definitions | | |
| Encountering pressure to compromise with expectations | | |
| Experience of receiving direct offensive comments | Explicit and Hidden Discrimination | |
| Experience of double gender discrimination (female athletes) | | |
| Experience of discrimination in access to online facilities | | |
| Encountering professional prejudices | | |
| Feeling deprived of equal opportunities | | Confronting Discriminatory Structures |
| Experience of discrimination in financial support | | |
| Encountering the "inspirational athlete" stereotype | Stigmatization and Stereotyping | |
| Feeling objectified in media narratives | | |
| Encountering expectations of "extraordinary courage" | | |
| Experience of being reduced to "victim-hero" role | | |
| Feeling pressure to display constant happiness | | |
| Encountering the "overcoming disability" stereotype | | |
| Feeling judged based on severity of disability | | |
| Experience of inequality in media coverage | Power Systems and Marginalization | |
| Encountering lack of resources and support | | |
| Encountering discriminatory platform policies | | |
| Feeling voiceless in mainstream discourse | | |
| Experience of being ignored in policy-making | | |
| Encountering discriminatory institutional structures | | |
| Feeling struggle against entrenched systems | | |
| Experience of need for continuous proof of competence | | |
| Experience of receiving unexpected support from strangers | Support and Solidarity | |
| Experience of forming meaningful online friendships | | |
| Feeling understood by people with similar experiences | | Social Relationship Dynamics |
| Experience of creating online support networks | | |
| Feeling of belonging to the athletes with disability' community | | |
| Encountering genuine empathy from users | | |

| | | |
|--|---|---|
| Encountering inappropriate curiosity about disability | Interaction with General Public | |
| Feeling influential on social perspectives | | |
| Experience of patience in the face of ignorance | | |
| Encountering prejudiced judgments | | |
| Feeling tired from repeated explanations | | |
| Encountering others' fear and concern | | |
| Experience of one-dimensional representation in public media | Interaction with Media and Institutions | |
| Encountering lack of access to main platforms | | |
| Experience of criticizing media policies | | |
| Feeling the need to fight for proper representation | | |
| Encountering excessive emphasis on disability | | |
| Encountering media silence about achievements | | |
| Feeling anxiety before publishing sensitive content | | |
| Feeling helpless against discrimination | | |
| Experience of spiritual exhaustion from continuous struggle | Coping with Emotional Tensions | |
| Encountering guilt for complaining | | |
| Experience of tension between hope and despair | | |
| Encountering anger from systemic injustice | | |
| Experience of depression after receiving negative comments | | |
| Experience of gaining self-confidence through positive interaction | Personal Growth and Empowerment | Psychological and Emotional Experiences |
| Feeling pride from influencing others | | |
| Encountering positive identity reinforcement | | |
| Experience of acquiring new communication skills | | |
| Feeling progress in self-acceptance | | |
| Encountering motivation reinforcement to continue | | |
| Experience of creating positive change in society | | |
| Using humor to combat discrimination | Active Resistance | Resistance and Action Strategies |
| Participating in research and studies | | |
| Using negative experiences as motivation | | |
| Encouraging constructive dialogue about disability | | |
| Publicly criticizing discriminatory policies | | |

| | |
|--|------------------------------|
| Creating online support campaigns | |
| Actively rejecting stereotypes and stigmas | |
| Producing awareness-raising content about disability | |
| Using empowering hashtags | |
| Building online support groups | Creating Support Networks |
| Producing positive role models | |
| Creating joint educational content | |
| Forming pressure groups for change | |
| Sharing effective coping strategies | |
| Encouraging young athletes with disability | |
| Creating safe spaces for discussion and exchange | |
| Producing joint content with like-minded individuals | |
| Creating coalitions with other athletes | |

Identity Reconstruction in Digital Space. The first principal theme that emerged from the lived experiences of athletes with disabilities reveals a complex process of Identity Reconstruction in Digital Space, where participants navigate the intricate intersection of their athletic identity, disability experience, and digital self-presentation. This theme encompasses three interconnected dimensions that illuminate the multifaceted nature of constructing and maintaining identity within social media environments.

The experience of representing a body with disability in virtual space emerged as a central concern for participants, revealing the profound complexity of digital embodiment. Athletes described the unique challenge of translating their physical reality into a digital format while navigating societal expectations and personal comfort levels. Many participants expressed a heightened sense of control over their digital image, recognizing social media as a space where they could curate their representation in ways that physical spaces might not always allow. P2 reflected: *"When I post a photo, I can choose the angle, the lighting, the story I want to tell. It's empowering because I'm not just the person people see rolling by in my wheelchair – I'm the athlete, the advocate, the person with dreams and achievements."*

However, this control came with significant challenges. Participants frequently encountered criticism about their representation methods and faced pressure to conform to conventional standards of beauty. P11: *"People expect you to either hide your disability completely or make it the center of everything. There's no middle ground where you can just be an athlete who happens to have a disability."*

The complex interplay between athletic identity and disability identity revealed itself through participants' desire to be recognized primarily as athletes while navigating expectations to represent the broader disability community. P6 described this tension: *"I train six hours a day, but the first comment is always about how 'inspiring' I am just for existing. I want people to see the athlete first, not the disability."*

The sense of responsibility to present a positive image created additional pressure for many participants, who felt obligated to be perpetually upbeat and motivational. P8 reflected: *"I can't have a bad day online. If I post about being frustrated with training or disappointed with a performance, people either think I'm ungrateful or that I'm reinforcing negative stereotypes about disability."*

The experience of resisting external definitions emerged as crucial for maintaining autonomy in digital spaces. Many participants developed strategies to push back against limiting narratives while remaining accessible to their audiences, often focusing on technical aspects of their sport or sharing behind-the-scenes training content. The tension between freedom of expression and self-censorship was particularly pronounced. P1 explained: *"I want to be real about my experiences, but I also know that everything I post becomes part of how people understand disability. It's exhausting to always be thinking about the bigger picture when you just want to share a moment."*

Confronting Discriminatory Structures. The second principal theme revealed the pervasive nature of discriminatory structures that athletes with disabilities encounter across digital platforms. This theme illuminates how systemic barriers and prejudicial attitudes manifest in online spaces, creating additional layers of challenge beyond the physical and social barriers these athletes face in offline contexts. Participants described confronting discrimination that ranged from overt hostility to subtle systemic exclusions, each contributing to a complex landscape of digital marginalization.

Participants consistently reported experiencing direct offensive comments that targeted both their athletic abilities and their disabilities. These encounters ranged from questioning their legitimacy as "real" athletes to crude remarks about their physical appearances or capabilities. P3: *"The comments section becomes a battlefield sometimes. People say things like 'that's not real running' or 'why don't you just focus on being grateful instead of competing.' It's like they can't accept that we're serious athletes."*

Female athletes with disabilities faced a compounded form of discrimination that intersected gender and disability bias. P5: *"As a woman with a disability, I get comments about my appearance, my femininity, and my disability all at once. Men tell me I'm 'inspirational but not attractive,' and women sometimes question whether I should be 'putting myself out there' like this. It's exhausting to fight on multiple fronts."*

Many participants expressed feeling deprived of equal opportunities in digital spaces, particularly regarding sponsorship visibility, algorithmic promotion, and platform features. Athletes described how their content received less engagement and reach compared to non-athletes with disability, creating disparities in professional opportunities and income generation through social media. The discrimination extended to access issues, with participants encountering platforms and features that were not fully accessible, creating barriers to full participation in digital athletic communities.

The expectation of "extraordinary courage" created additional pressure for participants, who found themselves positioned as inherently brave simply for participating in sport. Athletes described how this stereotype diminished their achievements by suggesting that their success was primarily about courage rather than skill, training, or talent. P10: *"People act like showing up to practice makes me some kind of superhero. But I'm not brave – I'm an athlete who loves my sport. My courage isn't in competing; it's in dealing with all these assumptions about what my life must be like."*

The systemic nature of discrimination became evident through participants' experiences with power systems and marginalization within digital platforms and broader media coverage. Athletes described significant inequality in media coverage, with their achievements receiving less attention and different framing compared to non-athletes with disability. P9: *"When I win a race, the story is about inspiration. When an able-bodied athlete wins, it's about technique, strategy, and athletic excellence. The coverage makes it seem like we're playing a completely different game."*

Discriminatory platform policies emerged as a subtle but significant barrier, with participants describing how platform algorithms, accessibility features, and content policies created systemic disadvantages. P6: *"The platform's algorithm doesn't seem to understand our content. Videos of adaptive equipment get flagged as medical content, training posts don't get the same reach, and sometimes our accounts get restricted for sharing information about our disabilities that the platform considers 'sensitive.'"*

Social Relationship Dynamics. The third principal theme explores the complex web of social relationships that athletes with disabilities navigate in digital spaces, revealing how online platforms both facilitate meaningful connections and create new challenges in interpersonal dynamics. This theme encompasses the multifaceted nature of digital social interaction, from the profound solidarity found within disability athletic communities to the exhausting labor of public education and media representation battles.

Participants consistently described finding deep meaning and connection within online communities of athletes with disability, experiencing a sense of belonging that was often difficult to achieve in physical spaces dominated by non-athletes with disability. P14: *"When I found other adaptive athletes online, it was like coming home. These are people who understand what it's like to have your technique questioned, to deal with equipment failures, to celebrate victories that others don't fully appreciate. We get each other in ways that go beyond just sport."*

The experience of creating online support networks extended beyond formal athletic communities to include informal mentorship relationships and peer support systems. Athletes described how digital platforms enabled them to connect across geographic and sport boundaries, creating relationships that transcended traditional community limitations. P12: *"I mentor young athletes through Instagram now. Kids from small towns who've never seen someone like them compete can reach out directly. It's powerful to see someone realize they're not alone and that their dreams are possible."*

The formation of meaningful online friendships emerged as an unexpected but significant benefit of digital platform engagement. Participants described developing genuine relationships with other athletes, supporters, and even critics who evolved into allies. P4: *"Some of my closest friendships now started as comments on my posts. People who initially just followed for inspiration became real friends who check in when I'm struggling, celebrate my victories, and challenge me to grow both as an athlete and as a person."*

However, these positive connections existed alongside more challenging dynamics with the general public. Many participants described feeling influential on social perspectives, recognizing their unique position to shape public understanding of disability and athletic capability. This influence came with significant responsibility and emotional labor. P13: *"I can see how my posts change people's minds. Someone will comment that they never thought about adaptive sport before, or they'll share how seeing my training videos*

made them reconsider their assumptions about disability. It's rewarding but also overwhelming to know that my existence online is constantly educating people."

The experience of exercising patience in the face of ignorance became a daily reality for most participants. Athletes described developing strategies for responding to well-meaning but misinformed questions, distinguishing between genuine curiosity and willful ignorance, and managing their emotional responses to repeated misunderstandings. P3: *"How did you become disabled?" 'Are you in pain?' 'Can you drive?' I try to remember that most people are genuinely curious, but some days I just want to talk about technique without having to explain my entire medical history first."*

The excessive emphasis on disability in media representation frustrated participants who sought recognition for their athletic accomplishments, training innovations, and competitive achievements. Athletes described feeling trapped in narrative frameworks that prioritized emotional impact over sporting analysis, creating a cycle where their athletic expertise was consistently overshadowed by their disability status. P15: *"Sports media covers my competitors' training methods, race strategies, and technical improvements. But my coverage is always about inspiration and overcoming challenges. It's like they don't think I have anything valuable to say about actual racing."*

Psychological and Emotional Experiences. The fourth principal theme reveals the profound psychological and emotional landscape that athletes with disabilities navigate through their social media engagement, encompassing both the significant challenges and transformative growth opportunities that emerge from their digital presence. This theme illuminates how online participation becomes deeply intertwined with psychological well-being, creating complex emotional experiences that range from debilitating anxiety to profound empowerment.

The experience of anxiety before publishing sensitive content emerged as a pervasive challenge for participants, who described carefully weighing the potential consequences of sharing personal experiences, challenging societal perceptions, or addressing controversial topics related to disability and sport. P7: *"Before I post anything about my disability experience, I spend hours thinking about how it might be interpreted, who might attack me for it, and whether I'm ready to deal with the backlash. Sometimes I write posts and then delete them because the anxiety becomes too overwhelming."*

The spiritual exhaustion from continuous struggle became a defining feature of many participants' experiences, as they described feeling drained by the constant need to defend their legitimacy as athletes, educate others about disability, and maintain positive public personas while facing ongoing discrimination and misunderstanding. P10: *"There are days when I wake up and the thought of engaging with social media feels impossibly heavy. It's not just about posting a photo or sharing an update – it's about being ready to fight for basic respect and understanding all over again. The weight of that never goes away."*

Despite these significant challenges, participants also described profound experiences of personal growth and empowerment that emerged through their social media engagement. The experience of gaining self-confidence through positive interactions became a powerful counterbalance to negative experiences, with athletes describing how supportive comments, shares, and meaningful connections helped them develop stronger self-esteem and more resilient identities. P8: *"When young athletes reach out to say that seeing my*

posts helped them believe in their own potential, it transforms how I see myself. I'm not just training for my own goals – I'm part of something bigger, and that gives me confidence I never had before."

The feeling of pride from influencing others emerged as a significant source of empowerment, with participants recognizing their unique ability to shape public understanding and inspire other individuals with disabilities to pursue athletic goals. P11: *"Knowing that my posts have convinced parents to enroll their blind children in sports programs, or that I've helped someone understand that disability doesn't mean inability – that pride is indescribable. It makes all the negative stuff worth enduring."*

The experience of acquiring new communication skills emerged as an unexpected benefit of digital platform engagement, with athletes developing sophisticated abilities to articulate complex ideas about disability, sport, and identity to diverse audiences. P5: *"I never considered myself a good communicator, but managing my social media has taught me how to explain complicated concepts simply, how to respond to criticism constructively, and how to tell stories that connect with people. These skills have helped me in every area of my life."* These communication competencies often translated into professional opportunities beyond sport, including speaking engagements, writing opportunities, and consulting roles.

Resistance and Action Strategies. The fifth principal theme illuminates the sophisticated and multifaceted approaches that athletes with disabilities employ to challenge discriminatory structures and create positive change through their digital presence. Rather than merely enduring negative experiences, participants demonstrated remarkable agency in developing both individual and collective strategies that transform their online spaces from sites of marginalization into platforms for resistance, advocacy, and community building. The use of humor to combat discrimination emerged as one of the most creative and effective resistance strategies employed by participants. Athletes described developing sophisticated approaches to address ignorant comments and stereotypes through wit and irony, often disarming critics while educating audiences simultaneously. P9: *"When someone comments that I'm 'so inspiring for just getting out of bed,' I respond with something like 'Thanks! Tomorrow I'm planning to attempt the incredibly heroic act of brushing my teeth.' The humor shows how ridiculous their comment is without being mean about it."*

Participation in research and studies represented another form of active resistance, with many athletes recognizing their unique position to contribute to academic understanding of disability sport and digital representation. P12: *"I participate in every research study I can find about athletes with disability and social media. If academics are going to study us, I want to make sure our real voices are heard, not just what researchers think we experience."*

The production of joint content with like-minded individuals became a powerful strategy for amplifying messages and creating stronger advocacy voices. Athletes described collaborating across sports, disability types, and geographic locations to create content that reached broader audiences and demonstrated the diversity within the disability athletic community. P6: *"When I collaborate with other adaptive athletes, we can reach each other's audiences and show people that there's no single 'athlete with disability' experience. Our joint content gets much more engagement than our individual posts."*

The sharing of effective coping strategies became an informal but crucial form of mutual support, with athletes developing repositories of practical advice for managing the emotional challenges of public

visibility while maintaining competitive athletic careers. P3: *"We share everything – how to respond to trolls, techniques for managing anxiety before big posts, strategies for maintaining boundaries with media, ways to stay motivated when the negativity gets overwhelming. This shared knowledge makes all of us stronger and more resilient."*

Conclusion

This study reveals the multifaceted nature of athletes with disability' experiences in social media, uncovering five interconnected themes that illuminate both the opportunities and challenges they face. The findings demonstrate that social media serves as a complex terrain where athletes with disability engage in identity reconstruction, confront discriminatory structures, navigate social relationship dynamics, experience intense psychological and emotional responses, and develop sophisticated resistance and action strategies. These experiences reflect a nuanced reality where digital platforms simultaneously offer unprecedented opportunities for self-representation and community building while perpetuating existing forms of discrimination and creating new challenges. The complexity of these experiences challenges simplistic narratives about technology as either purely liberating or oppressive for marginalized communities.

The findings reveal that athletes with disability actively engage in identity reconstruction within digital environments, demonstrating remarkable agency in choosing how to represent their embodied experiences online. Participants navigated the tension between authentic self-representation and societal expectations, making strategic decisions about disclosure levels while resisting external definitions imposed upon them. Their experiences of controlling their digital image, choosing between concealment and disclosure, and defining themselves as athletes first rather than disabled individuals highlight the empowering potential of digital spaces for identity work. However, this agency operates within constraints, as athletes encounter criticism about their representation methods and pressure to conform to normative standards of appearance and behavior. These findings strongly support Xu's (2023) finding that disabled individuals use social media to present themselves through video content, bridging the gap between disabled and able-bodied communities while navigating complex psychological feelings about online self-presentation. However, our findings partially contradict Gündüz's (2017) optimistic view that social media provides unlimited freedom for identity expression, as our participants faced significant constraints and backlash when challenging normative expectations.

Despite the democratizing potential of social media, the study reveals that discriminatory structures persist and often intensify in digital spaces. Athletes with disability encountered both explicit discrimination through direct offensive comments and subtle forms of marginalization through stereotyping and limited representation opportunities. Female athletes with disability faced the additional burden of intersectional discrimination, experiencing both ableism and sexism simultaneously. The findings demonstrate how digital platforms can reproduce existing power hierarchies through discriminatory policies, unequal access to resources, and the perpetuation of harmful stereotypes such as the "inspirational athlete" narrative or expectations of "extraordinary courage." These experiences reflect broader patterns of digital exclusion that extend beyond individual interactions to structural inequalities. Raffone (2025) explores how people with disabilities use social media to resist discriminatory attitudes. Heung (2024) identifies social media as

"breeding grounds for hate and harassment" where the disability community faces targeted discrimination, emphasizing that ableism has been largely overlooked compared to other forms of online discrimination. The research illuminates the dual nature of social relationships in digital spaces, where athletes with disability simultaneously build supportive communities while engaging in exhausting educational labor with the general public. Participants found belonging and solidarity within athlete with disability communities, creating meaningful support networks and friendships that transcended geographical boundaries, consistent with Bundon and Clarke's (2015) findings that para-sport participants use social media platforms to form strong networks that extend both online and offline. These connections prove particularly valuable as Silverman et al. (2017) demonstrated that friendships with others sharing similar disabilities buffer well-being from disability-related stressors, with participants reporting higher quality of life and social role satisfaction when having more friends with shared diagnoses. However, their interactions with the broader public revealed the emotional toll of constantly explaining their experiences, combating ignorance, and managing others' fear and discomfort. The findings highlight how athletes with disability become inadvertent educators and advocates, taking on the responsibility of representing entire communities while seeking recognition as individual athletes—a dynamic that Lindemann and Cherney (2014) explain occurs as athletes with disability gain legitimacy, visibility, and connectivity through social media while simultaneously negotiating representation of their entire communities. This reflects the broader phenomenon of marginalized groups bearing disproportionate responsibility for educating dominant groups about their experiences, revealing the complex burden that accompanies digital visibility and advocacy.

The findings reveal the profound psychological and emotional dimensions of athletes with disability' social media engagement, characterized by both significant challenges and transformative growth. The research shows experiences of anxiety before publishing sensitive content, spiritual exhaustion from continuous struggle, and depression following negative comments, highlighting the emotional toll of maintaining visibility in digital spaces—experiences that align with Trevisan's (2020) observation that disabled individuals experience stress, anxiety, and isolation in social media contexts. However, these challenging experiences coexisted with powerful moments of personal growth and empowerment. Athletes reported gaining self-confidence through positive interactions, feeling pride from influencing others, and acquiring new communication skills through their online presence, reflecting Kim and Qian's (2019) findings that social media platforms facilitate relationship maintenance, initiation of new connections, and engagement in self-advocacy. The positive dimensions of engagement further correspond with Caton and Chapman's (2016) research showing that disabled users experience happiness, enjoyment, and development of communication and literacy skills through social media use, contributing to positive social identity formation and improved self-esteem. The tension between hope and despair emerged as a central emotional experience, with athletes navigating the psychological demands of advocacy while maintaining their competitive identity. This emotional complexity underscores how social media engagement for athletes with disability extends far beyond simple communication, becoming a site of both vulnerability and strength. Rather than passive victims of discrimination, findings reveal athletes with disability as active agents of resistance who develop sophisticated strategies to challenge ableist assumptions and create positive change,

aligning with Struck and Leonowicz's (2023) findings that disabled Instagram users effectively create self-representations that differ significantly from traditional media portrayals of disabled people as "victims" and "supercrips." They employed humor to combat discrimination, participated in research and advocacy, produced educational content about disability, and created online support campaigns to raise awareness—activities that Maulana (2020) recognize as ways social media platforms provide greater opportunities for people with disabilities to interact with non-disabled individuals, increase confidence and optimistic attitudes for public appearance, and prove their capabilities to the community. Beyond individual resistance, participants demonstrated collective action through producing joint content with like-minded individuals, creating safe spaces for discussion and exchange, and forming pressure groups for systemic change. Their commitment to encouraging young athletes with disability and sharing effective coping strategies illustrates how resistance becomes a form of community building and mentorship. These multifaceted strategies demonstrate not only individual resilience but also collective action aimed at transforming social attitudes and institutional practices, exemplifying what Ellis & Kent (2016) identify as the transformative potential of social media platforms as important media for communication, exchange, and activism that can increase employment and leisure opportunities for traditionally isolated groups.

The practical implications demand immediate attention across multiple sectors. Platform designers must urgently integrate accessibility and inclusion considerations into their foundational policies, algorithmic design, and content moderation systems rather than treating these as peripheral concerns. Sports organizations face a critical imperative to address documented representation gaps through proactive inclusion initiatives, authentic partnership with athlete with disability communities, and fundamental restructuring of promotional strategies that move beyond tokenistic gestures. Media professionals must abandon stereotypical portrayals that oscillate between victimization and superhuman narratives, instead developing nuanced representation practices that honor the full humanity and complexity of athletes with disability' experiences. Most critically, institutions must establish comprehensive support systems that explicitly acknowledge the substantial emotional labor involved in digital advocacy, providing concrete resources, mental health support, and compensation structures that recognize athletes with disability' educational and advocacy contributions as valuable professional work rather than expected charity.

While this study provides valuable insights into athletes with disability' social media experiences, several areas warrant further investigation. Longitudinal research could examine how these experiences evolve over time and across different career stages, while comparative studies might explore variations across different sports, disability types, or cultural contexts. Future studies could focus on specific populations. Additionally, studies focusing on the perspectives of audiences, media professionals, and platform designers could provide a more comprehensive understanding of the digital ecosystem surrounding athletes with disability.

Study Limitations

This study's limitations include a small sample size of 15 participants that may limit generalizability across different disability types, sports contexts, and cultural backgrounds. Recruitment bias likely favored active social media users, potentially excluding less digitally engaged athletes or those who have withdrawn from online platforms. The cross-sectional design captured experiences at a single point in time, missing evolving

digital engagement patterns, while platform-specific variations and cultural/linguistic diversity were not fully explored. Additionally, researcher positionality may have influenced data interpretation, and reliance on self-reporting could introduce social desirability bias and exclude athletes with limited digital access or literacy.

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Competing Interests

The authors declare no financial, professional, or personal competing interests that could have inappropriately influenced this research.

Informed Consent

Comprehensive written consent was obtained from all participants covering study purpose, voluntary participation, confidentiality measures, data storage timelines, and publication plans. Privacy protection involved pseudonyms, data de-identification, secure storage, and audio file deletion after five years. Special considerations for athletes with disability included maintaining dignity, acknowledging power dynamics, and providing opportunities to review interpretations.

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ORIGINAL ARTICLE

Are Artificial Intelligence-Prescribed Exercise Programs Valid for General Health and Weight Loss?

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Abstract: This study aims to examine the validity of prescribed AI-generated exercise interventions for general health and weight loss. This study developed an AI-generated exercise program using the Delphi method. The Delphi process involved administering a structured questionnaire within the relevant domain, whereby a panel of experts evaluated the appropriateness of the program. To assess validity, three established measures were employed: the Content Validity Ratio (CVR), the Content Validity Index (CVI), and the Impact Score (IS). In addition, the Fleiss' Kappa coefficient (κ) was calculated to determine the degree of agreement (reliability) among the experts. All statistical analyses were conducted using SPSS software version 27 and Microsoft Excel. The IS indicates that all exercises achieved the required level of validity. Also, based on the CVI and CVR, all exercises demonstrated acceptable content validity for general health and weight loss. However, the negative kappa value suggests poor agreement among the experts for the mentioned variables. Findings indicate that while platforms such as ChatGPT-4o can produce broadly



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appropriate exercise content, expert agreement on the validity of these protocols was very low. Accordingly, AI should be viewed as a supplementary tool that can assist in designing individualized health and weight management programs.

Keywords: CVI, CVR, AI generated program, ChatGPT-40, Weight Management Program

Introduction

The rise of artificial intelligence (AI) in healthcare provides new possibilities for personalized health management (Canzone et al., 2025a), with AI-based fitness applications becoming more common and facilitating opportunities for individualized exercise prescription (Canzone et al., 2025b; Mohan et al., 2020). AI-driven exercise prescription, using neural networks and logistic regression, tailors training programs to user needs and is expanding in the fitness domain (Masagca, 2024). Although the use of new technologies is associated with sedentary behavior (Gordon-Larsen et al., 2004), AI has now emerged as a promising tool to overcome barriers, offering innovative and personalized solutions to meet the individual needs of those who use it (Rosa, 2025). Furthermore, findings from previous studies indicate that AI has been effective in promoting physical activity among various populations, including children, adolescents, adults, and the elderly (Salamati et al., 2025), and individuals with disabilities (Ebrahimi et al., 2024). Moreover, the use of artificial intelligence can be crucial in public health. In a systematic review of the use of chatbots for healthcare applications, Xu et al. describe integrating these elements into clinical practice, such as weight loss and general, equipping healthcare workers with a valuable resource (Xu et al., 2021). According to the World Health Organization (WHO), overweight and obesity have emerged as major global public health challenges, reaching epidemic proportions (Organization, 2022). Dietary habits, physical activity levels, genetics, environmental exposures, and socioeconomic status all contribute to their development (Waxman, 2004; Zhang et al., 2017). Exercise serves as an integral part of weight management programs, particularly for weight maintenance, with activities like walking, running, and cycling being most effective for reducing body fat (Jagsz & Sikora, 2025; Petridou et al., 2019). Evidence from studies applying AI for weight loss and physical activity prescription indicates that AI can facilitate food recognition, eating behavior assessment, physical activity monitoring, and energy balance estimation (Chew, 2022), while also enhancing weight loss prediction, intervention adherence, and activity levels (Chew et al., 2021; Oh et al., 2021). Additionally, lack of physical activity is a leading modifiable factor driving the global burden of disease (Liu et al., 2025). It is linked to conditions such as cardiovascular disease, type 2 diabetes, several forms of cancer, depression, and early death (Xu et al., 2022). According to the WHO, more than five million deaths each year can be traced to insufficient activity, placing it among the most pressing public health issues of this century (Santos et al., 2023). To counter these risks, adults are advised to engage in 150 to 300 minutes of moderate-intensity aerobic activity each week and include muscle-strengthening workouts on at least two days (Brellenthin et al., 2022). Regarding public health, considerable efforts have been directed toward implementing AI in clinical practice. Park et al. (2020) reported that AI-based public health technologies demonstrated remarkable performance in accurately

diagnosing and classifying patient conditions, as well as predicting disease trajectories from aggregated medical data (Park et al., 2020).

Despite growing interest in AI-driven exercise prescription, current research remains confined to specific musculoskeletal outcomes. For instance, a recent study validated AI-generated programs for improving Upper Crossed Syndrome and Dynamic Knee Valgus, demonstrating that AI can produce clinically plausible exercise plans (Sheikh Hoseini et al., 2025). Prior studies have not explicitly addressed the extent to which these AI-designed programs are valid and effective in achieving these outcomes, nor have they evaluated whether AI can generate evidence-based, high-quality training plans tailored to such health-related variables. Therefore, the current study is presented as a validation pilot, aimed at testing the feasibility and preliminary validity of AI-generated exercise prescriptions for general health and weight management. The present study addresses this gap by applying established content validation approaches, Content Validity Ratio (CVR), Content Validity Index (CVI), and Impact Scores (IS). It should be considered that this represents one of the first attempts to employ such methods in the context of AI-prescribed exercise prescription.

Materials and Methods

The study focused on creating an AI-generated exercise program designed for general health and weight loss, employing the Delphi method for validation. This method involves circulating a structured questionnaire within a specialized domain, allowing a panel of experts to evaluate the appropriateness and relevance of the program. The research panel included physiotherapists with at least five years of clinical experience, university faculty members specializing in rehabilitation and corrective exercise with documented academic contributions, exercise physiology experts, and certified sports science coaches. A statistician and a research methodology specialist with extensive experience in applied studies also contributed. The study was approved by the Ethics Committee of Allameh Tabataba'i University (Code: IR/ethics.2024.81200.1143), and the participants gave written informed consent.

Three methods were used to determine validity: Content validity ratio (CVR), content validity index (CVI), and Impact Score (IS). Ten experts in corrective exercise and sports injuries, who were university professors, were asked to choose one of three options to determine the CVR: a) Necessary, b) Helpful but not necessary, and c) Necessary for each question or item. According to Lawshe's table (Romero Jeldres et al., 2023), if the score obtained for each question is more significant than 0.62 (based on evaluations from ten experts), it suggests that the question is essential to be included in the tool with an acceptable level of significance. Ten experts were asked to evaluate each question's CVI, relevance, clarity, simplicity, and ambiguity using a 4-point Likert scale. One way to assess the relationship between two items is by using a scale of 1 to 4. The options are "no relation", "somewhat related", "good relation", and "very high relation". CVI was calculated as the percentage of items with agreeable points (ranks 3 and 4) among the total voters. The CVI score required for item acceptance was higher than 0.79 (Romero Jeldres et al., 2023). Moreover, IS was used to assess each item's importance and relevance based on expert consensus. Ten experts were asked to rate each exercise or component of the protocol on a 5-point Likert scale ranging from 1 (not important) to 5 (very important). The impact score for each item was calculated using the following formula: $IS = \text{Frequency (\%)} \times \text{Importance (mean score)}$. An $IS \geq 1.5$ was considered acceptable and indicative of

satisfactory face validity, as per established psychometric validation guidelines (Zamanzadeh et al., 2015). This approach ensured that only exercises deemed both clinically relevant and contextually appropriate by the expert panel were retained in the final protocol.

Additionally, the Fleiss Kappa coefficient (g) was calculated to assess the degree of agreement (reliability) between the experts' responses. The interpretation of this coefficient was based on the following criteria (Fleiss et al., 2013): (a) $g \leq 0.4$: weak or poor reliability; (b) $0.4 < g \leq 0.6$: moderate reliability; (c) $0.6 < g \leq 0.8$: good reliability and, (d) $g > 0.8$: excellent reliability.

Participants and Sampling. Moreover, two Iranian participants were assessed in this study, one for general health (age: 22 years, weight: 65kg, and height: 185cm) and the other for weight loss (age: 60 years, weight: 90kg, and height: 162cm). Inclusion criteria were adults aged 18–65 years, Free from acute or uncontrolled chronic illnesses, completion of the PAR-Q (Physical Activity Readiness Questionnaire), Body Mass Index (BMI) ≥ 25 kg/m², and not having any musculoskeletal injuries (past 6 months). Exclusion criteria included neurological conditions, recent acute musculoskeletal discomfort, lower limb or spinal surgical history, or any other condition that would make it unsafe to participate in functional tests. Furthermore, all assessments were conducted by a qualified specialist with relevant professional experience.

General Health Assessment. General health was evaluated using the Physical Activity Readiness Questionnaire (PAR-Q), a widely used and clinically validated screening tool designed to identify individuals who may be at risk of adverse events during physical activity (Venkataraman et al., 2024). The PAR-Q consists of a series of structured questions addressing cardiovascular, musculoskeletal, and other health conditions that could contraindicate exercise participation. The participant completed the questionnaire before beginning the study, and responses were reviewed to ensure safety for engagement in the AI-prescribed exercise program. Individuals reporting positive responses indicating potential risk were flagged for further medical evaluation before participation. This assessment provided an objective and standardized method to confirm the participant's suitability for exercise and established a baseline for monitoring health outcomes throughout the intervention.

Obesity Assessment. Obesity status was evaluated using BMI, a clinically validated and widely used anthropometric indicator of excess body weight relative to height (Khanna et al., 2022). The Participant's weight was measured using a calibrated digital scale, and height was recorded with a stadiometer; BMI was then calculated as weight in kilograms divided by height in meters squared (kg/m²). A BMI ≥ 30 kg/m² was used to classify the participant as obese, in accordance with WHO guidelines. This objective measurement provided a standardized baseline for identifying participants with obesity and for monitoring potential changes in body composition following the AI-prescribed exercise intervention.

Intervention/Procedures. Following the initial assessment and identification of the participants, an 8-week exercise protocol was designed using ChatGPT-4o. Specific, evidence-based prompts, grounded in exercise science, public health guidelines, and weight management principles, were used to generate a personalized training regimen aimed at improving overall health and weight loss. Moreover, to ensure the clarity, relevance, and consistency of the AI-generated content used in this study, we utilized the Originality. AI

Prompt Generator for crafting each prompt. This tool was employed to systematically generate prompts used for analysis, content creation, and communication within the study framework.

The prompt of General Health: You're a seasoned fitness coach with over 15 years of experience in designing personalized workout programs based on the FITT principles (Frequency, Intensity, Time, and Type). You specialize in creating effective and sustainable fitness plans that cater to individual needs and goals, ensuring optimal results while considering the client's current physical condition and lifestyle. Your task is to write an 8-week general health (fitness) program for a student. Here are the details to consider: - Age: 22 - Weight: 65 kg - Height: 185 cm - Current Activity Level: No special physical activity - Body Type: mesomorph. Please ensure that the program incorporates the FITT principles effectively and includes a variety of exercises to maintain motivation and engagement throughout the 8 weeks. Include considerations for progression and recovery, and highlight any important factors that the student should keep in mind while following the program (Supplementary file 1).

The prompt of Weight Loss: You're a certified fitness coach and nutritionist with over 15 years of experience in creating personalized weight loss programs for diverse clients. Your specialty lies in developing safe and effective plans that cater to individual health conditions and lifestyle factors while emphasizing the FITT principles (Frequency, Intensity, Time, and Type) for optimal results. - Age: 60 - Weight: 90 kg - Height: 162 cm - Job: Housewife - Special considerations: Pain in knees and Osteoarthritis, history of back pain (healed), no signs of blood pressure issues, Fasting Blood Sugar: 100 mmol/L (Supplementary file 1).

Data analysis. To calculate the level of agreement among experts, Fleiss' Kappa coefficient was used. In addition, to assess the validity of the exercises, three key indices were employed: CVR, CVI, and IS. Data analysis was performed using SPSS version 27 and Microsoft Excel version 2024.

Results

According to Table 1, the IS indicates that all exercises possess the required level of validity. Also, based on the CVI and CVR, all exercises demonstrated acceptable content validity. Additionally, the Fleiss' Kappa coefficient for expert agreement on the entire set of exercises was -0.16, with a 95% confidence interval ranging from -0.038 to 0.014 (Table 2). This negative kappa value suggests poor agreement among the experts, indicating that their evaluations may not be consistent beyond a chance level.

Table 1. Validity of weight loss exercises

| <i>Exercises</i> | <i>IS</i> | <i>CVI</i> | <i>CVR</i> |
|------------------|-----------|------------|------------|
| 1 | 3.9 | 0.8 | 0.9 |
| 2 | 4.1 | 1.2 | 0.8 |
| 3 | 4.2 | 0.9 | 0.8 |
| 4 | 4.1 | 1.1 | 0.8 |
| 5 | 4 | 1 | 0.9 |
| 6 | 3.8 | 1.3 | 0.9 |
| 7 | 4.5 | 0.9 | 0.9 |
| 8 | 4.3 | 0.8 | 0.8 |
| 9 | 4.4 | 0.9 | 0.7 |
| 10 | 4 | 0.9 | 1.2 |
| 11 | 3.7 | 0.8 | 1.3 |
| 12 | 3.5 | 1.1 | 0.8 |
| 13 | 3.4 | 0.8 | 1.1 |
| 14 | 3.1 | 1.2 | 0.9 |
| 15 | 2.4 | 1.3 | 0.8 |
| 16 | 3.2 | 1.1 | 0.8 |
| 17 | 3.3 | 0.9 | 0.9 |
| 18 | 4.5 | 1.3 | 1.5 |

IS>1.5, CVR => 0.62, CVI => 0.79, IS Impact Score, CVR Content Validity Ratio, CVI Content Validity Index

Table 2. Fleiss' Kappa Coefficient for weight loss

| Confidence Interval | | Fleiss' Kappa |
|---------------------|-------------|---------------|
| Upper Bound | Lower Bound | |
| 0.14 | -0.038 | -0.12 |

$g \leq 0.4$: weak or poor reliability; $0.4 < g \leq 0.6$: moderate reliability; $0.6 < g \leq 0.8$: good reliability and, $g > 0.8$: excellent reliability

According to Table 3, the IS indicates that all exercises possess the required level of validity. Also, based on the CVI and CVR, all exercises demonstrated acceptable content validity. Additionally, the Fleiss' Kappa coefficient for expert agreement on the entire set of exercises was -0.16, with a 95% confidence interval ranging from -0.050 to 0.017 (Table 4). This negative kappa value suggests poor agreement among the experts, indicating that their evaluations may not be consistent beyond a chance level.

Table 3. Validity of general health exercises

| <i>Exercises</i> | <i>IS</i> | <i>CVI</i> | <i>CVR</i> |
|------------------|-----------|------------|------------|
| 1 | 4.1 | 0.9 | 0.8 |
| 2 | 4.4 | 1.3 | 0.9 |
| 3 | 4.4 | 0.8 | 0.7 |
| 4 | 3.1 | 1.2 | 0.9 |
| 5 | 4.7 | 1.3 | 0.9 |
| 6 | 4.8 | 1.4 | 0.8 |
| 7 | 4.8 | 0.8 | 0.9 |
| 8 | 4.7 | 0.9 | 0.9 |
| 9 | 4.5 | 0.9 | 0.8 |

IS>1.5, CVR => 0.62, CVI => 0.79, IS Impact Score, CVR Content Validity Ratio, CVI Content Validity Index

Table 4. Fleiss' Kappa Coefficient for general health

| Confidence Interval | | Fleiss' Kappa |
|---------------------|-------------|---------------|
| Upper Bound | Lower Bound | |
| 0.017 | -0.050 | -0.15 |

$g \leq 0.4$: weak or poor reliability; $0.4 < g \leq 0.6$: moderate reliability; $0.6 < g \leq 0.8$: good reliability and, $g > 0.8$: excellent reliability

Discussion

Leveraging AI to design exercise programs represents an emerging and innovative approach, valued for its ability to scale interventions and adapt to individual needs. In this study, ChatGPT-4o was employed to generate personalized, 8-week exercise programs aimed at improving general health and promoting weight loss. These programs were structured using the FITT principles to ensure systematic progression and adherence to current public health and exercise science guidelines. Evaluations by domain experts using content validity measures (including CVR, CVI, and IS) indicated that the AI-generated exercises were generally relevant and appropriate; however, consensus among experts was low, highlighting substantial variability in judgments despite the overall quality of the program. This suggests that, although AI can generate plausible exercise recommendations, expert oversight remains necessary to refine and ensure the clinical applicability of these programs.

Prior research supports the potential of AI in health-focused exercise prescription. For example, studies investigating AI-generated fitness and calisthenics programs have shown improvements in health-related physical fitness components, though professionally designed interventions were sometimes superior in certain measures (Dergaa et al., 2024; Masagca, 2025). Similarly, AI-based programs for balance, core stability, and functional movement in specialized populations have demonstrated efficacy when combined with expert supervision (Ebrahimi et al., 2024; Salamati et al., 2025). These findings highlight that AI can

produce theoretically sound, evidence-informed exercise content; however, human oversight is essential to ensure safety, contextual appropriateness, and individualized progression (Washif et al., 2024). The AI-generated programs adhered to FITT principles and included commonly recommended exercises for health and weight management. This likely involved a combination of moderate-intensity aerobic activity, resistance training to improve muscular strength and endurance, and flexibility exercises to support functional movement and injury prevention. Prior work has shown that structured AI-assisted exercise protocols can serve as effective tools for improving cardiovascular health, metabolic outcomes, and body composition, particularly when tailored to individual anthropometrics and baseline fitness levels (Muse & Topol, 2024; Nasb et al., 2025)

One of the most concerning outcomes of this study was the poor reliability among experts, as reflected in Fleiss' Kappa coefficient. This negative value implies that the agreement among reviewers was worse than random chance. This could result from multiple factors: variability in expert backgrounds (e.g., physiotherapy, biomechanics, sports coaching), ambiguities or inconsistencies in the AI-generated content, and differences in interpretative criteria for what constitutes a "valid" exercise program. Moreover, to improve reliability in future studies, methodological refinements are recommended. These include calibration meetings prior to independent scoring, consensus-building exercises, and the use of standardized evaluation rubrics to reduce ambiguity and enhance inter-rater agreement. The use of AI platforms like ChatGPT-4o may accelerate the development of first-draft rehabilitation protocols, reduce planning time for clinicians, and allow for mass customization (Neha et al., 2024). However, validation mechanisms such as CVR and CVI, as employed here, are essential before any AI-generated program can be adopted clinically.

Limitations and Suggestions

AI lacks the experiential judgment and contextual understanding required to account for complex factors such as specific pathologies, comorbidities, stages of recovery, or an individual's readiness and psychosocial context. Consequently, AI should be regarded not as a replacement for human expertise, but as a supportive tool that can generate initial exercise plans, which must then be refined and adapted by clinicians. This hybrid approach enables healthcare professionals to leverage the efficiency and scalability of AI while maintaining the necessary oversight to ensure safety and individualized care. The study's main limitations include the small sample size ($n = 2$ participants) and the absence of follow-up data on actual health outcomes. Additionally, the small expert panel ($n = 10$) likely contributed to variability in validation indices. Moreover, using ChatGPT-4o with structured prompts may introduce potential bias, as the quality and content of the generated exercise plans are dependent on the skill of prompt design. Finally, although multiple validation metrics were employed (CVR, CVI, IS), the observed poor inter-rater agreement diminishes confidence in the reported results. Due to these limitations, the findings cannot be generalized to larger populations, and the study should be considered a preliminary validation pilot rather than an effectiveness trial.

Conclusions

This study represents an initial effort to explore the validity of AI-generated exercise programs for promoting general health and supporting weight loss. The findings indicate that while platforms such as ChatGPT-4o can produce broadly appropriate exercise content, there remains considerable variability in expert agreement with established validity standards. Accordingly, AI should be viewed as a supplementary tool that can assist in designing individualized health and weight management programs, rather than as a standalone solution, with professional oversight remaining essential for safe and effective implementation.

Declarations

Authors' contribution

EE, RS, RE, and HP contributed to the study design and data collection. RS and EE drafted the manuscript and made critical revisions. All authors read and approved the final manuscript.

Conflict of Interest

All authors have no conflict of interest to declare.

Ethical Considerations

The study was approved by the Ethics Committee of Allameh Tabataba'i University (Code: IR/ethics.2024.81200.1143), and all participants gave written informed consent. Participants were also explicitly informed of their right to withdraw from the study at any time without any penalty or loss of benefits. The authors confirm that all methods followed the relevant guidelines and regulations.

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Availability of Data and Materials

The data that support the findings of this study are available on request from the corresponding author.

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Appendix

Weight Loss Protocols

Prompt

You're a certified fitness coach and nutritionist with over 15 years of experience in creating personalized weight loss programs for diverse clients. Your specialty lies in developing safe and effective plans that cater to individual health conditions and lifestyle factors while emphasizing the FITT principles (Frequency, Intensity, Time, and Type) for optimal results.

Your task is to write an 8-week weight loss program for a woman. Here are her details:

- Age: 60
- Weight: 90 kg
- Height: 162 cm
- Job: Housewife
- Special considerations: Pain in knees and Osteoarthritis, history of back pain (healed), no signs of blood pressure issues, Fasting Blood Sugar: 100 mmol/L

Keep in mind that the program should focus on low-impact exercises that accommodate her knee pain and overall health, incorporating balanced nutrition guidelines to support her weight loss goals. Please provide a breakdown of the weekly plan, including specific exercises, duration, and modifications for her conditions.

8-Week Weight Loss Program for a 60-Year-Old Woman with Osteoarthritis and Knee Pain

**General Principles: **

- ****Low-Impact Movement****: All exercises will be low-impact to reduce stress on the knees and avoid exacerbating osteoarthritis. These exercises also help minimize the risk of injury while allowing her to burn calories and lose weight.
- ****Strengthening Muscles****: Strengthening the muscles surrounding the knee, hips, and core will help support the joints and improve function, reducing the pain associated with osteoarthritis.
- ****Focus on Nutrition****: Balanced meals with a focus on whole, anti-inflammatory foods that support healthy blood sugar levels and fat loss.
- ****Rest and Recovery****: Adequate rest, stretching, and proper hydration are essential for recovery and to prevent overuse injuries.

Week 1-2: Foundation Phase – Building Strength & Mobility

**1. Walking (or Stationary Bike) **

- ****Duration****: 10-20 minutes, 2-3 days per week
- ****Intensity****: Slow to moderate pace (aim for a comfortable pace, where speaking is still possible)
- ****Modification****: If walking outdoors is painful, use a stationary bike or recumbent bike for a gentler movement that does not strain the knees.

Mark your level according to the exercise

| | | | | | | |
|------------------------------|-------------------------------|----------------------|--|-------------------|----------------------------|---------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
|------------------------------|-------------------------------|----------------------|--|-------------------|----------------------------|---------------------------|

Do you have suggestions for this exercise?

****2. Seated Leg Extensions (Knee Strengthening) ****

- ****Target****: Quadriceps, knee joint stabilization
- ****How to Perform****: Sit in a sturdy chair with feet flat on the floor. Slowly extend one leg straight in front of you, hold for 1-2 seconds, and lower back down. Repeat on both legs.
- ****Reps****: 2 sets of 10-12 reps per leg
- ****Modification****: Start with very light resistance (e.g., bodyweight only) to avoid stressing the knee joint.

Mark your level according to the exercise:

| | | | | | | |
|------------------------------|-------------------------------|----------------------|--|-------------------|----------------------------|---------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
|------------------------------|-------------------------------|----------------------|--|-------------------|----------------------------|---------------------------|

Do you have suggestions for this exercise?

****3. Wall Push-ups (Upper Body Strength) ****

- ****Target****: Chest, arms, shoulders
- ****How to Perform****: Stand facing a wall with feet about 2 feet away. Place hands on the wall, shoulder-width apart. Slowly bend your elbows and lower your chest toward the wall, then press back up.
- ****Reps****: 2 sets of 10-12 reps
- ****Modification****: Keep the body in a straight line, and avoid arching the lower back.

Mark your level according to the exercise:

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|------------------------------|-------------------------------|----------------------|--|-------------------|----------------------------|---------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
|------------------------------|-------------------------------|----------------------|--|-------------------|----------------------------|---------------------------|

Do you have suggestions for this exercise?

****4. Glute Bridges****

- ****Target****: Glutes, lower back, core, hip muscles
- ****How to Perform****: Lie on your back with knees bent, feet flat on the floor, and arms by your sides. Push through your heels, lift your hips to form a straight line from shoulders to knees, hold for 2-3 seconds, and lower back down.
- ****Reps****: 2 sets of 12-15 reps
- ****Modification****: Keep the core engaged throughout the movement.

Mark your level according to the exercise:

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|-------------------------------------|--------------------------------------|-----------------------------|---|--------------------------|-----------------------------------|----------------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
|-------------------------------------|--------------------------------------|-----------------------------|---|--------------------------|-----------------------------------|----------------------------------|

Do you have suggestions for this exercise?

****5. Stretching Routine****

- ****Target****: Hamstrings, quadriceps, calves, lower back
- ****Duration****: 10-15 minutes post-workout, focusing on mobility and reducing muscle tightness.
- ****Types of Stretches****: Hamstring stretch, quad stretch (standing or lying), calf stretch, and gentle back stretches (e.g., child's pose or cat-cow for the spine).

Mark your level according to the exercise:

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|-------------------------------------|--------------------------------------|-----------------------------|---|--------------------------|-----------------------------------|----------------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
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Do you have suggestions for this exercise?

**Week 3-4: Building Endurance & Strength******1. Chair Squats (Knee-Friendly)****

- ****Target****: Quadriceps, glutes, hips
- ****How to Perform****: Stand in front of a sturdy chair with feet shoulder-width apart. Slowly bend your knees and lower your hips as if you're going to sit down, but before you touch the chair, stand back up. Ensure knees don't go past toes.
- ****Reps****: 2 sets of 10-12 reps

- **Modification**: Use a chair or wall for support if necessary.

Mark your level according to the exercise:

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|-------------------------------------|--------------------------------------|-----------------------------|---|--------------------------|-----------------------------------|----------------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
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Do you have suggestions for this exercise?

2. Step-Ups (Low Step)

- **Target**: Glutes, quads, hamstrings

- **How to Perform**: Using a low step (6-8 inches), step one foot onto the step and push through the heel to lift your body up. Step down and repeat on the other side.

- **Reps**: 2 sets of 10 reps per side

- **Modification**: Use a support (e.g., chair or handrail) if needed for balance.

Mark your level according to the exercise:

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|-------------------------------------|--------------------------------------|-----------------------------|---|--------------------------|-----------------------------------|----------------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
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Do you have suggestions for this exercise?

3. Dumbbell Bicep Curls

- **Target**: Arms, biceps

- **How to Perform**: Stand or sit tall with a dumbbell in each hand. Keeping elbows close to your sides, curl the weights toward your shoulders, then lower back down.

- **Reps**: 2 sets of 12-15 reps

- **Modification**: Start with light dumbbells (1-3 kg) to avoid strain on the wrists.

Mark your level according to the exercise:

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|-------------------------------------|--------------------------------------|-----------------------------|---|--------------------------|-----------------------------------|----------------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
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Do you have suggestions for this exercise?

****4. Seated Row with Resistance Band****

- ****Target****: Upper back, shoulders, arms
- ****How to Perform****: Sit with legs extended, loop a resistance band around the soles of your feet, and hold the ends. Pull the band towards you, elbows close to the body, squeezing your shoulder blades together.
- ****Reps****: 2 sets of 12-15 reps
- ****Modification****: Use a resistance band with adjustable resistance.

Mark your level according to the exercise:

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|-------------------------------------|--------------------------------------|-----------------------------|---|--------------------------|-----------------------------------|----------------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
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Do you have suggestions for this exercise?

****5. Core Exercises****

- ****Target****: Abdominals, obliques
- ****Examples****:
 - ****Seated Marching****: Sit tall and alternate lifting one knee at a time towards your chest, engaging the core.
 - ****Pelvic Tilts****: Lie on your back, knees bent, and gently tilt the pelvis to flatten the lower back, engaging the abdominal muscles.
- ****Reps****: 2 sets of 10-12 reps for each exercise

Mark your level according to the exercise:

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|-------------------------------------|--------------------------------------|-----------------------------|---|--------------------------|-----------------------------------|----------------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
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Do you have suggestions for this exercise?

**Week 5-6: Increasing Strength and Cardiovascular Endurance**

****1. Swimming or Water Aerobics (Optional but Excellent for Joint Health)****

- ****Duration****: 20-30 minutes
- ****Intensity****: Moderate (focus on controlled, rhythmic movements)
- ****Modification****: Swim or perform water exercises to minimize joint stress.

Mark your level according to the exercise:

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|-------------------------------------|--------------------------------------|-----------------------------|---|--------------------------|-----------------------------------|----------------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
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Do you have suggestions for this exercise?

****2. Resistance Band Squat to Press****

- ****Target****: Lower body, arms, and shoulders
- ****How to Perform****: Perform a squat while holding a resistance band at shoulder height. As you rise from the squat, press the band overhead.
- ****Reps****: 2 sets of 10-12 reps

Mark your level according to the exercise:

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|-------------------------------------|--------------------------------------|-----------------------------|---|--------------------------|-----------------------------------|----------------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
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Do you have suggestions for this exercise?

3. Deadlifts (With Light Dumbbells or Resistance Band)**

- ****Target****: Hamstrings, glutes, lower back
- ****How to Perform****: Stand with feet hip-width apart. With slight bend in knees, hinge at the hips to lower weights down toward the floor, keeping a straight back. Engage glutes to return to standing.
- ****Reps****: 2 sets of 10-12 reps

Mark your level according to the exercise:

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|------------------------------|-------------------------------|----------------------|--|-------------------|----------------------------|---------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
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Do you have suggestions for this exercise?

4. Resistance Band Lateral Leg Raises**

- **Target**: Hip abductors, gluteus medius

- **How to Perform**: With a resistance band around your legs, lift one leg out to the side while keeping your torso upright. Return to starting position.

- **Reps**: 2 sets of 12 reps per side

Mark your level according to the exercise:

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|------------------------------|-------------------------------|----------------------|--|-------------------|----------------------------|---------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
|------------------------------|-------------------------------|----------------------|--|-------------------|----------------------------|---------------------------|

Do you have suggestions for this exercise?

Week 7-8: Focus on Intensity and Fat Loss

1. Interval Walking or Cycling

- **Duration**: 30 minutes of alternating between fast and moderate-paced walking or cycling for 1-2 minute intervals.

- **Intensity**: Moderate to high during fast intervals.

Mark your level according to the exercise:

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|------------------------------|-------------------------------|----------------------|--|-------------------|----------------------------|---------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
|------------------------------|-------------------------------|----------------------|--|-------------------|----------------------------|---------------------------|

Do you have suggestions for this exercise?

****2. Squat Holds with Calf Raises****

- ****Target****: Quads, calves, glutes

- ****How to Perform****: Hold a squat position (slightly above parallel) and perform small calf raises while maintaining the squat hold.

- ****Reps****: 2 sets of 10-12 reps

Mark your level according to the exercise:

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|-------------------------------------|--------------------------------------|-----------------------------|---|--------------------------|-----------------------------------|----------------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
|-------------------------------------|--------------------------------------|-----------------------------|---|--------------------------|-----------------------------------|----------------------------------|

Do you have suggestions for this exercise?

****3. Chair Dips (for Triceps)****

- ****Target****: Upper arms (triceps)

- ****How to Perform****: Sit on the edge of a sturdy chair, place hands on the chair for support, and slowly lower the body down by bending the elbows. Push back up to starting position.

- ****Reps****: 2 sets of 10 reps

Mark your level according to the exercise:

| | | | | | | |
|-------------------------------------|--------------------------------------|-----------------------------|---|--------------------------|-----------------------------------|----------------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
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Do you have suggestions for this exercise?

**Nutrition Guidelines:**

1. ****Balanced Meals****: Include a mix of lean proteins, complex carbohydrates, healthy fats, and plenty of vegetables.

- ****Protein****: Chicken, turkey, tofu, beans, lentils, fish (salmon, mackerel, sardines)

- ****Carbohydrates****: Whole grains (brown rice, quinoa, oats), sweet potatoes, and non-starchy vegetables (spinach, broccoli, zucchini)

- **Fats**: Olive oil, avocado, nuts, seeds
- **Avoid**: Processed sugars, refined carbs (white bread, sugary snacks)

2. **Blood Sugar Management**: Focus on meals that have a low glycemic index to prevent spikes in blood sugar levels.

- **Include**: Fiber-rich foods (vegetables, whole grains, legumes)
- **Avoid**: High-sugar and high-fat foods, which can lead to increased blood sugar and insulin resistance.

3. **Hydration**: Drink at least 8 cups (2 liters) of water per day to stay hydrated and support fat loss.

Mark your level according to the exercise:

| | | | | | | |
|------------------------------|-------------------------------|----------------------|--|-------------------|----------------------------|---------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
|------------------------------|-------------------------------|----------------------|--|-------------------|----------------------------|---------------------------|

Do you have suggestions for this exercise?

General Health Protocols

Prompt: You're a seasoned fitness coach with over 15 years of experience in designing personalized workout programs based on the FITT principles (Frequency, Intensity, Time, and Type). You specialize in creating effective and sustainable fitness plans that cater to individual needs and goals, ensuring optimal results while considering the client's current physical condition and lifestyle.

Your task is to write an 8-week general health (fitness) program for a student. Here are the details to consider:

- Age: 22
- Weight: 65 kg
- Height: 185 cm
- Current Activity Level: No special physical activity
- Body Type: mesomorph

Please ensure that the program incorporates the FITT principles effectively and includes a variety of exercises to maintain motivation and engagement throughout the 8 weeks. Include considerations for progression and recovery, and highlight any important factors that the student should keep in mind.

Warm-Up Routine (5-10 minutes)

A good warm-up is key to preventing injury and improving exercise performance.

1. **Dynamic Stretches** (2-3 minutes)

- **Arm Circles**: 10 reps forward, 10 reps backward.
- **Leg Swings**: 10 reps front to back, 10 reps side to side.
- **Torso Twists**: 10 reps each side.

2. **Light Cardio** (3-5 minutes)

- Brisk walking or jogging
- Jump rope (if space allows)
- Stationary cycling or elliptical

Cool-Down Routine (5-10 minutes)

Focus on slow, deep breathing and static stretches.

1. **Hamstring Stretch**: Hold for 30 seconds on each side.
2. **Quad Stretch**: Hold for 30 seconds on each side.
3. **Chest Stretch**: Hold for 30 seconds, stretching arms wide.
4. **Child's Pose** (or Cat-Cow): Hold for 1 minute to stretch the back and hips.
5. **Calf Stretch**: Hold for 30 seconds on each side.

Week 1-2: Foundation Phase – Establishing Consistency

Frequency: 3 days per week

Intensity: Low to moderate

Time: 30 minutes per session

1. Full-Body Circuit (Strength & Conditioning)

- **Bodyweight Squats**: 2 sets of 10-12 reps
- **Push-ups** (knee or standard): 2 sets of 8-10 reps
- **Glute Bridges**: 2 sets of 10-12 reps
- **Plank**: Hold for 20-30 seconds (build up over time)
- **Walking Lunges**: 2 sets of 10 steps per leg
- **Rest**: 1-2 minutes between each circuit

Perform the circuit 2-3 times, depending on your energy level. Focus on proper form.

Mark your level according to the exercise:

| | | | | | | |
|-------------------------|--------------------------|-----------------|-----------------------------------|--------------|-----------------------|----------------------|
| Totally disagree | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree | Totally agree |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Do you have suggestions for this exercise?

2. Cardio (Low-Impact)*

- ****Brisk Walking**** or ****Cycling**** (stationary or outdoor):

- 20-30 minutes at a moderate pace, where talking is possible but slightly challenging.

Mark your level according to the exercise:

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|-------------------------------------|--------------------------------------|-----------------------------|---|--------------------------|-----------------------------------|----------------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
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Do you have suggestions for this exercise?

****3. Flexibility****

- ****Yoga or Stretching****: Follow a simple 5-10 minute routine that targets major muscle groups. Incorporate deep breathing for relaxation.

Mark your level according to the exercise:

| | | | | | | |
|-------------------------------------|--------------------------------------|-----------------------------|---|--------------------------|-----------------------------------|----------------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
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Do you have suggestions for this exercise?

**Week 3-5: Strength & Cardio Development Phase**

Frequency: 4 days per week

Intensity: Moderate (gradually increasing)

Time: 40-45 minutes per session

****1. Strength Training (Split Routine)****

- **Upper Body (Day 1)**
 - **Push-ups** (standard or incline): 3 sets of 10 reps
 - **Dumbbell Rows** (use light dumbbells or household items): 3 sets of 10-12 reps
 - **Bicep Curls** (using dumbbells): 3 sets of 10-12 reps
 - **Shoulder Press** (using dumbbells): 3 sets of 10-12 reps
- **Lower Body (Day 2)**
 - **Bodyweight Squats**: 3 sets of 12-15 reps
 - **Lunges** (bodyweight or with light dumbbells): 3 sets of 10 reps per leg
 - **Glute Bridges**: 3 sets of 12 reps
 - **Calf Raises**: 3 sets of 15-20 reps

Mark your level according to the exercise:

| | | | | | | |
|-------------------------------------|--------------------------------------|-----------------------------|---|--------------------------|-----------------------------------|----------------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
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Do you have suggestions for this exercise?

2. Cardio (Moderate Intensity)

- **Jogging** or **Brisk Walking** (outdoor or treadmill):
 - 30-35 minutes at a moderate pace, increasing your pace for short intervals (1-2 minutes) to elevate heart rate.

Mark your level according to the exercise:

| | | | | | | |
|-------------------------------------|--------------------------------------|-----------------------------|---|--------------------------|-----------------------------------|----------------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
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Do you have suggestions for this exercise?

3. Flexibility & Core Work

- **Plank**: Hold for 30-45 seconds (add more sets if easy)
- **Russian Twists**: 3 sets of 15 reps per side (can be done with or without weight)
- **Stretching or Yoga**: Follow a 10-minute routine to stretch key areas like hamstrings, quads, chest, and back.

Mark your level according to the exercise:

| | | | | | | |
|-------------------------------------|--------------------------------------|-----------------------------|---|--------------------------|-----------------------------------|----------------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
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Do you have suggestions for this exercise?

****Week 6-8: Performance & Progression Phase****

****Frequency****: 4-5 days per week

****Intensity****: Moderate to high (strength + cardio intervals)

****Time****: 45 minutes per session

****Type****: Increased intensity in both strength training and cardio

****1. Strength Training (Split Routine – 4 days per week)****

- ****Upper Body (Day 1)****

- ****Push-ups****: 3 sets of 12-15 reps
- ****Dumbbell Rows****: 3 sets of 12-15 reps
- ****Chest Press**** (dumbbells): 3 sets of 12-15 reps
- ****Lateral Raises**** (dumbbells): 3 sets of 12 reps

- ****Lower Body (Day 2)****

- ****Bodyweight or Weighted Squats****: 3 sets of 12-15 reps
- ****Lunges (Weighted or Bodyweight)****: 3 sets of 12 reps per leg
- ****Step-ups**** (with or without dumbbells): 3 sets of 12 reps per leg
- ****Hip Thrusts**** (using bench or mat): 3 sets of 12-15 reps

Mark your level according to the exercise:

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|-------------------------------------|--------------------------------------|-----------------------------|---|--------------------------|-----------------------------------|----------------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
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Do you have suggestions for this exercise

****2. Cardio (HIIT + Steady State Intervals)****

- ****HIIT on Treadmill/Cycling**** (Alternate 30 seconds high-intensity, 1 minute low-intensity):

- 20-25 minutes total (e.g., alternate between fast walking and jogging or cycling)

- ****Steady-State Cardio**** (Jogging, Brisk Walking, or Swimming):

- 25-30 minutes at moderate intensity

Mark your level according to the exercise:

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|-------------------------------------|--------------------------------------|-----------------------------|---|--------------------------|-----------------------------------|----------------------------------|
| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
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Do you have suggestions for this exercise?

****3. Flexibility & Core Work****

- ****Plank Variations****: 3 sets of 45 seconds (side planks, forearm planks)

- ****Leg Raises or Bicycle Crunches****: 3 sets of 12-15 reps

- ****Stretching or Yoga****: Incorporate dynamic and static stretches, holding each stretch for 30 seconds to 1 minute.

Mark your level according to the exercise:

| | | | | | | |
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| Totally disagree 1 | Strongly disagree 2 | Disagree 3 | Neither agree nor disagree 4 | Agree 5 | Strongly agree 6 | Totally agree 7 |
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Do you have suggestions for this exercise?



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ORIGINAL ARTICLE

The Effect of a Selected Aerobic Training Program on Cardiovascular Indices, Anxiety, and Aggression in Male Students with Hearing Impairment


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Abstract: The purpose of the present study was to determine the effect of a selected aerobic step training program on cardiovascular indices, maximal oxygen uptake ($VO_2\max$), subcutaneous fat, anxiety, and aggression in deaf male students. Thirty males with hearing impairment with a mean age of 19–25 years, height ranging from 167 to 186.5 cm, and weight between 51 and 105 kg were randomly divided into experimental ($n = 15$) and control ($n = 15$) groups. The training program for the experimental group lasted for six weeks, consisting of three sessions per week, each session lasting 45 minutes with an intensity of 80–85% of maximum heart rate (HR_{\max}). Pre- and post-tests were administered to measure aerobic capacity, anxiety, and aggression using the aerobic step test, Spielberger's Anxiety Inventory, and the Buss–Perry Aggression Questionnaire, respectively. Subcutaneous fat was measured using a



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skinfold caliper. Data were analyzed using independent t-tests and covariance analysis. The results revealed a significant increase in aerobic capacity as well as a significant decrease in anxiety, aggression, and subcutaneous fat percentage following the aerobic training intervention. Overall, the findings indicate that aerobic exercise has a positive effect on aerobic capacity adaptation, body composition, anxiety reduction, and aggression control in deaf individuals.

Keywords: Aerobic exercise, Maximal oxygen uptake (VO_{2max}), Anxiety, Aggression, Body fat percentage.

Highlights

- Aerobic training improved the cardiovascular capacity of adolescents with hearing impairment.
- A significant reduction in anxiety and aggression was observed following the exercise intervention.
- Aerobic exercise serves as an effective tool for promoting both physical and psychological health in individuals with hearing impairments.

Introduction

Hearing impairment, as one of the major global public health challenges, affects not only biological functioning but also various dimensions of quality of life, social interactions, and educational opportunities (Sabato et al., 2023). According to the World Health Organization (2021), more than 1.5 billion people worldwide suffer from some degree of hearing loss, of whom approximately 430 million experience disabling hearing impairment; a figure projected to exceed 700 million by 2050 (Chilton, 2025). Although the prevalence of hearing loss is generally higher among the elderly, an alarming increase has also been observed among young people and adolescents. Prolonged exposure to loud sounds, including the use of headphones and staying in noisy environments, has placed nearly 1.1 billion individuals aged 12 to 35 at risk of noise-induced hearing loss (Sabato et al., 2023). This indicates that hearing impairment is not limited to old age but has become an intergenerational issue. In Iran, similar statistics have been reported. According to data from the Ministry of Health, Treatment, and Medical Education (2024), more than 5.5 million people in the country experience some degree of hearing loss. Among children and adolescents, about 3 to 5 percent are affected, a significant portion of which results from environmental factors and modern lifestyle habits. Among the elderly, this rate is considerably higher, with approximately 48 percent of individuals over the age of 65 and almost all people over 80 experiencing some level of hearing loss (Jalilvand, 2021).

Aggression is defined as any behavior that is deliberately performed with the intention of causing harm to another individual. In order to control such behaviors, the perpetrator must believe that their action was aimed at harming another person, which consequently evokes avoidance behaviors in the target. Aggression may manifest in various forms. Its verbal and physical expressions represent the instrumental or behavioral components, anger reflects the emotional dimension, and hostility represents the cognitive aspect of aggression (Hafezian et al., 2020). Anxiety can also be defined as a feeling of worry accompanied by physiological arousal, which may arise from one or more of the following: threat to self-esteem caused by failure, physical danger (injury), ambiguity (unpredictability and fear of the unknown), or disruption of

daily life balance (Roos et al., 2021). In this regard, adolescents with hearing impairment—who are in a critical stage of developing social and emotional behaviors—show greater vulnerability to various forms of maltreatment and abuse compared to their hearing peers. Evidence indicates that this group is two to three times more likely to experience violence and abuse, which can lead to the emergence or exacerbation of disorders such as anxiety, depression, and aggressive behaviors (Karic et al., 2023). These findings clearly demonstrate that hearing impairment is a multidimensional phenomenon that not only affects an individual's health but also directly influences social participation, equitable access to educational opportunities, and the realization of health equity at the societal level. Therefore, addressing this issue and designing specialized interventions tailored to the unique characteristics of the hearing impairment community are of vital importance from two perspectives: first, from a human rights standpoint, emphasizing the provision of equal conditions for achieving an adequate quality of life; and second, from a clinical effectiveness perspective, highlighting the necessity of developing practical and evidence-based solutions.

From an epidemiological and behavioral perspective, lifestyle changes in recent decades—particularly the reduction of physical activity—have imposed an additional burden on the biological and psychological systems of younger generations. Physical inactivity is associated with an increased risk of obesity, metabolic disorders, and cardiovascular diseases, and it also shows a significant relationship with the onset and exacerbation of mental disorders such as anxiety and depression (Fulton et al., 2022). In this regard, aerobic exercise, as a low-cost, safe, and scientifically well-supported intervention, has considerable potential for simultaneously promoting physical and mental health. Classical studies and numerous meta-analyses have demonstrated that regular aerobic activity leads to increased maximal aerobic capacity ($VO_2\text{max}$), improved body composition (reduced body fat percentage), and decreased symptoms of anxiety and aggression (Ouyang & Liu, 2023). From a physiological perspective, the increase in $VO_2\text{max}$ resulting from aerobic training is the outcome of a series of adaptations, including increased stroke volume and cardiac output, greater capillary density in active tissues, enhanced mitochondrial efficiency, and higher oxidative capacity in skeletal muscles. These adaptations ultimately result in more efficient oxygen utilization and improved ATP production (Li, 2022). Such physiological changes not only enhance physical performance and endurance but are also psychologically associated with reduced fatigue and increased self-efficacy. From a metabolic standpoint, elevated energy expenditure during and after exercise leads to a reduction in fat stores and improved body composition over the long term (Van Baak et al., 2021).

In explaining the psychological effects of aerobic exercise, several mechanisms can be proposed. First, the regulation of neuroendocrine systems: regular aerobic activity is associated with modulation of the hypothalamic–pituitary–adrenal (HPA) axis, increased secretion of endorphins, and changes in neurotransmitter levels such as serotonin and dopamine, all of which play essential roles in mood regulation and anxiety reduction (Fulton et al., 2022). Second, from a psychosocial perspective, participation in physical activities—especially in group settings—can strengthen social support networks, enhance self-efficacy, and improve emotion regulation and impulse control skills, all of which are linked to reduced aggression and anxiety (Peng et al., 2025; Tamminen et al., 2025). Despite existing evidence on the general

benefits of physical activity, limited studies have examined the simultaneous effects of structured exercise interventions on both physiological and psychological indices in adolescents with hearing impairment (Liu et al., 2022; Jones & Smith, 2021). Previous research has commonly suffered from methodological limitations such as non-random sampling, lack of appropriate control groups, incompatibility of measurement tools with the characteristics of people with hearing impairment, and short follow-up durations. Accordingly, the present study was designed to fill this research gap by focusing on the fundamental question: Can a selected aerobic training program simultaneously improve aerobic capacity ($VO_2\text{max}$) and body composition while reducing symptoms of anxiety and aggression in adolescents with hearing impairment? Therefore, this study employed a quasi-experimental pretest–posttest design with a control group, grounded in a theoretical framework emphasizing the influence of exercise on neurohormonal physiology and metabolic health (Wilson & Brown, 2020). This integrative approach not only contributes to a better understanding of the multidimensional effects of exercise but also provides a scientific framework for developing evidence-based rehabilitation and educational programs in relevant institutions, ultimately enhancing quality of life and promoting social participation among adolescents with hearing impairment.

Materials and Methods

Participants: The statistical population included all male students with hearing impairment, aged 18 to 25 years enrolled in exceptional secondary schools in Rasht during the 2024–2025 academic year, totaling 50 individuals. From this population, 30 participants were purposefully selected based on inclusion and exclusion criteria and randomly assigned to two groups: experimental ($n=15$) and control ($n=15$). Inclusion criteria consisted of confirmed hearing impairment (verified by educational and medical records), the ability to participate in aerobic physical activities, absence of cardiovascular or musculoskeletal disorders limiting activity, and obtaining informed parental consent. Exclusion criteria included absence from more than two training sessions, injury or illness during the intervention period, and noncompliance in completing questionnaires.

Instruments: Anxiety and aggression indices were assessed using the Spielberger State–Trait Anxiety Inventory (STAI-Y) and the Buss–Perry Aggression Questionnaire (AQ), respectively. Maximal aerobic capacity ($VO_2\text{max}$) was measured using the Forestry Step Test. Anthropometric indices—including height, weight, and body fat percentage—were measured using a stadiometer, scale, and skinfold caliper, respectively. The intervention for the experimental group consisted of a six-week aerobic training program, three sessions per week, each lasting 45 minutes, while the control group did not receive any intervention.

Spielberger State–Trait Anxiety Inventory (STAI-Y): This questionnaire, first introduced by Spielberger et al. (1970), measures state and trait anxiety (both overt and covert) and was revised in 2025 (Valente et al., 2025). It consists of two 20-item forms: the state anxiety form assesses the individual’s level of anxiety “at this moment,” whereas the trait anxiety form evaluates general attitudes and experiences of anxiety. This instrument has demonstrated high reliability and validity in both international and domestic studies; Cronbach’s alpha coefficients for the various scales have been reported above 0.9, and its reliability has been calculated at 87% (Illardi et al., 2021). Criterion and concurrent validity of the questionnaire have

also been confirmed in Iranian samples using the means of state, trait, and total anxiety scores (Rouhzadeh et al., 2021).

Buss–Perry Aggression Questionnaire (AQ): Developed in 1992 by Arnold H. Buss and Mark Perry, this questionnaire consists of 29 items with four subscales: physical aggression, verbal aggression, hostility, and anger. This self-report instrument has been validated internationally and domestically for reliability and validity. The overall Cronbach’s alpha coefficient is 0.89, with subscale alphas ranging from 0.72 to 0.85 (Loja Secua et al., 2021). Studies in Iran have also confirmed its reliability and validity (Afshari et al., 2025). Its use in the present study allowed precise assessment of aggressive behaviors and analysis of the effects of aerobic exercise on its various dimensions.

Data Collection: The present study was quasi-experimental research with a pretest–posttest design and a control group. Necessary permissions were first obtained from the Department of Education of District 2 in Rasht and subsequently from the Organization for Exceptional Education. A list of secondary schools for male students with hearing impairment in Rasht was then acquired. On the first day, after participants arrived at the testing site, comprehensive explanations regarding the study objectives, procedures, and importance of each stage were provided. The explanations were delivered with the assistance of the school physical education teacher proficient in sign language, ensuring that all participants fully understood the research process and could provide informed consent. Following this, written consent forms and questionnaires were distributed, and anthropometric measurements including height and weight were taken. Height was measured using a wall-mounted stadiometer with standardized posture, and weight was measured with a precise scale without shoes. All data were recorded individually and systematically.

On the second day, body fat percentage was measured using a Lafayette caliper following Jackson–Pollock’s three-site method (chest, abdomen, and thigh) for males. Measurements were conducted with high precision and the assistance of the physical education teacher. Participants were then prepared for the Forestry Step Test, which was demonstrated both practically and visually. They stepped up and down the platform for five minutes at a pace of 22.5 steps per minute. A visual metronome was used to maintain rhythm, ensuring correct performance. Heart rate was recorded immediately after the test to calculate $VO_2\text{max}$. This test is based on the Harvard Step Test and the Strand–Ryming test and has demonstrated validity and reliability in multiple domestic (Shadab et al., 2023) and international studies (Jensen et al., 2023). Following the pretests, the experimental group began the six-week aerobic training program, three sessions per week, 45 minutes per session. Each session included 10 minutes of warm-up with stretching, 30 minutes of main training including running and team games, and 5 minutes of cool-down. Exercise intensity was set at 80–85% of maximum heart rate. The first week involved running 1,500 meters in 8 minutes, 4 minutes of slow jogging, followed by 2,200 meters in 13 minutes with 5 minutes of slow jogging. In the second week, the running protocol was similar, with the addition of team games such as basketball. The program was adapted from published aerobic training protocols (Ge et al., 2023). The control group did not receive any intervention.

At the end of the six-week period, posttests—including repetition of the step test, measurement of body fat percentage, and completion of anxiety and aggression questionnaires—were conducted for both groups.

Data Analysis: Data were collected and entered into SPSS version 24 for descriptive and inferential analyses, including means, standard deviations, independent t-tests, and analysis of covariance (ANCOVA) to examine the effects of aerobic exercise on the variables. A significance level of $p \leq 0.05$ was considered.

Results

The findings of the present study include descriptive and inferential results regarding the effects of a selected aerobic training program on maximal aerobic capacity ($VO_2\max$), anxiety, aggression, and body fat percentage in male adolescents with hearing impairment. Prior to conducting inferential analyses, the data were presented descriptively, and the distribution of the study variables—including $VO_2\max$, anxiety, aggression, and body fat percentage—was examined in both the experimental and control groups.

Results of the Shapiro–Wilk and Kolmogorov–Smirnov tests indicated that all p-values were greater than 0.05, suggesting that the data distribution was approximately normal. Additionally, inspection of Q–Q plots and histograms confirmed that the use of parametric tests, such as independent t-tests and ANCOVA, was appropriate. The significance level for all tests in this study was set at $p \leq 0.05$.

Table 1 provides an overview of the descriptive indices, including the means and standard deviations of the main study variables—maximal aerobic capacity ($VO_2\max$), anxiety, aggression, and body fat percentage—in both the experimental and control groups at pretest and posttest stages.

Table 1. Descriptive indices (mean \pm standard deviation) of the study variables in the two groups

| Variable | Group | Pre-test (Mean \pm SD) | Post-test (Mean \pm SD) |
|-------------------------|--------------|--------------------------|---------------------------|
| $VO_2\max$ (ml/kg/min) | Experimental | 42.86 \pm 3.85 | 48.46 \pm 3.62 |
| | Control | 42.53 \pm 4.62 | 42.13 \pm 4.61 |
| Anxiety | Experimental | 42.86 \pm 3.14 | 40.13 \pm 2.29 |
| | Control | 42.53 \pm 2.23 | 41.20 \pm 1.78 |
| Aggression | Experimental | 71.20 \pm 3.99 | 66.73 \pm 2.94 |
| | Control | 71.60 \pm 3.12 | 70.93 \pm 2.61 |
| Body fat percentage (%) | Experimental | 23.40 \pm 3.85 | 17.93 \pm 3.62 |
| | Control | 22.93 \pm 2.29 | 22.60 \pm 2.19 |

Based on the descriptive results (Table 1), the mean $VO_2\max$ in the experimental group increased from 42.86 mL/kg/min at pretest to 48.46 mL/kg/min at posttest. In contrast, the control group showed no substantial change (42.53 at pretest to 42.13 at posttest). These findings indicate that a selected aerobic training program had a significant effect on improving the aerobic capacity of male adolescents with hearing impairment.

Regarding anxiety, a notable reduction was observed in the experimental group (from 42.86 at pretest to 40.13 at posttest), whereas the control group experienced only a slight decrease (from 42.53 to 41.20). This suggests that the training intervention had a clear effect on reducing participants' anxiety levels.

Similarly, aggression scores in the experimental group decreased from 71.20 at pretest to 66.73 at posttest, while the control group showed only a minor reduction from 71.60 to 70.93. This difference reflects the effective role of aerobic exercise in controlling and reducing aggressive behaviors in adolescents with hearing impairment.

Finally, body fat percentage in the experimental group decreased from 23.40% at pretest to 17.93% at posttest, whereas changes in the control group were negligible (from 22.93% to 22.60%). Thus, as observed, the experimental group showed significant improvements across all variables compared to the control group. While the control group demonstrated minimal changes in most indices, the substantial increase in VO_{2max} and meaningful reductions in anxiety, aggression, and body fat percentage in the experimental group highlight the positive impact of the exercise intervention.

The results of the independent t-test for posttest comparisons between the experimental and control groups are reported in Table 2. The findings indicate that the observed changes in the experimental group compared to the control group were significant and reliable across all variables. The significance level was set at $p \leq 0.05$.

Table 2. Results of Independent t-test in the Post-test for Comparison Between the Two Groups

| Variable | t | df | Sig (2-tailed) |
|-------------------------|-------|----|----------------|
| VO_{2max} | -3.35 | 28 | 0.002 |
| Anxiety | 7.13 | 28 | 0.001 |
| Aggression | 5.89 | 28 | 0.001 |
| Body fat percentage (%) | 2.70 | 28 | 0.01 |

The t-values and significance levels reported in Table 2 indicate that the posttest mean differences between the two groups were significant for all indices. Notably, the substantial differences in anxiety and aggression ($p < 0.001$) suggest that aerobic exercise had a highly positive effect in reducing negative psychological factors among adolescents with hearing impairment. Additionally, the significant increase in VO_{2max} ($p = 0.002$) and reduction in body fat percentage ($p = 0.01$) demonstrate the notable impact of aerobic training

on improving physiological indices. These results indicate that the observed changes in the experimental group were attributable to the exercise intervention rather than natural or random variations.

Table 3 presents the results of the analysis of covariance (ANCOVA) for the study variables at posttest. This table reports F-values, significance levels, and effect sizes (η^2). The ANCOVA was conducted to control for potential pretest effects and to more precisely examine the impact of the aerobic exercise intervention on the dependent variables. In this study, the groups were randomly assigned, and the pretest statistical analysis indicated no significant differences between the groups at baseline. Therefore, the randomization was successful and valid, minimizing the likelihood of selection bias.

Table 3. Results of ANCOVA in the Post-Test for the Study Variables

| Variable | F | Sig | η^2 |
|-------------------------|-------|-------|----------|
| VO ₂ max | 27.16 | 0.01 | 0.53 |
| Anxiety | 44.79 | 0.001 | 0.65 |
| Aggression | 45.05 | 0.001 | 0.67 |
| Body Fat Percentage (%) | 8.94 | 0.01 | 0.27 |

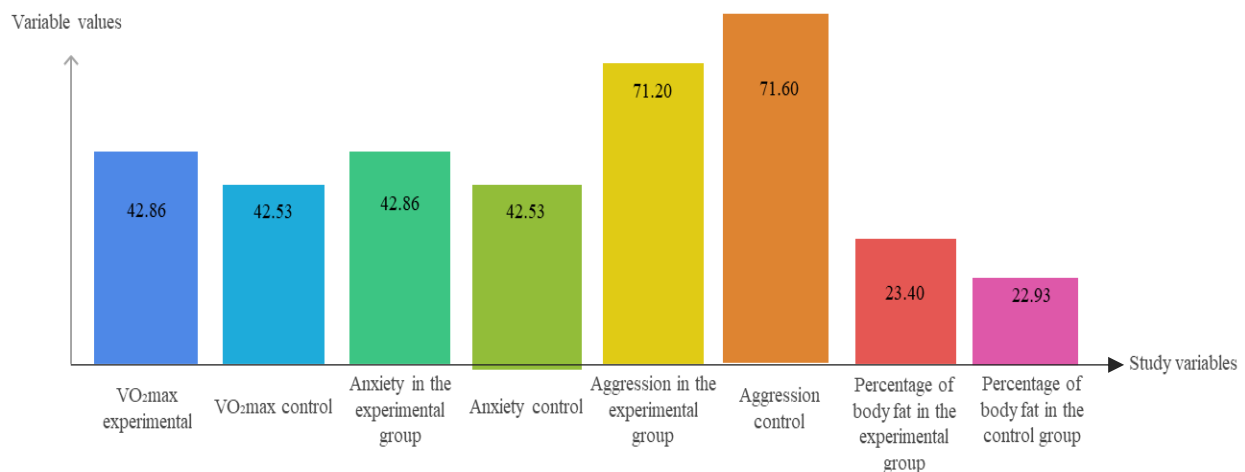


Figure 1 . Comparison of study variables between experimental and control groups

Table 4. Effects of Aerobic Exercise Intervention on Study Variables

| Variable | Group | Pre-test | Post-test | t | p | f | p | η^2 |
|---------------------|--------------|------------|------------|-------|---------|-------|---------|----------|
| VO ₂ max | Experimental | 42.86±3.85 | 48.46±3.62 | -3.35 | 0.002 | 27.16 | 0.001 | 0.53 |
| | Control | 42.53±4.62 | 42.13±4.61 | | | | | |
| Anxiety | Experimental | 42.86±3.14 | 40.13±2.29 | 7.13 | < 0.001 | 44.79 | < 0.001 | 0.65 |
| | Control | 42.53±2.23 | 41.20±1.78 | | | | | |
| Aggression | Experimental | 71.20±3.99 | 66.73±2.94 | 5.89 | < 0.001 | 45.05 | < 0.001 | 0.67 |
| | Control | 71.60±3.12 | 70.93±2.61 | | | | | |
| Body fat % | Experimental | 23.40±3.85 | 17.93±3.62 | 2.70 | 0.01 | 8.94 | 0.01 | 0.27 |
| | Control | 22.93±2.29 | 22.60±2.19 | | | | | |

Discussion

The present study aimed to examine the effects of a selected aerobic exercise program on cardiovascular indices, body fat percentage, and psychological variables of anxiety and aggression in male adolescents with hearing impairment. The findings indicated that regular and targeted implementation of this type of exercise led to significant improvements in maximal aerobic capacity (VO₂max), reductions in body fat percentage, and decreases in anxiety and aggression symptoms. Accordingly, the results of the present study are consistent with those of Eghbalian et al. (2025), Karic et al. (2023), Shave et al. (2021), and Vali & Hossein (2021), which reported positive effects of aerobic exercise and physical activity on cardiovascular health and psychological well-being, including reductions in anxiety and aggression. These findings are particularly significant given the multifaceted impact of hearing impairments on the physical and mental health of individuals with hearing impairment, highlighting the importance of exercise for both physiological and psychological dimensions in this population. Moreover, in the context of the limited research conducted in this area, these results provide a valuable contribution to the scientific community, especially within the Iranian context. The evidence from the present study indicates that aerobic activities can significantly contribute to improving the psychological well-being of individuals with hearing

impairment, particularly in reducing anxiety and aggressive behaviors. These effects are not only clinically significant but can also be scientifically explained through models related to neuroendocrine mechanisms. According to theories associated with the hypothalamic–pituitary–adrenal (HPA) axis, regular aerobic exercise modulates the body’s stress responses, enhances endorphin secretion, and activates neurotransmitters related to mood regulation (Fulton et al., 2022). Consequently, these processes lead to a reduction in negative emotions such as anxiety and aggression, providing a foundation for psychological stability and improvement. Additionally, physiological changes, such as increased tolerance to environmental stressors and enhanced autonomic nervous system functioning, play a supportive role in this process (Peng et al., 2025).

Aggression is, in fact, a major behavioral challenge during adolescence and young adulthood, which becomes more pronounced in individuals with sensory impairments such as deafness due to their unique social and psychological circumstances (Bard et al., 2025). From a physiological perspective, exercise reduces stress and balances hormonal activity, thereby creating conditions for decreased aggressive reactions (Ouyang & Liu, 2023). Moreover, from a psychosocial standpoint, group physical activities and the training of communication and emotional skills provide greater opportunities for positive interaction, which, by strengthening social support networks and enhancing the sense of belonging, play a crucial role in moderating aggression (Peng et al., 2025). Furthermore, research shows that beyond physiological effects, sports activities can foster positive social contexts and create meaningful participation opportunities for adolescents with hearing impairment. Engagement in sports groups enhances psychosocial skills such as emotion regulation, impulse control, and communication abilities—skills that contribute to reducing aggressive behaviors and promoting psychological cohesion (Cho & Yang, 2020). Since adolescents with hearing impairments are at a sensitive stage of psychological and social development, targeted exercise interventions can induce substantial positive changes in both their clinical and social trajectories (Khalid et al., 2025).

Moreover, the analysis of the results indicates that the design and implementation of training programs for this population require adaptation to their specific characteristics and limitations, including the use of visual instructions, the presence of a sign language interpreter, and the employment of non-auditory control tools. This approach not only ensures compliance with scientific and ethical standards but also facilitates the development of culturally adapted and locally relevant interventions, thereby paving the way for future research in populations with specialized needs (Werfel & Lund, 2024).

From a physiological perspective, the increase in $VO_2\text{max}$ reflects an enhanced capacity of the body to utilize and transport oxygen to active tissues, resulting from multiple physiological adaptations, including increased stroke volume, improved cardiac output, and greater capillary density in skeletal muscles (Kayam et al., 2021). This finding is particularly important for adolescents with hearing impairment, as they are at higher risk for cardiovascular disorders and reduced physical fitness due to communication limitations, lower physical activity levels, and social challenges (Norkadri et al., 2021). The present study also demonstrates that targeted exercise interventions can elicit favorable physiological adaptations, thereby improving functional capacity and cardiovascular health in this population. This underscores the importance

of designing training programs that are tailored to the specific characteristics and needs of adolescents with hearing impairment.

A significant reduction in body fat percentage in the intervention group represents another important finding of this study, with well-established positive effects on general health, decreased risk of chronic diseases, and improved body composition (Khan & Joz, 2021). Aerobic exercise, by increasing energy expenditure and enhancing fat metabolism, directly contributes to the reduction of subcutaneous fat stores, which can serve as a preventive and therapeutic strategy for metabolic issues in this population (Bernot et al., 2023). Individuals with hearing impairment face substantial limitations in verbal and nonverbal communication, which can lead to social isolation, loneliness, and the emergence of psychological problems such as anxiety and aggression (Uma et al., 2024). Participation in group-based physical activities and regular aerobic training provides a valuable opportunity to foster positive social interactions, strengthen cooperation and civic skills, and enhance self-concept. Recent research has shown that building strong support networks through sports and recreational activities significantly contributes to reducing psychological stress and improving social awareness among individuals with hearing impairment (Karampidis et al., 2021). Finally, the present study, by providing robust empirical evidence, highlights the importance of aerobic exercise in improving both the physical and psychological health of male adolescents with hearing impairment and underscores the necessity of policy-making and development of sports programs focused on special-needs populations. This not only represents a scientific and clinical imperative but also an ethical and social commitment to ensure equal rights and enhance the quality of life for individuals with hearing impairment.

Conclusion

The present study, by providing robust empirical evidence, underscores the importance of aerobic exercise in enhancing both the physical and psychological health of boys with hearing impairment and highlights the necessity of policymaking and the development of targeted exercise programs for populations with special needs. This emphasis represents not only a scientific and clinical imperative but also an ethical and social responsibility to ensure equal rights and to improve the quality of life of individuals with hearing impairment.

Limitations and Future Directions

The limitations of the present study include the short duration of the intervention (six weeks), a relatively small sample size, the gender-specific nature of the sample (only male adolescents with hearing impairment from a single geographic area), and the use of self-report questionnaires, which may be subject to response biases. Additionally, although participants were randomly assigned to groups, a thorough statistical verification of randomization was not conducted, which may affect the internal validity of the study. Therefore, it is recommended that future research be conducted with larger samples, including female participants and individuals from diverse geographic regions, and employ multi-dimensional assessments and biological markers to enhance generalizability and strengthen internal validity.

Given the positive effects of aerobic exercise on the physical and psychological health of adolescents with hearing impairment, it is essential to integrate specialized and targeted sports programs into their

educational framework. The Ministry of Education and the Organization for Exceptional Education can facilitate active participation of this population in physical and psychological activities by developing comprehensive plans, providing trained instructors capable of effective communication with hearing impaired individuals, and equipping necessary facilities. Furthermore, future research with larger samples, including hearing impaired girls and other special-needs populations across different regions of the country and over longer intervention periods, can consolidate scientific knowledge in this field and reliably assess the long-term effects of sports interventions.

Improving assessment tools, including the design of psychological and physiological instruments tailored to the characteristics of hearing impaired individuals and combining self-reported and objective measures, is also crucial for increasing the accuracy and validity of study outcomes. Education and support for families and caregivers regarding the importance of physical activity and active participation in sports are vital for enhancing the effectiveness and sustainability of interventions. Interagency coordination between the Ministry of Health, Ministry of Education, and organizations related to individuals with disabilities is necessary for designing, implementing, and evaluating comprehensive therapeutic-rehabilitation sports programs effectively. Adopting these coordinated and evidence-based approaches can contribute to social inclusion, sustainable health, and improved quality of life for hearing impaired adolescents, representing a significant step toward fulfilling social responsibilities and human rights.

Declarations

Ethical Considerations

This study was conducted as a research project in full compliance with ethical guidelines concerning participants. All principles, including obtaining voluntary informed consent, respecting the right to withdraw from the study at any time, and ensuring the confidentiality of participants' information, were strictly adhered to.

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Authors' Contributions

All authors contributed equally to every stage of the project, including study design, implementation, and manuscript preparation.

Conflict of Interest

According to the authors, the results of this study do not present any conflict of interest with any organization or entity.

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ORIGINAL ARTICLE

Structural Modeling of the Relationships between Personality Style and Sports Identity with Psychological Resilience in Athletes with a Disability

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Abstract: This study's purpose was to structurally model the relationships between personality style and sports identity with psychological resilience in athletes with a disability. The research method was descriptive-correlational, using structural equation modeling. The sample included active athletes with a disability (club, provincial) who had experienced at least one sports injury in the past two years. Data collection utilized McCrae and Costa's Personality Questionnaire, Brewer et al.'s Sports Identity Questionnaire, and the Connor-Davidson Resilience Scale. Data were analyzed using partial least squares. Findings showed personality style has a positive, significant effect on psychological resilience. Sports identity also had a positive, significant effect on resilience. These variables explained a significant variance in resilience. Results indicate athletes with positive personality traits and stronger sports identity have a greater ability to bounce back from difficult situations. From an applied perspective, findings can be used in designing psychological interventions to enhance resilience. Sports federations should include personality skills development.

Keywords: Rehabilitation Centers, Personal Skills, Sports Performance, Sports Federations.



Highlights

- Athletes with positive personality traits have a greater ability to bounce back from difficult situations.
- Athletes with stronger sports identity have a greater ability to bounce back from difficult situations.
- Sport education organizations/officials have a responsibility in athletes personality development.

Introduction

Professional and competitive sports present a landscape rife with physical, psychological, and social pressures, subjecting athletes to various chronic and situational stressors. These can range from the demands of competition and media scrutiny to the challenges posed by injuries and environmental changes (Rice et al., 2016; Abdoshahi, 2024). Within this framework, psychological resilience emerges as a crucial factor for achieving success and sustaining performance. It equips athletes with the ability to bounce back or even enhance their performance following setbacks, defeats, or external pressures, all while maintaining emotional stability and motivation (Galli and Gonzalez, 2015). Consequently, resilience has evolved from a simple individual trait to a fundamental aspect of athletes' preparation and professional development.

Psychological resilience in sports has garnered significant interest over the past decade, recognized as a crucial factor for athletes' sustained performance and mental well-being (Fletcher and Sarkar, 2012, 2013). Moving away from essentialist perspectives, resilience is understood as a dynamic outcome of interactive processes that evolve over time, encompassing individual, team, and organizational dimensions (Ilkim, 2024). This involves a complex interplay of cognitive, emotional, and social mechanisms that activate in response to stress, facilitating a return to or maintenance of optimal performance levels (Den Hartigh et al., 2022). Recent literature in sport psychology emphasizes that resilience models should reflect its multifaceted and contextual nature, highlighting not only individual traits but also the importance of support systems and performance culture (Gupta et al., 2022). Thus, resilience transcends mere recovery; it encompasses the capacity to adapt and learn from experiences, enabling athletes to not only withstand challenges but also to redefine their goals, manage emotions, and seek necessary support for future development (Sadeghi Pour, 2024).

The urgency of addressing resilience in disability sports is particularly pronounced, as para-athletes encounter numerous challenges, including structural barriers, social discrimination, and accessibility issues, alongside increased financial and time commitments compared to their able-bodied peers. Despite these obstacles, research indicates that engaging in adaptive sports can significantly improve mental health, social support, and resilience (Mira et al., 2023). Concurrently, recent studies have revealed high levels of anxiety and depression among elite para-athletes, often linked to injuries and health issues, underscoring the necessity for supportive programs within training and competitive settings (Bentzen et al., 2025). The International Olympic Committee has highlighted the interconnectedness of mental and physical health, advocating for interventions that address both areas simultaneously, which necessitates the implementation of screening and support systems at major sporting events (Reardon et al., 2019; Mountjoy et al., 2023). Additionally, emerging research points to the importance of "hardiness" and coping strategies in fostering resilience and distress tolerance among para-athletes, ultimately contributing to their overall well-being and sustained involvement in sports (Goh et al., 2024).

One key factor influencing athletes' reactions to pressure is their sports identity, which reflects the extent to which they embrace the athlete role. This concept, initially defined and measured by Brewer et al. (1993), encompasses dimensions such as role sociality, role exclusivity, and role affect, all of which impact an athlete's commitment, training choices, and time dedication. Recent systematic reviews have reinforced the idea that a stronger sports identity correlates with heightened engagement, more intense emotional experiences, and varied coping strategies, with fluctuations occurring throughout an athlete's career in response to events like injuries or changes in competition levels (Edison et al., 2021; Lochbaum et al., 2022; Renton et al., 2021). Additionally, qualitative research involving Paralympic athletes has highlighted how disruptions to training and competition schedules, such as those experienced during a pandemic, can significantly affect identity and lead to emotional and motivational shifts (Hu et al., 2021). Moreover, the development of updated identity assessment tools aims to capture a broader range of dimensions and indicators, facilitating more detailed analyses of sports identity (Brewer, 2022).

The phenomenon of "sports identity blockage" arises when individuals become overly committed to their roles as athletes without considering other aspects of their identity. This fixation can lead to negative outcomes such as burnout, anxiety during transitions, and challenges in adjusting to performance declines or retirement (Brewer, 2017). Research on career transitions indicates that the effectiveness of these changes is closely linked to identity factors, the availability of social support, and proactive planning, with strategic interventions showing promise in enhancing psychological well-being (Park et al., 2013). In the context of parasport, notable differences in identity development have been observed between individuals with acquired versus congenital disabilities, influencing their adaptation processes and support systems (Rougeau et al., 2025). This body of evidence highlights that identity can serve as both a protective factor and a source of vulnerability in the face of competitive pressures, emphasizing the importance of considering a diverse range of non-sporting roles and the quality of one's support network.

Personality style is intricately connected to resilience, reflecting stable individual differences. Meta-analyses indicate that neuroticism has a negative correlation with resilience, while traits such as extraversion, openness, agreeableness, and conscientiousness show positive correlations, a trend that holds true across diverse samples and contexts (Oshio et al., 2018). The Five Factor Model's theoretical foundations highlight its broad relevance across various cultures, establishing it as a foundational framework in the study of individual differences (McCrae & John, 1992). In sports, research indicates that personality traits significantly affect motivational patterns, self-regulation, and coping strategies, although the impact varies depending on factors like skill level, discipline, and age (Shuai et al., 2023). Recent studies examining "resilience profiles" reveal that athletes exhibiting high resilience tend to demonstrate better health behaviors and psychosocial outcomes, enhancing our understanding of how personality traits interact with environmental resources (Chrétien et al., 2024).

The significance of social support in alleviating the challenges associated with training and competition has been well-established at the interpersonal level. Research indicates that when the type of support provided aligns with the specific stressor—such as informational support versus evaluative support—there is a notable enhancement in both performance and well-being (Rees & Hardy, 2004). In the context of injury, the transition back to competition often brings about worries related to adequacy, pain, and the fear of re-

injury. If the rehabilitation process fails to address the fundamental needs for autonomy, competence, and relatedness, individuals may find themselves trapped in a cycle characterized by avoidance, anxiety, and diminished functioning (Clement et al., 2015). Furthermore, recent studies highlight a reciprocal relationship between mental health and injury risk, suggesting that unresolved psychological distress not only hinders performance but also raises the chances of future injuries and prolongs recovery times (Rogers et al., 2023). Consequently, a comprehensive understanding of resilience mechanisms must take into account the social and organizational contexts, as well as the effectiveness of return-to-competition protocols.

Research conducted domestically has yielded significant insights into the experiences of athletes with a disability. For instance, Mollanorouzi et al. (2023) demonstrated that resilience is closely linked to psychological well-being, with perceived stress acting as a crucial mediator in this dynamic. Similarly, Safi et al. (2024) identified a notable positive impact of resilience and optimism on self-efficacy among individuals with physical and motor disabilities in Mashhad, highlighting the mediating role of motivation to progress. Furthermore, Dirmanchi and Khanjani (2019) found that athletes with a disability exhibit higher levels of resilience and self-efficacy compared to their non-athletic counterparts, underscoring the beneficial influence of sports participation on psychological support resources. These findings underscore the relevance of the current study, which aims to explore the interplay between personality style and sports identity in predicting resilience.

Despite the existing body of research, significant gaps persist in our understanding of the relationship between personality and resilience, particularly in para-athletic contexts. Much of the current evidence is derived from general populations or non-athletes with a disability, leaving the applicability to para-athletes largely unexamined (Oshio et al., 2018). Additionally, while the literature on sport identity has primarily concentrated on its outcomes, the potential mediating or moderating effects of identity on the connection between personality traits and resilience remain underexplored (Lochbaum et al., 2022; Renton et al., 2021). Furthermore, there is a scarcity of studies investigating how individual factors interact with contextual elements, such as social support and the dual education-sport pathways, in fostering resilience among athletes with disabilities. Research indicates that adaptive sports can enhance support networks and overall well-being (Mira et al., 2023), yet barriers faced by these athletes in their career and educational pursuits can significantly impact their identity and motivation (Maciá Andreu et al., 2023). To bridge these gaps, it is essential to develop testable causal models that can assess both direct and indirect effects while accommodating sample diversity.

The theoretical framework of the present study is based on the integration of the Five-Factor Model of Personality (McCrae & John, 1992), the Sport Identity Model (Brewer et al., 1993), and multifactor models of resilience in sport (Fletcher & Sarkar, 2012, Galli & Gonzalez, 2015). According to this framework, personality traits as the basis of the individual's reactive and regulatory patterns and sport identity as a motivating and meaningful role factor can directly affect the capacity for psychological resilience. Choosing a structural model to simultaneously test these relationships allows for the measurement of the relative and common contributions of these two psychological sources and helps identify the pathways of

influence in the population of athletes with disabilities. There exists a notable gap in the literature regarding the interplay between personality styles, sports identity, and psychological resilience among athletes with disabilities. While previous research has typically focused on these variables in isolation, there is a scarcity of studies that explore their combined effects on psychological resilience, particularly within this specific population. Consequently, this study seeks to address two primary relationships: the influence of personality style on psychological resilience and the impact of sports identity on psychological resilience among athletes with disabilities. By examining these factors together, the research aims to provide a more nuanced understanding of the psychological elements that contribute to the adaptation and performance of athletes with disabilities, thereby informing the development of targeted psycho-sport interventions.

Materials and Methods

This study employed a quantitative and causal-correlational approach, utilizing structural equation modeling to explore the relationships among personality style, sports identity, and psychological resilience in athletes with a disability.

Participants. The target population consisted of athletes with a disability engaged in both individual and team sports at club, provincial, and national levels, all of whom had sustained a sports injury at least once in the previous two years. The inclusion of injury experience was crucial, as it contextualizes the concepts of sports resilience and coping strategies in relation to returning to training and competition. The study focused on adult athletes aged 18 and older to adhere to ethical standards concerning informed consent. A purposive-accessible sampling method was employed, targeting athletes who had experienced an injury within the last 24 months, with a planned sample size of 300 to ensure adequate statistical power for estimating coefficients and testing mediation effects, while a minimum of 250 participants was deemed acceptable. Inclusion criteria for the study required participants to have an active sports membership within the past six months and to have experienced at least one documented or self-reported sports injury in the last 24 months that necessitated a cessation of training or competition for a minimum of seven days. Participants needed to be 18 years or older and capable of reading Persian sufficiently to complete the questionnaire, or willing to receive assistance from the researcher if they had mobility or vision impairments. Informed consent was also mandatory. Exclusion criteria encompassed individuals reporting acute psychiatric disorders with unstable symptoms, recent acute injuries lasting less than seven days without functional impact, incomplete responses exceeding 15% of the questionnaire, and failure to meet the injury experience requirement within the designated timeframe.

Instruments. To account for demographic and sports-related variability, a questionnaire was designed to collect data on age, gender, type and severity of disability, type of discipline, competition level, sports history, weekly training volume, recent injury specifics, and the time elapsed since the injury, which would serve as control variables in the analyses or for potential multigroup comparisons. The study utilized three standardized and psychometrically validated Persian scales for measurement. The ARS-30 scale assessed sports resilience through 30 items across six dimensions: emotional stability, goal focus, emotional control, self-confidence, social support, and adaptability, using a five-point Likert scale ranging from strongly disagree to strongly agree. Scoring was conducted according to the scale's guidelines, with reverse items recoded prior to aggregation. For personality assessment, the Persian version of the Big Five Factor

Inventory (NEO-FFI) was employed, consisting of 60 items that evaluate the traits of neuroticism, extraversion, openness, agreeableness, and conscientiousness, also on a five-point scale. Scores for each dimension were calculated as means or sums, with each trait treated as a first-order construct for modeling. Additionally, the Persian version of the Athlete Identity Scale (AIMS) measured various aspects of athlete role identity, including social identity, role exclusivity, and role affect, using a five-point Likert scale to derive total and dimensional identity scores.

Procedure. To facilitate equal access, data collection was conducted through an accessible online format compatible with screen readers and high-contrast settings, as well as a paper version administered via interviews at selected sports centers. For those with mobility or vision challenges, assistance from a trained facilitator was available. Prior to participation, participants were provided with a research information form and an informed consent document written in clear language, highlighting the voluntary nature of the study and the right to withdraw at any time without repercussions. Data were collected anonymously, assigned unique codes, and utilized exclusively for research purposes. The research design received approval from the ethics committee of the conducting university, ensuring compliance with all data protection and confidentiality standards.

Analysis. Prior to the main analyses, internal reliability for each instrument was assessed using Cronbach's alpha and composite reliability (CR), with acceptable thresholds set at 0.70. Convergent validity was evaluated through average variance extracted ($AVE \geq 0.5$), while divergent validity was determined using the Fornell-Larcker criterion and HTMT ratios, ideally maintaining HTMT values below 0.85. In the initial phase, the dataset was scrutinized for incomplete entries, missing patterns, and outliers. For item-level missing data, if the absence was below 5%, mean imputation or full maximum likelihood estimation (FIML) was employed for CB-SEM, while the EM method was utilized for PLS-SEM. In cases of systematic missingness, multiple imputation techniques were applied. The normality of the data distribution was assessed using skewness and kurtosis indices, adhering to the thresholds of permissible skewness (≤ 2) and kurtosis (≤ 7), alongside the Shapiro-Wilk test. Outliers were detected through a combination of boxplots, Z-Scores, and Mahalanobis distance calculations. The analysis of multicollinearity between the independent variables, specifically personality style and sports identity, was conducted using Variance Inflation Factor (VIF) and Tolerance indices, with a VIF threshold of 3.3 established as the acceptable limit. To mitigate common method bias, several procedural strategies were implemented, including anonymizing participant responses, randomizing the order of items, and employing varied response scales for demographic questions. Additionally, Harman's univariate factor statistical test was utilized to further assess potential bias in the data. In the modeling phase, personality style and sports identity were examined as predictor variables, while psychological resilience served as the criterion variable, all represented through first-order structures based on valid questionnaire indicators. The parameters were estimated utilizing the partial least squares (PLS) method within the SmartPLS 4 software. The adequacy of both the measurement and structural models was assessed through various indices, including SRMR, NFI, R^2 , Q^2 , and f^2 .

The importance of the direct paths was evaluated through the bootstrap method, utilizing 5000 samples and a 95% confidence interval. The model's predictive capability was analyzed using the PLSpredict approach.

To examine the consistency of the results across various subgroups, including team and individual disciplines as well as different types of motor and sensory disabilities, a multigroup analysis was conducted within the SmartPLS 4 framework. This analysis included assessments of measurement homogeneity (both Configural and Metric) and comparisons of path coefficients. All statistical analyses were carried out at a significance level of 0.05, with effect sizes (β and f^2) and confidence intervals reported to ensure that the results were interpretable from both statistical and practical perspectives.

Results

Demographic characteristics of the participants in the study are shown in the table below.

Table 1. Demographic characteristics of the research sample

| Characteristic | Group | Frequency (n) | Percentage (%) |
|-----------------------|---------------------|---------------|----------------|
| Gender | Male | 180 | 60 |
| | Female | 120 | 40 |
| Age | 18–25 years | 85 | 28.3 |
| | 26–35 years | 140 | 46.7 |
| | 36 and over | 75 | 25 |
| Type of disability | Motor | 200 | 66.7 |
| | Visual | 60 | 20 |
| | Hearing | 30 | 10 |
| | Combined | 10 | 3.3 |
| Sports field | Team | 165 | 55 |
| | Individual | 135 | 45 |
| Level of competition | Club | 90 | 30 |
| | Provincial | 120 | 40 |
| | National | 90 | 30 |
| Sports experience | 1–5 years | 80 | 26.7 |
| | 6–10 years | 145 | 48.3 |
| | More than 10 years | 75 | 25 |
| Distance from injury | Less than 6 months | 75 | 25 |
| | 6–12 months | 120 | 40 |
| | More than 12 months | 105 | 35 |
| Injury severity | Mild | 95 | 31.7 |
| | Moderate | 140 | 46.7 |
| | Severe | 65 | 21.7 |
| Type of recent injury | Strain | 85 | 28.3 |
| | Tear | 70 | 23.3 |
| | Fracture | 55 | 18.3 |
| | Joint Injury | 55 | 18.3 |
| | Other | 35 | 11.7 |

| | | | |
|------------------------|--------------------|-----|------|
| Weekly training volume | 1–5 hours | 65 | 21.7 |
| | 6–10 hours | 170 | 56.7 |
| | More than 10 hours | 65 | 21.7 |

Indices of the data normality are shown in the table below.

Table 2. Data normality indices (skewness, kurtosis, and k-s)

| Variable | Mean | SD | Skewness | Kurtosis | K-S | P value |
|-------------------|------|------|----------|----------|-------|---------|
| Neuroticism | 2.87 | 0.65 | 0.21 | - 0.45 | 0.089 | 0.021 |
| Extroversion | 3.45 | 0.72 | - 0.32 | 0.58 | 0.073 | 0.047 |
| Openness | 3.28 | 0.69 | 0.15 | - 0.25 | 0.061 | 0.089 |
| Agreement-seeking | 3.75 | 0.62 | - 0.27 | 0.39 | 0.058 | 0.115 |
| Conscientiousness | 3.90 | 0.65 | - 0.41 | 0.44 | 0.082 | 0.033 |
| Sports identity | 4.12 | 0.58 | - 0.23 | 0.33 | 0.064 | 0.072 |
| Sports resilience | 3.98 | 0.61 | - 0.25 | 0.29 | 0.071 | 0.051 |

The skewness and kurtosis values for all variables fall within acceptable limits (skewness ≤ 2 and kurtosis ≤ 7), suggesting that the overall data distribution is not significantly skewed (West et al., 1995). While the Kolmogorov-Smirnov test indicated significance for some variables ($p < 0.05$), this result is not necessarily indicative of a substantial departure from normality, particularly given the large sample size. Since the PLS-SEM method does not require strict adherence to normality assumptions, the data were deemed appropriate for structural analysis.

Table 3. Reliability and validity indices of constructs

| Construct | Cronbach's alpha (α) | Composite reliability (CR) | Average variance extracted (AVE) |
|-------------------|-------------------------------|----------------------------|----------------------------------|
| Neuroticism | 0.78 | 0.84 | 0.57 |
| Extroversion | 0.82 | 0.88 | 0.60 |
| Openness | 0.75 | 0.83 | 0.55 |
| Agreement-seeking | 0.79 | 0.85 | 0.58 |
| Conscientiousness | 0.84 | 0.89 | 0.62 |
| Sports identity | 0.85 | 0.90 | 0.64 |
| Sports resilience | 0.88 | 0.92 | 0.65 |

The values of Cronbach's alpha and composite reliability for all constructs exceed 0.70, while the average variance extracted (AVE) values are above 0.50. These results demonstrate a strong level of convergent reliability and validity for the instruments utilized in the study. Consequently, this suggests that the items within each construct effectively capture their respective dimensions and exhibit a robust internal correlation among the indicators.

Table 4. Divergent validity (Fornell–Larcker criteria)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|----------------------|--------|------|------|------|------|------|------|
| 1. Neuroticism | 0.75 | | | | | | |
| 2. Extroversion | 0.32 | 0.77 | | | | | |
| 3. Openness | 0.21 | 0.36 | 0.74 | | | | |
| 4. Agreement-seeking | - 0.18 | 0.28 | 0.33 | 0.76 | | | |
| 5. Conscientiousness | - 0.35 | 0.41 | 0.29 | 0.38 | 0.79 | | |
| 6. Sports identity | - 0.27 | 0.52 | 0.34 | 0.41 | 0.48 | 0.80 | |
| 7. Sports resilience | - 0.30 | 0.45 | 0.28 | 0.33 | 0.51 | 0.56 | 0.81 |

The principal diameter values, represented by the square root of the AVE (noted as highlighted numbers), consistently exceed the inter-construct correlations found in the respective rows and columns. This observation supports the divergent validity of the constructs, indicating that each construct demonstrates a stronger correlation with its own indicators compared to those of other constructs.

Table 5. Model fit indices in PLS-SEM

| Index | Value | Desired limit |
|----------------|-------|---------------|
| SRMR | 0.057 | ≤ 0.08 |
| NFI | 0.91 | ≥ 0.90 |
| R ² | 0.55 | ≥ 0.26 |
| Q ² | 0.36 | ≥ 0.00 |
| GOF | 0.58 | ≥ 0.36 |

A SRMR index below 0.08 and an NFI above 0.90 suggest that the model fits well. The R² value of 0.55 indicates that the predictor variables, personality style and sports identity, account for over half of the variance in sports resilience. Additionally, the positive Q² and a GOF of 0.58 further validate the model's predictive capability and robust fit.

Table 6. Path coefficients and significance test

| Predictor variable | Dependent variable | β | t-value | P value | Result |
|--------------------|--------------------|---------|---------|---------|------------------------|
| Neuroticism | Sports resilience | - 0.21 | 4.35 | < 0.001 | Negatively significant |
| Extroversion | | 0.28 | 5.12 | < 0.001 | Positively significant |

| | | | | |
|-------------------|------|------|---------|------------------------|
| Openness | 0.19 | 3.48 | < 0.001 | Positively significant |
| Agreement-seeking | 0.09 | 2.15 | 0.032 | Positively significant |
| Conscientiousness | 0.31 | 6.02 | < 0.001 | Positively significant |
| Sports identity | 0.37 | 5.62 | < 0.001 | Positively significant |

The findings indicate that all six primary research pathways are significant and exhibit positive correlations, with the exception of neuroticism. This suggests that a more optimistic personality and a robust sports identity contribute to enhanced sports resilience among athletes with a disability. The research model is illustrated below, detailing the path coefficients and t-values associated with these relationships.

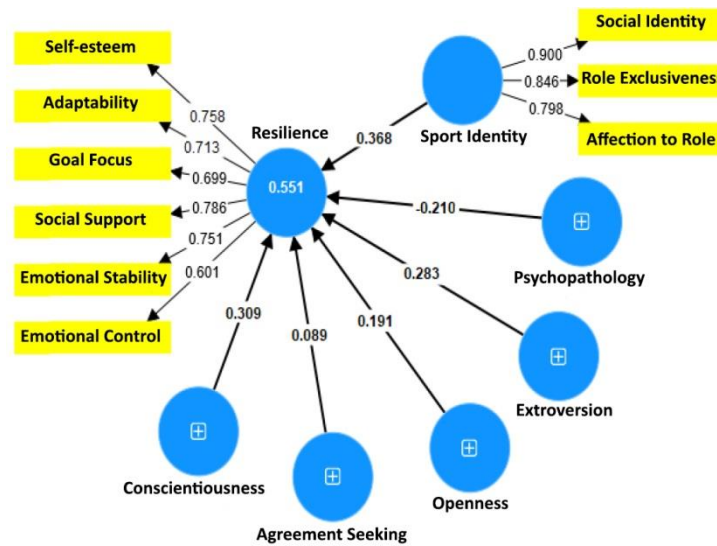


Figure 1. Model in path coefficient mode

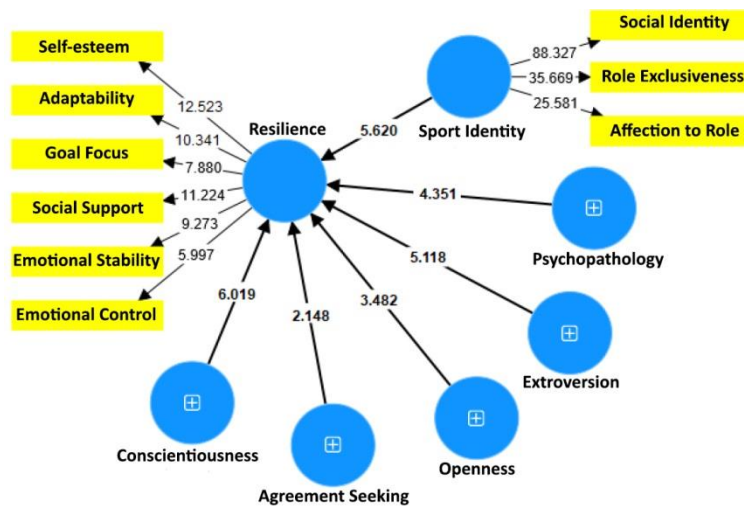


Figure 2. Research model based on T-value

Discussion

The results of this study indicate that two primary sources of stable personality traits, along with the internalization of the athlete identity, account for a substantial portion of the variations in psychological resilience among athletes with disabilities. This finding aligns with existing theoretical and empirical research. Within this context, personality serves as the foundational "behavioral-emotional infrastructure," while sports identity functions as a mechanism for "meaning-making and resource mobilization." The interplay between these elements fosters effective coping strategies, ultimately contributing to psychological and functional resilience.

The personality component of the model aligns closely with findings from quantitative reviews. Meta-analyses indicate that traits such as conscientiousness and extraversion are frequently linked to higher levels of agreeableness, emotional regulation, and perseverance, while neuroticism correlates with heightened sensitivity to threats, rumination, and the recollection of negative emotions (Oshio et al., 2018). A mechanistic interpretation of these results suggests that adaptive personality traits enhance three key processes: self-regulation (including goal setting, progress tracking, and adherence to rehabilitation protocols), emotional processing (such as cognitive appraisal and reducing catastrophizing), and social behavior (like effective help-seeking and utilizing support networks). In the context of parasport, which faces challenges like accessibility issues, additional costs, and societal stereotypes, these processes can confer a psychological competitive edge. Athletes who are disciplined and motivated are more likely to endure delays in recovery, recognize incremental progress, and adhere to their rehabilitation plans (Fletcher & Sarkar, 2012). Conversely, traits associated with neuroticism can lead to detrimental cycles, characterized by negative appraisals of physical symptoms, anxiety about performance, and motor avoidance—patterns that have been documented in the literature regarding return to sport post-injury (Clement et al., 2015). This perspective aligns with longitudinal studies that link psychological distress to an increased risk of injury and extended recovery times (Rogers et al., 2023).

The identity component of the model aligns with existing research on "sports identity," highlighting its significance in an athlete's self-concept. Since the introduction of the AIMS scale, studies have demonstrated that the internalization of the athlete role correlates with training dedication, coping mechanisms, and emotional investment (Brewer et al., 1993). Recent findings indicate that a stable identity serves as a protective factor during transitional phases, such as injuries or competition suspensions, and is linked to more adaptive coping strategies (Edison et al., 2021; Renton et al., 2021; Lochbaum et al., 2022). In the context of the Paralympics, disruptions like the COVID-19 pandemic have illustrated how such upheavals can destabilize identity and lead to emotional challenges (Hu et al., 2021). The current results underscore that when role identity offers a sense of meaning and belonging, resilience is also maintained. This notion is further supported by recent research on resilience among para-athletes (Goh et al., 2024).

The comparison of our findings with Iranian studies is promising. Research within Iran indicates that athletes with disabilities exhibit greater resilience and self-efficacy compared to their non-athletic peers, with resilience showing a positive correlation to psychological well-being (Mollanorouzi et al., 2023; Shafiee et al., 2023). Furthermore, the influence of psychological resources on self-efficacy, particularly through the mediation of motivation among individuals with disabilities, has been established (Safi et al., 2024). This body of domestic research not only aligns with our overall conclusions but also underscores a critical insight: in the Iranian context, focusing on personality and identity development is essential for fostering well-being and sustaining participation in sports, rather than being viewed as an optional enhancement.

Conclusion

It is recommended that team psychology units establish a pre-season screening protocol to assess key indicators of personality, sports identity, resilience, and risk factors such as injury history, perceived stress, and training volume. These assessments can inform tailored intervention strategies: for athletes exhibiting neurotic tendencies, interventions could focus on reducing rumination and enhancing cognitive appraisal and distress tolerance; for those with low extroversion, promoting help-seeking behaviors, expanding support networks, and gradually exposing them to stressors may be beneficial; and for individuals with low conscientiousness, implementing structured micro-goals, regular feedback, and accountability measures can enhance performance. Concurrently, to foster a sense of identity, team policies should emphasize "role ownership" by involving athletes in training design, assigning micro-leadership roles, sharing narratives of recovery through internal media, and engaging in community outreach. These initiatives not only cultivate a sense of meaning and belonging but also serve as a psychological buffer during challenging times.

Organizational synergy is crucial for effective mental health care in sports. The International Olympic Committee highlights the importance of integrating mental health services with physiotherapy and establishing clear referral pathways (Reardon et al., 2019; Mountjoy et al., 2023). It is advisable for clubs and federations to incorporate regular screenings for psychological distress, re-injury risk, and resilience into their standard practices. Additionally, providing mental health literacy training for coaches and physiotherapists, along with ensuring confidential access to sports psychology services, is essential for fostering a supportive environment (Purcell et al., 2019).

To mitigate the adverse effects of "overidentity," it is advisable to implement personal development programs that foster complementary roles, such as adaptive identities alongside the primary sports identity. Engaging in roles like student, athlete, assistant coach, and community ambassador can enhance psychological resilience and lessen vulnerability in the face of setbacks or disruptions (Brewer, 2017; Park et al., 2013). Consequently, technical staff should adopt a balanced approach in their feedback and evaluations, focusing not only on outcomes but also on the processes involved and the cultivation of psychosocial skills. Furthermore, educational planning must consider individual differences related to disability type and severity, competitive level, and discipline to ensure equitable access to support resources (Mollanorouzi et al., 2023; Shafiee et al., 2023).

Future research should focus on several key areas: employing multi-wave longitudinal designs to investigate the directionality of relationships and the temporal aspects of resilience; utilizing multi-source assessments from athletes, coaches, and therapists to mitigate common method bias; conducting multi-group analyses to examine variations based on the type and severity of disabilities as well as different disciplines; exploring nonlinear and threshold models to determine if the risk of obstruction escalates beyond a certain level of identity; and implementing bi-axial interventions that are personality-based, identity-based, or a combination of both, while using objective outcome measures. Additionally, in light of recent discussions regarding the psychometric properties of resilience scales in sports and advancements in mental health screening for athletes, it is recommended that updated, context-specific versions of these instruments be utilized, with their validity independently assessed within para-populations.

The current findings highlight the significance of "individual wisdom," represented by stable personality traits, and "meaning and belonging," reflected in sports identity, as essential components of resilience among athletes with disabilities. These insights advocate for practical applications such as early-season assessments, tailored interventions based on personality profiles, initiatives to foster identity and role within teams, integration with mental health services, and data-driven evaluations. This approach aligns with existing theoretical frameworks and consensus literature, such as Reardon et al. (2019), while also being straightforward, cost-effective, and measurable, thereby enhancing its potential for acceptance and sustainability within the disability sports community.

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