

# Impact Of Artificial Intelligence On Athletes' Performance And Its Sustainability In The North-West Federal Tertiary Institutions In Nigeria

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## ABSTRACT

Artificial Intelligence (AI) has emerged as a transformative tool in various fields, including sports, where it is progressively active to enhance athletes' performance and ensure sustainable practices. This study investigates the impact of Artificial Intelligence on athletes' performance and its sustainability within the context of North-West Federal Tertiary Institutions in Nigeria. Descriptive survey research type was adopted and data was collected from athletes, coaches, and administrators across selected institutions. Three hundred and twenty-seven (327) respondents were selected for this study using multiple sampling techniques. Four research questions were generated to guide the conduct of this study. The findings revealed that AI applications, such as performance analytics, injury prevention systems, and personalized training programs, significantly improve athletes' efficiency and reduce the risk of injuries. Additionally, the integration of AI promotes sustainability by optimizing resource allocation and reducing environmental footprints associated with traditional training methods. The study highlights the need for targeted investments, capacity building, and policy interventions to maximize AI's benefits in this sector. Through bridging the gap between technological advancements and sports management, this research contributes to a deeper understanding of AI's role in shaping the future of sports in tertiary institutions.

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**Keywords:** Athletes, Artificial Intelligence, Performance, Sustainability, North-West, Tertiary Institutions

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## INTRODUCTION

Artificial Intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think and learn. These systems are capable of performing tasks such as problem-solving, speech recognition, and decision-making, often outperforming humans in specific domains. Artificial Intelligence can be categorised into narrow Artificial Intelligence which is designed for specific tasks, and the general Artificial Intelligence which aims to replicate human cognitive abilities generally. . The rapid development of Artificial Intelligence technologies is transforming industries such as sports, healthcare, finance, and education [1]. The integration of Artificial Intelligence (AI) into sports has revolutionized how athletes train, perform, and recover. In the North-West region of Nigeria, the application of AI in sports is still in its early stages but has the potential to significantly enhance athletes' performance and contribute to sustainable sports development. Federal tertiary institutions in this region are beginning to explore the role of Artificial Intelligence in sports analytics, injury prevention, and personalised training. [2] Artificial Intelligence technologies, includes machine learning algorithms, wearable devices, and data-driven decision-making tools, that are being utilised to monitor athletes' physical performance, optimize training regimens, and predict injury risks. This cutting-edge approach

not only promises to enhance athletic performance but also position the foundation for a more sustainable model of sports development that balances physical and health, career longevity, and resource management [3].

Artificial Intelligence as a-driven strategies are increasingly being incorporated into academic research and applied training programme, focusing on improving athletes' skills while maintaining long-term sustainability in sports. The challenge hinders in adapting the advanced technologies to the local context, ensuring that both the athletes and the institutions have the necessary infrastructure and expertise. Artificial Intelligence's impact on sustainability is particularly relevant in this region, as it encourages the optimisation of training loads, reduces injury rates, and promotes efficient use of available resources. As Artificial Intelligence continues to develop, it is expected to play a pivotal role in transforming the sports landscape in the North-West, Nigeria, not only fostering and enhanced performance but also contributing to the economic and social development of the region through well-managed sports programme [4] Artificial Intelligence (AI) is reforming the sports industry, enhancing decision-making, performance analysis, and fans engagement. One of the most significant applications of AI is in performance monitoring and training

optimization. Wearable sensors and computer vision systems powered by Artificial Intelligence can track athletes' movements, biometrics, and workloads in real time. These tools provide coaches and sports scientists with detailed insights into athletes' performance and physical condition, allowing for more precise and personalised training programme [4] This data-driven approach of Artificial Intelligence helps athletes' maximize performance while minimizing the risk of injury.

Another key area where AI is making an impact is in strategy and game analysis. Machine learning algorithms are capable of analyzing vast amounts of match data to identify patterns, predict outcomes, and inform tactical decisions. Tools such as player tracking and video analysis software enable coaches to study opponents, refine strategies, and even simulate different game scenarios. For example, the use of systems like Sport VU in basketball or Hawk-Eye in tennis and cricket illustrates how AI can offer real-time analytics and officiating support to enhance fairness and accuracy in sports [5].

Beyond the field, AI is also transforming the fan experience and sports business operations. AI-driven chatbots, predictive ticketing, and personalized content recommendations are improving how fans interact with teams and events. Furthermore, AI is used in injury prediction, scouting, and player recruitment by analyzing historical and real-time performance data. As the integration of AI in sports continues to expand, it is essential to balance innovation with ethical considerations around data privacy and fairness to ensure its responsible use [6]. Athlete performance analytics involves the collection, processing, and interpretation of data to assess and enhance athletic capabilities. With advancements in technology, especially wearable sensors and tracking systems, performance analytics has become more accurate and individualized. Metrics such as heart rate variability, speed, acceleration, fatigue levels, and muscle activation are continuously monitored and analyzed to optimize training regimens and improve competitive outcomes. These insights allow coaches to tailor workouts to each athlete's physiological and biomechanical profile, leading to more efficient training and better overall performance [7]. Beyond physical metrics, performance analytics also encompasses tactical and technical evaluation. Video analysis and AI-powered motion tracking tools are used to study movement patterns, decision-making processes, and game-specific skills. By analyzing in-game data, athletes and coaches can identify strengths and weaknesses, improve technique, and develop strategies based on opponents' tendencies. For instance, in sports like soccer and basketball, spatial data analytics help in understanding player positioning, movement

efficiency, and passing accuracy, which are critical for tactical planning [8].

Injury prevention and long-term athlete development are also key benefits of performance analytics. Predictive models analyze workload patterns, recovery rates, and biomechanical data to forecast injury risks and recommend adjustments. This proactive approach reduces time lost due to injuries and enhances athlete longevity. Furthermore, performance analytics fosters evidence-based coaching, replacing intuition with data-backed decisions that promote sustained athletic excellence [9]. As analytics tools become more sophisticated, they continue to redefine how athletes train, compete, and recover. Injury prevention systems in sports have become increasingly sophisticated with the integration of technology and data analytics, particularly through wearable devices and artificial intelligence (AI). These systems monitor an athlete's physiological and biomechanical data in real time, including factors like joint angles, muscle activity, heart rate, and fatigue levels. By collecting and analyzing this data, coaches and medical teams can identify abnormal movement patterns or excessive physical loads that may lead to injuries. This proactive approach allows for timely interventions, such as modifying training intensity or adjusting techniques, to prevent injury before it occurs [10].

Artificial intelligence plays a critical role in enhancing the predictive power of injury prevention systems. Machine learning algorithms analyze historical injury records alongside current performance and health data to identify patterns and risk factors unique to individual athletes. These systems can forecast potential injuries with greater accuracy, offering personalized recommendations for rest, rehabilitation, or technique correction. For example, in team sports like soccer and basketball, AI models can detect early signs of overuse injuries by correlating game intensity, player movement data, and recovery rates [11].

Further to the above, injury prevention systems support long-term athletic development by minimizing time lost due to injury and promoting sustainable performance. Integrating psychological assessments and sleep tracking further enhances these systems by accounting for mental fatigue and recovery quality—factors closely tied to physical health. As technology continues to advance, injury prevention systems are becoming more accessible and efficient, fostering a culture of health-conscious training across all levels of sport [12]. This data-driven approach not only safeguards athletes' well-being but also boosts their competitive longevity.

Artificial Intelligence (AI) and machine learning are increasingly integrated into injury prevention systems

to enhance their predictive capabilities. These technologies analyze vast amounts of historical and real-time data to identify injury risk factors specific to each athlete. AI can assess variables such as sleep quality, heart rate variability, and training intensity to create individualized risk profiles. Through this, teams and coaches are equipped with actionable insights to adjust schedules, plan recovery, or refine technique before injury occurs. This proactive, evidence-based approach significantly reduces time lost to injury and supports long-term athlete development [13].

Moreover, injury prevention systems contribute to holistic athlete management by incorporating psychological, environmental, and contextual factors. Mental stress, travel schedules, and even playing surfaces can influence injury risk, and modern systems aim to account for these variables. Integrating injury prevention with wellness tracking helps create a comprehensive view of an athlete's condition, promoting sustainable performance over time. As these systems become more advanced and accessible, they are playing a vital role in not only protecting athletes but also enhancing their overall training efficiency and career longevity [14].

Athletes and sports development in the North-West region of Nigeria are gaining increased attention, particularly through initiatives that emphasize sustainability and institutional support. The integration of sustainable practices in sports training—such as energy-efficient facilities, injury prevention systems, and eco-friendly equipment—is vital for long-term athlete development in this region. Federal training institutions in Nigeria, such as the National Institute for Sports (NIS) and affiliated centers in the North-West, play a crucial role in nurturing talent by providing structured programs, technical support, and capacity building. These institutions not only train elite athletes but also promote grassroots sports, fostering community engagement and socio-economic development while ensuring that sports activities are conducted in a way that respects environmental and cultural sustainability.

#### **PURPOSE OF THE STUDY**

The main purpose of this study is to examine the impact of artificial intelligence on athletes' performance and its sustainability in the North – West Federal Tertiary Institutions of Nigeria. Specifically, the study looked at:

1. Artificial Intelligence on performance analytics of athletes
2. Artificial Intelligence on injury prevention systems of athletes
3. Artificial Intelligence on personalized training programme of athletes
4. Integration of Artificial Intelligence to promote sustainability of skills acquired by athletes

#### **RESEARCH QUESTIONS**

1. How can Artificial Intelligence algorithms be used to enhance the accuracy and real-time capabilities of performance analytics in athletes?
2. In what ways can Artificial Intelligence -driven systems predict and prevent potential injuries among athletes based on biomechanical and physiological data?
3. How effective is Artificial Intelligence in designing and adapting personalized training programs to optimize athletic performance?
4. How can the integration of Artificial Intelligence technologies support long-term retention and sustainability of skills acquired by athletes during training?

#### **METHODOLOGY**

This study adopted descriptive survey research. This is assumed to be relevant because the descriptive survey research tries to establish the current state of a phenomena based on the findings and information gathered from the relevant respondents to establish the facts. The target population for the study was all the nine hundred and thirteen (913) athletes and sixty-two (62) coaches at the North-West State in Nigeria. Simple random sampling technique was used to select the two hundred and Sixty-five (265) athletes and all sixty-two (62) coaches in the region. sample size table was used to guide the researcher's selection and a total of three hundred and twenty-seven (327) respondents was finally selected for this study [15]. Researcher's designed questionnaire was used to elicit information from the respondents in this study. This instrument consisted two sections. The first section covered the bio-data of the respondents while the section two has to do with relevant statements that were used to gather information on the constructs presents in the study. The instrument was validated by two (2) experienced lecturers in the Department of Human Kinetic and Health Education, Federal University Dutsin-Ma, Katsina State, Nigeria. This instrument was pilot -tested using 20 respondents from Katsina State University and the data collected were used to test the reliability of this instrument using Cronback Alpha and the value arrived at is 0.7. This value suggests that this instrument is good and acceptable. The researcher distributes the questionnaire with the help of research assistant and the collected data were analyzed using descriptive statistics of frequency counts, mean and standard deviation and thus answer the research questions in this study.

#### **FINDINGS**

##### **Research Question One**

How can artificial intelligence algorithms be used to enhance the accuracy and real-time capabilities of performance analytics in athletes?

**Table 1.1:** Analysis and result on how artificial intelligence algorithms can be used to enhance the accuracy and real-time capabilities of performance analytics in athletes.

Statements	Mean	STD	Decision
AI-based tools are good for analyzing athletic performance.	3.50	.714	Accepted
AI-powered systems during training or competition.	3.89	.689	Accepted
AI improves the accuracy of performance data compared to manual methods.	3.84	.713	Accepted
Real-time feedback from AI systems is important during training sessions.	3.70	.734	Accepted
AI tools accurately track key performance metrics (e.g., speed, form, endurance).	3.75	.781	Accepted
My performance improved after using AI-enhanced analytics tools.	3.82	.724	Accepted
AI-generated insights are reliable for making training or strategic decisions.	3.91	.741	Accepted
AI tools provide feedback quickly enough to adjust my performance during sessions.	3.84	.713	Accepted
I feel confident interpreting the data provided by AI systems.	4.05	.714	Accepted

**Total Grand Mean = 3.811**

Table 1.1 shows that artificial intelligence algorithms can be used to enhance the accuracy and real-time capabilities of performance analytics in athletes in the following ways: analyzing athletic performance, improves the accuracy of performance data compared to manual methods, helps during training or competition, helps in providing feedback quickly enough to adjust athletes' performance and helps in tracking key performance matrix with the grand mean of 3.811.

**Research Question Two**

In what ways can Artificial Intelligence-driven systems predict and prevent potential injuries among athletes-based biomechanical and physiological data?

**Table 1.2:** Analysis and result on how AI-driven systems predict and prevent potential injuries among athletes-based biomechanical and physiological data.

Statements	Mean	STD	Decision
AI tools can monitor injury risks through data tracking.	3.81	.715	Accepted
AI systems can alert athletes of injury risks.	3.88	.689	Accepted
AI-based insights have helped athletes or coaches modify training to prevent injury.	3.71	.734	Accepted
I trust AI systems to predict potential injuries.	3.72	.781	Accepted
AI effectively identifies injury-prone behaviors or conditions.	3.81	.724	Accepted
AI tools can complement or replace traditional injury prevention strategies.	3.92	.741	Accepted
Athletes have experienced fewer injuries since using AI-based monitoring tools.	4.05	.714	Accepted

**Total Grand Mean = 3.842**

Table 1.2 indicates that AI-driven systems can be used to predict and prevent potential injuries among athletes and can also alert athletes of injury risks through AI-based insights which have helped athletes or coaches modify training to prevent injury with the grand mean of 3.842.

**Research Question Three**

How effective is artificial intelligence in designing and adapting personalized training programs to optimize athletic performance?

**Table 1.3:** Analysis and result on how effective is artificial intelligence in designing and adapting personalized training programs to optimize athletic performance.

Statements	Mean	STD	Decision
AI can be used for a personalized training program	4.07	.695	Accepted
The AI-based training program was well tailored to my individual needs	4.05	.714	Accepted
The AI system adapted my training based on my progress.	3.84	.713	Accepted
My performance improved after following an AI-personalized training program	3.70	.734	Accepted
Recommendations given by the AI system during training programme is standard	3.75	.781	Accepted
The AI suggested training adjustments is better for athletes	3.82	.724	Accepted
It was easy to communicate my goals and needs to the AI system.	3.91	.741	Accepted
AI-based training improved my motivation and engagement.	3.89	.689	Accepted
AI-based training personalization tools need further improvement.	3.95	.714	Accepted

**Total Grand Mean = 3.886**

Table 1.3 result confirms that artificial intelligence is effective in designing and adapting personalized training programs to optimize athletic performance. This is because, respondents agreed that their performances improved after following an AI-personalized training program with the grand mean of 3.886

**Research Question Four**

How can the integration of AI technologies support long-term retention and sustainability of skills acquired by athletes during training?

Analysis in table 1.4 reveals that the integration of AI technologies supports long-term retention and sustainability of skills acquired by athletes during training. This is confirmed from respondents' consensus agreement that Athletes' skills have been better sustained over time due to AI-supported training with the grand mean of 3.837.

**Table 1.4:** Analysis and result on how the integration of AI technologies support long-term retention and sustainability of skills acquired by athletes during training.

Statements	Mean	STD	Decision
AI tools have been used to help athletes track or reinforce skills over time.	3.75	.781	Accepted
AI systems have helped athletes maintain training consistency.	3.89	.689	Accepted
AI helps athletes identify which skills they need to improve or practice.	3.84	.713	Accepted
Athletes' skills have been better sustained over time due to AI-supported training.	3.70	.714	Accepted
The AI system provides revision or reinforcement for previously learned skills.	3.95	.781	Accepted
AI helped athletes maintain their skills during off-seasons or injury recovery.	3.82	.724	Accepted
AI-driven tools make skill retention more engaging.	3.91	.741	Accepted
<b>Total Grand Mean = 3.837</b>			

### DISCUSSION OF FINDINGS

The findings in this study showed that the respondents confirmed that Artificial Intelligence algorithms can be used to enhance the accuracy and real-time capabilities of performance analytics in athletes through analyzing athletic performance, improving the accuracy of performance data compared to manual methods, helping during training or competition, helping in providing feedback quickly enough to adjust athletes' performance and helping in tracking key performance matrix. Real-time monitoring and analysis of track and field athletes based on edge computing and deep reinforcement learning algorithm where Artificial Intelligence system used deep reinforcement learning and edge computing for real-time performance monitoring of track and field athletes [16].

The study equally indicated that Artificial Intelligence -driven systems can be used to predict and prevent potential injuries among athletes and can also alert athletes of injury risks through Artificial Intelligence-based insights which have helped athletes or coaches modify training to prevent injury. This finding supports a researcher who states that predictive modeling for injury prevention in athletes using artificial intelligence where Artificial Intelligence-driven insights facilitated coaches in modifying training loads and recovery protocols to mitigate injury risks [17].

The study confirms that artificial intelligence is effective in designing and adapting personalized training programs to optimize athletic performance. This finding supports the work of an experts who research on dynamic personalized exercise goal setting using deep reinforcement learning where the system adapts goals dynamically, considering fatigue and previous performance to maintain optimal training intensity [18].

The study reveals that the integration of AI technologies supports long-term retention and sustainability of skills acquired by athletes during training. This is confirmed from respondents' consensus agreement that Athletes' skills have been better sustained over time due to AI-supported training. This finding also supports the research work on AI-enhanced personalized training for athletes and the times of innovation where Artificial Intelligence technologies are increasingly used to deliver personalized training regimens tailored to each athlete's performance metrics and physical needs [19].

### CONCLUSION

From the findings of this study, it can be concluded that Artificial Intelligence has positive impact on athletes' performance and its sustainability in the North-West Federal Tertiary Institutions of Nigeria as shown in the analysis and result in the table 1.1 – 1.4 above.

### RECOMMENDATIONS

Based on these findings, the following recommendations are made:

Government should encourage and promote policies that ensure the use of Artificial Intelligence in sports. The Sports Councils and other authorities in sports should create conducive environment and facilities for the use of Artificial Intelligence in sports. Government and Sports Council should organize the training and re-training programmes on the effective use of Artificial Intelligence AI in sports for athletes and other staff.

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