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Artificial Intelligence as a Tool for Healthy Lifestyle Assessment of Athletes for Sustainable High Performance of Nigerian Elite Athletes

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Abstract

The study investigated artificial intelligence as a tool for healthy lifestyle assessment of athletes for sustainable high performance of Nigerian elite athletes. In order to achieve this purpose, two null hypotheses were formulated and tested at 0.05 level of significance. Correlational survey research design was chosen as the most appropriate design for the study. The population of the study consisted of 703 elite athletes across Nigeria. In view of the size of the population of the study, census approach was adopted for the study, which implies that the entire population of the study was used for the study. A structured questionnaire titled "Artificial Intelligence as a Tool for Healthy Lifestyle Assessment of Athletes for Sustainable High Performance of Nigerian Elite Athletes Questionnaire (AITHLAASHPNEAQ)" was the instrument used for data collection. The instrument was subjected to reliability test using Cronbach alpha method with coefficient value ranging between .72 to .87. To test the two hypotheses formulated for the study, simple linear regression statistical tool was utilized for data analysis. The result obtained from analysis of data and testing of hypotheses in the study revealed that the promotion of Nigerian elite athletes' recovery patterns and promotion of Nigerian elite athletes' training load management for healthy lifestyle are significant factors in achieving sustainable high performanceamong elite

	athletes in Nigeria. Based on the findings of the study, it was recommended among others that national sport federations and high-performance centers should incorporate qualified sport scientists, physiologists, and performance analysts into coaching teams. Their expertise is essential for interpreting training load data, designing individualized programs, and preventing training-related health issues.

Introduction

The global sports industry has undergone a profound transformation driven by rapid advancements in artificial intelligence (AI) and data-driven technologies. Over the past decade, AI has been increasingly integrated into sports training, performance optimization, injury prevention, and athlete health monitoring, enabling unprecedented levels of precision and personalization (Hammes, Hagg & Asteroth, 2022). Elite athletes generate extensive and complex data through wearable devices, GPS trackers, physiological sensors, and high-speed video tools. Unlike traditional methods of athlete assessment, AI techniques allow the processing of these large datasets in real time, enabling coaches and sports scientists to make evidence-based decisions that directly influence performance and well-being.

AI's capacity to model physiological, biomechanical and psychological patterns makes it a highly effective tool for designing individualized training regimens. Machine learning algorithms can detect subtle deviations in movement mechanics, predict injury risk, and optimize training loads to prevent overtraining or chronic fatigue (Almeida, 2025). Deep learning models particularly convolutional neural networks have been shown to evaluate movement quality with higher accuracy than human observation alone, offering new insights into how athletes can improve efficiency and reduce injury risk. These innovations demonstrate how AI enhances the holistic development of athletes.

In addition to physical performance, AI supports nutritional and metabolic monitoring, which are essential for a healthy lifestyle among elite athletes. Roumeliotis (2025) reported that AI-driven systems can evaluate energy expenditure, hydration status, glucose variability, and recovery needs based on multimodal physiological inputs. This capacity enables daily, individualized nutrition and recovery planning which are critical components for sustaining long-term performance. Furthermore, AI tools in mental health monitoring, sleep tracking, and stress analysis contribute to a comprehensive approach to athlete wellness. In high-performance sports environments, there is growing recognition that sustainable success depends not only on physical output during competition but also on an athlete's overall lifestyle, health stability, and long-term development. AI systems employed in elite sports teams globally are now capable of integrating training data with medical records, providing early warnings for potential injuries, illnesses, or burnout (Muñoz-Macho, Domínguez-Morales & Sevillano-Ramos, 2024). These systems support medical teams and coaches in making proactive decisions, thereby reducing the likelihood of performance-limiting health conditions.

Despite the global adoption of AI for athlete assessment, Nigeria is still in the early stages of integrating AI into sports performance systems. Nigerian elite athletes have excelled in athletics, football, boxing, weightlifting, and other sports on international platforms. However, their performance trajectory is often characterized by inconsistencies linked to inadequate monitoring systems, insufficient sports science support, limited injury-prevention frameworks, and poor long-term athlete development structures. Many athletes rely on subjective assessments rather than objective, data-driven methods, leading to delayed identification of health concerns or performance deficiencies. The ecosystem of elite sports in Nigeria faces unique challenges, including inadequate technological infrastructure, limited funding for sports research, and

insufficient collaboration between sports scientists and AI experts. Additionally, cultural factors, training conditions, and resource availability create a performance environment that differs from those in technologically advanced countries. As a result, simply adopting foreign AI systems may not be effective without contextualized research that explores how AI can be adapted to Nigeria's realities. Given these gaps, this study focused on AI as a tool for healthy lifestyle assessment and sustainable high performance among Nigerian elite athletes.

Elite athletic performance in Nigeria continues to face significant challenges related to inconsistent training outcomes, increased injury prevalence, inadequate monitoring systems, and limited integration of scientific technologies in athlete assessment. Although Nigerian athletes have demonstrated exceptional potential on regional and global platforms, their performance and health sustainability are frequently undermined by the absence of systematic, evidence-based approaches to training, recovery, and lifestyle management. Traditional methods used by many coaches and sports administrators rely heavily on subjective judgment rather than data-driven insights, making it difficult to accurately track physiological status, detect early signs of injury, or assess holistic athlete well-being (Ibok, Ogar, Olofu, Anam, Bessong, Oduk, Bessong, Amos, Ewa, Obeten, Patrick, Masor, Owan, Akpan, Ani, Afiene, Olenye, & Igba, 2025). Globally, artificial intelligence (AI) has emerged as a powerful tool in sports performance and health monitoring, providing real-time analysis of biomechanical movements, training loads, metabolic responses, sleep patterns, and psychological states. These technologies have enabled many elite sports systems to optimize performance while preserving athlete health.

However, such AI-driven frameworks are largely absent within Nigeria's elite sports environment, where infrastructural limitations, limited access to advanced technologies, and inadequate sports science integration hinder the adoption of innovative athlete-assessment tools.

As a result, Nigerian elite athletes often experience preventable injuries, overtraining, poor recovery management, and suboptimal lifestyle habits that negatively affect long-term performance sustainability. Without AI-enabled assessment tools, coaches and medical teams lack timely, precise, and individualized data to make informed decisions that support athlete health and peak performance. The gap between global best practices and Nigeria's current athlete-monitoring systems continues to widen, threatening the competitiveness and career longevity of Nigerian elite athletes. Based on this premise, this study investigated how artificial intelligence can be applied as a tool for healthy lifestyle assessment and sustainable high performance among Nigerian elite athletes.

Purpose of the study

The purpose of this study was to examine the role of artificial intelligence (AI) as a tool for promoting a healthy lifestyle and achieving sustainable high performance among Nigerian elite athletes.

. Specifically, the study sought to:

1. Examine how AI-based assessment systems can promote Nigerian elite athletes' recovery patterns for a healthy lifestyle and achieving sustainable high performance.
2. Investigate how AI-based assessment systems can promote Nigerian elite athletes' training load management for a healthy lifestyle and achieving sustainable high performance.

Research hypotheses

1. AI-based assessment systems does not significantly promote Nigerian elite athletes' recovery patterns for a healthy lifestyle and achieving sustainable high performance.

2. AI-based assessment systems does not significantly promote Nigerian elite athletes' training load management for a healthy lifestyle and achieving sustainable high performance.

Literature review

Recovery has increasingly been recognized as a fundamental determinant of elite athletic performance. Contemporary sport science emphasizes that optimal recovery is essential not only for physiological adaptation but also for psychological resilience, injury prevention, and long-term athletic sustainability. In recent years, Artificial Intelligence (AI) has been integrated into athlete monitoring systems to enhance the precision and personalization of recovery assessment. The adoption of AI-based assessment technologies has been driven by the limitations of traditional monitoring approaches, which often rely on subjective self-reports and inconsistent observational evaluations. Recovery encompasses not only the physical but also the psychological domain. Adebisi, Balogun, Oguntuase, and Olajide (2024) carried out an integrative review on AI applications in stress management among athletes. Their findings suggested that AI-powered systems, including chatbots, biofeedback applications, and predictive stress monitoring, could significantly improve psychological recovery. By providing continuous, individualized insights into stress and mental fatigue, AI systems facilitate interventions that help athletes maintain optimal mental well-being, which is a crucial component of overall recovery.

Okon (2020) carried out a study on the application of AI-based wearable technologies for monitoring elite athletes' physiological parameters. The study revealed that AI algorithms could accurately track heart rate variability (HRV), sleep quality, and training load, thereby providing individualized recovery scores. This finding is consistent with Musat (2024), who reported that

machine learning models can integrate multimodal physiological data to predict fatigue levels and optimize training schedules for high-performance athletes.

Also, Thami, Gupta, and Kumar (2024) conducted a review of AI applications in sports medicine, emphasizing that AI-based systems enable predictive modeling of injury risk and recovery readiness. The authors argued that such systems can complement traditional coaching assessments, which are often subjective and sporadic, by providing continuous and objective monitoring of athlete health. Onifade, Ogunnowo, and Moronfolu (2025) carried out a study on the current state of AI applications in Nigerian sports. They found that AI technologies were still largely underutilized, with most programs being conceptual or pilot projects. The study recommended investment in infrastructure, capacity building, and research to tailor AI systems to the local environment. Similarly, Adebisi et al. (2024) emphasized that stress management interventions using AI could be particularly beneficial in Nigeria, given the limited availability of specialized mental health professionals in elite sports.

Recovery is a critical factor influencing athletic performance, injury prevention, and long-term health outcomes in elite athletes. Recent advances in Artificial Intelligence (AI) have provided opportunities to improve the monitoring of recovery patterns through physiological, biomechanical, and behavioral data. In the Nigerian context, the integration of AI-based assessment systems is still in its nascent stage, but it holds promise for promoting healthy lifestyles and achieving sustainable high performance.

Training load management is essential in high-performance sport because poorly calibrated load leads to overtraining, injury, and burnout, while optimal load promotes adaptation, health, and longevity. In this regard, Artificial Intelligence (AI)–driven assessment systems provide powerful tools to monitor, analyze, and predict athlete training load dynamics. Onifade,

Ogunnowo, and Moronfolu (2025) carried out a descriptive empirical study involving coaches, athletes, and administrators in Nigeria. Their survey found that AI applications (for example, performance analytics, personalized training programs, injury prevention systems) are viewed favorably and perceived to significantly improve athletic efficiency. However, they also reported major barriers: limited infrastructure, lack of trained personnel, and low adoption of AI in grassroots and elite sports. Akameze, Tyoakaa, and Akameze (2025) explored technological innovations in Nigerian sports science, including the use of wearable devices, data analytics, and AI. They argued that these technologies could support sustainable sports development by optimizing athlete training, reducing injury, and enabling more personalized training load prescriptions. Their review, though narrative, points to nascent empirical adoption: they document examples where GPS, accelerometers, and heart-rate monitors are already being used in some Nigerian training settings, though not yet widely integrated with AI.

Monitoring training load is a fundamental component of elite sports performance. Proper load management ensures athletes receive sufficient stimulus for adaptation while minimizing the risk of overtraining, injury, and burnout. Recent advances in artificial intelligence (AI) offer innovative methods for monitoring and managing athlete training loads. AI-based assessment systems, which integrate wearable sensors, machine learning algorithms, and data analytics, have shown potential in providing individualized insights for optimizing athlete performance, enhancing recovery, and promoting a healthy lifestyle (Ali & Shalal, 2025). Olowononi and Eletta (2023), in a legal analysis, discussed the ethical and data-governance issues associated with AI in sports in Nigeria. They highlight concerns around biometric data ownership, athlete consent, surveillance, and possible misuse of load-monitoring data (for example, selection, contract decisions). This is relevant to training load: if athletes are monitored continuously, questions arise

about who accesses the data, how it is used, and how this affects athlete autonomy and rights.Bassey (2025) investigated the application of AI-based wearable sensors in elite athletes and found that machine learning algorithms could accurately monitor real-time physiological and biomechanical parameters, allowing coaches to individualize training loads.

Similarly, Ali and Shalal (2025) examined AI predictive models for football players and demonstrated that these models could identify fatigue and overtraining patterns, enabling more precise load adjustments. Ismail (2025) explored the integration of biomechanical feedback with AI algorithms in weight training and observed that personalized training recommendations reduced injury risk and improved performance efficiency. Mandour (2024) studied AI applications in movement classification and strength training monitoring, emphasizing that AI systems enhanced the precision of internal load assessments and facilitated safe strength development. Moschoyannis (2025) investigated AI models in endurance sports and highlighted that integrating physiological, behavioral, and environmental data allowed athletes to optimize recovery and performance. Similarly, Baladaniya and Choudhary, (2025) reported that AI-based injury prediction systems could accurately identify musculoskeletal injury risks, supporting preventive strategies in professional sports.

Methodology

The correlational research design was employed in this study. This design involves the collection of data to accurately and objectively describe existing phenomena. The population of the study consisted of 703 elite Nigerian athletes. A census sampling technique was used to select respondents for the study. A census approach involves collecting data from every member of a defined population rather than using a sample. This method ensures that the study captures comprehensive information from all individuals within the target group. The researchers created a

well-structured questionnaire, ensuring it covered all relevant aspects of the study. With the assistance of sports agents and managers, the Google Form link was distributed to all members of the defined population. The link was sent via email, social media, and university communication channels. The instrument used for data collection was a structured questionnaire titled "Artificial Intelligence as a Tool for Healthy Lifestyle Assessment of Athletes for Sustainable High Performance of Nigerian Elite Athletes Questionnaire (AITHLAASHPNEAQ)" designed by the researcher and validated by three experts. One in measurement and evaluation and two in department of Health Education, University of Calabar. To determine the reliability of the instrument a trial testing was done using 50 respondents drawn from the study area with similar characteristics who were not included in the main study. A set of items was administered to the respondents after an interval of two weeks. The Cronbach Alpha reliability coefficient was used to test the degree of consistency of the instrument. They were found to range from .72 to .87. This implies that the instrument was reliable enough to be used for this investigation.

The procedure for data analysis was based on the already structured research hypothesis. Prior to the administration of the questionnaire to the respondents (elite athletes), the researcher secured information on the venue and date of training per LGAs of the sampled area. This the researcher attended with three other trained research assistants to other locations depending on the LGAs. At the meeting venue after the elite athletes had concluded their meeting deliberations and training, the researcher and the assistants respectively formally introduced themselves stating the aim of their visit, after which the questionnaire was administered to the respondents. Simple regression statistical technique was used to analyzed data for the study.

Results

Hypothesis one

AI-based assessment systems does not significantly promote Nigerian elite athletes' recovery patterns for a healthy lifestyle and achieving sustainable high performance.The independent variable is Nigerian elite athletes' recovery patternsfor a healthy lifestyle while the dependent variable is achieving sustainable high performance, both measured continuously. To test this hypothesis, simple linear regression analysis was used, and the result as presented in Table 1 showed that R= .581 which implies that a positive relationship exists between promotion of Nigerian elite athletes' recovery patterns for ahealthy lifestyle and achieving sustainable high performance. That is, the higher the Nigerian elite athletes' recovery patterns for a healthy lifestyle are promoted, the higher the level of achieving sustainable high performance. More so, the result produced an Adj R^2= .337which shows that the variation in achieving sustainable high performance could be explained using 33.7% contribution of promotion of Nigerian elite athletes' recovery patterns for a healthy lifestyle. This implies that there are other factors that can contribute 66.3% in explaining the noticeable variations in the results. However, to test the significance of the variables, the Analysis of Variance (ANOVA) table was assessed, and the result showed that (F=353.203*,p-=.000). since p(.000) is less than p(.05), this implies that the hypothesis that stated that AI-based assessment systems does not significantly promote Nigerian elite athletes' recovery patterns for a healthy lifestyle and achieving sustainable high performanceis rejected and the alternate hypothesis upheld.

Table 1

Simple linear regression analysis of I-based assessment systems and promotion of Nigerian elite athletes' recovery patterns for healthy lifestyle and achieving sustainable high performance.

Source of variations	Sum of Squares	df	Mean Square	F	Sig.
Regression	2773.079	1	2773.079	353.203	.000[b]
Residual	5433.054	692	7.851		
Total	8206.133	693			

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	T	Sig.
(Constant)	-1.612	.787		-2.047	.041
Nigerian elite athletes' recovery patterns	1.620	.086	.581	18.794	.000

R=.581; R^2 = .338; Adj. R^2 = .337; Std Estimate = 2.082

*=significant at .05 level

Source: Researcher's Field work (2025)

Hypothesis two

AI-based assessment systems does not significantly promote Nigerian elite athletes' training load management for a healthy lifestyle and achieving sustainable high performance.The independent variable is promotion of Nigerian elite athletes' training load management for a healthy lifestyle while the dependent variable is achieving sustainable high performance, both measured continuously. To test this hypothesis, simple linear regression analysis was used, and the result as presented in Table 2 showed that R= .192 which implies that a positive relationship exists between promotion of Nigerian elite athletes' training load managementfor healthy lifestyle and achieving sustainable high performance. That is, the higher the promotion of Nigerian elite athletes' training load managementfor a healthy lifestyle that is provided, the higher the level of achieving sustainable high performance. More so, the result produced an Adj R^2= .035 which shows that the variation in achieving sustainable high performance could be explained using 3.5% contribution of promotion of Nigerian elite athletes' training load managementfor a healthy lifestyle. This implies that there are other factors that can contribute 96.5% in explaining the

noticeable variations in the results. However, to test the significance of the variables, the Analysis of Variance (ANOVA) table was assessed, and the result showed that (F=26.373*,p-=.000). since p(.000) is less than p(.05), this implies that the hypothesis that stated that AI-based assessment systems does not significantly promote Nigerian elite athletes' training load management for a healthy lifestyle and achieving sustainable high performanceis rejected and the alternate hypothesis upheld.

Table 2

Simple linear regression analysis of the promotion of Nigerian elite athletes' training load management for a healthy lifestyle and achieving sustainable high performance.

Source of variations	Sum of Squares	Df	Mean Square	F	Sig.
Regression	301.260	1	301.260	26.373	.000[b]
Residual	7904.872	692	11.423		
Total	8206.133	693			

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
(Constant)	9.056	.789		11.483	.000
Nigerian elite athletes' training load management for a healthy lifestyle	.344	.067	.192	5.135	.000

R=.192; R^2 = .037; Adj. R^2 = .035; Std Estimate = 3.378

*=significant at .05 level

Source: Researcher's Field work (2025)

Discussion of findings

The finding obtained from analysis of data and testing of hypothesis one in the study revealed that the null hypothesis was rejected. The findings of the study demonstrate that AI-based assessment systems offer substantial potential for enhancing the recovery patterns of Nigerian elite athletes, thereby supporting healthier lifestyle behaviours and enabling sustainable high performance. Overall, the results align with growing global evidence that intelligent monitoring

and data-driven recovery interventions can improve athlete wellbeing, reduce injury incidence, and optimize long-term performance trajectories.

The finding of the study is in line with that of Adebisi, Balogun, Oguntuase, and Olajide (2024) who carried out an integrative review on AI applications in stress management among athletes. Their findings suggested that AI-powered systems, including chatbots, biofeedback applications, and predictive stress monitoring, could significantly improve psychological recovery. By providing continuous, individualized insights into stress and mental fatigue, AI systems facilitate interventions that help athletes maintain optimal mental well-being, which is a crucial component of overall recovery.

The finding also aligns with the study of Okon (2020) who carried out a study on the application of AI-based wearable technologies for monitoring elite athletes' physiological parameters. The study revealed that AI algorithms could accurately track heart rate variability (HRV), sleep quality, and training load, thereby providing individualized recovery scores. This finding is consistent with Musat (2024), who reported that machine learning models can integrate multimodal physiological data to predict fatigue levels and optimize training schedules for high-performance athletes.

The finding obtained from analysis of data and testing of hypothesis two in the study revealed that the null hypothesis was rejected. The finding of the study indicated that effective training load management is essential for balancing performance development with athlete health, and the findings of this study emphasize its critical role in the Nigerian high-performance sport environment. The results show that well-structured monitoring and regulation of training load help athletes avoid excessive physiological and psychological stress, thereby reducing the risk of overtraining, recurrent injuries, and burnout.

The finding of the study agrees with the study of Jeon and Seshadri (2024) who asserted that Athletes who engaged in systematic load management exhibited improved recovery quality, better adherence to healthy lifestyle behaviours such as adequate sleep and nutrition, and more consistent training availability all of which are key determinants of long-term performance sustainability.

Also, the finding of the study is in line with that of Hammes, Hagg and Asteroth (2022) who highlighted that inappropriate or poorly monitored training loads remain a challenge in many Nigerian elite sport programs, where pressure to achieve rapid performance gains or perform continuously across competitions often leads to high training volumes without corresponding recovery periods. Such practices can undermine both short-term performance outcomes and long-term athlete development. In contrast, athletes whose training was managed through structured frame works including daily load tracking, recovery profiling, and periodized training plans demonstrated more stable performance trajectories and fewer injury-related disruptions. Nevertheless, effective load management in Nigeria faces several constraints. Limited access to sport science expertise, insufficient use of objective monitoring tools, and inconsistent collaboration between coaches, medical staff, and performance specialists reduce the potential for evidence-based decision-making. Cultural norms that valorize “hard training” over strategic conditioning also contribute to suboptimal load practices. Addressing these challenges requires greater investment in education, interdisciplinary teamwork, and technological tools that support accurate load monitoring (Oladipo, 2021).

Conclusion

Based on the result of the study the following conclusions were reached that: the promotion of Nigerian elite athletes’ recovery patterns and promotionof Nigerian elite athletes’ training load

management for healthy lifestyle are significant factors in achieving sustainable high performance among elite Athletes in Nigeria.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. National sport federations and high-performance centers should incorporate qualified sport scientists, physiologists, and performance analysts into coaching teams. Their expertise is essential for interpreting training load data, designing individualized programs, and preventing training-related health issues.
2. Coaches and teams should adopt simple, reliable, and cost-effective monitoring tools such as session-RPE, wellness questionnaires, and heart-rate–based measures to track athletes' internal and external loads consistently. This will support evidence-based planning and reduce harmful training spikes.

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