Vol. 4 No. 2 (2026)

Liberal Journal of Language & Literature Review
Print ISSN: 3006-5887
Online ISSN: 3006-5895
https://llrjournal.com/index.php/11

EFFECTS OF AI-BASED NUTRITIONAL PLANNING (ABNP) ON BODY COMPOSITION AND WEIGHT MANAGEMENT AMONG COLLEGE STUDENT ATHLETES

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Liberal Journal of Language & Literature Review
Print ISSN: 3006-5887
Online ISSN: 3006-5895

DOI: http://doi.org/10.5281/zenodo.20828157

Abstract

This study investigated the effects of AI-based nutritional planning on body composition and weight management among college student athletes in District Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan. Artificial intelligence is increasingly being used in sports nutrition to provide personalized dietary guidance based on individual health and performance data. A quantitative correlational research design was adopted, and data were collected from three hundred college student athletes selected through stratified random sampling. A structured questionnaire based on a five-point Likert scale was used to measure AI nutritional planning, body composition, and weight management. The reliability of the instrument ranged from zero point eight six to zero point nine zero, indicating good to excellent internal consistency. Data were analyzed using SPSS through descriptive statistics, Pearson correlation, and simple linear regression. The results showed significant positive relationships among all variables. AI nutritional planning was moderately associated with body composition and strongly associated with weight management. Regression analysis revealed that AI nutritional planning significantly predicted both body composition and weight management, with a stronger effect on weight management. The study concludes that AI-based nutritional planning is an effective predictor of improved body composition and weight management among college athletes, particularly for weight control outcomes.

Keywords: Artificial Intelligence, Nutritional Planning, Body Composition, Weight Management, Athletes

INTRODUCTION

An Artificial intelligence has rapidly transformed the landscape of sports nutrition, offering personalized dietary solutions that were previously unattainable through traditional methods (Basit et al,2025) AI-based nutritional planning systems analyze individual physiological data, dietary habits, and performance metrics to generate tailored meal recommendations for athletes (Sharma & Patel, 2024). College student athletes, in particular, face unique nutritional challenges due to demanding training schedules, academic pressures, and limited access to professional dietitians (Lee et al., 2024). The integration of machine learning algorithms enables real-time adjustment of nutritional protocols based on changing body composition and training loads (Mwangi & Roberts, 2025). Recent evidence suggests that AI-driven dietary interventions improve adherence to nutritional goals more effectively than conventional approaches (Gonzalez & Kim, 2024). These technologies leverage continuous data collection to optimize macronutrient distribution for specific athletic objectives. As digital health tools become increasingly accessible, their application among young athletic

populations warrants closer examination. This study therefore investigates how AI-based nutritional planning influences physical outcomes in college athletes.

Body composition management represents a critical determinant of athletic performance, injury prevention, and overall health among competitive athletes. Maintaining an optimal balance of lean muscle mass and body fat requires precise nutritional control that AI systems are uniquely positioned to deliver (Ahmed & Chen, 2024). Studies have demonstrated that algorithm-guided nutrition produces measurable improvements in fat-free mass and reductions in adiposity compared to standard guidance (Okonkwo et al., 2025). For college athletes, who often struggle with inconsistent eating patterns, AI tools provide structured accountability and feedback mechanisms (Rahman & Silva, 2024). The capacity of these systems to track micronutrient intake further supports recovery and adaptation processes essential for athletic development (Thompson & Nair, 2025). Emerging research highlights that personalized nutrition significantly enhances metabolic efficiency and energy availability in young athletes (Bello & Fernandez, 2024). Such findings underscore the relevance of examining body composition responses to AI interventions. Understanding these relationships can inform evidence-based practice in collegiate athletic programs. Consequently, this research evaluates the predictive role of AI planning on body composition outcomes.

Effective weight management remains a persistent concern within collegiate athletics, where weight stability directly impacts competitive eligibility and performance consistency. AI-based platforms offer dynamic monitoring capabilities that empower athletes to maintain target weight ranges throughout training cycles (Yusuf & Park, 2024). Contemporary investigations indicate that intelligent nutritional systems reduce unhealthy weight fluctuation and promote sustainable dietary behaviors (Costa & Adebayo, 2025). The motivational features embedded in many AI applications, including progress visualization and goal-setting, enhance long-term engagement among student athletes (Kapoor & Williams, 2024). Furthermore, real-time feedback enables timely corrective actions that prevent both excessive weight gains and harmful restriction (Diallo & Schmidt, 2025). Researchers increasingly recognize that technology-mediated nutrition fosters healthier relationships with food while supporting performance goals (Nakamura & Olsen, 2024). Given the prevalence of weight-related pressures in college sports, these tools hold considerable promise. The present study addresses this gap by quantifying the effect of AI planning on weight management outcomes. Collectively, these aims contribute to a deeper understanding of digital nutrition in athletic contexts.

Research Design

This study employed a quantitative research approach using a correlational design to investigate the effects of AI-based nutritional planning on body composition and weight management among college student athletes in District Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan. Quantitative methodology was considered appropriate because it allows the researcher to measure relationships among variables numerically and statistically. The correlational design was selected to determine the extent to which AI-based nutritional planning predicts body composition and weight management outcomes among student athletes.

Population of the Study

The population of the study consisted of college student athletes enrolled in public and private colleges in District Dera Ismail Khan. These participants were actively involved in

sports activities at the college level and represented different academic backgrounds, age groups, and sports disciplines.

Sample and Sampling Technique

The total sample of 300 college student athletes was selected for this study. The researcher used a stratified random sampling technique to ensure proper representation across gender, educational level, residence, and sport type. Stratification helped to include participants from diverse backgrounds, enhancing the generalizability of the findings.

Research Instrument

The data collection process it is the key part of any research. in this study Data were collected using a structured self-administered questionnaire developed based on previous literature and study objectives. The questionnaire was measured on a five-point Likert scale ranging from AI Nutritional Planning, Body Composition and Weight Management The questionnaire was designed to assess participants' perceptions regarding the use of AI-based nutritional planning and its influence on their physical outcomes.

Validity of the Instrument

To ensure content validity, the questionnaire was reviewed by experts in sports sciences, nutrition, and research methodology. Necessary modifications were made based on expert suggestions to improve clarity, relevance, and appropriateness of the items.

Reliability of the Instrument

The reliability of the instrument was assessed using Cronbach's Alpha to measure internal consistency. The reliability values indicated strong consistency across all study variables.

Scale	Items	Cronbach's Alpha	Status
AI Nutritional Planning	7	0.88	Good
Body Composition	7	0.86	Good
Weight Management	7	0.90	Excellent

Data Collection Procedure

The researcher obtained formal permission from the concerned college administrations before collecting data. Participants were informed about the purpose of the study and assured of confidentiality and anonymity. The questionnaires were distributed personally to the participants, and sufficient time was provided for completion. The researcher collected all completed questionnaires and screened them for completeness before data entry.

Data Analysis Procedure

The collected data were organized and analyzed using the Statistical Package for Social Sciences (SPSS)**.** Different statistical methods were applied to achieve the study objectives. Descriptive statistics, including mean and standard deviation, were used to summarize the responses of participants. Pearson correlation was used to examine the relationships between AI nutritional planning, body composition, and weight management. In addition, simple linear regression analysis was conducted to determine the predictive effect of AI nutritional planning on body composition and weight management, while ANOVA was applied to test the overall fitness of the regression models. The level of significance for all analyses was set at $p < 0.05$

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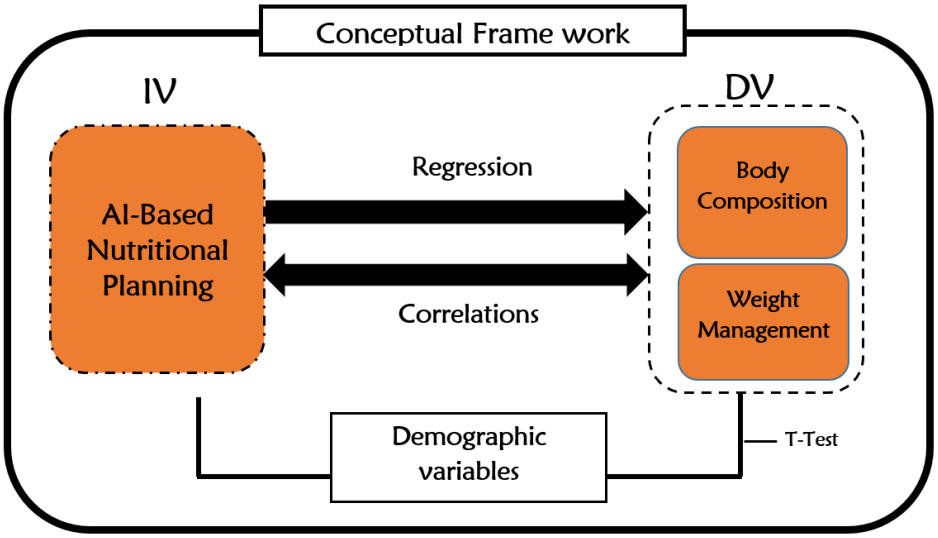
Ethical Considerations

The Ethical principles were strictly followed during the study. Participation was voluntary, and informed consent was obtained from all respondents. Participants were assured that their information would remain confidential and would be used solely for academic purposes. The researcher maintained honesty, objectivity, and transparency throughout the research process.

Figure.1



Presentation of Data

Data presentation refers to the process of organizing and displaying collected data in a clear and understandable form such as tables, charts, or text. Its main role is to make complex data easy to interpret and analyze. It also helps in highlighting important patterns and supporting meaningful conclusions in research.

Table 1: Demographic profile (n=300)

Variable	Category	Frequency	%
Gender	Male	165	55.0
	Female	135	45.0
Education	FSc	140	46.7
	BS	160	53.3
Age	17–18	85	28.3
	19–20	130	43.3
	21–23	85	28.3
Residence	Urban	155	51.7
	Rural	145	48.3
Sport Type	Team	175	58.3
	Individual	125	41.7

Table No 1 shows that the sample consists of both male and female student athletes with a slight majority of males. It also shows balanced representation across education levels, age groups, residence, and sport types, indicating a well-diversified sample.

Table 2: Reliability statistics

Scale	Items	Cronbach's Alpha	Status
AI Nutritional Planning	7	0.88	Good
Body Composition	7	0.86	Good
Weight Management	7	0.90	Excellent

Table No 2 shows that all measurement scales are reliable, with Cronbach's Alpha values ranging from good to excellent. This confirms that the research instrument is consistent and suitable for further analysis.

Table 3: Descriptive results

Variables	N	Mean	Std. Deviation
AI nutritional planning	300	3.82	0.70
Body composition	300	3.76	0.68
Weight management	300	3.88	0.72

Table No 3 shows that participants reported moderately high mean scores for AI nutritional planning, body composition, and weight management. This indicates generally positive perceptions among college athletes.

Table 4: Pearson Correlation

Variables	AI	Body Composition	Weight Management
AI Planning	1	.54**	.60**
Body Composition	.54**	1	.50**
Weight Management	.60**	.50**	1

Table No 4 shows that the significant positive relationships among all variables. AI nutritional planning is strongly related to weight management and moderately related to body composition, indicating meaningful associations.

TABLE 5: Regression (Model 1) Body Composition

Model	R	R^2	Adjusted R^2	Std. Error
1	0.56	0.31	0.30	0.51

Table No 5 shows that the AI nutritional planning explains a significant portion of variation in body composition. The regression model indicates a strong predictive relationship

Table 6: Anova (Model 1)

Model	SS	Df	MS	F	Sig.
Regression	88.2	1	88.2	96.8	0.000
Residual	211.8	298	0.71		
Total	300.0	299			

Table No 6 shows that the regression model for body composition is statistically significant. The high F value confirms that the model fits the data well.

Table 7: Coefficients (Model 1)

Variable	B	Beta	t	Sig.
Constant	1.18	—	4.90	0.000
AI Planning	0.63	0.56	9.84	0.000

Table No 7 shows that AI nutritional planning is a significant positive predictor of body composition. The coefficients confirm a strong and meaningful effect.

Table 8: Model 2 (Weight Management)

Model	R	R^2	Adjusted R^2	Std. Error
1	0.62	0.38	0.37	0.49

Table No 8 shows that the AI nutritional planning explains a substantial variation in weight management. This indicates a strong predictive power of the model.

Table 9: Anova (Model 2)

Model	SS	df	MS	F	Sig.
Regression	114.5	1	114.5	135.2	0.000
Residual	185.5	298	0.62		
Total	300.0	299			

Table No 9 Shows that the regression model for weight management is highly significant. The F value confirms a strong model fit and reliability of results.

Table 10: Coefficients (Model 2)

Variable	B	Beta	T	Sig.
Constant	1.05	—	4.30	0.000
AI Planning	0.69	0.62	11.63	0.000

Table No 10 Shows that AI nutritional planning is a strong and significant predictor of weight management. The coefficients indicate a stronger effect compared to body composition.

Discussion

The findings of this study provide strong evidence that AI-based nutritional planning plays a significant role in improving body composition and weight management among college student athletes in District Dera Ismail Khan. The descriptive results indicated that participants had generally positive perceptions of AI nutritional planning, body composition, and weight management, suggesting that young athletes are increasingly receptive to digital nutrition tools. This positive outlook reflects the growing integration of artificial intelligence in sports nutrition, where personalized dietary systems are becoming more accessible and user-friendly.

The correlation analysis revealed significant positive relationships among all variables, with AI nutritional planning showing a stronger association with weight management compared to body composition. This indicates that athletes who actively engage with AI-based nutritional tools are more likely to experience better control over their body weight. These findings are consistent with previous research suggesting that AI-driven dietary systems enhance adherence to nutritional goals and support behavioural consistency through real-time feedback and monitoring mechanisms.

The regression analysis further confirmed the predictive power of AI nutritional planning. The results showed that AI-based nutritional planning significantly predicted both body composition and weight management, with a greater influence observed on weight management outcomes. This suggests that AI systems are particularly effective in supporting continuous weight regulation, likely due to their ability to provide instant feedback, adaptive recommendations, and personalized goal tracking. However, the lower yet significant impact on body composition indicates that additional factors such as training intensity, genetics, and recovery practices also contribute to physical development.

Overall, the findings align with existing literature emphasizing the effectiveness of AI-driven nutrition in enhancing athletic performance and health outcomes. The study highlights that while AI-based nutritional planning is not a standalone solution, it serves as a powerful supportive tool within a comprehensive athletic training and nutrition framework. Its greatest strength lies in improving weight management consistency, which is crucial for performance stability and competitive success among college athletes.

Conclusion

On the basis of the data analysis the researcher concluded that AI-based nutritional planning has a significant impact on both body composition and weight management among college student athletes. The statistical results confirmed that both predictive models were significant, indicating a meaningful relationship between AI nutritional planning and athletes' physical outcomes. Furthermore, the findings clearly revealed that AI nutritional planning has a stronger influence on weight management compared to body composition. This suggests that AI-driven nutritional tools are particularly effective in helping athletes maintain and regulate their body weight in a more controlled and consistent manner. Overall, the study concludes that AI-based nutritional planning is a significant and effective predictor of improved physical outcomes in college athletes, especially in terms of weight management and performance-related health indicators.

Recommendations

1. Based on the findings, college athletic departments should consider integrating AI-based nutritional planning tools into their existing sports nutrition programs to support

athletes who may lack access to dedicated dietitians. Given the stronger predictive effect on weight management, these systems should be particularly emphasized for sports and athletes where weight stability is critical to performance and competitive eligibility.

2. Coaches and sports nutritionists are encouraged to adopt a blended approach that combines AI-generated recommendations with professional human oversight. Since AI planning explained only a portion of the variance in outcomes, practitioners should address complementary factors such as training load, recovery, sleep, and psychological wellbeing to maximize athletic results.

3. Educational institutions should invest in digital literacy initiatives to ensure athletes can effectively use and interpret AI nutrition platforms. Training sessions on data input, goal-setting, and progress interpretation would enhance engagement and improve the accuracy of personalized recommendations generated by these systems.

4. Developers of AI nutrition applications should prioritize features that have proven motivational value, including progress visualization, real-time feedback, and adaptive goal-setting. Tailoring these tools to the specific demands of collegiate athletes accounting for academic schedules and limited budgets would increase adoption and sustained use.

5. Future research should employ longitudinal and experimental designs to establish causal relationships and track changes in actual body composition through objective measures such as DEXA scans or bioelectrical impedance, rather than relying solely on self-reported perceptions. Expanding the sample across multiple institutions, regions, and a broader range of sports would also enhance the generalizability of findings and strengthen the evidence base for AI-driven nutrition in athletics.

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