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EFFECT OF NUTRITIONAL STATUS ON THE PERFORMANCE COMPONENTS OF PHYSICAL FITNESS OF AMATEUR BASKETBALL PLAYERS IN MAKURDI, BENUE STATE, NIGERIA

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ABSTRACT

Optimal nutritional status is crucial for enhancing the physical fitness components of amateur basketball players as it directly influences their strength, endurance, and overall performance. This study assessed the effect of nutritional status on the performance components of physical fitness of amateur basketball players in Makurdi, Benue State, Nigeria. This was a cross-sectional *ex post facto* study. Participants were 80 (40 male and 40 female) secondary school basketball players from a population of 160 (80 males (8 teams) and 80 females (8 teams) who were selected using random sampling technique from 16 registered teams from the 2023 Benue State Secondary School Basketball League organized by the Benue State Sports Council, Makurdi. All the participants underwent nutritional assessment based on WHO standards. The participants' height and weight were measured in accordance with the protocol of ISAK. The Slalom test was performed to evaluate agility. The Harre circuit test (HCT) was used to assess coordination. Speed was assessed using the 50m dash. Reaction time was assessed using the reaction time ruler drop test. In all the tests, those with lower time were considered to be more fit and vice versa. Mean and standard deviation were computed for the performance of the participants in agility, coordination, speed and reaction time. The participants were split into three in relation to nutritional status (normal, thin/wasted and stunted). The analysis of variance was used to find out the different performance components of adolescents in relation to nutritional status. All the analyses were performed on 95% confidence intervals using the statistical package for social sciences (SPSS v21). The result of the study indicated that nutrition has significant effects on agility ($F=10.495$, $df=2, 77$; $p<0.05$), coordination ($F=17.750$, $df=2, 77$; $p<0.05$), speed ($F=5.908$, $df=2, 77$; $p<0.05$) and reaction time ($p<0.05$) of amateur basketball players in Makurdi. It was concluded that nutritional status has a significant effect on several key performance components of physical fitness among amateur basketball players in Makurdi, Benue State, Nigeria. It was recommended among others that coaches should take the nutritional status of their players as important as other parameters to ensure a better performance of their players in basketball.

Key words: Nutritional status, physical fitness, performance, amateur, basketball, secondary school

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INTRODUCTION

Basketball is a sport that requires intermittent bursts of high-intensity activity, demanding both physical agility and mental sharpness. Consequently, sports scientists have emphasized the importance of gaining a deeper understanding of the game and the primary challenges faced by players [1]. While much of the existing knowledge, such as the studies conducted by Rusell *et al.* [2] and Huyghe [3], focuses on men's basketball, there is a growing interest in exploring the unique aspects of female players, including hormonal, biological, and anatomical factors. This is driven by the increasing presence of women's basketball across all categories and levels of play [4]. Therefore, further research is necessary, particularly in the field of nutrition especially in Benue State, Nigeria where stapple foods are most consumed.

The monitoring of athletes who are following a nutrition programme is a crucial factor in enhancing their physical fitness effectiveness [5]. It is imperative for athletes and coaches to possess and utilize accurate information regarding nutrition in sports [6], especially the upcoming athletes in general and basketball in particular. Adequate and well-balanced nutrition entails the consumption of sufficient amounts of energy and essential nutrients such as protein, carbohydrates, vitamins, and minerals [7,8]. An athlete's dietary consumption directly impacts body weight, body composition, recovery time, sport-specific physical fitness parameters, and overall health [9]. Ural *et al.* [9] further emphasize that sports nutrition is essential to meet the increased energy demands caused by training. It is crucial to consume an adequate number of calories and nutrients (such as carbohydrates, protein, and fluids) to supply the necessary energy and maintain a positive energy balance.

Integrating fitness and nutrition for amateur basketball players is essential for optimizing performance, preventing injuries, enhancing mental focus, and promoting long-term health. By focusing on both aspects, players can achieve their full potential on and off the court. Previous research [10, 11] suggested that athletes can enhance their overall physical fitness and gain a competitive advantage by implementing nutritional strategies during training and competition periods. By providing athletes with the necessary energy, nutrients, and fluids, their adaptation and recovery process after training, specifically in basketball, can be supported. However, these studies did not specifically examine the impact of nutrition on the individual performance components of amateur basketball players. Additionally, the nutrients evaluated in these studies may differ from the main staple food in Benue State. In an ideal scenario, the relationship between nutritional status and the performance components of physical fitness in amateur basketball players in Makurdi should be well established. Coaches, players, and

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support staff are expected to possess a thorough understanding of the nutritional needs specific to basketball players. However, in reality, several challenges and limitations exist that prevent the ideal situation from being fully realized. It is necessary for regular fitness assessments and dietary adjustments to maintain peak performance. Addressing these gaps requires a concerted effort especially in Makurdi where school sports is on the verge of going extinct. To the best of the researchers' knowledge, this study is the first to investigate the effect of nutrition on the performance-related aspects of physical fitness among amateur basketball players in the Makurdi.

MATERIALS AND METHODS

Makurdi is the capital of Benue State, situated in the Middle Belt region of Nigeria. The city's geographical features include the Benue River, which significantly influences local agriculture and economy. Makurdi lies on latitude 7.7321516 and longitude, 8.539144. Makurdi is located in the time zone West Africa Standard Time. The area has a diverse population, with a mix of ethnic groups including the Tiv, Idoma, and Igede. Understanding demographic diversity is important for considering dietary habits and cultural influences on nutrition. The economy of the town is largely agrarian, with a significant portion of the population engaged in farming. The availability of locally produced food items and the economic status of the residents can influence dietary choices and nutritional status. The diet in Makurdi typically includes staples such as yams, cassava, maize, and legumes, along with vegetables and fruits. Protein sources often include fish, chicken, and goat meat. The town houses a lot of secondary schools with Aper Aku Stadium as the center for sporting activities in the state.

Research Design

The cross-sectional *ex post facto* research design was used for the study. There was no control group. The *ex post facto* research design is well-suited for the study as it allowed the researcher to observe and analyze existing differences in nutritional status and their potential impacts on physical fitness without the ethical and practical issues of experimental manipulation.

Participants

Participants were 80 (40 male and 40 female) secondary school basketball players from a population of 160 (80 males (8 teams) and 80 females (8 teams) who were selected using random sampling technique to select four male and female teams each out of the 16 registered teams comprising of eight male teams and eight female teams from the 2023 Benue State Secondary School Basketball League organized by the Benue State Sports Council, Makurdi. The total sample was based on the convenience to manage data collection procedures within the limited

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time after the tournament before the teams depart to their destinations. The Benue State Secondary School Basketball League is an annual competition organized by the Benue State Sports Council for schools within the Makurdi metropolis with facilities for playing basketball, especially within the age bracket of 11-16 for both male and female in secondary schools. The participants normally engage only in school sports. The Ethical committee of the Benue State University, Makurdi, reviewed and approved the protocol for this study. Informed consent was received from the participants as well as their parents and school management for those in boarding school whose parents cannot be easily assessed. For confidentiality, the participants were assigned numbers instead of using their names.

Assessment of Nutritional Status

The nutritional status of the participants was evaluated based on WHO z-scores (BMI for Age) in children [12]. The collected anthropometric data were entered and converted to height-for-age and BMI-for-age Z-scores using the Antro Plus software. Adolescents with a BMI-for-age below -2Z scores and height-for-age below -2Z scores of the 2007 WHO reference population were classified as thin and stunted, respectively [12]. The participants' height and weight were measured in accordance with the protocol of the International Society for the Advancement of Kinanthropometry [12]. Each participant was measured twice and the average values were used. The participants' Body Mass Index (BMI) was calculated by dividing their weight (in kilograms) by the square of their height (in meters), according to Plowman and Smith [13]. The BMI was then expressed as a Z-score, which is a standard deviation unit, as recommended by WHO to determine normal weight, wasting, and stunting [12]. The data collection process was conducted by two research assistants who were experts in exercise and sports science who assisted in anthropometric measurements. They underwent trial versions of the data collection process in the Human Performance Laboratory, Benue State University, Makurdi before the actual data collection. This was done to ensure familiarity with the instruments and the testing protocols. The instruments used for measurement were calibrated after each measurement, ensuring accuracy.

Assessment of Agility

The Slalom test was used to evaluate agility. Six cones were located 2 m apart, the first cone 1 m away from the starting line. Every player stood still facing the starting line, with his/her feet apart and the cone between his/her legs. They started after the signal and ran from point to point. The player at second point had to be passed on his right-hand side. The player continued to run as fast as possible constantly, changing the direction from right to left until he or she reaches the finish line. The player reached the last point, afterward, the player turned 180°, and kept on running based on the Slalom style to the starting line. The time taken to

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complete the test was recorded. The primary metric for the Slalom test is the time taken to complete the course. Faster times generally indicate better agility. Participants were divided into two based on their average completion time of the test. Those who completed the test 15 seconds and below were considered to be more agile than those who completed the test beyond 15 seconds [14].

Assessment of Motor Coordination

The Harre circuit test (HCT) was used to assess coordination. After an initial somersault, participants were asked to perform three consecutive passages above and below three obstacles, turning around a central cone. Three trials were performed and separated by 5 minutes of rest. Total time of each trial was recorded and the average time was considered in the analysis. Participants were divided into two categories based on their average completion time of the test. Those who complete the test 50 seconds and below were considered to be more coordinated than those who completed the test beyond 50 seconds.

Assessment of Speed

Speed was assessed using the 50m dash. Participants ran a single maximum sprint over 50 meters, with the time recorded. It was started from a stationary standing position (hands not touching the ground), with one foot in front of the other. The front foot was behind the starting line. Once the subject was ready and motionless, the starter gives the instructions "set" then "go.". Two trials were allowed, and the best time was recorded to the nearest 2 decimal places. The timing started from the first movement using a stopwatch and finishes when the chest crosses the finish line. Lower time indicates higher speed, higher time indicates lower speed. Participants who completed the 50m dash in 7.0 seconds or less were classified as being more fit than those who took longer time.

Assessment of Reaction Time

Reaction time was assessed using the reaction time ruler drop test. The person to be tested stood or sat near the edge of a table, resting their elbow on the table so that their wrist extends over the side. The assessor holds the ruler vertically in the air between the subject's thumb and index finger, but not touching. Align the zero mark with the player's fingers. The subject indicated when they are ready. Without warning, the ruler was released. The player was to catch it as quickly as possible as soon as he/she sees it fall. The average reaction time ranges from approximately 214.2 m to 248.8 m. Values beyond this indicate low reaction time [15].

Method of Data Analysis

Mean and standard deviation were computed for the performances of the participants in agility, coordination, speed and reaction time. The anthropometric

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data were entered and converted to height-for-age and BMI-for-age *Z* scores by using the Antro Plus software. Adolescents with BMI-for-age below −2*Z* scores and height-for-age below −2*Z* scores of the WHO reference population were classified as wasted and stunted, respectively [16]. Agility was assessed by the Slalom test; participants were divided into two based on their average completion time of the test. Those who complete the test 15 seconds and below were considered to be more agile than those who completed the test beyond 15 seconds. The Harre circuit test (HCT) was used to assess coordination. Participants were divided into two categories based on their average completion time of the test. Those who completed the test 50 seconds and below were considered to be more coordinated than those who completed the test beyond 50 seconds. Speed was assessed using the 50m dash. Participants who completed the 50m dash in 7.0 seconds or less were considered to be more fit than those who took longer time. Reaction time was assessed using the reaction time ruler drop test. The average reaction time from approximately 214.2 m to 248.8 m were considered to have good reaction time and vice versa. The participants were split into three in relation to nutritional status (normal, thin/wasted and stunted). The analysis of variance was used to find out the differences in performance components of adolescents in relation to nutritional status. All the analyses were performed using a 95% confidence interval. The analyses were performed using the statistical package for social sciences (SPSS v21).

RESULTS AND DISCUSSION

The findings of the study as presented in Table 1 indicated that 50% of the respondents were males and 50% were females with a mean age of 15.74±3.05 years. The analysis further indicated that 41.3% of the participants had normal nutritional status, 30.0% were stunted and 28.8% were wasted. This indicates that slightly less than half of the participants have a nutritional status that meets the expected standards for their age and sex. Stunting, characterized by low height for age, reflects chronic malnutrition. The high percentage suggests prolonged nutritional deficiencies, which can impact physical and cognitive development. Wasting, characterized by low weight for height, indicates acute malnutrition. This high percentage points to recent and severe weight loss, which may be due to inadequate food intake, as most schools hardly provide for the needs of athletes during competitions. Participants in this study may not be an exception. These findings underscore the critical need for targeted nutritional interventions. The high rates of stunting and wasting suggest both long-term and immediate nutritional issues that must be addressed to improve health outcomes in the population.

The descriptive analysis of the participants as presented in Table 2 indicated that, overall, the mean time taken by the participants to complete the Slalom test to

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assess agility of the participants was 5.59±1.09. In the same vein, the time taken to complete the HCT which measured coordination was 20.31±4.15. The average speed of the participants was 5.80±0.77 and the average reaction time of the participants was 1.88±0.22. The analysis further indicated that, those who had normal nutritional status were more agile ($\bar{x}$= 5.03±0.99) than those who were stunted ($\bar{x}$= 5.75±1.06) and those who were wasted ($\bar{x}$= 6.22±0.85). Similarly, the participants who had normal nutritional status were more coordinated ($\bar{x}$= 17.73±3.80) than those who were stunted ($\bar{x}$= 21.08±3.57) and those who were wasted ($\bar{x}$= 23.22±2.81). In terms of the speed level of the participants, those who had normal nutritional status were faster ($\bar{x}$= 5.47±0.62) than those who were stunted ($\bar{x}$= 6.37±0.74) and those who were wasted ($\bar{x}$= 5.69±0.66). Finally, the analysis indicated that those who had normal nutritional status reacted faster ($\bar{x}$= 1.80±0.28) than those who were stunted ($\bar{x}$= 1.87±0.23) and those who were wasted ($\bar{x}$= 2.0±0.00). Recent studies corroborate these findings, emphasizing the profound impact of nutritional status on physical performance and development. For instance, research by Smith [17] found that malnutrition significantly impairs motor skills and cognitive functions in children, affecting their agility, coordination, speed, and reaction time. Additionally, a study by Jones and Brown [18] demonstrated that children with adequate nutritional intake showed better performance in physical fitness tests, highlighting the crucial role of nutrition in developing motor abilities.

The result of the study as presented in Table 3 indicated that there is a significant difference in the agility of basketball players based on nutritional status with the basketballers with the normal nutritional status being more agile than those who were stunted and wasted ($F=10.495$, $df=2, 77$; $p<0.05$). This means that nutrition has a significant effect on the agility of amateur basketball players in Makurdi. The result of the study is not surprising because sports nutrition is one of the major components of improving physical fitness and maintaining good health status in athletes. Previous research supports the notion that nutritional status significantly impacts athletic performance, particularly agility. For instance, a study by Deighton [19] found that adolescent athletes with optimal nutritional intake performed better in agility tests compared to their malnourished counterparts. Similarly, research by Harris [20] demonstrated that malnutrition adversely affects neuromuscular coordination and overall physical performance, further supporting the findings that well-nourished athletes have superior agility. Though there were no direct results at the secondary school levels to make direct comparisons. The result of the study was in line with Ural *et al.* [9] who assessed the effects of nutritional habits on physical fitness parameters in athletes in the sports club of Istanbul Okan

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University and found that athletes who had normal nutrition were found to be more successful in physical fitness tests such as slalom as the case of the present study. Similar results were documented [21] in a two-month nutrition programme for athletes in the pre-competition period. It can be deduced here that a well-nourished athlete will have higher physical fitness and concentration ability and maximum efficiency of the training.

The findings of the study as presented in Table 4 indicated that there is a significant difference in the coordination of basketball players based on nutritional status with the basketballers with the normal nutritional status being more coordinated than those who were stunted and wasted ($F=17.750$, $df=2, 77$; $p<0.05$). Players with a normal nutritional status likely have adequate energy reserves and nutrient intake, which support muscle function, endurance, and overall physical performance. Good nutrition ensures that athletes have the energy required for training, practice, and games. Stunted and wasted players may suffer from fatigue more quickly due to inadequate energy reserves. Low energy levels can impair concentration and motor skills, leading to poorer coordination. Findings on the effect of nutritional status and coordination of amateur basketball are scarce. However, the findings are related to Adam [22] who investigated the relationship between the nutritional status and physical fitness of Islamic Senior High School's students in South Sulawesi, Indonesia and showed a significant relationship between nutrition status and physical fitness components including but not limited to coordination. More studies are needed in the relationship between nutritional status and motor performance components of physical fitness of amateur basketball players.

Furthermore, Table 5 indicated that there is a significant difference in the speed of basketball players based on nutritional status with the basketballers with the normal nutritional status being faster than those who were stunted and wasted ($F=5.908$, $df=2, 77$; $p<0.05$). The significant difference in speed based on nutritional status among basketball players emphasizes the crucial role of adequate nutrition in athletic performance. Proper nutrition supports energy levels, muscle strength, cognitive function, and overall physical development, all of which are essential for achieving and maintaining high speeds in sports. The result of the study was in line with Chatterjee, Biswas and Adhikary [23] who assessed the relationship between nutrition status and physical fitness of schoolboys from Puratan Pitamberpur Primary School and Chapra Primary School and found that motor performance variables like 50m dash are influenced by the nutrition status of an individual to a greater extent. Earlier, Chatterjee *et al.* [23] found in his study on adolescent boys that underweight boys were less likely to be physically active than

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boys of normal weight. Thus, it may be concluded that the findings of the present study are in close proximity with the findings of some leading researchers.

Finally, the study results as presented in Table 6 indicated that there is a significant difference in the reaction time of basketball players based on nutritional status with the basketballers with the normal nutritional status having a quick reaction time than those who were stunted and wasted ($F=5.59$, $df=2, 77$; $p<0.05$). Stunted and wasted players may have impaired neuromuscular function due to deficiencies in essential nutrients such as B vitamins, magnesium, and omega-3 fatty acids, which are vital for nerve health and muscle function, resulting in slower reaction times. It is expected that fitness levels will differ between subjects having malnourished and normal nutritional status. Several studies failed to demonstrate that nutritional status does discriminate for physical performance, except for the tasks where body size is a determinant in school-aged children [24]. The interpretation of fitness results in poor nutritional environments using body size adjustments is still controversial [25, 26]. Some argue that the adjustments for size and the disappearance of the differences in fitness do not imply that these children are healthy since their growth is impaired. From this perspective, children performed well for their impaired growth status, which does not mean that their growth status was not affecting their health in some way.

CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

This study reported a significant effect of nutrition on the agility, coordination speed and reaction time of amateur basketball players in Makurdi. Basketball players who had normal nutritional status were more agile, coordinated, fast and had a quicker reaction time than those who were stunted and wasted. The implication of this finding is that proper nutrition is crucial in nurturing a good basketball team performance where agility, coordination, speed, and reaction time are vital. Coaches, players, and trainers should be aware of the significant impact that nutrition has on athletic abilities. Coaches and trainers can use this information to develop comprehensive training programmes that not only focus on skill development but also emphasize proper nutrition. Lastly, addressing nutrition early in an athlete's career can have long-term implications for their success and longevity in the sport. By promoting healthy eating habits and providing adequate nutrition support, coaches and trainers can help amateur basketball players maximize their potential and minimize the risk of injuries or health issues associated with poor nutrition.

Based on the findings of the study, the following recommendations were made: Coaches should take the nutritional status of their players as important as other parameters to ensure a better performance of their players.

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1. Athletes need different nutritional requirements depending on factors such as gender, age, sport, training/competition time. Therefore, coaches should take this information and implement it while preparing basketball players for a major tournament.
2. The dietary education of athletes is a key aspect that can promote appropriate eating behaviour. Therefore, educating athletes on sports nutrition and following athletes with an appropriate personal diet programme can be effective in improving physical fitness parameters and efficiency of the training.

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Table 1: Gender and nutritional status of the participants

Gender	**Frequency**	**Percentage (%)**
Male	40	50.0
Female	40	50.0
Total	**80**	**100.0**
Nutritional Status	**Frequency**	**Percentage (%)**
Normal	33	41.3
Stunted	24	30.0
Wasted	23	28.8
Total	**80**	**100.0**
Age	**Mean**	**Std**
	15.74	3.05

Table 2: Descriptive analysis of the participants

	Overall n=80		**Nutritional Status** Normal (n=33)		Stunted (n=24)		Wasted (n=23)	
Variable	$\bar{x}\bar{x}$	SD	$\bar{x}\bar{x}$	SD	$\bar{x}\bar{x}$	SD	$\bar{x}\bar{x}$	SD
Agility	5.59	1.09	5.03	0.99	5.75	1.06	6.22	.85
Coordination	20.31	4.15	17.73	3.80	21.08	3.57	23.22	2.81
Speed	5.80	0.77	5.47	0.62	6.37	0.74	5.69	0.66
Reaction time	1.88	0.22	1.80	0.28	1.87	0.23	2.00	0.00

Table 3: Summary of ANOVA of Nutritional Status and Agility of Basketball Players

	Sum of Squares	**Df**	**Mean Square**	**F**	**Sig.**
Between Groups	20.005	2	10.002	10.495	.001
Within Groups	73.383	77	.953		
Total	93.388	79			

Table 4: Summary of ANOVA of Nutritional Status and Coordination of Basketball Players

	Sum of Squares	**Df**	**Mean Square**	**F**	**Sig.**
Between Groups	428.896	2	214.448	17.750	.001
Within Groups	930.292	77	12.082		
Total	1359.187	79			

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Table 5: Summary of ANOVA of Nutritional Status and Speed of Basketball Players

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	11.816	2	5.908	13.129	.001
Within Groups	34.651	77	.450		
Total	46.467	79			

Table 6: Summary of ANOVA of Nutritional Status and Reaction Time of Basketball Players

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.529	2	.264	5.593	.005
Within Groups	3.639	77	.047		
Total	4.168	79			

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