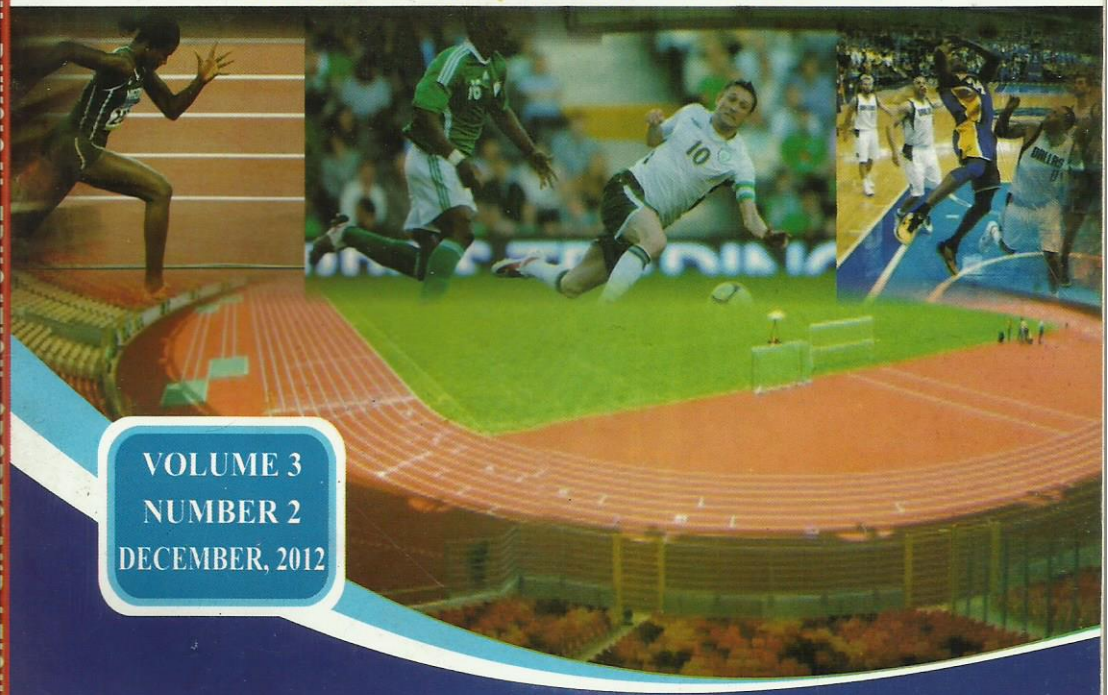
ISSN: 075-5316

JOURNAL of HEALTH, PHYSICAL EDUCATION, SPORTS AND LEISURE STUDIES



VOLUME 3
NUMBER 2
DECEMBER, 2012

A JOURNAL OF
THE DEPARTMENT OF PHYSICAL AND HEALTH EDUCATION
AHMADU BELLO UNIVERSITY, ZARIA

ISSN: 075-5316

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PERCENT BODY FAT (%BF) AND EXPLOSIVE POWER OF BADMINTON PLAYERS IN NORTHERN NIGERIA

Abdullahi Yahaya

Abstract

This study was designed to relate the percent body fat (%BF) to explosive power characteristics of badminton players in Northern Nigeria. To achieve this, a purposive sampling was used for the selection. Twenty (20) male and nine (9) female participants who featured in the Common Wealth Games Trials 2010 were the subjects. They were subjected to the following standardized measurements: skinfold, vertical and broad jumps. %BF was obtained using Slim-Guide skinfold caliper, explosive power was assessed from data results of vertical and broad jumps. Data was analyzed using SPSS version 17. Descriptive statistics, correlation coefficient (r) and a t-test were computed. An alpha level of 0.05 was used for all statistical tests. The result shows that; a significant correlation between %BF and explosive power in vertical jump and proved no significance correlation in broad jump. In testing the differences between the sexes: There is a significant difference in %BF and vertical jump. There was no significant difference in terms of broad jump distance. No significant difference in %BF. Significant difference in explosive power was clearly observed among the national and non-national players. As part of the recommendations: Athlete trainers, coaches, exercise scientists and all personnel concerned with designing training programmes for badminton players should lay an emphasis on %BF and explosive power characteristics for enhancement. Moreover, should realize that females are physiologically disparate from males.

Introduction

Badminton comprises a number of skilled related movements, such as: footwork in the playing centre using a split jump/pre-tension jump, footwork, lunge, scissors jump, two-feet landing, and two legged jumps, movement back towards the playing centre using many different movement patterns. The physiological (percent body fat) and performance (explosive power) of badminton players are basic tools for assessing performance of badminton players (Faccini & Dalmonte, 1996). Competitive badminton requires

a good stroke production and good physical fitness, as well as psychological characteristics that will enable successful performance at the competitive level (Faccini & Dalmonte, 1996).

Body composition is an important aspect of fitness (Reilly & Stratton, 1995), and can be predicted from anthropometric measures (Maud & Foster, 1995). According to Maud and Foster (1995); International Society for the Advancement of Kinanthropometry (ISAK) (2006), anthropometry is the science that deals with the measurement of size, weight, and proportions of the human body, the study of anthropometry is important on body size and proportions, physique, and body composition which are important factors in physical performance and fitness. A standard anthropometric analysis during a physical fitness assessment would involve determining the height, mass, somatotype and body fat percentage of an individual or athlete (Maud & Foster, 1995; ISAK, 2006).

Body fat percentage is a key component of an individual's health and physical fitness profile (Heyward, 1998). It is an important aspect of fitness as superfluous body fat acts as dead weight in activities where body mass must be lifted repeatedly against gravity in movement during exercise (Reilly & Stratton, 1995). A high percentage body fat is detrimental in terms of performance as fat cells are not the primary source of energy production, yet energy is required to move the excess mass around the court (Elliot, Ackland, Blanksby, Hood, & Bloomfield, 1989; Chin, Wong, So, Siu, Steininger, & Lo, 1995).

It has been well established that excess body fat is detrimental to health and that the body fat percentage required for excellence in performance differs between males and females, and varies from sport to sport (Powers & Howley, 1997). Junior males differ from females in many morphological and physiological characteristics, and it is therefore important to consider the sexes separately in data analysis (Marshall, 1978 as reported in Van Lieshout, 2002).

Top competitive players tend to have a low body fat percentage, as the negative impact of excess body fat would increase the energy expended in moving around the court (Elliot *et al.*, 1989; Chin *et al.*, 1995). Lower levels of body fat will enhance the game of badminton as it permits a more effective gradient for the rapid

transfer of heat produced during high intensity exercise, and would be advantageous concerning moving quickly across the court and in leaping to smash the shuttlecock. In a research carried out by Elliot *et al.*, (1989), body composition was found to be an important indicator of tennis performance for 11 - 15 year old male and female players. In studies performed on American footballers by Wilmore and Haskell (1972) as reported in Van Lieshout (2002), it was concluded that lean body mass rather than total body weight was the critical factor relative to performance ability.

Reilly & Palmer, (1995), Faccini and DalMonte (1996) and Majumdar, Khanna, Malik, Sachdeva, Arif and Mandal (1997) recorded relatively low average body fat percentages for national and international male badminton players respectively. The body fat percentages obtained from racketball studies by Pipes (1979) as used in Van Lieshout (2002), Todd and Mahoney (1995) and Powers and Howley (1997) are relatively low. Low body fat percentage values have also been recorded for squash racket players in studies performed by Chin *et al.*, (1995).

According to Jaski and Bale (1987), a moderate increase in lean body mass will result in greater speed, strength and power without a loss of flexibility and explosive power.

A vital aspect of sports such as tennis and badminton is the ability of the player to exert muscular force at high speed. Many sports require generation of high forces and power outputs (Reilly & Palmer, 1995), and badminton at the highest level places a great demand on explosive power (Omosegaard, 1996). Explosive power is an important component in badminton in that it results in the player being able to move quickly and explosively to the shuttle in various directions and to jump high to play overhead strokes. Greater leg power results in a greater acceleration and faster speed when lifting off the floor while moving, or jumping towards the shuttle. According to Omosegaard (1996), an explosive player will typically be able to jump high, change direction quickly and will generally appear to be swift and mobile on the badminton court. Explosive power is therefore a combination of coordination and muscular properties.

A common impression of an explosive player is one who has quick, smooth footwork, with broad and/or high jumps as a natural part of the movement (Omosegaard, 1996). Explosive power is

important for sports requiring rapid and precise changes of direction, and depends on the strength, endurance, speed, balance, visual processing, timing, reaction time, perception, anticipation and skill of the athlete (Johnson & Nelson, 1986).

Explosive power is crucial to good court movement and correct positioning on the court (Groppel & Roetert, 1992). Correct positioning on the court is essential in order to strike the shuttle effectively, and requires the use of the legs and feet. While the upper extremity uses the racket to hit the shuttle, the lower extremity is responsible for getting the player in position to use the racket. Explosive power is important to the badminton player due to the variation in the speed, height and angle of approach to the shuttle (Todd & Mahoney, 1995). In badminton, the ability to keep one's balance while executing a stroke depends on proper footwork, with interplay of all the muscles of the body under the guidance of the labyrinth of the inner ear and vision (Van Lieshout, 2002). To be fast on a badminton court is not only a question of being in good physical condition or following the right tactics, but also taking into account technique and mental frame of mind (Omosegaard, 1996).

Due to the high number of instantaneous stops and starts in badminton, players must be quick and agile, with very fast reflexes and tremendous stamina. Badminton training ordinarily focuses on "explosive energy", and on endurance in a player's thigh and calf muscles. Badminton players' combination of quickness and power (both of which are needed in abundance when the shuttlecock comes off racket at about 240 kilometers an hour), make for rapid changes in the complexion and tempo of a rally, from when the players are close to the net to playing deep in their courts (Chin *et al.*,1995).

A badminton player would need to develop higher levels of the basic physical qualities such as strength, flexibility, endurance, speed and agility among others to be able to compete effectively against stronger opponents (Groppel & Roetert, 1992). Chin *et al.*, (1995), recommended that if a player wants to achieve reasonable success at international badminton competition, improvements in physical fitness needs to be emphasised in addition to skill training. It is therefore, useful to assess both physiological and motor performance components thought to be important in a particular sport at various levels (Elliot *et al.*, 1989).

The purpose of the current study was to relate the percent body fat and explosive power characteristics of badminton players in Northern Nigeria. This study was also focused on the region (Northern, Nigeria) for it is believed to be the power house of the game for producing more players in the National team than other regions in the country.

Nigerian badminton players have performed imperfectly at recent international competitions outside the continent (Africa), but performed delightfully within the continent. This appalling performance outside the continent could be because of players' lack of acquaintance with other regions rather than Africa, low fitness level, unqualified coaching personnel, lack of badminton halls in some states, cost of procurement of shuttle-corks and rackets or lack of states sponsorship among others. Of these factors, the players' low fitness level is probably the most important, because of lack of scientifically designed programmes or lack of the utilization of the knowledge. Therefore, since the aforementioned can account for differences in badminton players, the study was designed to answers the following research questions:

- What are the percent body fat (%BF) and explosive power characteristics of badminton players in Northern Nigeria?
- What are the differences in percent body fat (%BF) and explosive power characteristics of national and non-national badminton players in Northern Nigeria?
- What are the differences in percent body fat (%BF) and explosive power characteristics of male and female badminton players in Northern Nigeria?

Methodology

The purpose of the current study was to assess the Percent Body Fat (%BF) (physiological) and explosive power (motor performance) characteristics of selected badminton players in Northern Nigeria. Moreover, examine the correlation and differences (interdependence) between the players' %BF and explosive power characteristics based on gender and status.

A purposive sampling method was used to select the participants. One-shot study design was used for data collection. Twenty (20) male and nine (9) female participants from the Northern states totaling twenty nine (29) players were selected for the study.

There were four (4) male and two (2) female national team players among them, the remaining twenty three (23) were non-national team players. All the participants featured in the Common Wealth Games Trials 2010.

The following instruments were used for data collection: **Slim Guide skinfold caliper** (manufactured by Rosscraft International, Canada): This is a precision instrument designed for use in the performance of skinfold thickness measurements. The Skinfold Caliper was used as recommended by the ISAK (2006) and its use has been well established and documented for many years. **A flat surface and wall:** at Nigeria National Stadium, package "B", Gymnasium, Abuja, Nigeria was used for administering the vertical and broad jumps test. **Measuring steel tape** (Crown HB-78 flexible steel tape by Rosscraft, Canada): A flexible steel tape with a stub (blank area) of 3 – 4cm before the zero ends. It is enclosed in a case with automatic retraction and was used for the measurement of the vertical and broad jumps test.

Procedures

Percent body fat (%BF): It was estimated by skinfold thickness measurements. The tester pinch the skin at the appropriate site (triceps and subscapula) to raise a double layer of skin and the underlying adipose tissue, but not the muscle. The jaws of the caliper were then applied 1 cm below and at right angles to the pinch, and a reading taken two seconds later. The median of three successive measurements was taken and recorded in millimeters (mm) for each player. If the third measurement differs greatly, a fourth measurement was taken before the median value was recorded.

The sites: There are many common sites at which the skinfold pinch can be taken. For the purpose of this assessment, only two (2) sites triceps and subscapula were needed. For calculation of %BF from skinfolds, the following formulae were utilized as shown in Plowman and Smith (2008):

- *Male: $\%BF = 0.735(X_1) + 1.0$, where X_1 = sum of triceps and subscapula skinfolds.*

- *Female: %BF = 0.610(X_1) + 5.1, where X_1 = sum of triceps and subscapula skinfolds*

Plowman and Smith (2008).

Explosive power: A common impression of an explosive player is one who has quick, smooth footwork, with broad and/or high jumps as a natural part of the movement (Omosegaard, 1996). Two explosive power tests were used to determine the explosive power of the participants, namely the vertical jump test and the broad jump test. These tests respectively measured the instantaneous vertical and horizontal explosive power.

Vertical Jump Test (Johnson & Nelson, 1986). This procedure describes the method used for measuring the height jumped.

Description: The procedure was explained to participants and a room for practice was given. The procedure was as follows: The athlete stood side on to a wall and reached up with the hand closest to the wall. Keeping the feet flat on the ground, the point of the fingertips was marked or recorded. This is called the standing reach. The athlete then stood away from the wall, and jumped vertically as high as possible using both arms and legs to assist in projecting the body upwards. He/she attempted to touch the wall at the highest point of the jump. **Scoring:** The difference in distance between the standing reach height and the jump height was the score. The best of three attempts was recorded in cm.

Broad jump test – (Johnson & Nelson, 1986; Omosegaard, 1996).

Description: The test started with the measurement of a full static lunge, which was measured with the back knee touching the ground, and the front knee flexed to 90 degrees. The distance was measured from the toe of the back foot to the heel of the front foot. The subject jumped forward with his/her leg (same side as racket playing arm), and backwards to behind the starting line. During the lunge jump, the back leg was not allowed to touch the ground. The subject jumped forward and backwards again, each time trying to get further than the previous jump. The subject kept jumping until he/she could no longer jump back in balance behind the starting

line. **Scoring**: The score was the difference between the length of the standing lunge and the maximum broad jump length and recorded in cm.

Statistical Analysis

Data obtained were analysed using SPSS Version 17. Descriptive statistics including means and standard deviations ($\bar{x} \pm$ SD) were used to describe the %BF and explosive power characteristics. *Correlation coefficient* (*r*) was computed, *independent t-test* was also computed to examine the significant differences in the %BF and explosive power characteristics between the sexes (*Male and Female*) and their status (*National and Non-national*). An alpha level of 0.05 was used for all statistical tests.

RESULTS

Table I: Correlation values between %BF and explosive powers

VARIABLES	R	*Prob*
%BF vs. vertical jump	0.77	***0.00****
%BF vs. broad jump	0.26	***0.18****

***Correlation is significant at the .05 alpha level or <.**

Table II: *t*-Test Values between the Male and Female Badminton players

VARIABLES	SEX	N	$\bar{x}$	SD	*T*	Df	Prob
Percent body fat (%BF)	Female	9	12.6	1.5	6.5	27	0.00*
	Male	20	9.3	1.2			
Explosive power (vertical jump)	Female	9	38.8	4.3	7.3	27	0.00*
	Male	20	56.4	6.6			
Explosive power (broad jump)	Female	9	52.2	8.1	0.4	26	0.67
	Male	19	53.8	10.1			

****Correlation is significant at the .05 alpha level or <.***

Table III: *t*-Test Values between the National and Non-national Badminton

VARIABLES	STATUS	N	$\bar{x}$	SD	*T*	Df	PROB
Percent body fat (%BF)	Non-National	23	10.6	2.0	1.61	27	0.12
	National	6	9.1	1.9			
Explo. power (vertical jump)	Non-National	23	49.0	8.7	2.12	27	0.04*
	National	6	58.3	12.8			
Explo. power (broad jump)	Non-National	22	49.8	6.2	5.53	26	0.00*
	National	6	66.3	7.7			

***Significant at the .05 alpha level or <.**

Discussion

Percent Body Fat (%BF)

A significant correlation between %BF and explosive power characteristics was found only on vertical jump, and proved not significant on broad jump, where $r = 0.26$, $p = 0.178$ (Table I).

The male and female players had mean body fat percent of 9.3 ± 1.2% (n=20) and 12.6 ± 1.5 % (n=9), respectively (Table II). There was a significant difference in %BF between selected male and female badminton players in Northern Nigeria. This is because the calculated t value is greater than the t critical value at 5% level of significant with $p< 0.05$. The males were significantly possessed less %BF than the females ($t= 6.5$, $p= 0.00$) (Table II).

The national and non-national players in the study had mean body fat percent of 9.1 ± 1.9% (n=6) and 10.6 ± 2.0% (n=23), respectively (Table III). There was no significant difference in %BF between selected national and non-national badminton players in Northern Nigeria. This is because the calculated t value is less than the t critical value at 5% level of significant with $p > 0.05$ ($t= 1.61$, $p= 0.12$) (Table III).

The values are closely similar with those of national badminton players, first league and junior national squash players and male college tennis players who had mean body fat percents of 9.8 ± 3.5% (Faccini & DalMonte, 1996), 10.1 ± 2.7% and 10.9 ± 1.8% (Mahoney & Sharp, 1995), and 10.4 ± 3.2% (Groppel & Roetert, 1992), respectively. A mean body fat percent of 12.1 ± 3.4% was found for national male badminton players by Majumdar *et al.*, (1997). Body fat

percent found in squash players ranged from 7.4 – 12% (Chin *et al.*, 1995) and in badminton players ranged from 8.1 – 13.2% (Pipes, 1979; Rannou *et al.*, 2001 as disclosed in Van Lieshout, 2002). These values are higher than those reported for top squash and badminton players by Chin *et al.*, (1992) and Chin *et al.*, (1995) who found mean body fat percent of 7.4 ± 3.4%, 5 ± 1.2% and 7.3 ± 3%, respectively. The body fat values for the girls is higher than that of the boys, which compares with results of Groppel and Roetert (1992) who noted that tennis girls have higher body fat values than tennis boys.

Excess body weight as fat would be disadvantageous in moving quickly around the court, as well as jumping to strike the shuttle. Top competitive players tend to have a low body fat percent, as the negative impact of excess body fat would increase the energy expended in moving around the court (Elliot *et al.*, 1989; Chin *et al.*, 1995). Lower levels of body fat will enhance the game of badminton as it permits a more effective gradient for the rapid transfer of heat produced during high intensity exercise, and would be advantageous concerning moving quickly across the court and in leaping to strike the shuttle. The average body fat percent of badminton players should range between 10 and 15 percent for males, and between 15 and 20 percent for females (van Lieshout, 2002). Any athlete with a higher fat percent is likely to be at a disadvantage when playing against a leaner badminton player of the same skill and experience.

Explosive power

The males in this study had a mean vertical jumping height of 56.4 ± 6.6 cm (n=20). The mean broad jumping distance was 53.8 ± 10.1 cm (n=19). Corresponding data for females in vertical jumping height: 38.8 ± 4.3 cm and broad jumping distance of the females was 52.2 ± 8.1 cm (n=9) (Table II). There was a significant difference between selected male and female badminton players in terms of vertical jump. This is observed as the calculated *t*-value of 7.3 is greater than the *t*-critical value ($p<0.05$). There was no significant difference in terms of broad jump distance, where ($t= 0.4$, $p= 0.67$) (Table II).

The national players in this study had a mean vertical jumping height of 58.3 ± 12.8 cm, and mean broad jumping distance was 66.3 ± 7.7 cm (n=6). The non-national players had vertical

jumping height value 49.0 ± 8.7 cm (n=23) and broad jumping distance of 49.8 ± 6.2 cm (n=22) (Table III). There was a significant difference in explosive power between selected national and non-national badminton players in Northern Nigeria. This is observed as the calculated *t*-values were greater than the *t*-critical values ($p<0.05$).

Male Australian tennis players in Buckeridge, Farrow, Gastin *et al.*, (2000) have mean vertical jumping heights of 53.2 ± 4.8cm and 54 ± 3cm which compares higher with the results obtained by the males in this study. This value however, corresponds with the values obtained from local league, national league and elite level badminton players by Omosegaard (1996), whose values ranged from 55 – 75cm, but is higher than values obtained from junior tennis players between the ages of 14 and 17 years, with values ranging from 32 – 39cm (Elliot *et al.*, 1989).

According to Omosegaard (1996), 60 – 70cm is the minimum range for the lunge jump for male badminton players. Female Australian tennis players reported in Buckeridge *et al.*, (2000) had mean vertical jumping heights of 40 ± 3cm and 40.3 ± 5.2cm, which are slightly higher than the results obtained by the females in this study. The values of the females in this study, however, are lower than those obtained from local league, national league and elite level badminton players by Omosegaard (1996), whose values ranged from 45 – 62cm. The values tend to correspond more closely with those obtained for junior tennis players between the ages of 14 and 17 years, whose values ranged from 32 – 33cm (Elliot *et al.*, 1989). This also tends to correspond with the 15 year old quarter- and semi-final tennis players in Elliot *et al.*, (1989), who had mean vertical jumping heights of 30 and 34cm, respectively. According to Omosegaard (1996), 35 – 45cm is the minimum range for the broad jump for female badminton players, which the female participants in this study comfortably meet up.

The vertical explosive values of the males and females in this study were satisfactory compared to that of other badminton players in other studies, like; Buckeridge *et al.*, (2000); Omosegaard, (1996); Elliot *et al.*, (1989). This is advantageous to the players as vertical power is important for jumping high to intercept the shuttle and in the smash stroke for some players. Jumping high to intercept the shuttle will result in a faster and more attacking game, as the player

is able to intercept the shuttle before it descends. Some players who have mastered the technique of jumping to hit the smash are at an advantage as they create a steeper angle for the shuttle and they intercept it sooner, making it more difficult for the opponent to return.

The females in this study compared to that of other badminton players in other studies in Omosegaard (1996) (with minimum range of 35 - 45cm) would not be at a great disadvantage about their broad jump, as their value falls within the normal range for female badminton players. The male players however, would be at a disadvantage as horizontal explosiveness is important in taking lunge jumps to execute net shots. A greater horizontal explosiveness will result in the player being able to reach the shuttle more quickly, and thus force a faster pace of play. Explosive power also helps in getting to un-anticipated shots, where a quick, explosive movement to a relatively far distance has to be made. An explosive player will typically be able to jump high, change direction quickly and will generally appear to be swift and mobile on the badminton court. Explosive power is therefore a combination of coordination and muscular properties.

Conclusion

Based on the results of this study, the following conclusions were made:

A significant correlation between %BF and explosive power characteristics was found on vertical jump and showed no significance correlation in broad jump. In testing the differences between the ***males and females***: There is a significant difference in %BF and vertical jump. There was no significant difference in terms of broad jump distance. In testing the difference between ***National and Non-national***: No significant difference in %BF. Even though, the non-national players obtained higher percent. Significant difference in explosive power was clearly observed between selected national and non-national badminton players.

Recommendations

The following recommendations were proffered:

1. Athlete trainers, coaches, exercise scientists and all personnel concerned with designing training programmes for badminton

players should lay an emphasis on %BF and explosive power characteristics for enhancement. Moreover, should realize that females are physiologically disparate from males.

2. The %BF and explosive power components of the players in this study need to be enhanced. Because, the quicker the player can intercept the shuttlecock and the greater the intensity and pace of play that can be forced on the opponent.
3. A good training programme should incorporate conditioned games, conditioning drills, strength training, aerobic training, speed and agility training, flexibility training, core stability training and circuit training, all in relation to badminton. This will help to improve the players' performances.

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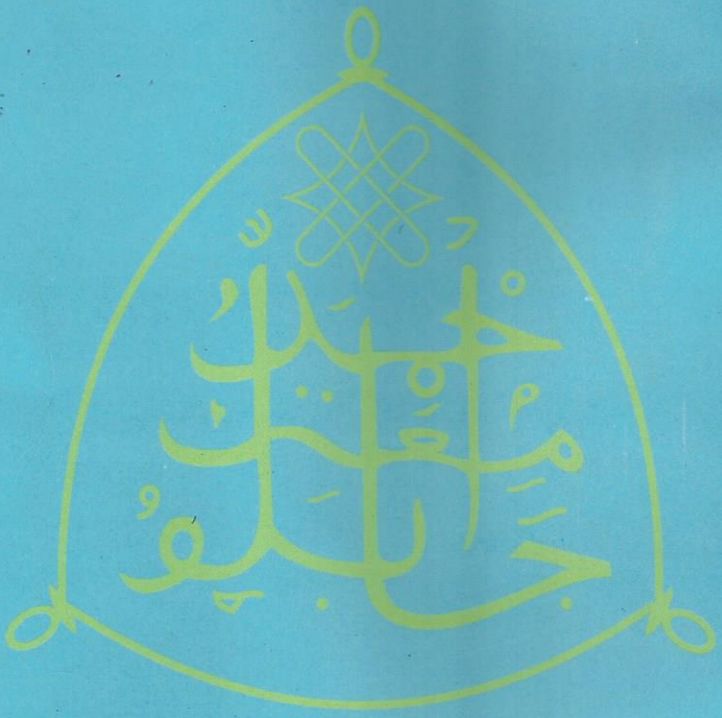
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ISSN: 075-5316

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