Journal of Fundamental and Applied Sciences

ISSN 1112-9867

Available online at http://www.jfas.info

Research Article

Special Issue

DETERMINATION ASSOCIATION OF ANTHROPOMETRIC AND PERFORMANCE ABILITY IN SEPAK TAKRAW YOUTH ATHLETE USING UNSUPERVISED MULTIVARIATE

N. A. Kosni[1,2], M. R. Abdullah[1,2,*], H. Juahir[1], R. M. Musa[2], A. B. H. M. Maliki[2], S. M. Mat-Rasid[1], A. Adnan[2], N. Alias[3] and V. Eswaramoorthi[3]

[1]East Coast Environmental Research Institute, University of Sultan Zainal Abidin, Gong Badak Campus, 21300 Terengganu, Malaysia

[2]Faculty of Applied Social Sciences, University of Sultan Zainal Abidin, Gong Badak Campus, 21300 Terengganu, Malaysia

[3]Faculty of Health Science, School of Rehabilitation Science, University of Sultan Zainal Abidin, Gong Badak Campus, 21300 Terengganu, Malaysia

Published online: 08 August 2017

ABSTRACT

The purpose of the current study was to determine the most important variable associated with the performance ability. Thirty-eight players of sepak takraw with the mean age 16.21 (0.93) years old participated in this study. A total 12 anthropometric measurements and sepak takraw performance ability were examined. The PCA revealed nine anthropometric parameters as most significant in sepak takraw. The significant parameters were then classified into two group of expertise labeled as high (HPT) and low performance team (LPT) using HACA. DA standard mode exposed hip circumference and performance ability are the best parameter to differentiate between the two groups, whereas both stepwise forward and backward exposed performance ability is significant parameter. The present study identified hip circumference and performance ability as foretelling factors of performance in sepak takraw.

Keywords: anthropometric; multivariate analysis; performance ability; sepak takraw; youth athletes.

Author Correspondence, e-mail: razali896@yahoo.com

doi: http://dx.doi.org/10.4314/jfas.v9i2s.33

1. INTRODUCTION

Sepak takraw sport is modern traditional sport that had been modified and recognized all around the world. This sport has been dominated by Asian country specifically in South East Asia. A team of sepak takraw called *regu* consist of three positions namely *tekong*, feeder and spiker. Each position has their particular role during the game. However, the player may change the position at anytime if necessary or order from the coach. Since the role of each player in a *regu* is different, physical attribute demand may be different associated with performances.

Anthropometric attributes are frequently tested in sport performance for both expert [1-2] and beginner athlete level [3-4]. Whilst the relative performance of such factors can fluctuate depends on the physical demands of a sport [5-6]. Previous study stressed that there is some significant confirmation supporting their contribution to player selection and performance in specific sport [7-9]. Individual athlete anthropometric characteristics are imitated to be an important factor of achievement in sport. In Malaysia, anthropometric measurement is the main parameter of talent identification and development program. Numerous reports exist trying to show the influence of anthropometric properties on exercise performance in different sports, such swimming [10], middle and long distance running [11-15], tennis [16], rowing [17], kayaking [18] or cycling [19-20] and also for many team sports (e.g. rugby [21], football [22-23], Australian football [31], soccer [24-26] and sepak takraw [27]. Age and height are revealed positively related to performance in both short and long distance swimming, but handgrip strength is only significant for short distance swimming performance [10]. In [12] stated that anthropometric factors have the same degree of influence on performance as physiological factors in distance running. The skinfold thickness in the lower limb of the distance runners related to performance encouragingly and could be used as a predictive factor for all distance runners [14].

In tennis, there is no significant different of height and weight measurement between high ranked and low ranked boy junior elite athlete but the high ranked girl junior elite athletes are significantly taller than low ranked girl and humeral and femoral breadths was also found wider as well [16]. The finding indicates that differences could influence the playing style of

junior female players.

In [18] specified the trend of morphological elite paddlers is compact and robust physique seems to be positive for female athlete. Furthermore, senior sepak takraw athlete found to be taller and heavier than junior player. The senior players are better in range of motion of the neck, trunk and ankle joints as well as back and leg strength. Most of the previous studies measured specific anthropometric that related to the performance of the sports. However, only certain anthropometric indicator recognized beneficial for talent identification and development programmes in particular sports performance. Thus, the aim of the current study was to determine the most important anthropometric parameters that associated with sepak takraw performance ability.

2. MATERIALS AND METHODS

2.1. Participants

Thirty-eight players of sepak takraw player's age range 15 to 17 with the mean age 16.21 (0.93) years old joined in this study. The participants are competing in national youth completion in 2016.

2.2 Anthropometry Measurement

The measurement of anthropometrics were examines in this study are body mass, standing height, sitting height, leg length, waist circumference, hip circumference, thigh circumference, calf circumference, four site skinfold and sepak takraw game performance ability. The body mass was weighted using standardize digital weight scale to the nearest 0.1kg. The height was measured with stadiometer to the nearest 0.5cm. Standing height measures the maximum vertical height of the participant while sitting height measure the maximum height from vertex of the head to the seated buttocks. Circumference measurements were measured with a brittle measuring tape at four specific locations. Hip circumference was measured from top of the anterior superior iliac spines until the waist at the level of the navel. Circumference of the thigh recorded between the anterior iliac and the middle of the patella and calf circumference is the maximum circumference to the long axis of the calf. The length of the legs measured on the greater trochanter to the lateral malleolus. Skinfold was measured using skinfold caliper to

the nearest 0.1mm. Durnin 4-sites [28] skinfold measure recommended for athlete includes in this study (triceps, biceps, suprailiac and subscapular).

2.3. Player's Performance Ability Measurement

This measurement used to identify the player skill performance. The players are tested with five basic skill of sepak takraw game specifically, service, blocking, spiking, break ball and passing. The score were given in percentage of successful execution of the skill. The Cronbach's alpha coefficient indicates 0.998 which revealed a high consistency among the performance analysts in their analysis of the performance indicator, whereas the inferential statistics of the analysis for the Cohen's Kappa's measure of agreement shows $K = 0.76$, $p < 0.001$ which indicated that the agreements among the performance analysts was beyond any chance.

2.4. Statistics

The data were processes with XL-Stat add in software and analyzed with Multivariate analysis; principle component analysis (PCA), cluster analysis (HACA) and discriminant analysis (DA) to achieve the objective of the study. The PCA used to identify the most significant parameter of anthropometric attribution. The first assumptions to follow are Kaiser-Meyer-Olkin (KMO) value and Bartlett's Test of Sphericity. Both tests is a measure of sampling adequacy that is recommended to ensure the case to ratio of variable for the analysis being accompanied. KMO and Bartlett's test play an important role for accepting the sample adequacy. KMO is a statistic that indicates the proportion of variance in your variables that might be caused by underlying factors. Previous researcher recommends accepting the values greater than 0.5 as acceptable [35, 38-43]. The closer the value to 1.0 indicates that the selected variable is useful collected data. Eigenvalue accepted to rerun with varimax rotation is higher than 1 and variables selected as significant paramter are based on factor loading after varimax rotation that greater than 0.75 [44-48]. The analysis followed up with HACA to classify the group based on their similirity on selected parameters in this study. The last analysis applied is discriminant analysis (DA). The DA carried out through standard mode, forward stepwise and backward stepwise to look forward the variation and percision percentage of cross-validation rate the group assigned from HACA. Finally, the result from

DA will identify the parameters that discriminated between the groups.

3. RESULTS AND DISCUSSION

The KMO measure of sampling adequacy in this study was 0.798 which is above the suggested value of 0.5. The Bartlett's test of sphericity was significant $\chi^2 = 450.319$, $p < 0.05$). The result of both test revealed the existence of sample adequacy and relation among the selected variable correspondingly (Table 1).

Table 1. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		**0.798**
Bartlett's sphericity test	Chi-square (Observed value)	450.319
	df	66
	p-value	< 0.0001

The scree plots for the PCA show that up to 75.98% of variability is on the first two components (Fig. 1). The PCs with eigenvalues higher than one are deliberated significant based on eigenvalue-one criterion [29-30].

PCA were rerun with varimax rotation after two factor identified has high eigenvalue. The VF1 and VF contributed 50.32% and 25.66% respectively (Table 2). For VF1, six variables satisfied the 0.75 factor loading onset, namely body mass, waist circumference, hip circumference, thigh circumference, calf circumference and subscapular. Similarly, the VF2 recognizes only three variables fulfilled the 0.75 factor loading onset, explicitly standing height, sitting height and leg length. Therefore, the results from PCA revealed only nine variables out of 12 variables are significant and all nine variables show high positive factor loading.

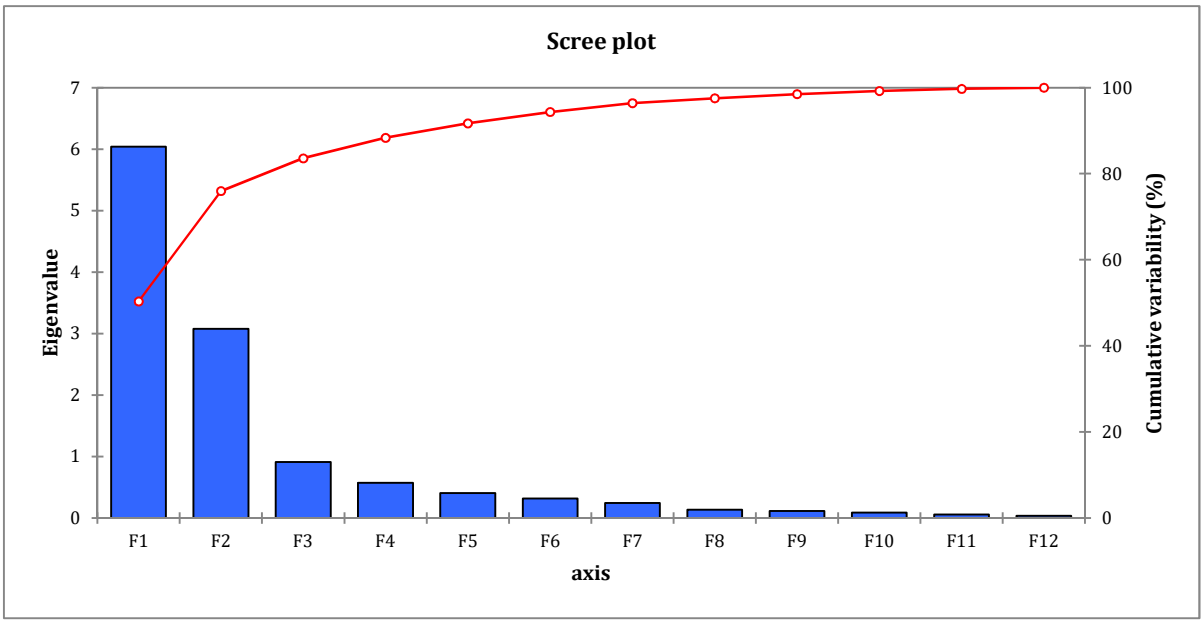

Fig.1. Scree plot for the principle component model

Table 2. Eigenvalue and the percentage of variability with factor loading after varimax rotation

Parameter	VF1	VF2
Body Mass	0.893	0.382
Standing Height	-0.100	0.923
Sitting Height	0.159	0.870
Leg Length	-0.082	0.896
Waist Circumference	0.893	0.141
Hip Circumference	0.861	0.338
Thigh Circumference	0.929	-0.066
Calf Circumference	0.891	0.084
Triceps	0.616	-0.262
Biceps	0.677	-0.239
Subscapular	0.858	-0.229
Suprailliac	0.655	-0.447
Eigenvalue	6.040	3.078
Variability (%)	50.321	25.660
Cumulative %	50.321	75.981

3.1. Classification of Group Performance Based on Anthropometrics and Skill Data

This part examines the anthropometrics and skill performance parameter in order to classify the performance group based on their correspondence level using HACA. HACA was performed on the sepak takraw athlete's data set to evaluate variation among the participants. The analysis ensued in the grouping of athletes into two groups. Dendrogram in Fig. 2 demonstrate different class of the sepak takraw athletes based on the anthropometrics and skill parameters namely high performance team (HPT) and low performance team (LPT).

The result from HACA yield two groups of the athlete labeled as high performance (class 1) and low performance (class 2). 26-participants in total identified as high performance group and 12 participants are in low performance group. This result implies that for instant assessment of the athlete, these two groups of athlete should treat separately based on their ability. The HACA technique is practical helps in monitoring the athlete based on the reliable classification of the athletes. The clustering procedure produced two clusters in a very undoubted method, as the sites in these groups have similar characteristics.

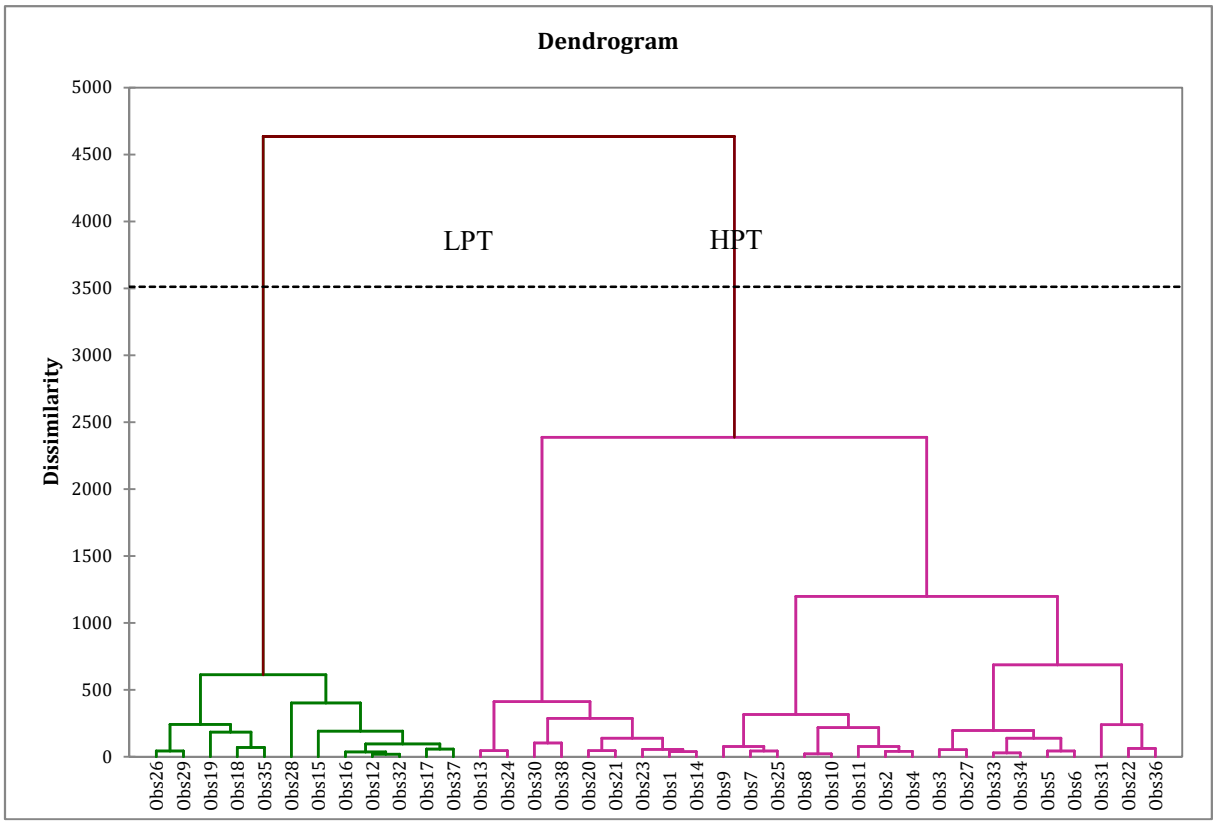

Fig.2. Dendrogram demonstrating the similarities among the athletes produced by cluster analysis

The high factor loading variable selected from PCA were underwent HACA to cluster the athletes based on their anthropometric measurement. For HACA, the researcher added performance ability in this analysis. A dendrogram of athlete pattern resulting from HACA presented in Fig. 2. The use of HACA is to monitoring a group of athlete of different character may be obviously distinguished. The dendrogram revealed there are two cluster produced from HACA. The groups created were then labeled as HPT and LPT based on their performance ability.

The two clusters (HPT and LPT) in the data model was confirmed by DA the run the row data of anthropometric and performance ability in the standard, forward stepwise and backward stepwise mode. For standard mode, two parameters was exposed as significantly differentiate the two HPT and LPT group namely hip circumference and performance ability. For both forward stepwise and backward stepwise indicates that only performance ability, differentiate well between HPT and LPT.

Table 3. The confusion matrix for the cross-validation of standard mode, forward stepwise and backward stepwise

Groups	% Correct	Group Allotted by DA	
		High Performance	**Low Performance**
Standard DA mode (2 parameters)			
High performance	84.62	22	4
Low performance	75.00	3	9
Forward stepwise mode (1 parameter)			
High performance	96.15	25	1
Low performance	91.67	1	11
Backward stepwise mode (1 parameter)			
High performance	96.15	25	1
Low performance	91.67	1	11

3.2. Determination of the Significant High Variation of Parameter Discriminating the Athlete between Groups

To examine the variation among the athletes, DA was employed on the raw data of

anthropometrics and skill performance into two groups defined by HACA. The groups treated as dependent variables, whilst anthropometric and skill performance treated as independent variables. In order to confirm the accurateness of the group classification, the DA was carried out via standard mode, forward stepwise and backward stepwise methods. The accuracy of classification using standard, forward stepwise and backward stepwise mode were 81.58% with two discriminant variables, 94.74% with one discriminant variable and 94.74% with one discriminant variable. Using these three methods of DA, skill found to be the significant parameter by standard mode and both stepwise forward and backward method while hip circumference is found as significant parameter in DA standard mode method. Box and whisker plots of the significant parameters are shown in figure. Two selected parameters that give high variation by standard mode DA were then used for further discussion.

3.3. Discussion

This study aims to identify the anthropometric that are most significant in youth sepak takraw athletes as well as the association of anthropometric and performance ability. To accomplish the objective of the study, the researchers employed 38 sepak takraw athletes from three different sport schools in Malaysia. Twelve anthropometric measurements were assessed and performance ability was evaluated. The raw data was analyzed by PCA to identify the most significant parameter among the sepak takraw athlete. HACA were applied to follow up the group obtained from nine significant variable that identified by PCA. The last step is applying DA to distinguish the two groups obtained from HACA.

In the current study, research standardized to set factor loading higher than 0.75 as the onset due to the fact that selected value has strong stable loading on extorted factors. Based on the Table 2 presented, nine variable revealed has high variation and it indicates that these nine variable are essential anthropometric that are needed for sepak takraw youth athletes. The VF1 contributes about 50.32% of the variation in anthropometric. Body mass (0.893), waist circumference (0.893), hip circumference (0.861), thigh circumference (0.929), calf circumference (0.891) and subscapular (0.858) has high positive factor loading (> 0.75). The parameter found as significant in VF1 narrowed as body composition

The VF2 contributes about 25.66% of the variation in anthropometric characteristic. The three

variables that has high positive factor loading (> 0.75) are standing height (0.923), sitting height (0.870) and leg length (0.896). Usually, these three types of height measurement are increasing parallels until the growth of the height stop growing. However, the variables are still essential to the sepak takraw youth athlete as the variable selected in VF1.

All these nine variables are the main parameters that should consider as main feature of sepak takraw athlete. Body mass and height are commonly used to measure anthropometric characteristic in talent development because it is part of greatest association with development of performance level [31]. In [32] stressed that body proportions, shape and size of the athletes are vital feature in considering player performance. Appropriate evaluation may replicate the quantification of the body's major physical components where different proportion acquires in various sports to achieve their excellence [33].

An appropriate body composition is essential for athletes. Different sports needs optimal body characteristics based on the demands of sports. The lack of data from Malaysian sepak takraw players limits the literature of the study. The body composition and height of Malaysian sepak takraw athlete were found to be within the Malaysian population according to their respective age [34]. However, the players of sepak takraw are tending to be very lean. The suitable body fat for sepak takraw players is in the range of 8 to 12% [27] and the height of 1.68 to 175m range is adequate [36].

The significant parameters were than classify with addition performance ability's parameter. HACA recognized two groups are well separated based on the similar anthropometric and performance ability characteristic. The parameters that discriminated well between these two groups are hip circumference and performance ability. The finding shows that skill and hip circumference is the best indicator to discriminate the best and the low performance group. Sepak takraw players reported have average to high ROM [27] that recommended by [37]. The hip circumference may associate with the performance of sepak takraw player. This is because flexibility is important attribute to sepak takraw particularly hip flexibility [35].

Nonetheless, sepak takraw sport is skillful sports. Three positions in a team have their own role to execute specific skill such service (*tekong*), feeding the ball to spiker (feeder) and spiking to kill the ball (spiker). The other two skills are blocking and breakball. Any players

can receive breakball and blocking skill usually takes over by the spiker. However, in sepak takraw, player who possessed more skills is advantage to the team. From the result of this current study, performance is the best parameter to differentiate between high and low performance team. This finding proved that sepak takraw is skillful sport. Although anthropometric attribute influence the performance in sport [35], but skill should be pay more attention.

4. CONCLUSION

This study employed three multivariate statistical methods (PCA, HACA and DA) identify the best variable differentiate between best and low performance group. PCA was applied to identify the most essential anthropometrics variables among sepak takraw youth. Nine anthropometric parameter were identified as the most essential parameter for sepak takraw youth player namely, body mass, waist circumference, hip circumference, thigh circumference, calf circumference, subscapular, standing height, sitting height and leg length. The HACA used categorized 38 sepak takraw players based on the variable selected from PCA with performance ability. Two groups of players were isolated have similarity of anthropometrics and performance ability characteristic. The DA was then used to follow up to confirm the cluster that identified by HACA. The current study discovered the measurement result of the athlete's status by performance ability and hip circumference in the sense of athlete classification. Coaches and trainer could pay more attention on their athlete performance ability and hip circumference when developing a training program for sepak takraw youth. The more skills the player mastered, the better team can be made.

5. ACKNOWLEDGEMENTS

The authors would like to thank the East Coast Environmental Research Institute, University of Sultan Zainal Abidin for financial support and sport science team for helping in collecting the data.

6. REFERENCES

[1] Gastin P B, Fahrner B, Meyer D, Robinson D, Cook J L. Influence of physical fitness, age, experience, and weekly training load on match performance in elite Australian football. Journal of Strength and Conditioning Research, 2013, 27(5):1272-1279

[2] Young W B, Newton R U, Doyle T L, Chapman D, Cormack S, Stewart C, Dawson B. Physiological and anthropometric characteristics of starters and non-starters and playing positions in elite Australian Rules football: A case study. Journal of Science and Medicine in Sport, 2005, 8(3):333-345

[3] Gastin PB, Bennett G, Cook J. Biological maturity influences running performance in junior Australian football. Journal of Science and Medicine in Sport, 2013, 16(2):140-145

[4] Woods C T, Raynor A J, Bruce L, McDonald Z, Collier N. Predicting playing status in junior Australian Football using physical and anthropometric parameters. Journal of Science and Medicine in Sport, 2015, 18(2):225-229

[5] Hoare D G. Predicting success in junior elite basketball players-The contribution of anthropometric and physiological attributes. Journal of Science and Medicine in Sport, 2000, 3(4):391-405

[6] Gabbett T, Georgieff B, Domrow N. The use of physiological, anthropometric, and skill data to predict selection in a talent-identified junior volleyball squad. Journal of Sports Sciences, 2007, 25(12):1337-1344

[7] Pyne D B, Gardner A S, Sheehan K, Hopkins W G. Fitness testing and career progression in AFL football. Journal of Science and Medicine in Sport, 2005, 8(3):321-332

[8] Veale J P, Pearce A J, Koehn S, Carlson J S. Performance and anthropometric characteristics of prospective elite junior Australian footballers: A case study in one junior team. Journal of Science and Medicine in Sport, 2008, 11(2):227-230

[9] Keogh J. The use of physical fitness scores and anthropometric data to predict selection in an elite under 18 Australian rules football team. Journal of Science and Medicine in Sport, 1999, 2(2):125-133

[10] Zampagni M L, Casino D, Benelli P, Visani A, Marcacci M, De Vito G. Anthropometric and strength variables to predict freestyle performance times in elite master swimmers.

Journal of Strength and Conditioning Research, 2008, 22(4):1298-1307

[11] Weston A R, Karamizrak O, Smith A, Noakes T D, Myburgh K H. African runners exhibit greater fatigue resistance, lower lactate accumulation, and higher oxidative enzyme activity. Journal of Applied Physiology, 1999, 86(3):915-923

[12] Tanaka K, Matsuura Y. A multivariate analysis of the role of certain anthropometric and physiological attributes in distance running. Annals of Human Biology, 1982, 9(5):473-482

[13] Larsen H B. Kenyan dominance in distance running. Comparative Biochemistry and Physiology Part A: Molecular and Integrative Physiology, 2003, 136(1):161-170

[14] Arrese A L, Ostariz E S. Skinfold thicknesses associated with distance running performance in highly trained runners. Journal of Sports Sciences, 2006, 24(1):69-76

[15] Bosch A N, Goslin B R, Noakes T D, Dennis S C. Physiological differences between black and white runners during a treadmill marathon. European Journal of Applied Physiology and Occupational Physiology, 1990, 61(1):68-72

[16] Sanchez-Munoz C, Sanz D, Zabala M. Anthropometric characteristics, body composition and somatotype of elite junior tennis players. British Journal of Sports Medicine, 2007, 41(11):793-799

[17] Bourgois J, Claessens A L, Vrijens J, Philippaerts R, Van Renterghem B, Thomis M, Janssens M, Loos R, Lefevre J. Anthropometric characteristics of elite male junior rowers. British Journal of Sports Medicine, 2000, 34(3):213-216

[18] Ackland T R, Ong K B, Kerr D A, Ridge B. Morphological characteristics of Olympic sprint canoe and kayak paddlers. Journal of Science and Medicine in Sport, 2003, 6(3):285-294

[19] McLean B D, Parker A W. An anthropometric analysis of elite Australian track cyclists. Journal of Sports Sciences, 1989, 7(3):247-255

[20] Campion F, Nevill A M, Karlsson M K, Lounana J, Shabani M, Fardellone P, Medelli J. Bone status in professional cyclists. International Journal of Sports Medicine, 2010, 31(7):511-515

[21] Gabbett T J. Physiological and anthropometric characteristics of amateur rugby league players. British Journal of Sports Medicine, 2000, 34(4):303-307

[22] Dupler T L, Amonette W E, Coleman A E, Hoffman J R, Wenzel T. Anthropometric and performance differences among high-school football players. Journal of Strength and Conditioning Research, 2010, 24(8):1975-1982

[23] Hetzler R K, Schroeder B L, Wages J J, Stickley C D, Kimura I F. Anthropometry increases 1 repetition maximum predictive ability of NFL-225 test for Division IA college football players. Journal of Strength and Conditioning Research, 2010, 24(6):1429-1439

[24] Reilly T, Bangsbo J, Franks A. Anthropometric and physiological predispositions for elite soccer. Journal of Sports Sciences, 2000, 18(9):669-683

[25] Reilly T, Williams A M, Nevill A, Franks A. A multidisciplinary approach to talent identification in soccer. Journal of Sports Sciences, 2000, 18(9):695-702

[26] Rienzi E, Drust B, Reilly T, Carter J E, Martin A. Investigation of anthropometric and work-rate profiles of elite South American international soccer players. Journal of Sports Medicine and Physical Fitness, 2000, 40(2):162-169

[27] Jawis M N, Singh R, Singh H J, Yassin M N. Anthropometric and physiological profiles of sepak takraw players. British Journal of Sports Medicine, 2005, 39(11):825-829

[28] Durnin, J V G A, Wormersley, J. Body fat assessed from total body density and its estimation from skinfold thickness measurements on 481 men and women aged 16-72 years. British Journal of Nutrition, 1974, 32(1):77-97

[29] Abdullah M R, Maliki A B H M, Musa R M, Kosni N A, Juahir H, Haque M. Multi-hierarchical pattern recognition of athlete's relative performance as a criterion for predicting potential athletes. Journal of Young Pharmacists, 2016, 8(4):463-470

[30] Abdullah M R, Maliki A B H M, Musa R M, Kosni N A, Juahir H. Intelligent prediction of soccer technical skill on youth soccer player's relative performance using multivariate analysis and artificial neural network techniques. International Journal on Advanced Science, Engineering and Information Technology, 2016, 6(5):668-674

[31] Sarah G L, Kenji D, Wade S, Harry B G, Carl W T. Identifying the physical fitness, anthropometric and athletic movement qualities discriminant of developmental level in elite junior Australian football: Implications for the development of talent. Journal of Strength and Conditioning Research, 2017, 31(7):1830-1839

[32] Toriola A L, Adeniran S, Ogunremi R T. Body composition and anthropometric characteristics of elite male basketball and volleyball players. Journal of Sports Medicine and Physical Fitness, 1987, 27(2):235-239

[33] Bandyopadhyay A. Anthropometry and body composition in soccer and volleyball players in West Bengal, India. Journal of Physiological Anthropology, 2007, 26(4):501-505

[34] Singh R, Singh H J, Sirisinghe R G. Cardiopulmonary fitness in a sample of Malaysian population. Japanese Journal of Physiology, 1989, 39(4):475-485

[35] Musa R M, Abdullah M R, Maliki A B H M, Kosni N A, Haque M. The application of principal component analysis to regnonize essential physical fitness components among youth development archers of Terengganu, Malaysia. Indian Journal of Science and Technology, 2016, 9(44):1-6

[36] Aziz A R, Teo E, Tan B, Chuan T K. Sepaktakraw: A descriptive analysis of heart rate and blood lactate response and physiological profiles of elite players. International Journal of Applied Sports Sciences, 2000, 15(1):1-10

[37] Leighton J R. An instrument and technic for the measurement of range of joint motion. Archives of Physical Medicine and Rehabilitation, 1955, 36(9):571-578

[38] Kaiser H F. An index of factorial simplicity. Psychometrika, 1974, 39(1):31-36

[39] Al-Odaini N A, Zakaria M P, Zali M A, Juahir H, Yaziz M I, Surif S. Application of chemometrics in understanding the spatial distribution of human pharmaceuticals in surface water. Environmental Monitoring and Assessment, 2012, 184(11):6735-6748

[40] Juahir H, Zain S M, Aris A Z, Yusof M K, Samah M A, Mokhtar M. Hydrological trend analysis due to land use changes at Langat River Basin. Environment Asia, 2010, 3:20-31

[41] Mun'im Mohd Han N, Latif M T, Othman M, Dominick D, Mohamad N, Juahir H, Tahir N M. Composition of selected heavy metals in road dust from Kuala Lumpur City Centre. Environmental Earth Sciences, 2014, 72(3):849-859

[42] Aris A Z, Abdullah M H, Praveena S M, Yusoff M K, Juahir H. Extenuation of saline solutes in shallow aquifer of a small tropical island: A case study of Manukan Island, North Borneo. Environment Asia, 2010, 3(Special issue):84-92

[43] Toriman M E, Gasim M B, Yusop Z, Shahid I, Mastura S S, Abdullah P, Jaafar M, Aziz N

A, Kamarudin M K, Jaafar O, Karim O. Use of 137 Cs activity to investigate sediment movement and transport modeling in river coastal environment. American Journal of Environmental Sciences, 2012, 8(4):417-423

[44] Abdullah M R, Maliki A B H M, Musa R M, Kosni N A, Juahir H, Mohamed S B. Identification and comparative analysis of essential performance indicators in two levels of soccer expertise. International Journal on Advanced Science, Engineering and Information Technology, 2017, 7(1):305-314

[45] Abdullah M R, Eswaramoorthi V, Musa R M, Maliki A B H M, Kosni N A, Haque M. The effectiveness of aerobic exercises at difference intensities of managing blood pressure in essential hypertensive information technology officers. Journal of Young Pharmacists, 2016, 8(4):483-486

[46] Abdullah M R, Musa R M, Maliki A B H M, Kosni N A, Suppiah P K. Development of tablet application based notational analysis system and the establishment of its reliability in soccer. Journal of Physical Education and Sport, 2016, 16(3):951-956

[47] Musa R M, Abdullah M R, Maliki A B H M, Kosni N A, Haque M. The application of principal components analysis to recognize essential physical fitness components among youth development archers of Terengganu, Malaysia. Indian Journal of Science and Technology, 2016, 9(44):1-6

[48] Abdullah M R, Kosni N A, Eswaramoorthi V, Maliki A B H M, Musa R M. Reliability of test of performance strategies-competition scale (TOPS-CS) among youth athletes: A preliminary study in Malaysia. Man in India, 2016, 96(12):5199-5207

How to cite this article:
Kosni NA, Abdullah MR, Juahir H, Musa RM, Maliki ABHM, Mat-Rasid SM, Adnan A, Alias N, Eswaramoorthi V. Determination association of anthropometric and performance ability in sepak takraw youth athlete using unsupervised multivariate. J. Fundam. Appl. Sci., 2017, *9(2S), 505-520.*