Applied Multidimensional Analysis for Assessing Youth Performance in Sports Talent Identification Program

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Abstract*: *This study attempts to apply multidimensional analysis for assessing the profile of male youth in sports talent identification program. Data of anthropometric and physical fitness included power, agility, speeds, flexibility, strength and endurance were obtained from 600 youth in a sports talent identification program aged 13-15 years. Data analyses were carried out using multivariate analysis cluster analysis (CA) and discriminant analysis (DA). Cluster analysis assigned three groups with different profile. While standard mode of DA demonstrated 90.0% accuracy of classification matrix for the assigned groups with nine discriminated variables. Forward and backward stepwise DA discriminated six variables from nine variables with 90.3% level of accuracy. The variables are weight, sitting height, armspan, 20 meter run, 40 meter run and VO_2 max. These selected variables of anthropometric and fitness are, therefore, revealed as the essential attributes those must be prioritized for a talent scouting in sports. Present results had demonstrated multidimensional analysis as comprehensive approach capable of providing an information that could help coaches in decision making during youth selection in sports talent identification.

Index Terms*: *Cluster analysis, Discriminant analysis, Multivariate analysis, Talent identification

I. INTRODUCTION

The interest of talent identification (TI) in sports is fully related to the coaching and current sports science studies [1]. TI in sport is generally intended to identify talent at an early age in order to provide excellent development opportunities in the future [2,3]. In order achieving the goal of TI, the main procedure was carried out is athlete selection as early as possible and common traditional way of selecting youth is depends on some experienced experts' judgments [4]. Standards of selecting and evaluating youth by this method are sometimes not complete and reasonable. As a result, the traditional way of evaluating youth' talents are influenced heavily by subjective factors, which bring about great deviations [1]. Concrete evidence emphasized that the potential and talented youth are often drop out because of traditional approach in TI concept that does not adequate [5]. Likewise, findings in detail interviews has revealed that coaches' decision making was influenced by preconceptions and various pressures to select certain players [6]. Among the influences had been identified are the stress experienced by the coach to maintain their profession and career goals, the existence of external factors when making decisions such as peers and parents, as well as the tension to choose the player for immediate success.

In line with recent studies those has explored scientific approach to be applied in athlete selection process to replace the traditional scheme [7,8,9,10], this study will apply multidimensional analysis of multivariate approach included CA and DA techniques to provide an analytical aid in talent identification in sports. The data of anthropometric measurement and physical fitness were obtained among male youth in a sport development program. Since the physical variations among adolescent are high, the identification, quantification and implementation of these anthropometric and fitness components attribute in selection decisions have a significant impact on assessing new talent in sports [11]. Proposed approach in this study can help experts in athlete selection scientifically and able to reduce the deviations caused by subjective factors.

II. MATERIALS AND METHODS

A. Participant

The anthropometric measurements and fitness test data in this study were obtained from 600 male youth (age 13.67 ± 0.57 year) in a sports identification program in Terengganu, Malaysia. The raw data was converted into a single matrix formed by 10 variables (4 anthropometric components and 6 physical tests) with 600

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male youth.
All the youth were informed to sign an informed consent form before the day of the program.

B. Anthropometric Measurements and Fitness Test

Anthropometric measurement involved in this study were included weight, standing height, sitting height and armspan. While fitness test of standing broad jump, 10-m run, 20-m run, 40-m run, sit and reach, and maximal multistage 20-m shuttle run test) were carried out. The youth were divided into groups with an adequate recovery period between tests (up to 3 minutes of rest).

C. Data Analysis

Preprocessing data: A matrix set of male youth contains 6000 matrices data (10 variables × 600 youth) were computed in this study. For matrices that have very small amounts of data lost (~ 3%) than the overall data recorded, the nearest neighboring method can be used [12,13]. This method examines the distance between each point and its nearest point [14]. The nearest neighboring method is the simplest method, where the endpoint of the gap is used as an estimate of all missing values [15,16].

Cluster Analysis (CA): In this study, CA was employed to investigate the grouping of the participant's profile in a sport development program. In this study, cluster analysis (CA) was employed to identify the grouping of the relative performance pattern. CA is a robust method to identify and categorize components or subjects (observations/population) into clusters with greater homogeneity state within the class and greater heterogeneity state among classes with regard to a predetermined selection criterion [17]. Moreover, Ward's technique utilizing Euclidean distances as a degree of resemblance in CA has shown to be a very effective technique. The finding is clarified by a dendogram, giving the clusters and their closeness [18]. However, the Euclidean distance which represents the quotient between the linkages distances alienated by the highest distance.

III. RESULT

Table 1 shows the descriptive statistics of anthropometric measurement and physical fitness among 600 male youth. It shows minimum and maximum scores, mean and standard deviations.

Table 1: Descriptive statistics of male youth involved in talent identification program

Variables	Min	Max	Mean	SD
Wg (kg)	25.8	68.8	44.9	9.6
Hg (cm)	129.0	180.0	154.5	9.2
SH (cm)	65.0	93.0	78.0	5.2
As (cm)	130.6	187.0	157.5	10.6
SBJ (cm)	110.0	236.0	172.5	25.2
10MR (s)	1.62	2.5	2.05	0.17
20MR (s)	2.85	4.36	3.59	0.30
40MR (s)	5.05	8.35	6.70	0.63
SAR (cm)	15.5	45.0	30.2	5.49
$VO_{2\ max}$ ($ml.kg^{-1}.min^{-1}$)	15.40	48.50	32.57	6.82

Wg: Weight, Hg: Height, Sitting Height, As: Armspan, SBJ: Standing Broad Jump, 10MR:10 Meter Run, 20MR: 20 Meter Run, 40MR: 40 Meter Run, SAR: Sit and Reach, SD: Standard Deviation.

CA result shows that the male youth can be assigned into three groups, as shown in the dendogram (Fig. 1). The subgroup of 600 male youth distributed 264 of them in MPG, 193 youth in MPG and 143 youth in HPG.

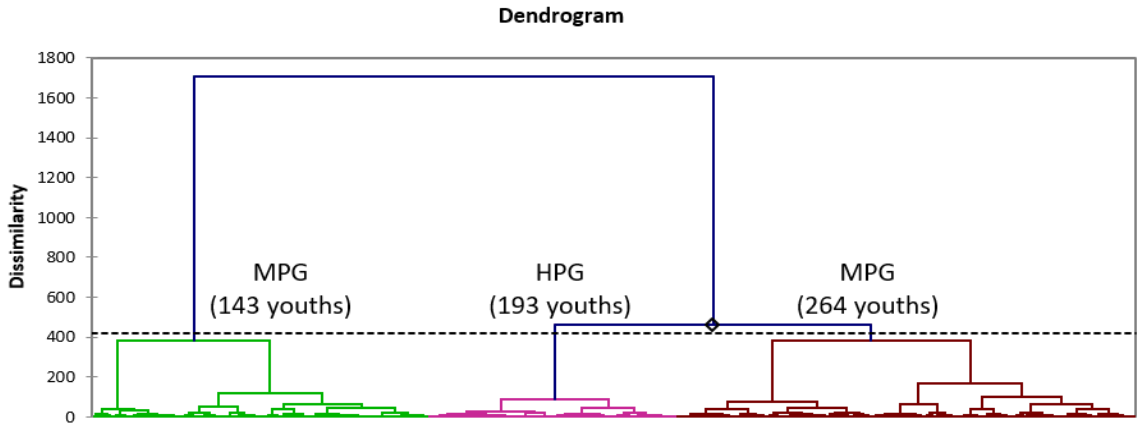

Fig. 1: Dendrogram of different groups of participants assigned by CA.

Referring to profile plot in Fig. 2, MPG has the highest level of anthropometric with less ability in speed test. Otherwise, HPG shows better performance for sit and reach test and predicted $VO_{2\ max}$. Comparing to the MPG profile, this group have the lowest anthropometric with high performance in a speed test. They are however lack ability in flexibility (sit and reach) and muscular endurance test ($VO_{2\ max}$). For HPG, this group has a moderate level of anthropometrics. Meanwhile, fitness performance in HPG showed slightly different with MPG. Among the groups, HPG also has the highest performance in $VO_{2\ max}$.

The result from CA provided detail on performance obtained

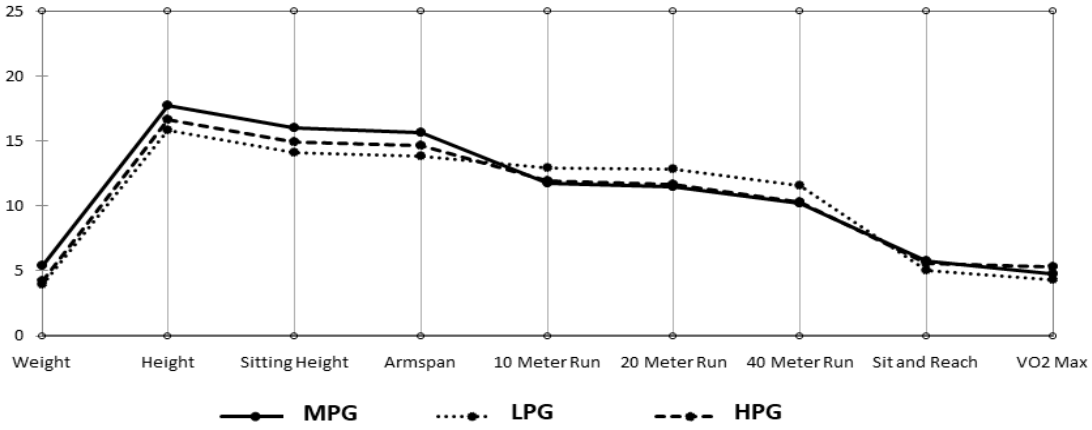

Fig.2: Profile plot of groups assigned by CA

Then, DA was applied on the raw data post grouping of the male youth into three main clusters/groups defined by CA. HPG, MPG and LPG were treated as dependent variables, while anthropometric and physiological parameters were treated as independent variables. DA was carried out via standard, forward stepwise and backward stepwise methods. The accuracy of classification for studied group using standard, forward stepwise and backward stepwise mode DA were 90.00% (9 discriminant variables), 90.33% (6 discriminant variables) and 90.33% (6 variables) respectively as shown in Table 2. Using forward stepwise and backward stepwise mode, the parameters of weight, sitting height, armspan, 20 meter run, 40 meter run predicted $VO_{2\ max}$ were found to be significant variables. Box and whisker plots of these significant parameters are shown in Fig. 3.

among the male youth involved in this study. Such information is very important to identify the talent of participant in particular sports.

In the end, the assigned three groups in this study were most differentiated by only six parameters (weight, sitting height, armspan, 20 meter run, 40 meter run, $VO_{2\ max}$) out of ten parameters. These results were confirmed by a high percentage of correctness in the classification assigned by DA. Current finding concordance to the previous study that emphasized anthropometric component and physical fitness were contributed high variation regarding the performance of sedentary youth [20,21].

The DA result also has revealed physical fitness of speed and endurance as major physical fitness must be prioritized when assessing current performance of youth. This has been

Table 2: Classification matrix by DA

DA Mode	Group assigned by CA	% correct	MPG	HPG	LPG	Total
Standard (9 discriminated variables)	MPG	94.32%	249	3	12	264
	HPG	92.75%	3	179	11	193
	LPG	78.32%	21	10	112	143
	Total	**90.00%**	**273**	**192**	**135**	**600**
Stepwise-Forward (6 discriminated variables)	MPG	93.56%	247	5	12	264
	HPG	94.30%	1	182	10	193
	LPG	79.02%	19	11	113	143
	Total	**90.33%**	**267**	**198**	**135**	**600**
Stepwise-Backward (6 discriminated variables)	MPG	93.56%	247	5	12	264
	HPG	94.30%	1	182	10	193
	LPG	79.02%	19	11	113	143
	Total	**90.33%**	**267**	**198**	**135**	**600**

IV. DISCUSSION

Amongst the various factors contributing to the athlete's performance, the most important is the athlete's physique, but at the same time the athlete's body, technical characteristics, mental state, and external environment will affect the athlete's sports performance to some extent [19].

supported by concrete evident when significant relationships between physical measured with both agility and explosively was noted among players [11,22].

Present finding also revealed male youth are attributable significantly of

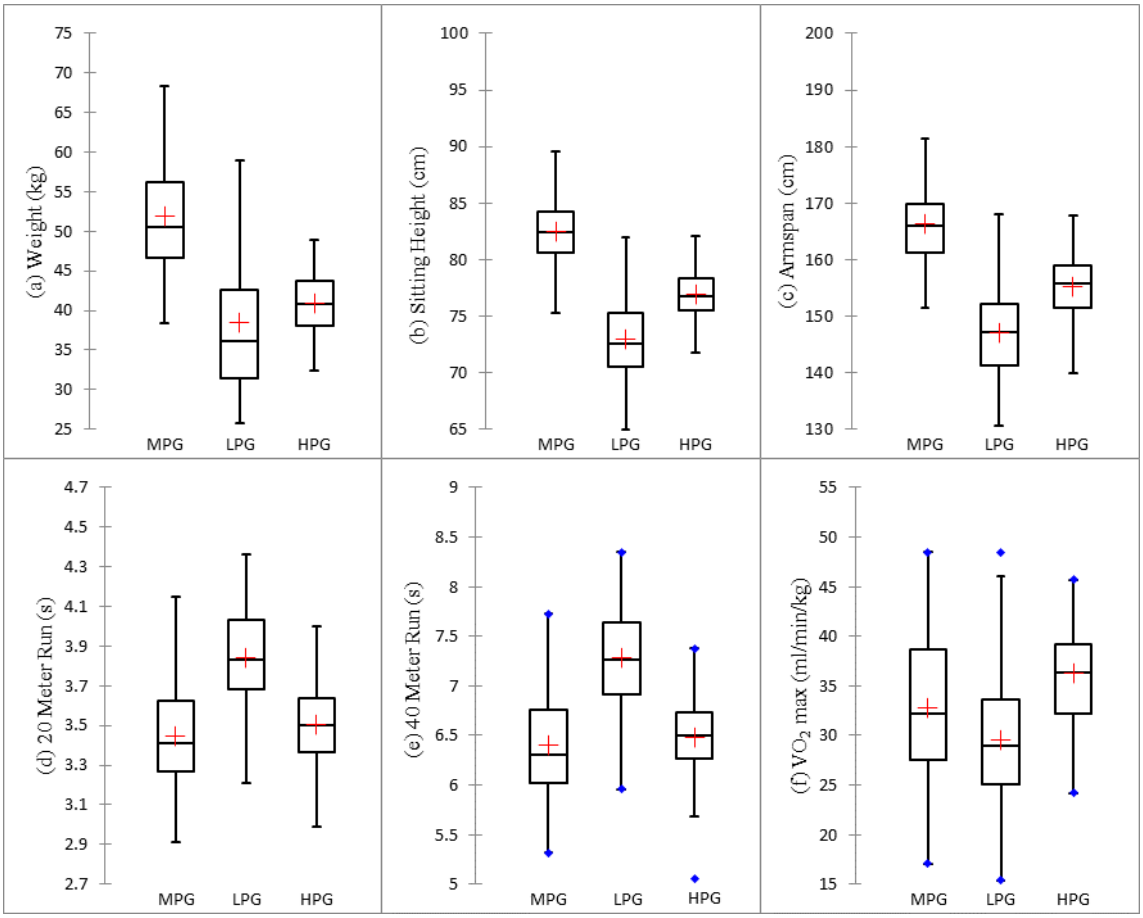

Fig. 1: Box and whisker plot of discriminated parameters of three profile groups.

cardiovascular endurance ($VO_{2\ max}$). This result is similar to the previous study which indicated that cardiovascular endurance provides youth with energy to carry out their sporting activities with vigor [23]. Moreover,

Cardio vascular endurance is a compulsory component for contribution in any type of sports. It is an important fundamental attribute of athletic performance since the heart controls the oxygen flow to all the working muscles [24]. Therefore, cardiovascular endurance has a strong impact on athlete's performance in various kinds of sports [25]. This finding is related to the previous investigation which reported that cardiovascular fitness improves the ability of the heart and lungs to supply oxygen-rich blood to the working muscles which in turn accelerates the actions of the athletes to act in response to the fitness requirement of the sport he or she participates in [26,27]. These significant parameters are being proposed must be prioritized when evaluating most talented youth in sports. This at once can save time, reduce the cost and overcoming limited manpower in talent identification program.

V. CONCLUSION

As the conclusion, multidimensional analysis using multivariate approach successfully demonstrated youth profile that could likely enables the coaches to select the best player. It could also serve an aid tool for evaluating the success of their training program as well as placement into an appropriate training group. Similarly, the results of this study imply that the application of advanced statistical method is vital in identifying essential performance parameters in the talent identification program which can save time, energy and cost. Coaches or other experts in the field could, in the future, find it useful to follow and improve performance, through the training process which could be most appropriate for specific sport.

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