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AN INTELLIGENT TALENT RECOGNITION OF MALE YOUTH FIELD HOCKEY PLAYERS USING PHYSICAL FITNESS, ANTHRO-ENERGY INTAKE AND PSYCHOLOGICAL VARIABLES

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ABSTRACT

The aim of this study was to determine the most significant of physical fitness, anthro-energy intake and psychological variables in identifying the talented male youth field hockey players. 40 male players (age, 14.6 ± 1.2 years) from Terengganu sport academy were evaluated in different tests and measurements. The rotated PCs resulted 4 components were significant in physical fitness, 8 components were significant in anthro-energy intake and 7 components were significant in psychology. HACA classified the players into 3 groups: high, middle and low performance. The precision of classification using standard, forward and backward stepwise mode have yielded 85.00%, 95.00% and 97.50%. Thus, certain components significantly involved in the talent identification of field hockey players. Effective specified trainings should be considered to increase performance among them.

Keywords: field hockey; physical fitness; anthro-energy intake; (TOPS); cluster analysis.

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1. INTRODUCTION

Field hockey is described as a competitive sport in which players attempt to attack the opponents and defend their own goal consecutively within 70 minutes [1]. This game consists of high intensity motions such as intermittent sprinting in varied directions with or without balls, changing directions frequently, cruising and dribbling [2-3]. Some low intensity motions such as walking and jogging are also part of the demands for performing the sport. It was documented that the length of the game is occupied mostly by motions. The nature of the field hockey game requires players to move and perform multiple actions during the game. According to the motion analysis's study, the players spent much time in kinematic such as walking (46.5%), jogging (40.5%), standing (7.4%) and sprinting (1.5%) [4]. However, minimal time was recorded in unexplosive action such as standing. Thus, it can be concluded that field hockey demands high aerobic capacity and excessive energy expenditure in order to perform all the required activities.

It has been stressed moreover, besides the aerobic capacity, the sport also requires sum of anaerobic capacity, muscular strength and power on the players [5]. A considerable amount of aerobic and anaerobic capacity is crucial in providing quick recovery process flowing high-intensity efforts among the players. It also can help them to maintain work rates towards the end of the game [6-7]. Thus, field hockey is classified as an endurance, team sport in which physiological, body composition and nutrition demands are considerable [8-9, 5]. Nowadays, it has been widely accepted by the experts that success in sport performance is achieved if an athlete has the basic anthropometric characteristics suitable for the sport. Thus, it indicates that anthropometric features can make a significant contribution to sport performance. Proper anthropometric characteristics may give advantages to the athletes for example to their level of physical fitness for performance [10].

Studies in nutrition have frequently been carried out in order to educate the athletes with proper nutritional knowledge, healthy dietary habits and food intakes among athletes because a good nutritional basis may result in many beneficial impacts on them. For example, adequate and healthy food intakes may provide energy for physical activity, assist in the body repairing process, enhance sports performance in competitions and produce health and

well-being [11]. According to the previous study, nutrition acts as an important complementary in physical fitness program because proper nutrition may aid in improving sports performance and promoting healthy dietary practices in the long-term [12]. In another perspective, psychology in field hockey and its outcomes has received many attentions as the requirement of psychological assessments in both individual and team sports for a successful delivery of performance. However, according to the previous study, it may place a different level of demands on each sport category as well as the type of the sport itself [13]. For example, a study of a psychological factor has conducted on junior hockey athletes in Malaysia to examine the relationship of both cognitive and somatic anxiety with task orientation and ego orientation has further expatiated that claim [14].

However, it may be suggested that there could be several factors that involve in the enhancement of field hockey sport. Scientific research that investigates the interaction of physical fitness, anthropometric, nutrition and psychology in field hockey performance among male youth players, especially in Malaysia context is less apparent. To date, there are limited data concerning the significant variables of physical fitness, anthro-energy intake and psychology in field hockey solely in Malaysia. Therefore, the goal of the present study was to determine the most significant physical fitness, anthro-energy intake and psychology components in identifying talents among male youth field hockey players.

2. METHODOLOGY

2.1. Participants

40 male aged 14-19 years olds with mean age and standard deviation of (14.6 ± 1.2 years) players from Sekolah Menengah Kebangsaan Padang Midin, Terengganu volunteered to participate in this study. Many researchers in this area consider the age of 14 as the final year of an athlete's developmental years [15-16]. After the age of 14, the players start their specialization years in which they focus solely on one sport activity [17]. In addition, they assign more time for practice in order to refining specific athletic skills. The coaches and managers of the academy gave permission for the study. All the players were not representing the state and free from any injury or illness. Parents signed an informed consent after

receiving an explanation about the study, previously approved university. The players were tested in three different components: physical fitness, anthro-energy intake and psychology. They performed a warm-up that consisted of a 5- to 10-min jog and a series of stretches prior to physical testing sessions. All the testing and measuring sessions were taken place at the academy hall and field with the permission.

2.2. Design

An ex-post facto design was employed to investigate the significance of physical fitness, anthro-energy intake and psychology in field hockey performance among youth male field hockey players. This design allows the researcher to assess the players' current conditions concerning physical fitness, anthropometry, nutrition and psychology. There was neither intervention nor training program implemented in this study. Therefore, controlling and monitoring the players' progression were not compulsory. The players were assessed on one occasion during their off day training, so their training schedule was not affected. All the testing and measurement sessions were completed in the same day.

2.3. Anthropometric Measurements

Anthropometric measurements were height (m), lean body mass (kg), limb girth circumferences (mm) and skinfolds (mm). All the anthropometric measurements on each player were taken using standard techniques [18-19]. For standing height, the players were asked to stand erectly with feet together and shoe off against a standard wall-mounted stadiometer. The readings were recorded to the nearest 0.1 cm at the highest point of head. Weight was measured to the nearest 0.1 kg using a calibrated scale (Karada Scan). In addition, middle upper arm, thigh and calf circumferences were measured using a standard measuring tape. Then, a 7-site skinfold was used to assess subcutaneous fat of each player. The skinfolds were measured on the right side of the body (thigh, calf, triceps, sub-scapular, mid-axillary, suprailiac, abdomen) using a calibrated Harpenden caliper (Baty International Ltd). The measurements were performed according to the protocols of [18]. Each skinfold measurement was taken two times and recorded to the nearest 0.1 mm. The average then was calculated for further statistical analysis.

2.4. Physical Fitness Tests

2.4.1. Vertical Jump

Vertical jump was used to assess lower limb muscular power. This test was performed using a standard method recommended by [20]. Players stood sideways to the wall with a measuring tape. Then, they reached up with the closest arm to the wall to the highest point while keeping the feet flat on the ground. Then, the point reached by the fingertips was recorded as the standing reach height. The players then stood apart from the wall with their outstretched arm above their head throughout the jumping action. The other arm was kept at their side. They marked the wall with sticky paper when they reached the highest point of the jump. Then, the height they reached was marked and recorded in centimeters (cm). The difference between the standing reach height and the jump height was defined as the vertical jump height. Two attempts were given to each player with a 3 min rest in between. Then, only the best result was used for the analysis.

2.4.2. Speed Test

Sprinting speed was recorded using 10-m and 40-m speed tests. The time for both the 10-m and 40-m speed was recorded using a stopwatch. From a stationary position, players started a run at the starting line. Each player performed two trials for both 10-m and 40-m speed tests separated by a recovery period. The fastest time for both the 10-m and 40-m run were recorded [20].

2.4.3. T-Test

T-test was used to determine agility, the speed with directional changes such as forward sprinting, left and right shuffling. The test was conducted using the standard protocol as described by a previous study [21]. Markers were set up 10-5-5 meters from a starting line forming a ‘T’. Each player started the run with both feet behind the starting line. The player ran forward in the 10m line. Then, he/she ran to the left through the 5m line. Player then ran to the right through the 5m line. Finally, the player ran back toward the starting line as quick as possible. The time was recorded using a stopwatch. Each player performed two trials and the fastest time was recorded to present the time of T-test. In addition, the player was recommended not to step on the line too much as it will increase their performance time.

2.4.4. V-Sit and Reach Test

The assessment of the lower back and hamstring flexibility were measured using V sit and reach test [22]. A standard measuring tape was secured to the floor (12 in. long). Then, another measuring tape was placed at a right angle to the 15 in. (38 cm) mark on the first measuring tape. Players were asked to sit, straddling the first measuring tape with both knees in extension (but not locked) and legs spread 12 in. (30.5 cm) apart. Then, the heels of the feet were ensured to touch the tape at the 15 in. mark. They were instructed to reach forward slowly and as far as possible along the first measuring tape while keeping the two hands parallel and overlapped on each other. They held this position approximately (~2 sec). In addition, they were not allowed to flex the knees and lead with one hand during the position. The most distant point on the first measuring tape contacted by the fingertips was recorded in centimeters. Each player performed two attempts and the best reading was recorded for further analysis [23].

2.4.5. Hand Grip Strength

The grip strength of both hands was measured using a standard adjustable grip strength dynamometer (Takei Scientific Instruments Co. Ltd.). Players were instructed to stand in erect position with shoulder in adduction, neutral rotation and elbow in full extension. The players then, held the dynamometer freely without support and apart from the subject's trunk. The position of the hand was remained without the downward direction. Then, the players were asked to put the maximum force on the dynamometer [24]. The players performed the test two times of each side. The values were documented in kilogram. The highest value was recorded for further statistical analysis.

2.4.6. Multistage Shuttle Run Test

The multistage Fitness Test Shuttle Run was used to measure VO_2max in team sport athlete because of its validity and reliability [25-26]. It presents with a series of 20m shuttle runs in which the speed increases progressively. The players ran continuously between the lines in time to the recorded beeps. They kept running until they were not affordable to keep pace with the velocity of the tape. The last level and ended shuttle number that the players voluntarily resigned from the test were recorded as the final results and the predicted VO_2max were calculated.

2.4.7. 1 Minute Push-up

Push-up was used to measure upper muscle strength. The American College of Sports Medicine (ACSM) and Canadian Society for Exercise Physiology (CSEP) [27-28] recommended using a push-up test to measure endurance of upper body musculature. Players lied prone on the floor and hands were in line with the shoulders and back kept straight throughout the test. The players then lowered their body from the starting position until the chest touched the clenched fist of the assistant, who held their fist underneath the body of sternum. At this point, only the hands and feet were in contact with the floor. Then, the players immediately straightened their both arms. The players were not allowed to rest their both knees on the ground if they stopped in the middle of the test or the test would be terminated. The procedure was repeated as many as possible within 1 minute. Repetitions not meeting the stated criteria should not be counted [23]. This test was performed only once to prevent fatigue.

2.4.8. 1 Minute Sit-up

The procedure of sit-up test was performed in accordance to the suggested method specifically for physical fitness test [29]. This test aimed to assess the endurance of the abdominal muscles [23]. Players were instructed to lie on their back with both knees flexed 90° while both feet resting flat on the ground. Their hands were held in cross against chest where they needed to sustain throughout the test. An assistant was required to hold the player's feet on the ground during the test. The players then, sat up from the starting position slowly until the point of where they touched their knees to both elbows. Then, they returned to the starting position. The procedure was repeated as much as possible within 1 minute. The total number of sit-ups that accomplished with the correct procedure only were accepted and counted by the assistant for records. The test was measured only once due to fatigue.

2.5. Psychological Variable

Test of Performance Strategies (TOPS) was used in this study to measure the psychological skills and strategies used by athletes in competition and practice. It consists of 64-items with two scales, competition and practice. Both scales consist of eight subscales. The eight subscales are: self-talk (upholding an optimistic internal dialogue), emotional control

(governing emotions in pressure), automaticity (acting with slight conscious effort, spontaneously), goal setting (setting personal, particular goals), imagery (visualizing sport performance), activation (sustaining an ideal level of arousal), relaxation (practicing to stay calm under pressure) and negative thinking (thoughts of failure). Meanwhile, for the practice subscales, they have similar items except negative thinking which is substituted by attention control (concentrating attention effectively) [13]. Five point Likert scale ranging from 1 (never) to 5 (always) were given as the answer. This questionnaire was translated into Malay language using back-translation method [30]. Cronbach Alpha´s Coefficient was used to validate the reliability and internal consistency of the each item [31]. The Cronbach's alpha values for competition goal setting are 0.728, automaticity is 0.512 and emotional control is 0.457. The alpha values for competition imagery is 0.673, activation is 0.667, self-talk is 0.744, relaxation is 0.545 and negative thinking is 0.619. Meanwhile, the alpha value for practice goal setting is 0.78 and automaticity is 0.67. The alpha value for practice emotional control is 0.72, imagery is 0.72, and activation is 0.66. Additionally, the alpha value for practice self-talk is 0.81, relaxation is 0.78 and attention control is 0.73 [32]. The TOPS forms then were distributed to all the players after the physical testings' and measuring sessions. They were given instruction on the guidelines to answer the questionnaire. There were no right and wrong answer for all the statements. Indeed, they were reminded to respond to all the items.

2.6. Nutrition

Dietary assessment was approached using 3-day dietary record to determine the daily energy intake and macronutrients requirements for carbohydrates, proteins and fats for male and female field hockey players respectively. The players recorded food and drink they consumed for 2 weekdays and 1 weekend day to account for food intake variability during the week. Prior the food record, each player was provided with detailed instructions on how to complete a 3-day food record. They were needed to return the 3-day food record within 1 week. The researcher immediately checked the food record once they returned it. A follow up was set with the players for clarification of specific items and/or obtaining more details necessarily [33]. Then, dietary analysis of the 3-day food record was calculated in order to determine the

daily energy intake and macronutrients percentages for carbohydrates, proteins and fats. The data analysis was executed using the Nutritionist Pro™-Diet Analysis and Nutrition Food Labelling Software.

2.7. Data Analysis

The total of missing data, data error and outlier were determined prior the main statistical analysis. Normality of the data and outlier then were identified using Kolmogorov-Smirnov. Principal Component Analysis: Principal Component Analysis (PCA) was used to identify the most significant components of each variable in male youth field hockey players respectively. It can be expressed in Equation (1):

$$z_{ij} = a_{il}x_{1j} + a_{i2}x_{2j} + \ldots + a_{im}x_{mj} \quad (1)$$

where z is the element score, a is defined as the element stacking, x is the assessed estimation of the variable, i is assumed as the element number, j is the subject number and m is the aggregate number of variables [34]. It explains the most critical parameters because of differences of relative performance found in the components that explain the whole dataset with a minimal loss of original data [35]. Cluster Analysis: In this study, Hierarchical Agglomerative Cluster Analysis (HACA) was used to investigate the grouping in relative to the performance of each evaluated variable. HACA is commonly used to classify [36] variables or cases (observations/samples) into clusters with high homogeneity level within the class and high heterogeneity level between classes with respect to a predetermined selection criterion [37]. The finding is presented in dendrogram, giving the clusters and their closeness [38]. Discriminant Analysis: Discriminant Analysis (DA) acts in controlling the variables that discriminates between two or more joined group/clusters. It builds a discriminant capacity (DF) for every group [39]. The Equation (2) is used to identify the DFs:

$$f(G_i) = k_i + \sum_{j=1}^{n} w_{ij} P_{ij} \quad (2)$$

where i is assigned as the amount of groups (G), ki is defined as the constant inherent to each group, n is the quantity of parameters used to categorize a set of data into a certain group and wj is the mass coefficient assigned by DF analysis (DFA) to a given parameter (pj). In this study, DA was employed to determine whether the groups obtained from HACA vary with respect to the mean of a variable and to utilize that variable to predict group membership [40].

The raw data then was analyzed using standard, forward stepwise and backward stepwise methods. The methods were operated to construct DFs to evaluate the three groups' variations in the physical fitness, anthropometric, psychological and nutritional performance. The groups of the athletes were dependent variables, while all the measured components treated as the independent variables. In forward stepwise mode, the variables were analyzed accordingly starting with the utmost significant variable until no significant changes were obtained. Meanwhile, in backward stepwise mode, the removal of variables occurs gradually starting with the less significant variable until no significant changes were obtained.

3. RESULTS

Prior to data analysis, the Kaiser–Meyer–Olkin (KMO) and Barlett's tests were applied to determine the adequacy of the sampling to quantify and interpret the data [41]. The KMO value presented 0.69 for physical fitness components, 0.86 for anthro-energy intake components and 0.74 for psychological components. It indicates that all the data met the assumptions of the sampling adequacy and adequate to make a realistic interpretation.

Table 1. Descriptive statistics of the evaluated physical, anthro-energy intake and psychological variables for the male players

Variables	N	Min	Max	M	SD
Vertical Jump	40	26.50	59.00	38.48	7.96
10M	40	1.09	5.77	2.13	0.64
40M	40	3.95	7.57	6.28	0.55
Agility	40	9.86	11.82	10.98	0.50
Flex	40	3.00	99.00	41.14	24.07
Push-Up	40	10.00	63.00	23.80	10.58
Sit-Up	40	24.00	62.00	36.68	7.15
Rhg	40	19.10	45.05	32.12	6.58
Lhg	40	17.70	43.75	31.61	6.79
Endurance	40	25.50	53.50	42.29	6.02

Flex: flexibility, Rhg: right hand grip, Lhg: left hand grip

Table 2. Descriptive statistics of the evaluated anthro-energy intake variables for players

Variables	N	Min	Max	M	SD
MUAC	40	19.50	34.50	25.80	3.49
Thigh C	40	31.25	91.50	49.51	8.69
Calf C	40	3.00	42.50	34.62	6.05
Thigh	40	11.35	40.00	20.22	7.86
Calf	40	6.00	32.00	14.65	6.70
Triceps	40	6.00	27.20	11.51	5.04
Sub-Scapular	40	5.10	26.00	9.97	3.62
Mid-Axillary	40	5.00	30.00	9.71	5.36
Suprailiac	40	4.60	28.00	12.34	6.46
Abdominal	40	6.20	34.00	14.71	6.86
Energy Intake	40	1720.47	2202.29	2026.54	137.30

MUAC: middle upper arm circumference, C: circumference

Table 3. Descriptive statistics of the evaluated psychological variables for players

Variables	N	Min	Max	M	SD
C_Goset	40	1.50	4.75	3.33	0.78
C_Auto	40	1.25	7.50	3.14	0.93
C_Emocon	40	1.25	4.00	2.91	0.60
C-Imag	40	1.50	4.75	3.29	0.78
C_Activ	40	1.25	4.25	3.11	0.64
C_Seta	40	1.75	4.50	3.21	0.70
C_Relax	40	2.00	4.50	3.09	0.58
C_Nethin	40	1.25	3.50	2.46	0.52
P_Goset	40	1.75	4.25	3.21	0.57
P_Auto	40	1.25	4.25	2.98	0.68
P_Emocon	40	1.75	4.00	2.99	0.52
P_Imag	40	1.25	4.75	3.20	0.73
P_Activ	40	2.00	4.00	3.09	0.48

P_Seta	40	2.00	4.75	3.39	0.65
P_Relax	40	1.75	4.75	3.35	0.66
P_Attecon	40	1.75	4.00	3.11	0.45

C: competition, P: practice, Goset: goal setting, Auto: automaticity, Emocon: emotional control, Imag: imagery, Activ: activation, Seta: self-talk, Relax: relaxation, Nethin: negative thinking, Attencon: attention control

Table 1 presents the descriptive statistics of the evaluated components of physical fitness, meanwhile Table 2 demonstrates the descriptive statistics of the evaluated components of anthro-energy intake. Table 3 shows the descriptive statistics of the evaluated components of psychology. The number of observations for each component was 40. The scored values were reported in minimum, maximum, median and standard deviation.

Table 4. Factor loading after varimax rotation of physical fitness variable

Variables	**VF1**	**VF2**
Vertical jump	**0.89**	-0.01
10M	-0.30	**0.81**
40M	-0.68	-0.31
Agility	**-0.86**	0.01
Flex	-0.54	-0.25
Push-Up	0.60	0.16
Sit-Up	0.35	0.48
Rhg	0.50	0.69
Lhg	0.32	**0.79**
Endurance	0.50	0.23
Eigenvalue	4.05	1.60
Variability (%)	40.48	15.00
Cumulative (%)	40.48	56.47
Variables	**VF1**	**VF2**
Vertical jump	**0.89**	-0.01
10M	-0.30	**0.81**

Flex: flexibility, Rhg: right hand grip, Lhg: left hand grip

Table 4 demonstrates the factor loading after varimax rotation of physical fitness variable. It can be seen that from the results, vertical jump, agility, 10M speed and left hand grip have strong loadings higher than 0.75. They can be considered as the most significant components in field hockey performance. They should be used as indicators to identify talents among male youth players. The first factor (F1) explains 40.5% of the total variance which shows strong positive factor loading for vertical jump (0.89). However, the F1 shows negative strong factor loading for agility (-0.86). The second factor (F2) explains 15.0% of total variance and has strong positive loadings for 10M speed (0.81) and left hand grip (0.79). Thus, from this study it can be concluded that vertical jump, agility, 10M speed and left hand grip are demanded in field hockey performance. In addition, these parameters are also important when identifying talents among male youth players.

Table 5. Factor loading after varimax rotation of anthro-energy intake variable

Variables	**VF1**	**VF2**
MUAC	0.69	0.38
Thigh C	0.31	0.64
Calf C	0.48	0.52
Thigh	**0.92**	-0.02
Calf	**0.85**	0.00
Triceps	**0.89**	0.06
Subscapular	**0.84**	0.24
Mid-Axillary	**0.94**	0.19
Suprailiac	**0.90**	0.23
Abdominal	**0.90**	0.20
Energy intake	-0.03	**0.83**
Eigenvalue	6.81	1.27
Variability (%)	61.90	11.58
Cumulative	61.90	73.47
Variables	**VF1**	**VF2**

MUAC	0.69	0.38
Thigh C	0.31	0.64

MUAC: middle upper arm circumference, C: circumference

Table 5 displays the factor loading after PCA varimax rotation of anthro-energy intake variable for male youth players. It is highlighted that from the results, the seven sites skinfolds measurements have strong loadings higher than 0.75. The seven sites are namely calf, thigh, triceps, sub-scapular, mid-axillary, suprailiac and abdomen. These measurements are considered as the most essential parameters in enhancing field hockey performance. The measurements are important when identifying the talents among male youth players. The first factor (F1) explains 61.9% of the total variance which shows strong positive factor loading for calf (0.85), thigh (0.92), triceps (0.89), sub-scapular (0.84), mid-axillary (0.94), suprailiac (0.90) and abdomen (0.90). The second factor (F2) explains 11.6% of total variance and has strong positive loadings for energy intake (0.83). It can be concluded that the seven sites skinfolds and energy intake are required in field hockey game.

Table 6. Factor loading after varimax rotation of psychology variable

Variables	**VF1**	**VF2**	**VF3**	**VF4**
C_Goset	**0.86**	-0.05	0.31	0.09
C_Auto	0.39	0.08	0.10	-0.74
C_Emocon	0.48	0.62	0.26	-0.22
C-Imag	0.60	0.20	0.47	0.02
C_Activ	**0.78**	0.06	0.37	-0.06
C_Seta	**0.86**	0.13	-0.06	0.19
C_Relax	-0.02	-0.13	**0.86**	-0.16
C_Nethin	-0.10	0.66	0.15	-0.51
P_Goset	**0.85**	0.06	-0.07	-0.05
P_Auto	0.49	0.30	0.49	-0.21
P_Emocon	0.18	**0.83**	-0.15	0.10
P_Imag	0.68	0.29	0.20	0.04
P_Activ	0.27	-0.03	0.10	**0.79**

P_Seta	0.50	0.09	0.59	0.28
P_Relax	0.37	0.19	0.66	0.31
P_Attecon	0.25	-0.51	0.01	0.54
Eigenvalue	6.08	2.70	1.50	1.10
Variability (%)	38.00	16.81	9.40	6.90
Cumulative %	38.00	54.81	64.17	71.06
Variables	**VF1**	**VF2**	**VF3**	**VF4**
C_Goset	**0.86**	-0.05	0.31	0.09
C_Auto	0.39	0.08	0.10	-0.74

C: competition, P: practice, Goset: goal setting, Auto: automaticity, Emocon: emotional control, Imag: imagery, Activ: activation, Seta: self-talk, Relax: relaxation, Nethin: negative thinking, Attencon: attention control

Table 6 presents the factor loading after PCA varimax rotation of psychological variable for male youth player. The results obtained from this study revealed that competition: goal setting, activation, self-talk, relaxation and practice: goal setting, emotional control and activation have strong loadings higher than 0.75. These psychological parameters are essential to achieve good outcomes in field hockey performance and to identify talents in this game. The first factor (F1) explains 38.0% of total variance and has strong positive loadings for competition goal setting (0.86), competition activation (0.78), competition self-talk (0.86) and practice goal setting (0.85). The second factor (F2) explains 16.8% of total variance and has strong positive loading for practice emotional control (0.83). The third factor (F3) explains 9.4% of total variance and has strong positive loading for competition relaxation (0.86). The fourth factor (F4) explains 6.9% of total variance and has strong positive loading for practice activation (0.79). Thus, it can be concluded that certain psychological parameters have a significant role in enhancing field hockey performance and during recognizing talents among male youth players. As identified by PCA, factor loading plot after varimax rotation of physical fitness, anthro-energy intake and psychological variables were constructed in Fig. 1.

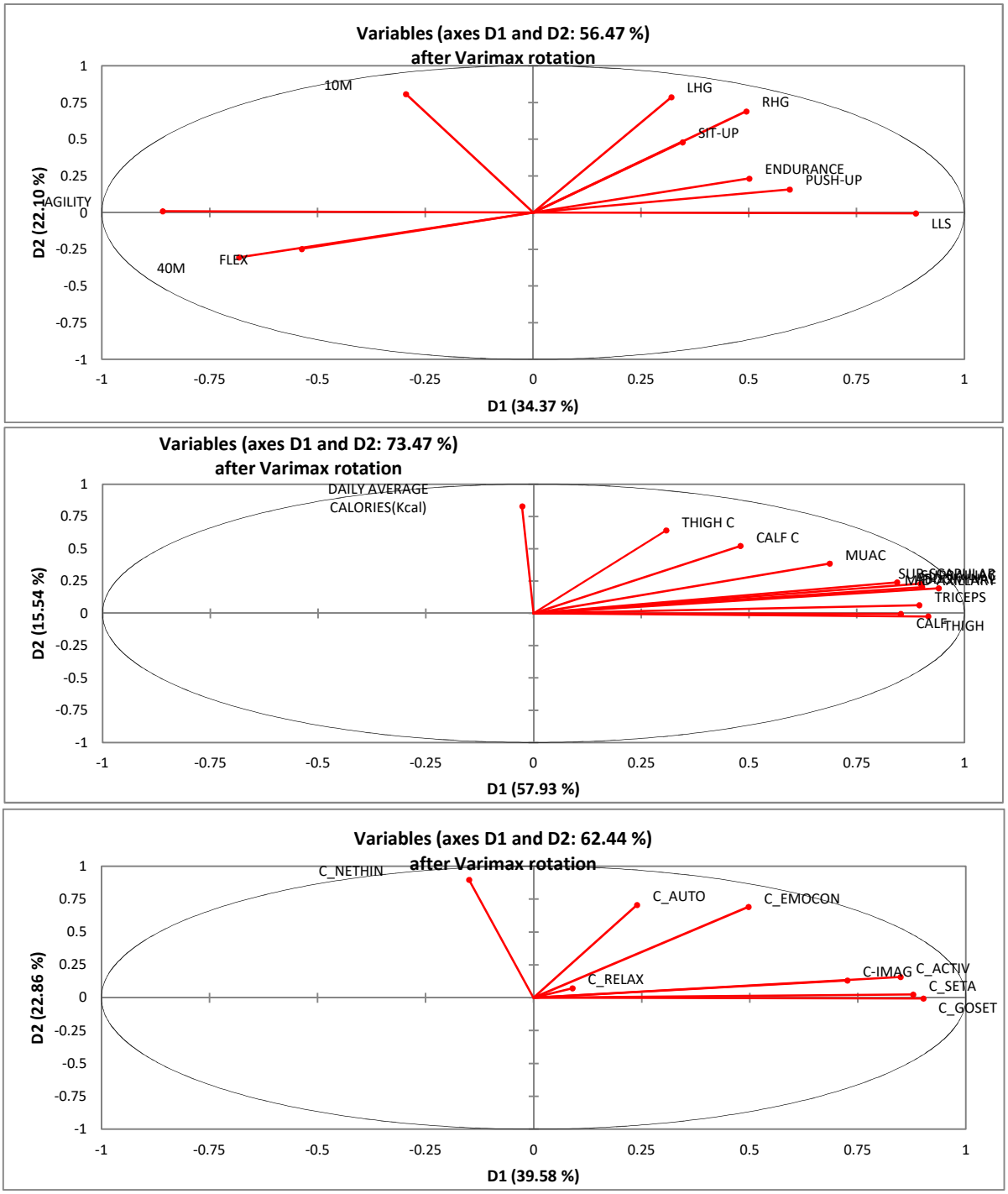

Fig.1. Factor loading plot after varimax rotation of physical fitness, anthro-energy intake and psychological variables

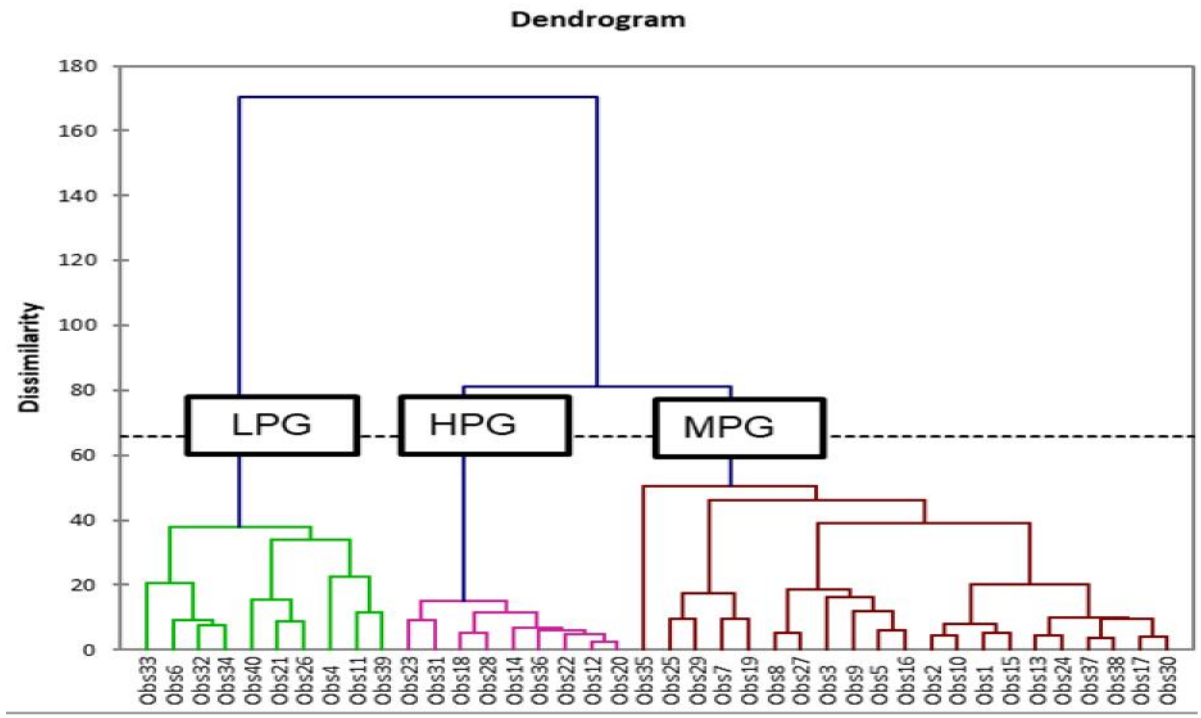

Fig.2. Dendogram of the three classes assigned by the Cluster Analysis

This section examines the players' performance in each variable in order to classify the players based on their similarity level using HACA. HACA was employed on the relative performance data set to investigate variation among the players performance. The analysis resulted in the grouping of players into three clusters/groups (Fig. 2) namely high performance group, middle performance group and low performance group. Players in each identified group have similar characteristics. It is evident that the HACA method is useful in classifying the players into groups based on their performance in these variables.

Table 7. Classification matrix of the Discriminant Analysis on the three classes in relation to their performances on the variables measured

		Classification Matrix Assigned by DA		
Assigned Classes	**%Correct**	**HPG**	**MPG**	**LPG**
Standard DA mode				
HG	88.89%	8	1	0
MG	90.48%	2	19	0
LG	70.00%	2	1	7
Total	85.00%	12	21	7

Forward stepwise mode				
HG	100.00%	9	0	0
MG	100.00%	0	21	0
LG	80.00%	1	1	8
Total	95.00%	10	22	8
Backward stepwise mode				
HG	100.00%	9	0	0
MG	100.00%	0	21	0
LG	90.00%	0	1	9
Total	97.50%	9	22	9

Table 7 demonstrates the discriminant analysis (DA) on clusters classified by HACA. DA was performed on the data of identified clusters in order to examine the variation of performance in relative to measured variables. Clusters/groups were assigned as dependent variables while the relative performance was treating as independent variables. Then, to determine the discriminating variables, the data were subjected to standard, forward and backward stepwise DA. In the forward stepwise mode, variables were included beginning with the more significant until no significant changes were obtained meanwhile in backward stepwise mode, variables were eliminated step-by-step beginning with the least significant until no significant changes were acquired. The results showed the precision of classification using standard mode was 85.0% using fourteen independent variables. The forward stepwise mode yielded 95% correctly using four independent variables with little difference in matching for each group compared with the standard mode. The backward stepwise mode yielded 97.5% using eight independent variables. Thus, DA results suggested that agility, skinfold measurements namely sub-scapular, mid-axillary, suprailiac, abdomen and competition activation as the most significant components to discriminate between each group, labelled high performance group, middle performance group and low performance group. Therefore, DA provided a considerable data reduction. As identified by DA (backward stepwise mode), box and whisker plots of selected discriminating parameters were constructed to assess different patterns associated with different performance groups as shown in Fig. 3.

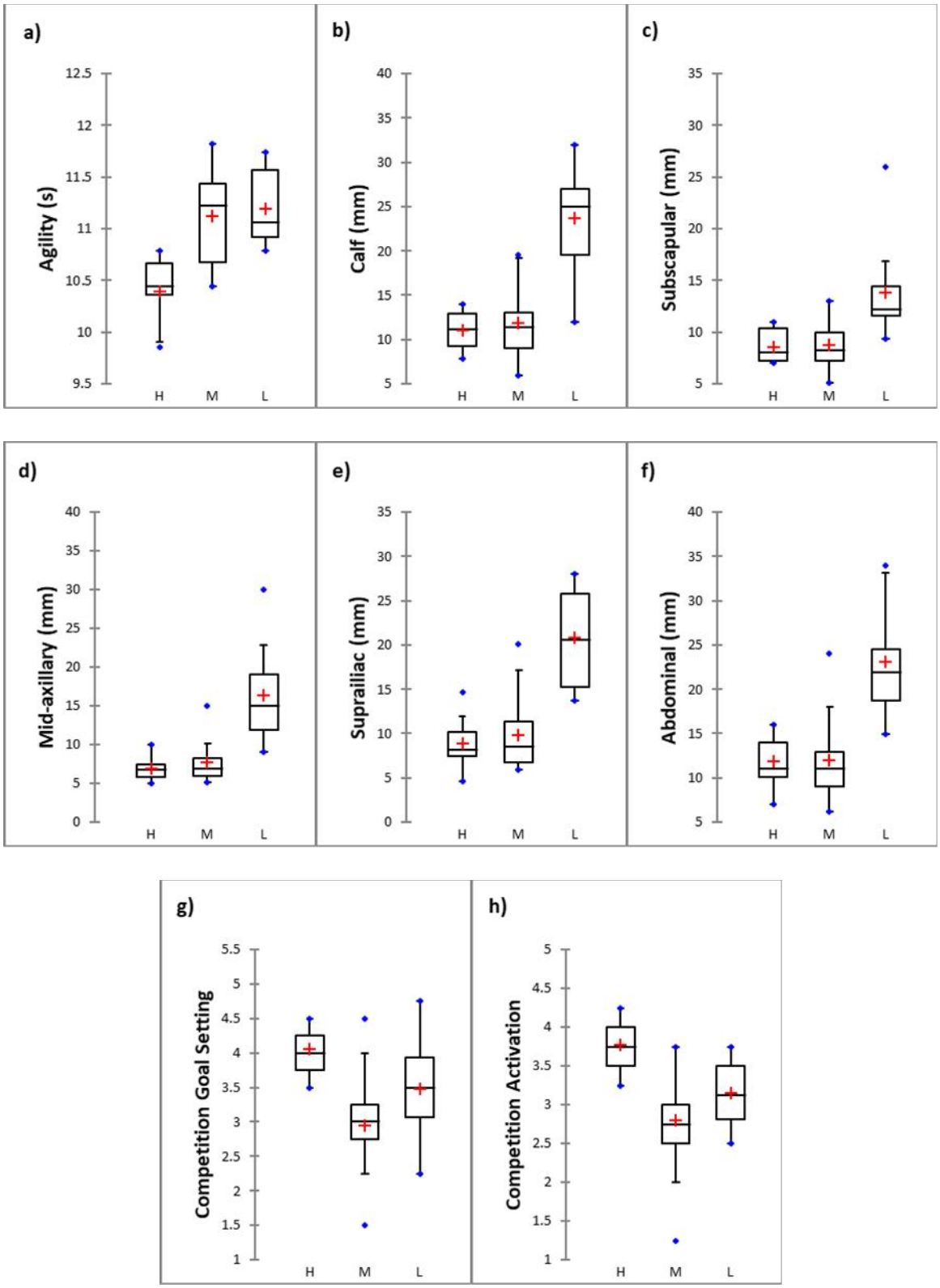

Fig.3. Box and whisker plots of some parameters separated by DA (backward stepwise mode)

4. DISCUSSION

The goal of the study was to determine the most significant parameters of physical fitness, anthro-energy intake and psychological variables in identifying the talents among male youth field hockey players. PCA was used in order to investigate the most essential parameters in each measured variable. The process of identifying the talented players was constructed using HACA and DA. HACA was performed on the data set of significant parameters to determine the clusters/groups of players based on their performance. Finally, the identified clusters/groups were then subjected to standard, forward and backward stepwise mode in DA in order to discover the discriminating variables. The PCs showed that vertical jump, agility, 10M speed and left hand grip were significant in field hockey performance among youth male players. Vertical jump, agility and 10M can be categorized as leg power whereas left hand grip can be referred as upper limb strength.

Result showed that in field hockey, speed played an important role in achieving high standard of performance during the game. This result is in accordance with previous findings suggesting that speed can assist the player to run faster the opposition in order to reach the ball first or to dribble past a player with a fast acceleration. Speed is generally referred to as the ability to react quickly, perform a short burst of movement or run continuously at high pace. It is highly demanded in field hockey as the disciplines in this game may require a player to reach the ball before opponents in order to win possession for their team. Thus, the player with this ability may able to attack and score goals for his/her team. The players from different positions includes goalkeepers must able to apply speed in a number of situations. Goalkeepers must react fast towards the ball in order to successfully defend their goal [42].

This present study also showed that agility is an important component in field hockey performance. In [43] defined agility as a rapid, whole body movement with change of velocity or direction in response to a stimulus. Field hockey is a team-sport with multidirectional changes. It consists of frequent changes of directions and accelerations-decelerations in addition to walking and jogging to cover a big area of the ground. Thus, agility is highly demanded in this game. This finding was similar to that reported by [44] using the same component in field hockey players. They reported that agility exercise like sprint and strength exercises is an essential component in field hockey training along with endurance and skills

training. In addition, a numerous studies acknowledged agility as an important fitness component for effective performance within many team field sports [23, 45-47]. Agility has been suggested to be useful indicator of playing standard and level of expertise in many field teams sports [48-50, 43] includes field hockey, which has a high level of agility.

Vertical jump has been founded as the most significant component in field hockey. The finding of this study is partially supported by previous studies who found that success and high achievement in sport depends upon the development of strength and as well as power. These two components contribute to vertical jump performance [51-54]. This present study demonstrated that left hand grip as the most essential component in this game. It is characterized as the player run along the long distance while carrying a stick. Hence, the hand grip strength is highly demanded as to shoot for goal and pass the ball to players several meter away [55]. Moreover, a number of studies have documented that hand grip strength provided great impact over the game, which is needed during hitting and passing the ball [9, 56-57]. Hand grip strength may result power output during the game. Thus, it permits the forceful and explosive activity like hitting the ball. This strength also may be beneficial in preventing any injury during hitting the ball [58, 9].

Results showed that skinfolds measurements namely calf, thigh, triceps, sub-scapular, mid-axillary, suprailiac and abdominal are the most significant components of anthro-energy intake in field hockey. This confirmed that percent body fat seems to have a crucial role in performance and in the selection of players, as it was previously suggested by other authors [24]. The previous study has reported that anthropometric characteristics such as weight and percent body fat were significant in field hockey performance. In addition, the components have been suggested as the indicators of field hockey performance [24]. This study also highlighted the importance of energy intake in field hockey performance. A possible explanation for the findings of this study is that energy intake is highly required in field hockey as to maintain good physical fitness among the players. As one of team sports, field hockey is characterized as moderate- to long duration exercise consisting repeated bouts of high-intensity activity interspersed with periods of low-to-moderate active recovery or passive rest [59]. Therefore, the requirements of carbohydrate and fat for aerobic system and

phosphagen and anaerobic glycolysis for anaerobic systems are highly demanded to maintain in this long duration of game. It also can be shown that carbohydrate intake as the priority supplement in dietary intake serves as a fuel for both energy systems [60].

In this study, youth male field hockey players had better results in TOPS inventory. They highly scored in competition: goal setting, activation, self-talk, relaxation and practice: goal setting, emotional control and activation, indicating that psychological variable is a predominant requirement for success in field hockey. The findings from the present study showed that the players used more relaxation in game which is in agreement with [61]. In addition, they also scored better in the use of self-talk which is similar to the results obtained from the previous studies [61-62]. It was reported that the use of mental skills could perceive themselves to succeed at practice and in competition [63].

5. CONCLUSION

In conclusion and in agreement with the findings of previous studies, the results of this study showed physical fitness, anthro-energy intake and psychological variables are significant in recognizing the talents in male youth field hockey players. It has been confirmed that the game's performance depends on physical fitness, anthro-energy intake and psychological variables. In addition, the results of this study also demonstrated that there are three different groups of performance in male youth players' namely high, middle and low. They have been discriminated by performance and scores in agility, skinfold measurement of calf, thigh, triceps, sub-scapular, mid-axillary, suprailiac, abdominal and competition goal setting and activation. Furthermore, the results of this present study also suggest which training might be required to compensate for areas where the players are in middle and low performance group for successful performance. Thus, coaches can modify the content and nature of sport training to increase their performance in game. However, the players who do not reach the ideal expectation of high performance players should not be eliminated but can still train them through improved training. From a practical perspective, this present study can develop a new pattern of recognition in field hockey players which may use minimal-time consuming, human power and cost. As a whole, the findings of the present study suggest that youth sport

programs should focus on developing the athletes that fulfil the standard requirements of physical fitness, anthro-energy intake and psychological skills.

6. PRACTICAL IMPLICATIONS

The results of this present study demonstrate physical fitness, anthro-energy intake and psychological variables play significant role in field hockey performance. Therefore, coaches and sport programs developers need to focus on increasing the level of physical fitness, anthro-energy intake and psychological skills among the players. Furthermore, the findings from this present study also can be used as the indicators to distinguish the high potential talents from middle and low groups scientifically using less efforts, money and time. Hence, players who are in low and middle performance groups should be provided with more effective and specified training in order to overcome their weakness and achieve optimal sports performance similar with the players in high performance group

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