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PREDICTION OF SPECIFIC PHYSICAL CHARACTERISTIC AND FITNESS RELATED VARIABLES ON CARDIOVASCULAR ENDURANCE AMONG SOME SELECTED MALE UNIFORM ARM UNITS OF UNIVERSITI SULTAN ZAINAL ABIDIN, MALAYSIA

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Abstract

Cardiovascular endurance is considered the most vital aspect of fitness due to its direct impact on human performance. For any uniform arm units to discharge their duties effectively, they need to meet up to the requirement of highest physical fitness level in respective of their body characteristics. This study aims to predict the relationship of physical characteristics and fitness variables on cardiovascular endurance performance among armed uniform package unit of Universiti Sultan Zainal Abidin. A total of 26 participants mean age and standard deviation of (±20.45 and 2.0) randomly selected from the three co-arm units of the university took part in this study. Standard physical characteristics measurement and fitness tests were conducted, and multiple linear regression was applied to predict their cardiovascular endurance performance as the dependent variables on their body characteristics and performance of physical fitness as the independent variable. A significant regression equation was obtained $F (9, 16) = 4.97$, $p < 0.05$, $R^2 = 0.74$ indicating that the model accounted for approximately 74% variability of the whole data set. Sensitivity prediction analysis of the contributions of each variable revealed that height, speed, agility, upper body strength and core body strength are factors to cardiovascular endurance $p < 0.05$ while, weight, waist circumference, neck circumference and flexibility were not predictors to cardiovascular endurance $p > 0.05$. To improve the cardiovascular performance of uniform arm units, certain physical and fitness variables have to be considered for an effective discharge of their duties.

Keywords: Physical fitness related performances, cardiovascular endurance, armed uniform package units, physical characteristics, Co-curriculum

Introduction

The Ministry of Health (2016) clarified that physical activity involves all body movements that use energy in everyday life such as work, recreation, exercise and sports. In distinction with physical activity, which is related to the movements accomplished by an individual, physical fitness is defined as a set of qualities that a person possesses or achieve (Abdullah et al., 2016a). Physical fitness is related to the ability to perform physical activity. Being physically fit has been defined as the capacity to carry out daily tasks with preparedness and vigour, without extreme exhaustion and with sufficient energy to enjoy leisure-time pursuits and to meet unforeseen emergencies (Caspersen, Powell, & Christenson, 1985). The most frequently cited components are separated into two groups which are one related to health and the other related to motor skills that refer more to athletic ability (Pate, 1983; Musa, Abdullah, Maliki, Kosni, & Haque, 2016). The health-related components of physical fitness are categorised as cardiorespiratory endurance, muscular endurance, muscular strength, body composition, and flexibility. Just as the sum of physical activity ranges from low to high, so does the level of physical fitness. Furthermore, the levels of the five health-related components usually differ in performance, for example, a person may be flexible but not strong. The five health-related modules of physical fitness are essential to community health than are the components related to athletic ability. The skill-related components of physical fitness are categorised as agility, balance, coordination, speed, and reaction time. These entire skill-related have always been used by previous researchers in their study. Agility is a skill-related element of physical fitness that relays to the ability rapidly to alter the location of the entire body in space with quickness and accurateness. Balance refers to the maintenance of equilibrium while stationary or moving. Coordination refers to the skill to use the senses, such as sight and hearing, together with body parts in performing motor tasks smoothly and accurately. Speed relates to the capacity to perform a movement within a short period of time. Reaction time refers to the time elapsed between stimulation and the beginning of the response to it. The possession of all the aforementioned components helps an individual to develop a sound mind in a healthy body (Erikssen, 2001).

Co-curriculum for university students is a major component, and it is mostly attached to the graduation requirements enshrined in students' rules and regulations guidebook. From the co-curriculum activity, students are giving a chance to integrate well with different racial backgrounds (Pettigrew, 1998). Till date, the co-curriculum activities have been proven to improve the students' academic performance. Guest and Schneider (2008) noted that researchers had found a positive association between the co-curricular activities and the academic performance of the students. The co-curriculum activities make the students tough enough for the future time and develop a sense of competitive spirit, leadership, cooperation, diligence as well as serve as the backdrop for the development of their creative talents (Villalobos et al., 2016). Co-curriculum in the Universiti Sultan Zainal Abidin (UniSZA)'s perspective is a major component that students must have as the requirement for graduation. In UniSZA, there are a number of co-curriculum units to be selected by the undergraduate students which are culture core, community and volunteerism core, entrepreneurship and self-construction core, sports core, unarmed uniform unit core and armed uniform unit core (Student's Holistic Development Centre, 2016). It is only through active participation in the co-curriculum activities that the students are considered to have fulfilled the graduation and commissioning requirements.

Cardiorespiratory endurance replicates the functioning of the pulmonary and cardiovascular systems to deliver oxygen and the capacity of tissues to extract oxygen from the blood for a better delivery of human performance. The Armed Uniform, Package Unit in UniSZA, plays a significant role in emergencies and other related activities within the university. The requirement for cardiovascular endurance among arm forces is, therefore, needful and essential. Anderson, Plecas, and Segger (2000) indicated that armed force in the world is faced with the schedules of shift-work and routine patrol to the physical responses and actions required in critical incidents. Furthermore, Trottier and Brown (1994) added that during recruiting process of police officers, failure to screen out candidates who cannot perform such responsibilities could result in long term disability, injury, poor productivity and rapid employee turnover, each having both economic and human cost. It is essential, therefore, to determine the association between the visible physical characteristics and some fitness components with the cardiovascular endurance of the uniform arm units which could help in the selection process as well as training structuring. However, to date, there seems to be limited or no literature in Malaysian perspective to examine these factors. Based on this background, therefore, the present study aims to predict the relationship of physical characteristics and fitness variables on cardiovascular endurance performance of male uniform, armed package units of Universiti Sultan Zainal Abidin specifically SUKSIS, PALAPES, and WATANIAH.

Materials and Method

Participants

The population of this study comprises of three armed uniform package units of Universiti Sultan Zainal's students who are active members from SUKSIS, PALAPES, and WATANIAH. A total of 26 (nine from each Suksis and Palapes and eight from Wataniah) male active trainees were randomly recruited to participate in this study. The inclusion criteria involve an active male member in either of the units. The current study only focused on male participants only. To ensure that the sample size is adequate to make a reasonable interpretation, the sample size was calculated using G power and were found to be sufficient as suggested by (Hulley & Stephen, 2007). The mean ages of the participants were ± 20.45 years old and standard deviation of 2.0. The trainers and the management of each armed uniform package unit were informed about the purpose of the research, and all the participants signed a consent form.

Trainees Fitness Examination

- *Physical Characteristics Test*

Standard Physical characteristics testing was conducted which constitutes of weight, height, waist circumference, and neck circumference. Standing height was measured with a wall-mounted wooden stadiometer (PRESTIGE-Haryana India) to the nearest 0.5 cm. Body weight was evaluated with a standardised electronic digital scale to the nearest 0.01 kg. Waist circumference was measured by using the measurement tape to the nearest 0.1 cm. Neck circumference was measured by using the measurement tape to the nearest 0.1 cm. All the measurements were executed in accordance with ISAK protocol (Marfell-Jones, Stewart, & de Ridder, 2012). The measurements were obtained twice, and the mean value was generated as the final score.

- *Muscular Strength*

The test was executed according to the suggested method by prior researchers for physical fitness tests (Noguchi, Demura, & Takahashi, 2013). Subjects laid on their back with their knees bowed at around right edges while both feet were situated level on the floor. Participants held their hands against their chest where they should stay during the test. In the test procedure, an assistance held the subjects' feet on the ground. Subjects sat up until they touched their knees to both elbows; then, they came back to the floor. The action was repeated as many times as possible in the period for 60 s. The aide totalled and recorded the quantity of right finished sit-ups. The test was measured just once attributable to the impact of exhaustion.

- *Upper Muscle Strength*

The participants assumed a prone position on the floor with the hands directly underneath the shoulders, legs extended and together, and toes tucked under so they are in contact with the floor, (push up position). The participants then push with the arms until they are fully extended and then lower their body until their chest down towards the floor. At this point, the line from the head to the toes should be straight. All of these actions were executed only by the arms and shoulders. The score was determined by the number of push-ups while maintaining correct form. The test was also administered ones to avoid fatigue as suggested by Musa et al., (2016).

- *Speed test*

As proposed by Russell and Tooley (2011), linear sprint speed was evaluated over 20 m. Starter and ending pointers were positioned for 20 m. Participants started the test from a standing start at a distance of 0.2 m behind the initial timing gate before starting the test taking after a countdown from the lead researcher. The participant was told to keep running at maximal velocity throughout the full length of time of the sprint test. To avoid a reduction in sprint speed on approach to the 15 m gate, a member of the coaching staff who stood on a marker 2 m beyond the final timing gate provided verbal encouragement throughout each effort. The participant was told to keep up the maximal pace until passing the marker on which the mentor stood. The execution times were recorded respectively. Participants performed two reiterations with the best (fastest) times utilised for statistical analysis. At least 4 min of restoration were given between repetitions. To ensure the standardised of data, 20 Meter Speed variable was transformed to Velocity. The data for velocity was generated with the formula $v = m/s^{(-1)}$.

- *Flexibility*

As proposed by the Mayorga-Vega, Merino-Marban, & Viciana, (2014) throughout a meta-analysis, the flexibility of the lower back and hamstrings was measured by the sit and reach test. The participant performed two trials, and the mean value was generated as the final score for further analysis.

- *Agility Test*

Agility was determined by the T-test agility test. The protocol was conducted as previously described (Hoffman, 2006). Pointers are set up 5 and 15 meters from a line marked on the ground. The participant runs from the 15 m marker near the line (run in distance to form up speed) and via the 5 m markers, turns on the line and runs back over the 5 m markers. The time is documented using a stopwatch, from when the participants first run through the 5 m marker and stopped when they return through these markers. Each subject performed two maximal attempts, and the fastest time was recorded for further analysis. The participants should be encouraged not to overstep the line by too much as this will increase their time.

- *Endurance Ability Test*

The multistage 20-m shuttle run test developed by Leger and Gadoury (1989) was employed to acquire the participant's maximal oxygen uptake. Every participant kept running for whatever length of time he/she could afford until could no more keep pace with the velocity of the tape. Test results for every participant were expressed as an anticipated VO_{2max} accomplished by checking the last level and ended shuttle number at the time when the participant voluntarily resigned from the test. In spite of the fact that motivation and drills of the participants might influence their scores, it is still a legitimate test in assessing maximum oxygen uptake and can be performed in considerably a large number of participants minimising expenses and time.

Data Analysis

The multiple linear regression analysis was implemented in the current study to predict the equation for the physical characteristics and fitness variables as well as the contribution of each variable to the prediction of the uniform arm units' cardiovascular endurance performance. In this study, the dependent variable was the uniform arm units' cardiovascular endurance performance while the independent variables were the nine physical characteristics and fitness variables (Weight (kg), Height (cm), Waist circumference (cm), Neck circumference (cm), 20 m speed (s), Agility t-test (s), Sit & reach (cm), Push-up (1 M) and, Sit up 1 M). All the statistical analysis was performed at $p \leq 0.05$ alpha level of confidence XLSTAT 2014 add-in software USA.

Results

Table1: Descriptive Statistic of the Variables

Variable	Observations	Minimum	Maximum	Mean	Std. Deviation
VO_{2max} (ml/kg/min)	26	24.20	47.10	34.31	6.34
Weight (kg)	26	38.50	98.00	59.31	12.68
Height (cm)	26	152.00	176.50	162.80	6.84
Waist circumference (cm)	26	71.75	112.00	93.16	7.91
Neck circumference (cm)	26	29.10	41.00	34.49	3.10
20 m speed (s)	26	3.33	5.10	3.91	0.43
Agility t test (s)	26	8.45	14.00	10.59	1.36
Sit & reach (cm)	26	8.25	46.75	34.99	9.26
Push up (1 M)	26	22.00	52.00	35.31	7.82
Sit up (1 M)	26	13.00	48.00	32.81	8.55

Table 1 projects the descriptive statistic for the participant in this pilot study. From the table, it can be seen that the number of participants observed (n = 26), the minimum, the maximum, the mean as well as the standard deviation of the variables are projected.

Table 2: Analysis of Variance

Source	Df	Sum Of Squares	Mean Squares	F	Sig
Model	9	739.829	82.203	4.972	0.003*
Error	16	264.538	16.534		
Corrected Total	25	1004.367			

*Significant at $p < 0.05$.

Table 2 demonstrates that the analysis of variance for the model to predict the measured variables. It can be realised from the table that a significant regression equation was obtained revealing that the model has the ability to make a reasonable justification on the measured variables.

Table 3: Standard Multiple Regression Analysis of VO_{2max} (ml/kg/min) Predicting the Physical Fitness Related Performance. The Goodness of Fit Statistics

Observations	26.000
Sum of weights	26.000
DF	16.000
R^2	0.737
Adjusted R^2	0.588
MSE	16.534
RMSE	4.066

Note: MSE = Mean squared error, RMSE = Root mean squared error.

Table 3 shows the goodness of fit statistics for 26 samples in this study. It shows the model has an $R^2 = 0.737$ which explained that the model has approximately accounted for the total of 74% variability of the whole data set. This result has indicated that the model is good enough to explain the measured variables and that enable us to further with the analysis having obtained a noteworthy model as suggested by the previous researchers (Abdullah, Musa, Maliki, Kosni, & Suppiah, 2016b).

Table 4: Inferential statistics of the contribution of each independent variable to the prediction of the dependent variable

Variables	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1. Weight	0	0.001	0.001	0.001	0.029	0.002	0.326	0.594	0.537	0.803
2. Height		0	0.414	< 0.001	< 0.001	< 0.001	0.528	0.117	0.100	0.009*
3. W. Circumference			0	0.016	0.700	0.513	0.275	0.496	0.791	0.344
4. N. Circumference				0	0.001	< 0.001	0.498	0.130	0.130	0.089
5. 20 m Speed					0	< 0.001	0.818	0.012	0.003	0.001*
6. Agility T Test						0	0.603	0.022	0.016	0.005*
7. Sit & Reach							0	0.420	0.502	0.406
8. Push Up								0	0.000	0.001*
9. Sit Up									0	0.001*
10. VO_{2max}										0

*Significant at $p < 0.05$

Table 4 shows Sensitivity prediction analysis of the contribution of each independent variable to the prediction of the dependent variable (VO_{2max}). It can be witnessed from the table that height, speed, agility, upper body strength and core body strength are factors to cardiovascular endurance $p < 0.05$ while, weight, waist circumference, neck circumference and flexibility were not predictors to cardiovascular endurance $p > 0.05$.

Table 5: Correlation Matrix of the measured variables

Variables	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1. Weight (Kg)	1.00									
2. Height (Cm)	0.66	1.00								
3. W. Circumference (Cm)	0.63	0.17	1.00							
4. N. Circumference (Cm)	0.89	0.77	0.47	1.00						
5. 20 M Speed (S)	-0.43	-0.72	-0.08	-0.65	1.00					
6. Agility T Test (S)	-0.58	-0.74	-0.13	-0.76	0.80	1.00				
7. Sit & Reach (Cm)	0.20	0.13	0.22	0.14	-0.05	0.11	1.00			
8. Push Up (1 M)	0.11	0.31	-0.14	0.30	-0.49	-0.45	0.17	1.00		
9. Sit Up (1 M)	0.13	0.33	0.05	0.31	-0.56	-0.47	0.14	0.65	1.00	
10. VO_{2max} (Ml/Kg/Min)	0.05	0.50	-0.19	0.34	-0.72	-0.54	0.17	0.61	0.60	1.00
Multicollinearity statistics:										
Tolerance	0.12	0.27	0.42	0.10	0.24	0.20	0.73	0.47	0.45	
VIF	8.59	3.66	2.37	9.54	4.08	5.05	1.38	2.13	2.24	

Abbreviations: W. Circumference (Cm) = waist circumference, N. Circumference (Cm) = neck circumference

Table 4 shows the correlation matrix between the dependent variables (VO_{2max}) with the independent variables (IV) and also the multicollinearity statistics. From the table, it can be observed that there are positive and negative correlations between the DV and the IVs. The height, push-up, and sit-up are positively correlated with VO_{2max} (r = 0.50, r = 0.47 and r = 0.60respectively). However, an inverse association was observed between the $VO_{2max,}$ agility and 20-meter speed (r = -0.54, r = -0.72) specifying that the greater the performance of these variables the more the endurance declines. Nonetheless, a very weak or no relationship was observed between the $VO_{2max,}$ weight, waist circumference, neck circumference as well as sit and reach emphasising the inability of the variables to explain the cardiovascular endurance.

Discussion

The purpose of present study was to predict the relationship of physical characteristics and fitness variables on cardiovascular endurance performance among male armed uniform package unit of UniSZA. The findings from the study revealed height, speed, agility, upper body strength and core body strength are factors to cardiovascular endurance while, weight, waist circumference, neck circumference and flexibility were not predictors to cardiovascular endurance.

Malina, Bouchard, and Bar-Or (2004) reported that the capability to execute continuous activity under mainly aerobic conditions depends on the ability of the cardiovascular and pulmonary systems to supply oxygenated blood to tissues and on the capacity of tissues (largely skeletal muscle) to extract oxygen and oxidise substrate. The researchers explained further that the dimensions of the heart and lungs expand with age in a manner consistent with the increase in body mass and stature. The increase in the size of the heart is related to increase in stroke volume (blood pumped per beat) and cardiac output (product of stroke volume and heart rate, litres per minute). Likewise, increase in lung size (proportionate to growth in height) results in greater lung volume and ventilation despite an age-associated decline in breathing frequency. This supported our findings that the height of an individual could determine the cardiovascular endurance of the person since the taller an individual is, the greater the size of his lungs which could result in higher oxygen carrying capacity.

Speed, agility, upper body strength and core body strength are components of health-related fitness historically assessed in school-based fitness assessment programs for explaining cardiorespiratory endurance (IOM, 2012). These components of health-related fitness are considered necessary since they can be linked to the risk of cardiometabolic disease and musculoskeletal disability, chronic hypokinetic-related diseases (Olufemi & Musa 2016). Nevertheless, our finding is in concord with the findings of the previous researchers who reported favourable associations between aerobic endurance speed, agility, upper body strength and core body strength (Jaakkola, Kalaja, Arijutila, Virtanen, & Watt, 2009). Another study also suggested that speed, muscle power, agility, and core strength are aspects of performance-related fitness that change during body development in predictable ways associated with the development of tissues and systems and subsequently positively related to endurance for a prolong physical activities (Janssen & LeBlanc, 2010).

There is evidence revealing an inverse relationship between cardiovascular endurance and some physical variables such as weight, waist/hip ratio neck circumference indicating that these anthropometric variables limit the longer duration of physical activities (Janssen et al., 2005). However, our findings also revealed that flexibility could not determine cardiovascular endurance. Although flexibility has long been encompassed in national youth fitness tests, it has proven difficult to establish a link between flexibility and cardiovascular health (IOM, 2012). In distinction to other fitness indicators that are universal or systemic in nature, flexibility is significantly peculiar to each joint of the body. Though proper stretching may increase flexibility, establishing a link to enhanced functional capacity and fitness is difficult. A few studies suggest that improvements in flexibility as measured by the sit-and-reach test may be related to a reduced amount of low-back pain (Jones, Stratton, Reilly, & Unnithan, 2007; Ahlqwist, Hagman, Kjellby-Wendt, & Beckung, 2008), but the evidence is weak. Subsequently, the Institute of Medicine (IOM) Committee on Fitness Measures and Health Outcomes in its recent report elected to decline to recommend a flexibility test for a national youth fitness test battery pending further research to confirm the relationship between flexibility and cardiovascular health and to improve national normative data (IOM, 2012).

Conclusion

The finding from the present study has shown that height, speed, agility, upper body strength and core body strength are factors to cardiovascular endurance while, weight, waist circumference, neck circumference and flexibility were not predictors to the cardiovascular endurance of the uniform arm package units. The need for any arm uniform package units to remain fit is non-negotiable. It is recognisable that the demand for fitness among the forces across the globe will be consistently relevant due to the responsibilities these arm units are saddled with. The possession of cardiovascular endurance will contribute to the development of healthy body and mind and hence enable the forces to discharge their duties effectively. Therefore, the cardiorespiratory endurance replicates the functioning of the pulmonary and cardiovascular systems to deliver oxygen and the ability of tissues to extract oxygen from the blood for a better delivery of human performance. The trainers might find the current finding useful in re-structuring their training programme to pay attention to the variables that are related to the cardiovascular endurance so as to improve trainees' level of physical fitness as well as for selection criteria.

Limitation and Future Direction

The current study serves as a pioneer for examining some related physical fitness and body characteristics with their association to the performance of cardiovascular endurance among core-curriculum units of Malaysia. However, the current study focused on the male subjects only. Further research is required to consider female subjects as well as investigate the association of other anthropometrics variables with cardiovascular endurance by reference to both males and females gender.

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