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Construction of Cardiovascular Endurance Test Norms for Physical Fitness Teacher Candidates in Malaysia

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Abstract

The aim of this study was to construct the norms of cardiovascular endurance test. The subjects involved in this study were 14531 subjects (male = 4323; female = 10208) consisting of candidates who participated in the Prospective Teachers Eligibility Test (PTET) during 2016 and 2017. The Multistage 20-meter Shuttle Run was used to test the cardiovascular endurance of each subject. The findings used mean and standard deviation to establish norms for VO₂max. VO₂max norms for each age and gender had been established and were classified into five stages; namely superior, excellent, good, average and poor. The norms formed were suitable as a norms-referenced for cardiovascular endurance component of the Physical Fitness Test in the selection of teacher candidates in Malaysia.

Key words: Prospective Teachers Eligibility Test, Multistage 20-meter shuttle run, maximal oxygen uptake, Norms

Introduction

In line with the National Education Philosophy (NEP), which aims to produce a balanced and harmonious human intellectually, spiritually, emotionally and physically, the Institute of Teacher Education (ITE) had implemented Physical Fitness Tests (PFT) for prospective Bachelor of Teacher Education. This test was intended to identify the fitness level of prospective teachers of their physical fitness. Physical fitness will be the criteria to produce graduate teachers who are always healthy, cheerful, disciplined, honourable, and competent and visionary in line with the level of skills and knowledge (Institut Pendidikan Guru Malaysia, 2017a). One of the components of physical fitness is cardiovascular endurance.

Cardiovascular endurance is one of physical fitness health related components that can be defined as the ability of the circulatory system, respiratory and muscular systems to supply oxygen during regular physical activity (Lee, Artero, Sui, & Blair, 2010) which were associated with maximal oxygen uptake (VO₂max). VO₂max refers to the intensity of an aerobic process and shows the maximum

capacity to transport and use oxygen during exercise of increasing intensity. $VO_2\text{max}$ is the highest rate of oxygen consumption during exercise achieved the maximum (Rancovic, Mutavdzic, Taskic, Preljevic, Kocic, & Rancovic, 2010). According to (American College of Sports Medicine, 1999), reported that $VO_2\text{max}$ is the best indicator to determine cardiovascular fitness. As a measure of aerobic capacity, $VO_2\text{max}$ is determined as an international standard physical activity (Fleg, Piila, & Balady, 2000).

Therefore, this study aimed to construct cardiovascular endurance norms for candidates who took the Physical Fitness Test in the Prospective Teachers Eligibility Test for Teacher Education Institute. This study was carried out to produce norms for the population aged between 17 and 36 years who took the Physical Fitness Test (PFT) in the Prospective Teachers Eligibility Test (PTET). The norms were supposed to have validity, reliability and objectivity. Valid and reliable norms to indicate the level of achievement of a factor that had been shown by the subjects that were tested. The norms constructed using related subjects would be more valid and reliable than the norm constructed using different research subjects with demographic characteristics such as lifestyle, socio-cultural and socio-economic status.

The data obtained can be used to build fitness test norms for cardiovascular endurance component. Moreover, it had helped the Institute of Teacher Education (ITE) in determining eligibility limit that can be certified for selecting prospective teachers. The norms build was also expected to serve as a guide in testing, measurement and evaluation of physical fitness of students IPG with the creation of student's profiles based on the Prospective Teachers Eligibility Test (PTET) in Cluster 6: Improvement students that target retention quality of students by teachers' personality, mental health and the fitness of the students during the period of study at the institute (Institut Pendidikan Guru Malaysia, 2017a).

Methodology

This study involved a total of 14,531 subjects aged between 17 to 36 years. The subjects were divided into three age groups of 17 to 20 years, 21 to 28 years and 29 to 36 years. The subjects were prospective teachers who undergo competency tests for admission to the Institute of Teacher Education in Malaysia for 2016 and 2017. The letter of consent and permission from the parents or guardians, and also the declaration of health status were received before the test was conducted.

All subjects went through Multistage 20-meter Shuttle Run according to the test procedures by Leger and Lambert (1982) to assess the level of cardiovascular endurance. Hamlin, et al. (2014), reported that the validity is associated with the test for children and adolescents with acceptable validity coefficient was $r = 0.73$. While the reliability was $r = 0.99$ (Pilianidis, et al. 2008). Testers at the test centres were appointed amongst physical education lecturers. All testers were given briefings and training for testing and measurement procedures. Those involved also provided with the Physical Fitness Testing Guidelines (Institut Pendidikan Guru Malaysia, 2017b) from the Institute of Teachers Education Malaysia (ITEM). This guideline contained instructions and procedures for the implementation of this test to ensure consistency in administering the test. All tests were conducted in the same week that had been set by ITEM.

$VO_2\text{max}$ was estimated using the method by Leger, Mercier, Gadoury and Lambert (1988), expressed in per unit of body mass ($\text{ml.kg}^{-1}.\text{min}^{-1}$). The establishment of norms for $VO_2\text{max}$ were created using standard deviation method by Miller (2014)(Table1). Data analysis was carried out using descriptive and inferential clues mean, standard deviation, t -test and ANOVA. To ensure that the data set is normally distributed, normality test was assessed using the distribution skewness and kurtosis, and normality revisions graphically based on probability plot (Normal Q-Q plot) (Pallant, 2011). All

analyses are managed using the software Statistical Package for the Social Sciences (SPSS) version 22.0.

Table 1: Norms Assigned by Standard Deviation Method

Standard Deviation Range
min + 1.5(sd) above
min + 0.5(sd) to min + 1.5(sd)
min – 0.5(sd) to min + 0.5(sd)
min – 1.5(sd) to min – 0.5(sd)
min – 1.5(sd) below

Multistage 20 Meter Shuttle Run Procedures

The subjects will stand behind the starting line and start running after a first 'bleep' sound. Subjects must cross the line ahead before the next 'bleep' sound. If the subject comes before the 'bleep' sound, the subject must wait until the next 'bleep' sound to continue the run. Scores will be calculated on the 'level' and 'shuttle' last achieved.

Results and Discussion

This study involved a total of 4323 male and 10208 female subjects. (Mean and standard deviation - Male: age = 21.9, sd = 4.5; height = 1.67m, sd = 0.1; weight = 63.4kg, sd = 11.8; Female: age = 19.75, sd = 3.6; height = 1.55m, sd = 0.1; weight = 53.8kg, sd = 11.4). For male and female, subjects were divided into three age groups as shown in Figure 1. The mean for each age category; 17 to 20 years (mean age: male = 18:22; female = 18:22), 21 to 28 years (mean age: male = 25.76; female = 25.56) and 29 to 36 years (mean age: male = 30.67; female = 30.73).

Exploratory data analysis was carried out to check the data from error before data analysis was performed. The analysis also showed that there were few cases of isolated data and the detected cases eliminated. Inter-examiner reliability of several test centre was between the range of acceptable reliability with a correlation coefficient between 0.82 to 0.87 (Baumgartner, Jackson, Mahar & Rowe, 2003).

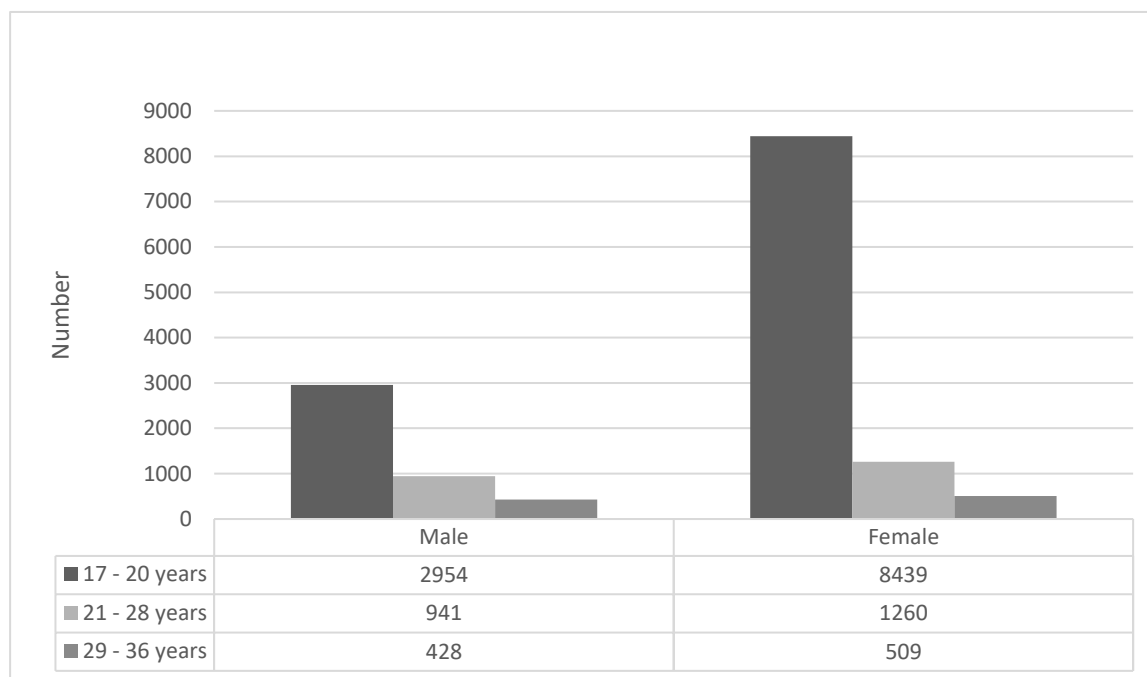


Figure 1: Age Category and Number of Male and Female Subjects

Independent *t*-test was conducted to compare $VO_2\max$ scores between male and female. The analysis showed that there was a significant difference [$t(5237.57) = 100.85, p = 0.000$] between male (mean = 51.85; *sd* = 4.2) and female (min = 45.00; *sd* = 2.1). Based on the results, formation of norms for male and female were separated. One-way ANOVA was conducted to compare $VO_2\max$ scores among the three age categories. The analysis showed significant differences [$F(2.4320) = 265,894, p = 0.000$] between the age categories for male at 0.05 significant level. For female, also showed significant differences [$F(2.10205) = 169,943, p = 0.000$] between the age categories at 0.05 significant level. Therefore, all analyses for the establishment of norms for $VO_2\max$ conducted separately by age categories for male and female.

Table 2 showed the mean and standard deviation for $VO_2\max$ scores of male and female subjects for each age category. Based on the analysis, it was found that the mean score of male subjects was higher than female for each age category. To test normality, referring to Table 3, the analysis showed coefficients of skewness and kurtosis were between -2 and +2 (George & Mallery, 2010) which showed that the data were normally distributed.

Table 2: Descriptive Analysis and Normality Tests of $VO_2\max$ Score Based on Gender and Age Category

Category / Age	Min	sd	Skewness	Kurtosis
<u>Male</u>				
17 – 20	52.78	4.4	-.045	-.521
21 – 28	50.28	2.9	.114	-.937
29 – 36	48.90	3.3	.079	-.320
<u>Female</u>				
17 – 20	46.00	2.1	.225	-.594
21 – 28	45.75	2.2	.255	-.200
29 – 36	44.00	2.1	.522	.383

Referring to Figure 2, a review of normal Q-Q plot showed that the distribution of data for each age groups and gender focused on the straight line which also showed that the data were normally distributed.

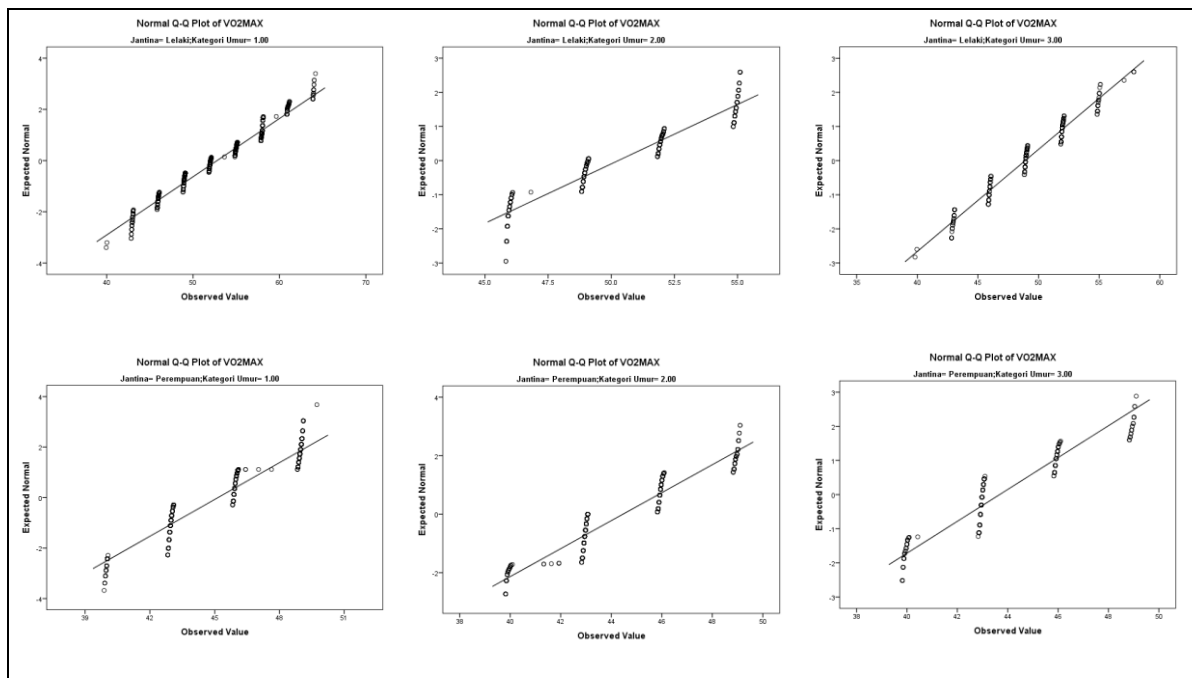


Figure 2: Analysis of normal Q-Q plot of $VO_2\max$ scores by age category and gender.

Based on the mean and standard deviation, $VO_2\max$ norms for each age groups for male and female has been set up as shown in Table 3 and can form a normal distribution (Figure 3).

Table 3: $VO_2\max$ Norms Based on Gender and Age Category

Gender	Performance	Age Category (Years)		
		17 – 20	21 – 28	29 – 36
Male	Superior	59.39 & above	54.64 & above	53.86 & above
	Excellence	54.99 – 59.38	51.74 – 54.63	50.56 – 53.85
	Good	50.58 – 54.98	48.83 – 51.73	47.25 – 50.55
	Average	46.18 – 50.57	45.93 – 48.82	43.95 – 47.24
	Poor	46.17 & below	45.92 & below	43.94 & below
Female	Superior	49.16 & above	49.06 & above	47.16 & above
	Excellence	47.06 – 49.15	46.86 – 49.05	45.06 – 47.15
	Good	44.95 – 47.05	44.65 – 46.85	42.95 – 45.05
	Average	42.85 – 44.94	42.45 – 44.64	40.85 – 42.94
	Poor	42.84 & below	42.44 & below	40.84 & below

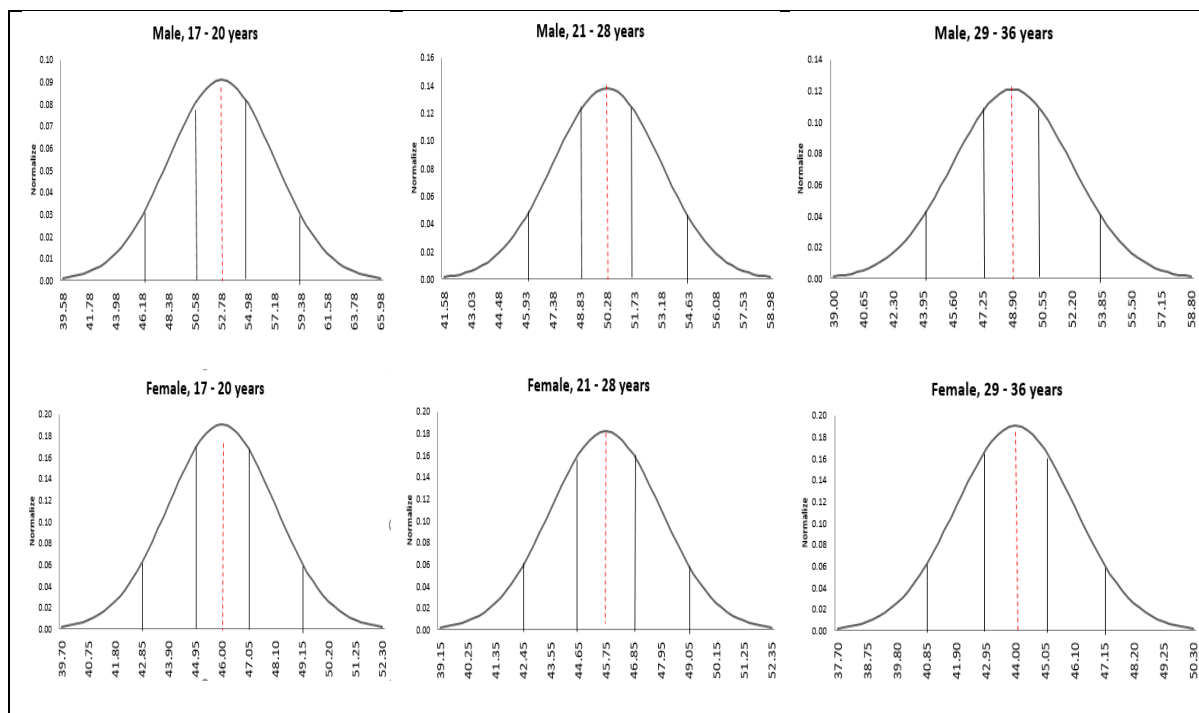


Figure 3: Normal Distribution Based on VO_{2max} Norms for Each Age Category for Male and Female

Conclusion

The construction of norm-referenced achievement based on health - related physical fitness for cardiovascular fitness was analysed using descriptive statistical (mean and standard deviation) (Miller, 2014). The analysis of achievements was classified into five stages, namely Superior, Excellent, Good, Fair and Poor. Norms was formed from the raw scores of the population aged between 17 and 35 years old. The norms formed can and be modified for use as norm-referenced for Physical Fitness Test in Malaysia Teacher Eligibility Test Candidates for determining the level of cardiovascular in Malaysia.

Appreciation

The Heads of Department and lecturers from the Department of Physical Education or the parties involved directly or indirectly in the execution of tests and data collection during PTET.

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