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Comparison of Anthropometric and Physical Fitness among Sprinters, Jumpers and Throwers in Male Student-Athletes

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ABSTRACT

The purpose of this study to determine the level of physical and anthropometric performance between sprinters, jumpers, and throwers among male student-athletes. This study is a cross sectional study involving a sample of 43 male athletic student-athletes (19 sprint athletes, 15 jump athletes and 9 throw athletes). The six fitness tests used in this study are push up test (PU), sit and reach test (SnR), sit up test (SU), standing long jump test (SLJ), 30-meter sprint test (30mS) and beep test (UB) to test the physical performance level of sprinters, jumpers, and throw athletes, while the two anthropometric tests are the measurement of standing height and weight. Data were analysed using descriptive statistics and MANOVA. The findings of the study showed that only four physical fitness tests were highly significant $p < 0.01$ on male athletes for the sub-disciplines of sprinters, jumpers, and throwers. The physical fitness tests were push up, standing long jump, 30-meter sprint, and beep test, while the other two physical fitness tests were not significant $p > 0.05$ (for sit and reach and sit up). The tests performed by the researchers can help coaches and sport teachers in sprinting, jumping and throwing events to improve the performance of their athletes.

Keywords: Anthropometric, Fitness Test, Physical Fitness

INTRODUCTION

Physical fitness is defined as the overall ability of the human body to function efficiently and effectively. In physical fitness, this covers two components that are based on 1) health, namely cardiovascular endurance, muscular endurance, muscle strength, flexibility and body composition, and 2) motor-based fitness, which consists of speed, agility, muscle power, balance and coordination as well as reaction time (Corbin et al, 2000).

In addition to physical fitness, anthropometry also has an influence on physical performance. Previous studies have shown that body composition is significantly associated with physical activity, especially in elite athletes. Continuous physical activity has a beneficial influence on body composition and performance (Santos et al, 2014). Body composition data can be very informative to plan training and nutrition schedules in physical activity and is also considered as one of the most important factors that contribute to achievement in many sports disciplines (Mazić et al, 2014).

In childhood and adolescence, physical performance is influenced by various factors, including training, maturity, and growth (Malina et al, 2014). Nevertheless, in childhood and adolescence, physical performance will increase on its own without undergoing direct physical training.

Improved physical performance of children and adolescents will occur in tandem with increases in age. In addition, increasing age has a relationship with the growth process. Improved physical performance of children and adolescents are due to changes in the physical structure associated with their age (Patton and Viner, 2007). In addition, an increase in an individual's level of physical performance can be seen observed significantly during adolescence, especially when they are at the primary and secondary school levels (7 years to 17 years).

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Athletics is a sport that is competed at the Olympic level which include race and field events. The race event consists of a running event which include sprinting, middle distance, long distance, steeplechase, and walking. Meanwhile, the field event involves throwing and jumping. Among the big names in track events are Usain Bolt (Jamaica), Asafa Powell (Jamaica), and Justin Gatlin (USA). For field events, Valerie Adams (New Zealand), David Storl (Germany), Christian Taylor (USA) and Yelena Isinbayeva (Russia) are the champions that dominate their events with outstanding performance.

In athletics, the development of athlete training needs to be carried out in stages. During the childhood stage, training should focus on the basic formation aspects that are comprehensive and varied to improve motor movements, skills sports fundamentals, and sport-specific skills. Specific initial training in a sport will extend at the junior level in stages according to the athlete's age to avoid early specialization and injury factors. After the athlete has mastered this training specifically, the athlete will be exposed to high performance training. At this stage, athletes are categorized as a mature athlete in both training and physical aspects (Bompa and Buzzichelli, 2019).

Anthropometric measurements and fitness tests are common practices in determining an athlete's current performance. Coaches will use this data to plan training regimes or as a selection criteria. Apart from that, anthropometric data and fitness tests have been used as talent identification tools. This was to make sure that the selection process was done scientifically and systematically to improve athletic performance later in the athletes' career (Ko, 2014). Thus, the purpose of this study is to measure the level of physical and anthropometric performance between sprinters, jumpers, and throwers among male student-athletes.

METHODS

Sample

A total of 43 male athletic students-athletes were involved in this study. Subjects were divided into three groups based on athletic sub-disciplines, which are sprinters (n=19), jumpers (n=15) and thrower (n=9) athletes. The subject population in this study was athletes from Sekolah Sukan Malaysia Pahang whose ages ranged from 13 to 15 years old. Athletes were informed about the risk and nature of the study and consent were obtained. All procedures were approved by an Ethics Committee.

PROCEDURES

Anthropometry Measurements

In this study, height and weight were measured in each athlete. Height was measured using a stadiometer where subjects were instructed to stand straight against the stadiometer with their feet close together and arms at the side of the body. For weight measurement, a scale was placed on a flat surface and the initial reading was set to zero. Subjects were instructed to take off their shoes, wear light clothing, and empty their pockets before the measurements were taken (Bahagian Pembangunan Kurikulum, 2016).

Physical Fitness Measurement

The physical fitness tests used in this study were 1-minute push-up, sit and reach, 1-minute sit-up, standing broad jump, 30-meter sprint and bleep test.

1-minute push-up test was conducted with subjects performing push-ups until their elbows reached 90^{o} at down position. They performed the push-up continuously for one minute and the repetition was counted as their score. For the 1-minute sit-up test, the starting position was when the subject laid flat on the floor with their knees flexed at 90^{o} position and their feet placed on the floor. Their hands were crossed against their chest and they sit up until both elbows touched their knees. They performed the sit up for one minute and repetition was measured as their score.

Sit and reach test was conducted based on the method described by Ayala (2012) and Pollock (1998). Briefly, the subjects sat on the floor with their legs fully extended and their feet touch the box. One hand was placed on top of the other while they slowly bend forward as far as they can and hold their maximum position for one second. They were given two trials and the best score was recoded.

Subjects performed the standing broad jump test by jumping along a measuring tape that was put on the floor. Subjects were instructed to start at the starting line with their feet shoulder-width apart. The subjects would swing their arms and jump forward. They were given two trials and the best score was recoded (Koch et al., 2003).

The 30-meter sprint test involved one maximum running. Subjects were instructed to stand at the starting line as the starting position. Subjects will sprint for 30 meters and the time was measured automatically using a timing gate device. Beep test was done to measure the subjects' VO2max. The subjects were instructed to perform a shuttle run between 20 meters markers at increasing speeds determined by a beep sound. The test ends when the subjects failed to keep pace with the beep sound (Otieno and Mutwol, 2019).

Results

TABLE 1
Descriptive Analysis for Physical and Anthropometric Performance

Total N=43		Sprinters (n=19)		Jumpers (n=15)		Throwers (n=9)	
		Mean	SD	Mean	SD	Mean	SD
Height	(m)	1.69	0.43	1.68	0.06	1.77	0.42
Weight	(kg)	58.72	4.82	56.62	5.39	95.10	14.92
PU	(r/60s)	50.89	16.49	43.87	13.53	30.56	8.10
SR	(cm)	32.58	8.17	32.21	4.19	29.94	4.36
SU	(r/60s)	35.21	5.81	33.00	8.30	31.11	8.51
SLJ	(cm)	2.40	0.21	2.27	0.21	2.07	0.23
30m	P (s)	4.20	0.13	4.45	0.18	4.65	0.33
BT (ml/ kg^{-1}/min^{-1})		9.56	2.21	9.60	1.93	6.86	2.32

**Note: PU (r)- Push Up (repetition), SM- Sit and Reach (cm), SU (r)- Sit-up (repetition), STD- Standing Long Jump (cm), 30m P- 30 meter sprint (s), BT- Beep Test (ml/kg^{-1}/min^{-1}*

Descriptive analysis was conducted to provide an initial description of the data that were obtained based on the studies that were carried out by the reviewers. Table 1 shows that 43 male athletes (42.2%) participated in this study. In terms of body height, the thrower athletes had the highest mean (1.77) compared to the sprinters and jumping athletes. In terms of body weight, the thrower athletes also showed the highest min (95.10) compared to the sprinters and jumpers. In the push-up test, the sprinters showed the highest mean (50.89) compared to the jumpers and the throwers, while for the sit and reach test, the sprint athletes showed the highest mean (32.58) compared to the jumpers and the throwers. The sprinters recorded the highest mean score (35.21) for the sit-up test compared to the jumpers and throwers. The sprinters also showed the highest mean (2.40) for the standing long jump test compared to the jumpers and throwers, while in the 30m sprint test, they also showed the highest mean (4.20 compared to the jumpers). In the beep test, the jumper athletes showed the highest mean (9.60) compared to the sprinters and throwers.

TABLE 2
MANOVA Analysis for Physical and Anthropometric Performance

N	**43**
Anthropometric	
Height	13.10
Weight	76.26
Physical Performance	
Push-up	6.34**
Sit and Reach	0.58
Sit-up	1.03
Standing Long Jump	6.85**

30m Sprint	16.89**
Beep Test	16.36**
1. Multivariat F	9.45**

* p < 0.05 ** p < 0.01

Based on Table 2, only four physical fitness tests were very significant, which was p < 0.01 for the sub-disciplines of sprint events, jumping events and throwing events. The physical fitness tests are push-up, standing long jump, 30m sprint, and beep test, while the other two physical fitness tests were not significant at p > 0.05, which was for seat and reach and sit-ups.

Post Hoc Bonferroni Analysis of Differences in Physical and Anthropometric Achievement Stages Between Sprint Athletes, Jumper Athletes and Thrower Athletes

TABLE 3
Full Analysis of Post Hoc Bonferroni on the Difference in Physical and Anthropometric Achievement Stages between Sprint Athletes, Jumper Athletes and Thrower Athletes

Variables	Subdiscipline	Subdiscipline	Differences (mean)
Push-up	Sprints	Throwers	20.34**
Seat and Reach			
Sit-up			
Standing Long Jump	Sprint	Throwers	0.32**
30m Sprint	Jumpers	Sprints	0.25**
	Sprints	Throwers	-0.45**
Beep Test	Jumpers	Throwers	2.70**
	Sprints	Throwers	3.90**
Height	Throwers	Jumpers	0.96**
	Throwers	Sprints	0.86**
Weight	Throwers	Jumpers	38.46**
	Throwers	Sprints	36.36**

** p < 0.05 ** p < 0.01*

Bonferroni Post Hoc test was done to see the difference in the physical performance between sprints, jumpers and thrower athletes. Sprinters had significantly better results in push-up and standing long jump compared to throwers. In the 30 meters sprint test, sprinters performed significantly better and faster compared to throwers and jumper athletes. Beep test results show that throwers had a significantly lower score compared to both jumpers and thrower athletes. Antrhopometry measurement (weight and height) of all athletes showed that thrower athletes were significantly taller and heavier while there was no significant difference between jumpers and sprinters.

DISCUSSION

The findings from this study indicate that six fitness tests were used to see the difference in physical and anthropometric performance levels between sprinter athletes, jumper athletes and thrower athletes. MANOVA analysis for physical and anthropometric performance showed that the four fitness tests were very significant, while the other two tests of fitness, which are the sit and reach and sit-up test, were not significant. Body composition and anthropometry are important in sport performance as well as for physiological, physical, psychological and skill aspects (Carter, 1990).

Post hoc Bonferroni analysis used six fitness tests which are the push-up test, standing long jump test, 30m sprint test, sit-up test, and beep test. The stage of muscle endurance will affect the individual's ability to carry out daily activities as well as other physical activities. In addition, with the data collected, it is very important for coaches to monitor the fitness level of their athletes as well as from the context of the selection of athletes in sports development programs (McManis et al., 2000).

Push-up test showed a very significant difference between sprinter athletes and thrower athletes at p<0.01. The standing long jump test showed that the difference between sprinters and throwers was very significant, at p < 0.01. The 30m sprint test showed that there was a very significant difference between sprinters and jumpers with throwers at p < 0.01. The beep test also showed differences and was very significant at p < 0.01 between the jumper athletes, sprinter athletes, and thrower athletes. Anthropometric tests for standing height showed that thrower athletes had very significant differences between jumper athletes and sprinter athletes p< 0.01.

Likewise, in the measurement of body weight, the thrower athletes showed a very significant difference $p < 0.01$ compared to jumper athletes and sprinter athletes.

Player performance is influenced by many factors such as physical, physiological and psychological variables, as well as technique, tactics, physical body size, body composition and use of bio-mechanical analysis (Ortega, 2008). In sports, muscle strength and muscular endurance have a significant impact on jumper athletes as well as thrower athletes. This is because it is an important factor in assisting athletes in their performance apart from technical and tactical factors (Hamiltonm, 1993; Korchmny, 1994).

The results of the study show that sprinter athletes showed a very significant difference in the standing long jump test compared to the thrower athletes. Previous studies have stated that sprinters showed a positive impression of physical fitness in power, where the power factor was the main contributor in improving performance. The success of an athlete is associated with the level of physical fitness in the power component. To produce good power, the components of maximum strength and strength need to be trained properly. The power component is very important in sprinting, fence running, jumping, and throwing (Thompson, 2009).

The results of the study in the 30m sprint test show that there are differences between sprinter athletes, jumper athletes and thrower athletes. Speed is the same as other fitness components that can be divided into several parts, including maximum speed, optimum speed, reaction time, and speed endurance. In jumping events, the optimum speed at which a fast but controlled run is essential is very important because at the end of the jump phase, the athlete needs to shift the speed from horizontal to vertical. This situation will affect the technique and jump performance (Thompson, 2009). Fast acceleration and maximum velocity are contributors to success in sprint events. The starting block requires good power and acceleration in the first 30 meters, while the next important phase is to maintain the running speed (acceleration) in the last 60 meters to determine the performance of sprinters sprinters (Slawinski et al, 2010).

The findings of the study show that there is a very significant difference in cardiovascular endurance between jumper athletes with thrower athletes, and sprinters with thrower athletes. Kaur's (2017) study showed a comparison of cardiovascular endurance between boxing athletes and judo athletes in a 12-minute test. The test results showed that boxing athletes had better levels of cardiovascular endurance than judo athletes (Kaur, 2017). The results of the study show that sprinter athletes have differences in physical agility and muscle endurance compared to thrower athletes.

The results of this study show that there is a significant difference for each physical fitness test in improving the performance of sprinters, jumpers and thrower athletes. The tests performed by the researchers can help sports coaches and teachers in sprinting, jumping and throwing events to improve the performance of their athletes. Apart from that, coaches and sports teachers can also choose an appropriate fitness test for sprinting, jumping and throwing events. Therefore, this study to some extent can help select athletes as well as improve and strengthen the performance of athletes at a higher level.

CONCLUSION

The study showed that there were four physical fitness tests which were very significant among sprinter athletes, jumper athletes and thrower athletes. The significant tests are push-up, standing long jump test, 30m sprint test, and beep test.

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