Comparison of Health-Related Fitness between Male Students of Exercise and Sports Science Program and Students of Other Programs in Universiti Sains Malaysia

Muhammad Zuhaili Suhaimi
Co-curriculum Centre
Centre for Fundamental and Liberal Education
Universiti Malaysia Terengganu
21030 Kuala Terengganu, Terengganu
Malaysia

Abstract

This study was conducted to compare the health-related fitness between male students of Exercise and Sports Science program and students of other programs in School of Health Sciences, Universiti Sains Malaysia, Kelantan. Forty six undergraduate students in School of Health Sciences, Universiti Sains Malaysia, Kelantan aged 20-32 years participated in the study. They were categorized into two groups which were Exercise and Sports Science group (n=23) and other programs (n=23). Anthropometric measurement (height, weight, body mass index (BMI), blood pressure, resting heart rate, fat percentage, muscle percentage) and health-related fitness assessment (1- min push-up, 1- min sit-up, sit and reach test, handgrip strength test, back and leg strength test, 20 m multistage shuttle run test) of both groups were compared by using Independent T-test. The results showed that there were significant differences between Exercise and Sports Science group and other programs group in muscle endurance (1 min push-up, 1 min sit-up) ($p<0.05$) and cardiorespiratory fitness (20 m Multistage shuttle run test) ($p<0.05$). As conclusion, this study found that Exercise and Sports Science students have higher level of cardiorespiratory fitness and muscle endurance compared to the students of other programs but there were no differences in muscle strength, flexibility and body composition.

Keywords: Health-related fitness, cardio respiratory fitness, muscle strength, muscle endurance, flexibility, body composition.

1.0 Introduction

Physical fitness is defined as a set of attributes or characteristics that people have or achieves related to the ability to perform physical activity (Carpersen *et al*., 1985). Physical fitness can be described in terms of health-related fitness and skill-related fitness (Ganley *et al*., 2011). Health-related fitness has been defined by the President's Council of Physical Fitness as consisting of those specific components of physical fitness that have a relationship with good health. The health-related fitness components include cardiorespiratory fitness, body composition, muscle strength, muscle endurance and flexibility (ACSM, 2010).

Regular participation in moderate and vigorous levels of physical activity increases physical fitness and preventing obesity in children (Ruiz *et al*., 2006). Research conducted by Blair *et al*. (1996) and Kampert *et al.* (1996) indicated that physical fitness was inversely associated with mortality and morbidity. Higher level of physical fitness appeared to delay all-cause of mortality primarily due to lower rates of cardiovascular disease and cancer. Epidemiological evidence suggested that high level of cardiorespiratory fitness and physical activity were associated with favorable metabolic risk profile in adults (Steele *et al.*, 2008). Meanwhile, poor cardiorespiratory fitness was not only associated with the metabolic syndrome but could also be considered features of the metabolic syndrome (Lakka *et al*., 2003).

Physical fitness has been proposed as a powerful marker of health (Ortega *et al.* 2008). The evidence showed that physical fitness and health-related fitness are the indicators of positive health state (Lamb *et al.*, 1988). The health-related physical fitness was used to determine the level of several health-related fitness components with respect to chronological and biological age (Ortega *et al.*, 2008).

The validity and reliability of the health-related fitness assessment was widely documented (Ortega *et al.*, 2008; Ruiz *et al.*, 2009). In Georgia's fifth and seventh-grade students, the Georgia Youth Fitness assessment was conducted to assess their health-related fitness levels. The results provided a baseline and guidance to public and private leaders and decision makers (Powell *et al.*, 2006).

As people started to realize the benefits and the importance of the health related assessment, many more health-related fitness assessments were used nowadays for many purposes such as the evaluation of physical characteristics of a group either in sport or non-sport groups. For example, a health-related fitness assessment was conducted on Western Australian Male Paramedic. The purpose of the investigation was to evaluate the physical characteristics of a group of West Australian male paramedics (Chapman *et al*., 2007). The same research was also conducted on students of the Physical Therapy program. The study began to establish physical fitness norms, as these physical fitness norms became established, it then was possible to determine how the norms of physical therapists and physical therapy students in comparison with established values (Sobush *et al*., 1983). Besides, physical fitness can also be a major determinant of many diseases. Ruiz *et al.*, (2007) employed physical fitness assessment as a predictor to cardiovascular disease risk factors, events and syndromes.

Furthermore, the health-related fitness is also important for individual or group to know their health status and tendency to get any diseases. There were many research conducted on many groups including student groups. A research was performed on Sport Science students at Universiti Malaysia Sabah. The purpose of the research was to determine the health-related fitness level of Sport Science students at Universiti Malaysia Sabah (Fauzee *et al*., 2010). The same research was carried out on Physical and Education students at University of Toronto. The results were compared with published information on physical education students from other nations (Sherpard and Pimm, 1975). In many research conducted so far, there were no evidence to prove that the health related fitness of Exercise and Sports Science students is better than the students of other programs. Therefore, this present study was done to compare the health-related fitness components between male students of Exercise and Sports Science program and students of other programs in School of Health Sciences, Universiti Sains Malaysia, Kelantan.

2.0 Material and Method

2.1 Participants

Forty-six male students of School of Health Sciences, mean ± SD age 22.54 ± 1.834 years, were recruited to assess their health-related fitness components. They were categorized into two groups which were Exercise and Sports Science group (n=23) and other programs group (n=23). Individuals were excluded from the study if they had acute heart disease, or any chronic disease such as hypertension (>140/90mmHg), diabetes mellitus, renal failure, heart disease or any medical problems.

2.2 Study Procedures

Before starting the testing, the subjects were briefed about the nature and risk of testing protocols. Each subjects signed an informed consent form. The study was approved by the research ethics committee (Human) of Universiti Sains Malaysia.

2.3 Anthropometric measurement

After recruitment, height, weight, fat percentage, muscle percentage, body mass index (BMI), resting heart rate and blood pressure of the subjects were taken. Resting heart rate and blood pressure of the subjects were measured using Omron Automatic Pressure Monitor (SEM1 - Model) and the height of the subjects were measured by using Body m 406 (SECA). While theweight, fat percentage, muscle percentage and BMI of the subjects were measured by using Bioelectrical Impedance Analysis (BIA). The measurements were also done in previous study (Kabir *et al.*, 1995).

2.4 Health-related fitness measurement

2.4.1 Muscle strength

The muscle strength of the subjects were measured by using Handgrip Strength Test and Back & Leg Strength Test.

2.4.1.1 Handgrip strength test

Handgrip dynamometer was used to conduct handgrip strength test of the participants. The test has been conducted according to previous research (Bansal, 2008). Each subjects were demonstrated on the use of the instrument by the administrator prior to testing. The subjects were coached to be in a standing position, arms extended straightly at their side, not touching their body. The subjects then were asked to squeeze the dynamometer with as much force as possible, being careful to squeeze only for each measurement. The test was done three times alternately for both hands. The highest score was recorded in the correct form.

2.4.1.2 Back and leg strength test

Back and leg dynamometer was used to conduct the back and leg strength test of the participants. The test has been conducted according to previous research (Koley *et al*., 2010). The test was conducted when the subjects stood on the base of the dynamometer with the chain handle in both hands which were already detached from the dynamometer. Then, the subjects bent the upper part of the body at the hip 30° forward and while this position was maintained, the chain was fixed without slack, to the dynamometer. Once this was done, the subjects then with all strength pulled the chain attached to the dynamometer. The score of the back and leg strength was read from the scale. The test was done three times and the best score was recorded in the correct form.

2.4.2 Muscle endurance

The muscle endurance of the subjects was assessed by using 1-Min Push-up and 1-Min Sit-up Test. The validity and reliability of push-up and sit-up test were widely documented (Ortega *et al*., 2008).

2.4.2.1 1- Min push-up test

This test measures muscular endurance of the upper body (anterior deltoid, pectoralis major, and triceps). The hands of the subjects were placed slightly wider than shoulder width apart, with fingers pointing forward. The administrator was placed one fist on the floor below the subject's chest. Starting from the up position (elbow extended), the subjects kept the back straight at all times and lowered the body to the floor until the chest touches the administrator's fist. Subjects then returned to the up position and this was counted as one repetition. Resting could be done only in the up position. The total number of correct push-up in 1 min was recorded as the score.

2.4.2.2 1- Min sit-up test

This test measures abdominal muscular endurance. The subjects started by lying on the back, knees bent, heels flatted on the floor. Arms were crossed on chest with hands on the opposite shoulders. The buttocks remained on the floor with no thrusting of the tips. A partner holds the feet down firmly. Then, the subjects performed as many correct sit-ups as possible in one min. In the up position, the subjects touched the elbows to the knees and then returned back until the shoulder blades touched the floor. Any resting was done in the up position. Neck of the subjects remained in the neutral position. The total number of correct sit-ups in 1 min was recorded as the score.

2.4.3 Flexibility

Flexibility of the subjects were measured using Sit and Reach Test. This test was widely used in many previous researches (Saint-Maurice *et al*, 2015) and has been validated by Lemmik *et al*. (2003) and Mayorga-Vega *et al*. (2014). By using a sit and reach box, the subjects sat on the floor with legs together, knees extended and soles of the sheet placed against the edge of the box. Then, the subjects were instructed to reach forward slowly and as far as possible along the top of the box while keeping their two hands parallel and to hold the position for approximately two second. The test was done three times and the most distant point on the box contacted by the subjects' finger tips were recorded in the appropriate and correct way.

2.4.4 Cardiorespiratory fitness

The cardiorespiratory fitness of the subjects were assessed using 20 m Multistage Shuttle Run test. The test has been conducted according to previous research (Zaqout *et al*. 2016). Reliability and validity of this test for determining the VO_{2max} among children and adolescent has been widely documented (Leger and Lambert, 1982; Leger *et al*., 1988; Ahmaidi *et al*., 1993; McNaughton *et al*., 1998; Mayorga-Vega *et al*., 2015). In Asia, the validity of 20 m multistage shuttle run for predicting VO_{2max} of adult Singaporean athletes has been accepted in general (Sproule *et al*., 1993). For the location of the multistage shuttle run test, it was performed at a large space situated at the School of Medicine, Universiti Sains Malaysia, Kelantan. The test consisted of progressive increases in running speed over 20 m distance with the running velocity for each 20 m distance dictated by audible 'beep'.

Each subject was required to complete the 20 m distance before each audible 'beep' occurred, turn 180° and again complete the 20 m in the opposite direction before the next audible 'beep'. This scenario was repeated by the subjects until exhausted which was defined by the inability of the subjects to cover the 20 m distance before an audible beep on two consecutive occasions.

2.5 Statistical analysis

Data were statistically analysed using the statistical software SPSS version 25.0. Independent T-test was performed to determine the significance of the differences between the two groups. The statistical significance was accepted at $p<0.05$. All the data were expressed as mean ± standard deviation (SD).

3.0 Results and discussion

Participants' anthropometric data

The anthropometric measurement of the participants was conducted to measure their body weight, height, body mass index (BMI), fat percentage, muscle percentage and resting heart rate. The anthropometric data of the participants are shown in Table 1.

Table 1.Anthropometric data of the participants

Variables	Exercise and Sports Science group	Other programs group
n	23	23
Age (years)	22.70 ± 2.44	22.39 ± 0.94
Body Weight (kg)	65.16 ± 11.23	64.74 ± 11.56
Height (cm)	168.90 ± 6.10	170.15 ± 5.14
BMI ($kg.m^{-2}$)	22.71 ± 2.93	22.20 ± 3.20
Fat (%)	16.71 ± 5.13	18.27 ± 5.01
Muscle (%)	36.82 ± 5.33	35.03 ± 1.96
Resting Heart Rate (bpm)	69.09 ± 8.51	71.04 ± 10.50

Values were presented as mean ± SD.

The health-related fitness assessment of the participants was conducted after anthropometric measurement. The results of health-related fitness components are shown in Table 2.

Table 2.The health-related fitness components of the participants

Variables	Exercise and Sports Science group (n=23)		Other programs group (n=23)	
	Mean	**Standard deviation (SD)**	**Mean**	**Standard deviation (SD)**
Multi-stage shuttle run test VO_{2max} ($mL.kg^{-1}.min^{-1}$)	41.44*	±5.98	33.21	±2.83
Push-up (repetition min^{-1})	40.91*	±15.40	26.17	±10.12
Sit-up (repetition min^{-1})	44.78*	±7.43	36.00	±13.05
Hand-grip right (kg)	45.17	±9.18	41.48	±7.45
Hand-grip left (kg)	41.78	±8.09	37.22	±9.01
Back & Leg (kg)	153.39	±30.45	143.48	±31.13
Flexibility (cm)	11.41	±7.78	10.02	±9.32

*There was significant differences between two groups ($p<0.05$)

Table 3. Normative data of health-related fitness components (McArdle and Katch, 2001)

Variables	Very Poor	Poor	Normal	Good	Very Good
Multistage shuttle run VO_{2max} ($mL.kg^{1-}.min^{-1}$)	≤24.9	25.0 – 33.9	34.0 – 43.9	44.0 – 52.9	≥53.0
Push-up (repetition min^{-1})	<30	31 – 34	35 – 38	39 – 42	>43
Sit-up (repetition min^{-1})	<30	31 – 34	35 – 38	39 – 42	>43
Hand-grip (kg)	<37	38 – 42	43 – 50	51 – 56	>57
Back & Leg (kg)	<118	119 – 138	139 – 165	166 – 185	>186
Flexibility (cm)	<2	3 – 9	10 – 16	17 – 23	>24

This study focused on health-related fitness among university undergraduate students. In the present study, we found that the students of Exercise and Sports Science have higher values in all health-related fitness components (cardiorespiratory fitness, muscle strength, muscle endurance, flexibility, and body composition) compared to the students of other programs and the observed differences were found significant in cardiorespiratory fitness and muscle endurance only.

In anthropometric data, several parameters were used to compare between both groups such as height, body weight, body mass index (BMI), fat percentage, muscle percentage and resting heart rate. The mean height of Exercise and Sports Science group and other programs group were 168.9 ± 6.10 cm and 170.15 ± 5.14 cm respectively (Table 1). It means height of the Exercise and Sports Science group was 1.25 cm shorter than other programs group. But by comparing the male students of Physical Therapy in a sectarian Midwestern university, their students were 7.62 cm taller than the students of Exercise and Sports Science program (Sobush *et al.*, 1983). From that comparison, we can see the differences in physical appearances between Asian and European students whereby Asian students were shorter than Europe students.

Meanwhile in the body weight parameter, results showed that the Exercise and Sports Science group was heavier than other programs group where their body weights were 65.16 ± 11.23 kg and 64.74 ± 11.56 kg respectively (Table 1). Even though the Exercise and Sports Science group was heavier than other programs group, there was no significant difference between both groups. By comparing the mean weight of students of the Exercise and Sports Science group and other program group to the students of Physical Therapy in a sectarian Midwestern university, the mean weight of both groups were lighter than the students of Physical Therapy (Sobush *et al.*, 1983). Basically, the body weight was directly proportional to the height of a subject. Taller people will have a higher value of body weight but it does not necessarily mean that people who have higher value of body weight are classified as obese people. The excess of body weight can be verified using BMI classification. The BMI classified body weight into underweight, normal or overweight (Shiwa *et al*., 2004). According to Shiwa *et al.* (2004), the normal range of body mass index (BMI) was between 18.5 - 24.9 $kg.m^{-2}$. This study found that the BMI's category for both group were normal but the value of BMI for Exercise and Sports Science group was slightly higher than other programs group. Even though the Exercise and Sports Science group has higher value of BMI than other programs group, their fat percentage was less compared to their counterpart. It means that the BMI parameter was not a precise parameter to determine the degree of obesity but it was accurate to determine the excess of body weight. An individual who has high value of BMI will not necessarily obese person. It was because the weight was influenced by muscle mass and skeletal. Therefore, in this present study, fat percentage was used as parameter in order to verify the degree of fatness of the subjects. Basically, when the fat percentage was higher, the muscle percentage was usually lowered. The same pattern of result was found in this study in which lower muscle percentage had been recorded when fat percentage was high. The fat percentage of Exercise and Sports Science group was lower than other programs group even though they have higher body weight.

In this study, resting heart rate (Table 1) of each subject was also measured. Resting heart rate was used to determine the health status and to obtain an approximation of the subjects' maximum heart rate. Generally, a low resting heart rate indicates that the person has good cardiorespiratory fitness because the heart does not need to work hard to pump and supply blood throughout the body. Typically, resting heart rate in healthy adults was 60-80 bpm. Resting heart rates below 60 bpm were referred to as bradycardia and rates above 100bpm were referred to as tachycardia (American Health Association, 2010). However, note that conditioned athletes have resting heart rates below 60 bpm. This present study showed that the resting heart rates of both groups were healthy.

The most important health-related fitness component is cardiorespiratory fitness. Cardiorespiratory fitness reflects the overall capacity of the cardiovascular and respiratory systems and their ability to carry out prolonged exercise (Taylor *et al*., 1955). It has been considered as a direct measure of the physiological status of the person (Ortega *et al*., 2008) and as a predictor of mortality in men (Laukkanen *et al*., 2001). The most valid and reliable measure of cardiorespiratory fitness was maximum oxygen consumption (VO_{2max}). The finding in this study showed that the VO_{2max} of Exercise and Sports Science group was significantly higher than other programs group ($p<0.01$) (Table 2). By comparing the $VO_{2max}$of both groups to the standard norm, the Exercise and Sports Science group was classified as normal and other programs group as poor in which the VO_{2max} of both groups were 41.44 ± 5.98 $ml.kg^{-1}.min^{-1}$ and 33.21 ± 2.83 $ml.kg^{-1}.min^{-1}$ respectively (Table 3). Therefore, both groups needed to improve their cardiorespiratory fitness in order to maintain and gain health benefits.

The previous finding proved that higher levels of cardiorespiratory fitness was associated with higher levels of habitual physical activity and a reduction in all causes of mortality whereas low levels was associated with an increased risk of cardiovascular disease and premature death (Blair *et al*., 1996). High cardiorespiratory fitness during childhood and adolescent has been associated with a healthier cardiovascular profile during this year (Mesa *et al.,* 2006). Among males in the United States Navy, a relatively higher level of cardiorespiratory fitness was associated with higher levels of health related quality of life (HRQL) (Sloan *et al*., 2009). The inverse relationship was noted between cardiorespiratory fitness and carotic atherosclerosis (Raurama *et al*., 1995) and prevalence of carotid atherosclerosis in hypertensive men (Jae *et al*., 2007). According to Lakka *et al*. (2001), good cardiorespiratory fitness was associated with slower progression of early atherosclerosis in middle-aged men. This finding was important to evaluate cardiorespiratory fitness and estimate their future risk for atherosclerosis because the research was accentuated at middle-aged men. Besides, Cohort study of fitness and digestive cancer mortality observed an inverse association between cardiorespiratory fitness and risk of mortality from colon, colorectal, and liver cancer (Peel *et al*., 2009). Furthermore, other findings showed that lower cardiorespiratory fitness was associated with an increased risk of any stroke and ischemic stroke (Kurl *et al*., 2003) and cardiovascular disease (Carnethon *et al*., 2003) while the moderate and high cardiorespiratory fitness was associated with a significant lower metabolic syndrome prevalence in adolescents (Janssen and Cramp, 2007) and cancer mortality among men with pre-diabetes and diabetes (Thompson *et al*., 2008). In another study, increased level of cardiorespiratory fitness blunts the inflammatory response in metabolic syndrome (Rana *et al*., 2006) and low cardiorespiratory fitness was a predictor of mortality in men with Type-2 Diabetes (Wei, 2000). Subjects who have high body weight performed at the low stage of 20 m multistage shuttle run test. This results was supported by previous research which stated that cardiorespiratory fitness was lower in males and females who were overweight than in those of normal weight (Pate *et al*., 2006). From the finding of this study, it was strongly encouraged the students especially in other programme to improve their cardiorespiratory fitness in order to gain health benefits and reduce the risk of many diseases.

In addition, a high level cardiorespiratory fitness is usually correlated with good muscle endurance (Zoeller *et al*., 2005). Results of this present study showed the same pattern as the previous study in which groups that have high value of cardiorespiratory fitness, score high value in muscle endurance test. The mean of push-up scores of Exercise and Sports Science group was 40.91 ± 15.4 repetitions min^{-1} while the other programs group was 26.17 ± 10.12 repetitions min^{-1}. The results showed that the mean of push-up scores of Exercise and Sport Science students was higher than other programs students which thus shows a significant difference ($p<0.05$). By comparing the standard norm of push-up, the Exercise and Sports Science group was classified as good and other programs as very poor. Therefore, the students of other programs group need to get better muscle endurance of upper body in order to avoid any health problem. The high level of musculoskeletal fitness was associated with positive health status and low level of musculoskeletal fitness was associated with lower health status (Warburton *et al*., 2001).The same pattern of result was shown in 1-min sit-up which the Exercise and Sports Science group scored higher value than the other programs group (Table 2). The mean of sit-up scores of Exercise and Sports Science group was 44.78 ± 7.43 repetitions min^{-1} while the other programs group was 36.0 ± 13.05 repetitions min^{-1} and a significant difference was found between both groups ($p<0.05$). Based on the standard norm of sit-up, the Exercise and Sports Science was categorized as very good and the other programs as normal (Table 3). The abdominal muscle endurance was very important to health. According to Nourbakhsh and Arab, (2002), poor abdominal muscle endurance was associated with lower back muscle pain. Improvement in abdominal muscle strength have been shown to not only reduce low back pain but also to prevent injury reoccurrence in athletes (Trainor and Trainor, 2004), and young adults (Arokoski *et al*., 2001). From this scenario, we can conclude that the muscle endurance of Exercise and Sports Science students was better than other programs students.

Muscle strength was another component of health-related fitness. According to Metter *et al*. (2002), the skeletal muscle strength was suggested as a predictor of all-cause mortality in healthy men and higher muscle strength was inversely associated with incidence of metabolic syndrome in men (Jurca *et al*., 2005). Moreover, Ruiz *et al*. (2008) found that muscle strength was inversely and independently associated with death from all known causes and cancer. In this study, Handgrip Strength Test and Back and Leg Strength Test were used to assess the muscle strength of the subjects. Handgrip strength test assessed the ability of hand and forearm muscle to produce maximal isometric force in handgrip performance. The handgrip strength test was a widely used test in experimental and epidemiological studies (Gonzales and Scheuermann, 2007; Gandhi *et al.*, 2010). A research showed that midlife handgrip strength is a predictor of old age disability (Rantanen *et al*., 1999).

In adults, handgrip strength has been proposed as a possible predictor of mortality (Snih *et al*., 2002). Alfaro-Acha *et al*., (2006) used the handgrip strength test as a predictor of cognitive function of older Mexican American. Older Mexican Americans with reduced handgrip strength at baseline demonstrated a statistically significant decline in cognitive function. By contrast, participants in the highest handgrip strength quartile maintained a higher level of cognitive function. In our study, the mean of handgrip scores (right) of Exercise and Sports Science group was found to be 45.17 ± 9.18 kg while the other programs group was 41.48 ± 7.45 kg (Table 2). The mean of handgrip scores (right) of Exercise and Sports Science group was higher than other programs group. But there were no significant differences found between the Exercise and Sports Science group and other programs group in muscle strength components ($p>0.05$). Based on standard norm of handgrip strength of right hand, the Exercise and Sports Science group was graded as normal and other programs group as poor (Table 3). This study recommends the students in both groups to maintain or increase their muscular strength by doing resistance training or other exercise such as circuit training. A finding suggested that maintenance of muscular strength throughout the lifespan may reduce the prevalence of functional limitations (Brill *et al*., 2000).

Similarly, the same pattern of result was shown in the left hand of handgrip performance. The mean of handgrip scores (left) of Exercise and Sports Science group was 41.78 ± 8.09 kg while the other program group was 37.22 ± 9.01 kg (Table 2). By referring to the standard norm, the handgrip strength of left hand of Exercise and Sports Science group was classified as poor and other programs group as very poor (Table 3). Even the mean of handgrip scores (left) of Exercise and Sports Science group was higher than other programs group, there was no significant differences noted between both groups. Hence, the handgrip scores of both hands of Exercise and Sports Science group was higher than other programs group. Besides, we can also generalize that most of the subjects were right-handed because the handgrip scores of the right hand was higher than the left hand in both groups. This result was supported with the previous study which state that the dominant hand score higher value compared to non-dominant hand (Incel *et al*., 2002).In the back and leg strength test, both groups performed at similar grades. Based on the standard norm, both groups were categorized as normal (Table 3). The mean of back and leg scores of Exercise and Sports Science group was found to be 153.39 ± 30.45 kg while the other programs group was 143.48 ± 31.13 kg (Table 2). Even though the mean of back and leg scores of Exercise and Sports Science group was higher than other programs group, there were no significant differences between two group ($p>0.05$). From these results, we can conclude that the muscle strength of Exercise and Sports Science students were stronger than other programs students.

Another component of health-related fitness component is flexibility. Flexibility is defined as an ability of joints and muscle groups to move freely through a full range of motion (ACSM, 2010). It significance to health is underscored by the fact that decreasing hamstring flexibility was associated with risk factor for developing muscle injuries in males professional soccer players (Witvrow *et al*., 2003) and poor trunk flexibility was associated with arterial stiffening (Yamamato *et al*., 2009). In this study, the flexibility of the subjects was assessed by using sit and reach test and the result showed that the mean of sit and reach scores of Exercise and Sports Science group was 11.41 ± 7.78 cm while the other programs group was 10.02 ± 9.32 cm (Table 2). It means that the mean of sit and reach scores of Exercise and Sports Science group was higher than other programs group but there was no significant difference between the two groups as observed ($p>0.05$). By referring to the standard norm of flexibility, the both groups were classified as normal (Table 3). Here, we may notice a trend that the flexibility of Exercise and Sports Science students was better than students of other programs.

Some of the limitations presented in this study such as lack in population-specific normative. In Asia, there was no standard normative of health-related fitness so far for university students even in the general population. Besides, lack of involvement in sports and exercise in young male adult students and more particularly pertains to the question of exercise adherence especially in Malay community. Furthermore, lack of adequate knowledge with regard to the beneficial impacts of sports involvement. The occurrence of this scenario may be due to lack of promotion and awareness program related with the beneficial impact of exercise.

4.0 Conclusion

At the end of this study we can conclude that the male students of Exercise and Sports Science were better than the students of other programs in School of Health Sciences. The students of Exercise and Sports Science have higher values in all health-related fitness components (cardiorespiratory fitness, muscle strength, muscle endurance, flexibility, body composition) as compared to the students of other programs and the observed differences were found significant in cardiorespiratory fitness and musculoskeletal fitness only.

Future studies should compare between two specific groups in the same university and involved more subjects. Other relevant variables such as skill related fitness components in term of speed, agility and motor control etc. may be considered for future replicated research studies. Besides, it is proposed that these results may also be used for the development of minimal entry requirement necessary for Exercise and Sports Science program. It also can be a baseline and guidance for public and private leaders. Baseline measurement was useful in setting individual goals and monitoring individual progress. Besides, this study can give knowledge and awareness to the subjects about practicing an active lifestyle with exercise in order to improve physical fitness. Furthermore, the data collected from this study can be used to establish a physical fitness norm for university students of Malaysia. Nonetheless, more researches are required in future with regard to the other universities in Malaysia.

References

American College of Sports Medicine (2010). ACSM's Guidelines for Exercise Testing and Prescription. 8th edition. Philadelphia, PA: Lippincott William & Wilkin.

Ahmaidi, S.B., Varray, A.L., Pacaux, A.M.S, & Prefaut, C.G. (1993). Cardiorespiratory fitness evaluation by the shuttle test in asthmatic subjects during aerobic training. American College of Chest Physicians, 103, 1135-1141.

Alfaro-Acha, A., Snih, S.A., Raji, M.A., Kuo, Y.K., Markides, K.S. & Ottenbacher, K.J. (2006). Handgrip strength and cognitive decline in older Mexican Americans. Journal of Gerontology, 61 (8), 859-865.

Arokoski, J.P., Valta, T., Airaksinen, O., & Kankaanpaa, M. (2001). Back and abdominal muscle function during stabilization exercises. Archives of Physical Medical and Rehabilitation, 82 (8), 1089-1098.

Blair, S.N., Kohl, H.W., Paffenbarger, R.S., Clark, D.G., Cooper, K.H. & Gibbons, L.W. (1989). Physical fitness and all-cause mortality: A prospective study of health men and women. Journal of the American Medical Association, 262 (17), 2395-2401.

Bansal, N. (2008). Normative data for young adults. Indian Journal of Physiotherapy and Occupational Therapy, 2(2), 29-33.

Blair, S.N., Kampert, J.B., Kohl, H.W., Barlow, C.E., Macera, C.A., Paffenbarger, R.S & Gibbons, L.W. (1996). Influences of cardiorespiratory fitness and other precursors on cardiovascular disease and all-cause mortality in men and women. Journal of American Medical Association, 276 (3), 205-210.

Brill, P.A., Macera, C.A., Davis, D.R., Blair, S.N. & Gordon, N. (2000). Muscular strength and physical function. Medicine and Science in Sports and Exercise, 32 (2), 412-416.

Carnethon, M.R., Gulati, M. & Greenland, P. (2005). Prevalence and cardiovascular disease correlates of low cardiorespiratory fitness in adolescents and adults. Journal of the American Medical Association, 294 (23), 2981-2988.

Caspersen, C. J., Powell, K.E. & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. Public Health Report, 100(2), 126-131.

Chapman, D., Peiffer, J., Abbis, C.R. & Laursen, P.B. (2007). A descriptive physical profile of western Australian male paramedic. Journal of Emergency Primary Health Care, 5 (1), 1-11.

Fauzee, M.S.O., Ahmad, R.I.R.L., Rashid, S.A., Din, A. & Hod, H., (2010). Sport science students' fitness at University Malaysia Sabah. European Journal of Social Science, 12 (4), 538-544.

Ganley, K. J., Paterno, M. V., Miles, C., Stout, J., Brawner, L., Girolami, G. & Meghan, W. (2011). Health-Related Fitness in Children and Adolescents. Pediatric Physical Therapy, 23(3), 208-220.

Gandhi, M., Koley, S. & Sandhu, J. S. (2010). Association between Antropometric Characteristics and Physical Strength in School Going Children of Amritsar. Antropologist, 12(1), 35-39.

Gonzales, J. U. & Scheuermann, B. W. (2007). Absence of gender differences in the fatigability of the forearm muscle during intermittent isometric handgrip exercise. Journal of Sports Science and Medicine, 6, 98-105.

Incel, N.A., Ceceli, E., Durukan, P.B., Erdem, H.R. & Yorgancioglu, Z.R. (2002). Grip strength: Effect of hand dominance. Singapore Medical Journal, 43 (5): 234-237.

Jae, S.Y., Carnethon, M.R., Heffernan, K.S., Choi, Y.H., Lee, M.K. & Ferhall, B. (2007). Association between cardiorespiratory fitness and prevalence of carotid atherosclerosis among men with hypertension. American Heart Journal, 153, 1001-1005.

Janssen, I. & Cramp, W. (2007). Cardiorespiratory fitness is strongly related to the metabolic syndrome in adolescents. Diabetes Care, 30 (8), 2143-2144.

Jurca, L., Lamonte, M.J., Barlow C.E., Kampert, J.B., Church, T.S. & Blair, S.N. (2005). Association of muscular strength with incidence of metabolic syndrome in men. Medicine and Science in Sports and Exercise, 37 (11), 1849-1855.

Kabir, I., Khatun, M., Islam, S., Mahalanabis, D. & Khaled, M.A. (1995). Estimation of body composition of adult Bangladesh male and female using bio-electrical impedance analysis. Engineering in Medicine and Biology society.

Kampert, J.B., Blair, S.N., Barlow, C.E. & Kohl, H.W., (1996). Physical activity, physical fitness, and all-cause and cancer mortality: A prospective study of men and women. Annals of Epidemiology, 6 (5): 452-457.

Koley, S., Khajuria, A. & Melton, S. (2010). The Correlation between back Strength and Leg Strength among Indian Inter-university male Cricketers. Physical Education and Sport, 8(2), 125-132.

Kurl, S., Laukkanen, J.A., Rauramaa, R., Lakka, T.A., Sivenius, J. & Salonen, J.T. (2003). Cardiorespiratory fitness and the risk for stroke in men. Archives of Internal Medicine, 163(14), 1682-1688.

Lamb, K.L., Brodie, D.A. & Roberts, K. (1988). Physical fitness and health-related fitness as indicators of a positive health state. Health Promotion International, 3 (2), 171-182.

Lakka, T.A., Laukkanen, J.A., Rauramaa, R., Salonen, R., Lakka, H.M., Kaplan, G.A. & Salonen, J.T. (2001). Cardiorespiratory fitness and the progression of carotid atherosclerosis in middle-aged men. Annals Internal Medicine, 134(1), 12-20.

Lakka, T.A., Laaksonen, D.E., Lakka, H-M., Mannikko, N., Niskanen, L.K., Rauramaa, R. & Salonen, J.T. (2003). Sedentary lifestyle, poor cardiorespiratory fitness, and the metabolic syndrome. Journal of the American College of Sports Medicine, 35 (8), 1279-1286.

Laukkanen, J.A., Lakka, T.A., Rauramaa, R., Kuhanen, R., Venalainen, J.M., Salonen, R. & Salonen, J.T. (2001). Cardiovascular fitness as a predictor of mortality in men. Archives of Internal Medicine, 161(6), 825-831.

Leger, L.A. & Lambert, J. (1982). A maximal multistage 20-m shuttle run test to predict VO_{2max}. European Journal of Applied Physiology Occupational Physiology, 49 (1), 1-12.

Leger, L.A., Mercier, D., Gadoury, C. & Lambert, J. (1988). The multistage 20 metre shuttle run test for aerobic fitness. Journal of Sports Science, 6 (2), 93-101.

Lemmink, K. A. P. M., Kemper, H. C. G., Greef, M. H. G., Rispens, P. & Stevens, M. (2003). The Validity of the Sit-and-Reach Test and the Modified Sit-and-Reach Test in Middle-Aged to Older Men and Women. Research Quarterly for Exercise and Sport, 74(3), 331-336.

Mayorga-Vega, D., Merino-Marban, R. &Viciana, J. (2014). Criterion-Related Validity of Sit-and-Reach Test for Estimating Hamstring and Lumbar Extensibility: a Meta-Analysis. Journal of Sports Science & Medicine, 13(1), 1-14.

Mayorga-Vega, D., Aquilar-Soto, P. &Viciana, J. (2015). Criterion-Related Validity of the 20-M Shuttle Run Test for Estimating Cardiorespiratory Fitness: A Meta-Analysis. Journal of Sports Science and Medicine, 14(3), 536-547.

McArdle W.D., Katch F.I. & Katch V.L. (2001). Exercise Physiology: Energy, Nutrition and Human Performance. (5^{th}ed.).Boston: William and Wilkins, 163.

McNaughton, L., Hall, P. & Cooley, D. (1998). Validation of several methods of estimating maximal oxygen uptake in young men. Percept Mot Skills, 87 (2), 575-584.

Mesa, J.L., Ortega, F.B., Ruiz, J.R., Castillo, M.J., Hurtig-Wennlof, A. & Gutierrez, A. (2006). The important of cardiorespiratory fitness for healthy metabolic traits in children and adolescents: the AVENA Study. Journal of Public Health, 14 (3), 178-180.

Metter, E.J., Talbot, L.A., Schrager, M. & Conwit, R. (2002). Skeletal muscle strength as a predictor of all-cause mortality in healthy men. Journal of Gerontology, 57 (10), 358-365.

Nourbakhsh M.R. & Arab, A.M. (2002). Relationship between mechanical factors and incidence of low back pain. Journal of Orthopedic & Sports Physical Therapy, 32 (9), 447-460.

Ortega, F.B., Ruiz, J.R., Castillo, M.J., Moreno, M.J., Urzanqui, A. & González-Gross, M. (2008).Health-related physical fitness according to chronological and biological age. Journal of Sports Medicine and Physical Fitness, 48 (3), 371-379.

Ortega, F.B., Ruiz, J.R., Castillo, M.J. & Sjostrom, M. (2008). Physical fitness in childhood and adolescence: a powerful marker of health. International Journal of Obesity, 32(1), 1-11.

Ortega, F.B., Artero, E.G., Ruiz, J.R., Vicente-Rodriguez, G., Bergman, P., Hagstromer, M., Ottevaere, C., Nagy, E., Konsta, O., Rey-Lopez, J.P., Polito, A., Dietrich, S., Plada, M., Beghin, L., Manios, Y., Sjostrom, M., & Castillo, M.J. (2008). Reliability of fitness assessment in adolescents. The HELENA Study.International Journal of Obesity, 32, 49–57.

Peel, J.B., Sui, X., Matthews, C.E., Adams, S.A., Hebert, J.R., Hardin, J.W., Church, T.S. & Blair, S.N. (2009). Cardiorespiratory fitness and digestive cancer and mortality: Findings from the aerobic center longitudinal study. Cancer Epidemiology Biomarkers & Prevention, 18 (4), 111-117.

Powell, K.E., Roberts, A.M., Ross, J.G., Phillips, M.A.C., Ujamaa, D.A. & Zhou, M. (2006). Low Physical Fitness AmongFith- and Seventh-Grade Students, Georgia. American Journal of Prevention Medicine,36 (4), 304-310.

Rana, J.S., Nasir, K., Santos, R.D., Roguin, A., Orakzai, S.H., Carvalho, J.A.M., Meneghello, R. & Blumenthal, R.S. (2006). Increased level of cardiorespiratory fitness blunts the inflammatory response in metabolic syndrome. International Journal of Cardiology, 110, 224-230.

Rantanen, T., Guralnik, J.M., Foley, D., Makasi, K., Leveille, S., Curb, J.D. & White, L. (1999). Middle hand grip strength as a predictor of old age disability. Journal of the American Medical Association, 281 (6), 558-560.

Raurama, R., Rankinen, T., Tuomainen, P., Vaisanen, S. & Mercuri, M. (1995). Inverse relationship between cardiorespiratory fitness and carotid atherosclerosis. Atherosclerosis, 112(2), 213-221.

Ruiz, J. R., Rizzo, N. S., Hurtig-Wennlöf, A., Ortega, F. B., W ànrnberg, J. &Sjöström, M. (2006). Relations of total physical activity and intensity to fitness and fatness in children: the European Youth Heart Study˙ The American Journal of Clinical Nutrition, 84(2), 299–303.

Ruiz, J.R., Ortega, F.B., Gutierrez, A., Meusel, D., Sjostrom, M. & Castillo, M.J. (2006). Health-related fitness assessment in childhood and adolescent: a European approach based on the AVENA, EYHS, and HELENA studies. Journal of Public Health, 14(5), 269-277.

Ruiz, J.R., Ortega, F.B., Rizzo, N.S., Villa, I., Wennlof, A.H., Oja, L. & Sjostrom, M. (2007). High cardiovascular fitness is associated with low metabolic risk score in children: The European Youth Heart Study. Pediatric Research, 61 (3), 350-355.

Ruiz, J.R., Casto-Pinero, J., Artero, E.G., Orgeta, F.B., Sjostrom, M., Suni, J. & Castillo, M.J. (2009). Predictive validity of health-related fitness in youth: A systematic review. Britisih Journal of Sports Medicine, 43(12), 902-923.

Ruiz, J.R., Sui, X., Lobelo, F., Jr, J.R.M., Jackson, A.W., Sjostrom, M., & Blair, S.N. (2008). Association between muscular strength and mortality in men: prospective cohort study. British Medical Journal, 337: 439-448.

Russell, R. P., Chia, Y.W., Marsha, D., Farrell, S. W. &Jennife, R. O. (2006). Cardiorespiratory fitness levels among US youth 12 to 19 years of age. Archives Pediatric Adolescent Medicine, 160(10), 1005-1012.

Saint-Maurice, P. F., Welk, G. J., Burns, R., Plowman, S. A., Corbin, C. B. &Hannon, J. C. (2015). The criterion-referenced validity of the FITNESSGRAM Trunk-Extension test. The Journal of Sports Medicine and Physical Fitness, 55(2), 1-12.

Sherphard R.J. & Pimm P. (2009). Physical Fitness of Canadian Physical Education Students with a Note on International Differences. British Journal of Sports Medicine, 9(4), 165-174.

Shiwa, K., Anuurad, E., Enkhmaa, B., Kitajima, K. & Yamane, Y. (2004). Appropriate BMI for Asian populations. The Lancet, 363(9414), 1077.

Sloan, R., Sawada, S.S., Martin, C.K., Church,T. & Blair, S.T. (2009). Association between cardiorespiratory fitness and health-related quality of life. Health and Quality of Life Outcomes. 7 (47), 1-5.

Snih, S. A., Markides, K. S., Ray, L., Ostir, G. V. & Goodwin, J. S. (2002). Handgrip Strength and Mortality in Older Mexican Americans. Journal of the American Geriatrics Society, 50(7), 1250-1256.

Sobush, D.C. & Fehring, R.J. (1983). Physical Fitness of Physical Therapy Students. Physical Therapy, 63 (8), 1266-1273.

Sproule, J., Kunalan, C., McNeil, M. & Wright, H. (1993). Validity of 20-MST for predicting VO_{2max} of adult Singaporea athletes. British Journal of Sports Medicine, 27 (2), 202-204.

Steele, R.M., Brage, S., Corder, K., Warehem, N.J. & Ekelund, U. (2008). Physical activity, cardiorespiratory fitness, and the metabolic syndrome in youth. Journal of Applied Physiology, 105(1), 342-251.

Taylor, H.L., Buskirk, E. & Henschel, A. (1995). Maximal oxygen uptake as an objective measure of cardiorespiratory performance. Journal of Applied Physiology, 8(1), 73-88.

Thompson, A.M., Church, T.S., Janssen, I, Katzmarzyk, P.T., Earnest, C.P., & Blair, S.T. (2008). Cardiorespiratory fitness as a predictor of cancer mortality among men with pre-diabetes and diabetes. Diabetes Care, 31 (4), 764-769.

Trainor, T.J. &Trainor, M.A. (2004). Etiology of low back pain in athletes. Current Sports Medicine Reports, 3 (1), 41-46.

Warburton, D.E., Gledhill, N., &Quinney, A. (2001). Musculoskeletal fitness and health. Canadian Journal of Applied Physiology, 26 (2), 217-237.

Watters, D.A.K., Haffejee, A.A., Angorn, I.B., & Duffy, K.J. (1985). Nutritional assessment by hand grip dynamometry. South Africa Medical Journal, 68(8), 585-587.

Wei, M., Gibbon, L.W., Kampert, J.B., Nichaman, M.Z., & Blair, S.T. (2000). Low cardiorespiratory fitness and physical inactivity as predictors of mortality in men with type 2 diabetes. Annals of Internal Medicine, 132 (8), 605-611.

Witvrouw, E., Danneels, L., Asselmen, P., D'Have, T., & Cambier, D. (2003). Muscle flexibility as a risk factor for developing muscle injuries in male professional soccer players: A prospective study. American Journal of Sports Medicine, 31 (1), 41-46.

Yamamoto, K., Kawano, H., Gando, Y., Iemitsu, M., Murakami, H., Sanada, K., Tanimoto, M., Ohmori, Y., Higuchi, M., Tabata, I. & Miyachi, M. (2009). Poor trunk flexibility is associated with arterial stiffening. American Journal of Physiology Heart and Circurlation Physiology, 297(4), 1314-1318.

Zaqout, M., Vyncke, K., Moreno, L. A., Miguel-Etayo, P. D. Lauria, F. Molnar, D., Lissner, L., Hunsberger, M., Veidbaum, T., Tornaritis, M., Reisch, L.A., Bammann, K., Sprengeler, O., Ahrens, W. & Michels, N. (2016). Determinant factors of physical fitness in European children. International Journal of Public Health,61(5), 573-582.

Zoeller, R.F., Riechman, S.E., Dabayebeh, I.B., Goss, F.L., Robertson, F.L. & Jacobs, P. (2005). Relation between muscular strength and cardiorespiratory fitness in people with thoracic-level paraplegia. Archives of Physical Medicine and Rehabilitation, 86 (7), 1441-1446.