ORIGINAL ARTICLE

Level of Physical Fitness among Physiotherapy Students in Public Universities in Malaysia

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ABSTRACT

Introduction: Physiotherapy profession requires a reasonably high level of physical fitness. This is due to their nature of job requiring them to do a lot of lifting and transferring of patients, use the extremities to give support and resistance during assessment and treatment, and prescribing exercise not only to patients but also to fit athletes. However, lack of attention was given to the physical fitness of physiotherapy students. The objective was to determine the level of physical fitness among physiotherapy students attending public universities in Malaysia. **Methods:** Each participant performed six physical fitness tests reflecting the four components of physical fitness. The Tanita-BC730G BIA was used to examine body composition. Push up and curl-up, shoulder scratch and back saver sits and reach (BSSR) and three-min step tests were used to determine muscular endurance, upper and lower limb flexibility and cardiorespiratory endurance, respectively. The scores were then categorized based on the normative values of each test. **Results:** A total of 261 participants completed all tests. For body composition, 73 (28%) participants were either overweight or obese. When compared to their normative values, both curl-up (17.2±11.2 reps in male and 7.1±8.7 reps in female) and heart recovery rate after the three-min step test (102±22bpm and 114±20bpm) were scored below average. For flexibility test, the BSSR was scored below average only in female (10±3.0 for right side and 11±3.1 for left vs. 12 inches). **Conclusion:** The level of physical fitness among physiotherapy students in public universities in Malaysia is somewhat below average.
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Keywords: Body composition, Malaysia, Physical fitness, Physiotherapy, Student

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INTRODUCTION

The American College of Sports Medicine (ACSM) (1) defines physical fitness as "a set of attributes that people have or achieve that relates to their ability to perform physical activity". There are four main components of physical fitness which include i) body composition, ii) muscular strength and endurance, iii) muscular flexibility and iv) cardiorespiratory fitness. Body composition is referring to the body core components such as Body Mass Index (BMI), body circumferences, skinfold measurements, densitometry, body fat %, body water % and muscular mass. The other three components of physical fitness involve physical tests such as curl-up and push-up tests for abdominal and upper limb muscular strength and endurance, shoulder scratch (SS) and back saver sit and reach (BSSR) tests for upper and lower limb flexibility, and three-min step test for cardiorespiratory fitness (1).

Physiotherapy profession requires a reasonably high level of physical fitness (2). This is due to their nature of job requiring them to do a lot of lifting and transferring of patients, use the extremities to give support and resistance during both assessment and treatment, and prescribing exercise not only to patients but also to athletes and healthy individuals. Physiotherapists also act as a role model and usually is the person referred for information and guidance on matters related to physical fitness. However, health care professionals, including physiotherapist, have been frequently reported adopting a sedentary lifestyle (3, 4). For example, Bello et al. (4) found that as high as 53% of Ghanaian physiotherapist aged between 21 and 59 years were under-exercised (i.e., < once/ week exercise engagement). In another example, Smetaniuk, T., et al. (3) found that only 26%

of Master of Physiotherapy students at University of Saskatchewan, Canada met the country recommended physical activity guidelines. The students even found to spend as high as 73% (i.e., 670.7 minutes) of their waking hours (i.e., 914.5 minutes) being sedentary (i.e., activities characterized by an energy expenditure of ≤ 1.5 metabolic equivalents such as sitting and standing).

Studies investigated the level of physical fitness among undergraduate physiotherapy students are limited. Three studies have been available to date of which two reported between 40% and 50% of the students were under low and average level of physical fitness category (2, 5) and one found that over two years of studying physiotherapy, there were no significant changes in cardiovascular and muscular endurance but a trend towards an increase in body fat percentage (%) (6). In Malaysia, studies reporting the level of physical fitness among healthcare professionals or health sciences students are scarce. We see that reporting the level of physical fitness in physiotherapy students is an important step in creating awareness on the importance of active lifestyle among health care professionals, specifically physiotherapy as early as during undergraduate study. Therefore, the objectives of this study were to (i) describe the level of physical fitness among physiotherapy students in public universities in Malaysia, and (ii) compare the level of physical fitness between male and female students.

MATERIALS AND METHODS

A cross-sectional study involving physiotherapy students from all three public universities offering Physiotherapy Bachelor Degree program in Malaysia was undertaken from April 2018 to May 2019. All participants attended a single testing session that lasted for approximately two hours duration at the gym of their respective universities. Each participant performed six different assessments in the following order: (i) body composition, (ii) curl-up, (iii) push-up, (iv) shoulder scratch, (v) back-saver sit and reach and (vi) three-minutes step test. The participants were given a minimum of five minutes rest in between tests. The protocol of the study was approved by the Human Research Ethics Committees of each participated universities (REC/504/18, KAHS 084/19). Informed consent was obtained from all participants before data collection.

Inclusion criteria comprised (i) age between 19 and 28 years and (ii) enrolled into physiotherapy bachelor degree program in either of the three public universities. Exclusion criteria for this study were those presented with (i) any of the contraindication for exercise and exercise testing (1), (ii) medical issues such as any cardiopulmonary (e.g., asthma), endocrine (e.g., hyper/hypothyroidism) and (iii) musculoskeletal pain/injury (e.g., low back pain, knee pain) that could affect their performance during assessment. Prior to the actual testing day, potential participant's free schedule was identified, and an appointment was made with the class representative. Participants were informed to (i) wear suitable clothing, (ii) avoid consumption of heavy meals/beverages and (iii) emptied their bladders immediately before the tests.

Measurement

Body composition: Height and weight were measured and recorded with participants standing upright without shoes on the height-weighing scale. Body mass index was determined as weight /height2 (kg/m2). Tanita Body Composition Monitor, model BC730 (Tanita Corporation, Tokyo, Japan) was used to measure body composition (i.e. body fat, body water and muscular mass %). The Tanita Body Composition has a high validity in comparison to air displacement plethysmography (ADP) measurement (r=0.972, SEE = 1.7kg on average) (7). Participants were asked to stand still barefoot for ten seconds while the investigator took the measurements. The categorization of body composition in this study were based on the Tanita Body Composition Monitor, model BC730 manufacturer guide (8). For BMI, the participants were classified as underweight for BMI < 18kg/m2, normal for BMI = 18.5 to 24.9kg/m2 or overweight/obese for BMI > 25kg/m2. For body fat % (BF), the participants were classified as underfat for BF<10% for male and <20% for female, healthy for BF = 10-25% for male and 20-35% for female or overfat/obese for BF > 25% for male and >35% for female. The muscular mass % was determined based on index amount of muscle against height (8).

Muscular endurance: A 900 push-up and curl-up tests were used to measure upper limb and abdominal muscular endurance. This tests has demonstrated a moderate correlation (r=0.64) with bench press test (9). For 900 push-up tests, the participants were asked to repeat the push-up movement at their own comfortable speed with no rest until fatigue. Similarly, for curl-up test they were asked to repeat the curl-up movement at their own comfortable speed with no rest until fatigue (10). The investigator then recorded the total number of repetitions completed in both tests.

Muscular Flexibility: A SS and BSSR were used for testing of the upper and lower muscular flexibility. Both test has been shown to be valid in measuring upper and lower muscular flexibility (11). For SS test, participants were asked to reach the right shoulder and down the back (scratch the shoulder blade) and at the same time places their left hand behind the back and tried to touch the fingers of the right hand. For BSSR, the participants extend their arm forward slowly over the measuring scale as far as possible and hold the position for at least 1 second (12). The investigator then recorded the distances between the overlapped fingers in SS test and the furthest distance achieved on measuring scale in BSSR test.

Cardiorespiratory Fitness: A three-minutes step test

performed on a standardised step (approximately 12 inches height) was used to measure cardiorespiratory fitness. The three-minutes step test has been shown to be a valid test in measuring cardiorespiratory endurance. Specifically, the test outcome has been found to have strong association with maximal exercise treadmill test (r=0.80) (13). In this test, participants were asked to repeat the movement up-up-down-down following the metronome cadence (96 beats/minute) for three minutes. The heart recovery rate (HRR) immediately between five and 20 seconds after the end of the step test was recorded as the test outcome (14). HRR level above 100 bpm for males and 110 for females indicate below average performance (15).

Sample size

Sample size was calculated by using the Raosoft calculator with a margin error set at 5%, confidence interval set at 95% and a response distribution of 50%. Given that the total number of potential study participants was 345 (institution A [n=205], institution B [n=49] and institution C [n=91]), the recruitment target for this study was 252 (institution A [n=134], institution B [n=44] and institution C [n=74]). The number was then inflated by 5% to account for any dropouts from those who may not be able to complete all test in one day or refuse any test(s) required for the study. Quota sampling method was used to ensure that an equal proportions of study participants were recruited from each institution.

Statistical analysis

Data were analysed by using the Statistical Package for Social Sciences version 21 (SPSS V.21). Descriptive statistical analysis was used to report the mean and standard deviation (Mean ± SD) of all continuous data, while number (%) were used to report categorical data. Independent t-test was used to compare the difference in the level of physical fitness between males and females.

RESULTS

Flow of the participants into the study is summarized in Figure 1. A total of 261 participants were recruited. Characteristics of the study participants and the results of their physical fitness assessments are summarized in Table I.

Level of physical fitness among physiotherapy students in public universities in Malaysia

As shown in Figure 2, majority of the participants (48% males and 61% females) lie within normal BMI category, followed by overweight/obese (38% males and 26% females) and underweight (15% males and 13% females). A similar pattern can be observed for body fat %. Majority (60% males and 48% females) were categorised as healthy, followed by overfat/obese (23% males and 24% females) and underfat (10% males and 29% females). For muscular mass, more than 90% of the participants had either high or very high muscular

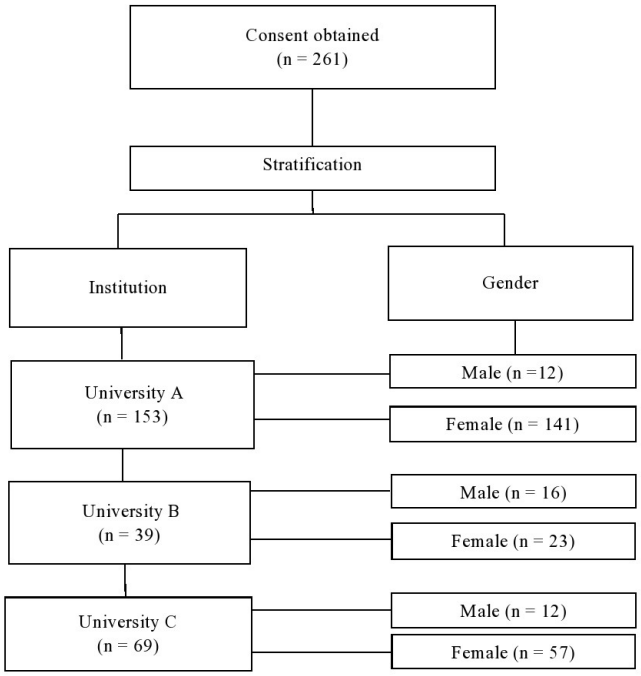

Figure 1: Flow chart showing the number, and the distribution of the sample according to institutions and gender

Table I: Characteristics of the study participants and their physical fitness assessments

Variables	All (N=261)	Male (n=40)	Female (n=221)
Age, yr	22±1.6 (19-28)	22±2.0 (19-28)	22±1.6 (20-28)
Height, cm	159±7.2 (145-179.7)	170±4.7 (160-179.7)	157±5.5 (145-171)
Weight, kg	58.5±13.7 (32.5-107.9)	68.7±15 (46.5-107.9)	56.7±12.6 (32.5-99.8)
Body composition			
BMI, kg/m²	23.1±4.8 (15.3-42.6)	23.7±4.8 (16.4-36.5)	23±4.8 (15.3-42.6)
Muscular mass	41.2±7.4 (27.7-69)	53.9±7.3 (41.8-69)	38.8±4.5* (27.7-51.9)
Body fat percentage, %	24.4±9.3 (5-46.8)	15.9±7.3 (5-33.8)	26±8.8* (5-46.8)
Body water	53.7±6.4 (38.8-70.5)	61.2±5.8 (48.5-70.5)	52.3±5.5* (38.8-68)
Muscular endurance			
Curl-up, rep	8.7±9.8 (0-50)	17.2±11.2 (0-50)	7.1±8.7* (0-40)
Push-up, rep	13.0±9.1 (0-60)	20.5±12.3 (0-60)	11.6±7.7* (0-40)
Muscular Flexibility			
SS			
Right, cm	4.6±4.4 (-12.5-15.8)	5.3±5.6 (-9.7-15.3)	4.5±4.1 (-12.5-15.8)
Left, cm	0.9±6.8 (-25-22.7)	0.7±8.9 (-25-22.7)	0.9±6.4 (-20.3-13.2)
BSSR			
Right, cm	10.8±3.0 (2.5-18.8)	10.3±2.9 (4-18.8)	10.9±3.1 (2.5-18.5)
Left, cm	10.9±3.2 (3-19.0)	10.6±3.2 (4-18.9)	11±3.2 (3-18.2)
Cardiorespiratory Fitness			
3-min step test, bpm	112.6±20.7 (51-167)	102.3±21.8 (66-140)	114.5±12* (51-167)

Data are presented as Mean ± standard deviation and (range). Abbreviation: BMI, Body Mass Index; bpm, beat per minute; BSSR, Back-saver sit and reach; Rep, Repetition; SD, Standard deviation; SS, Shoulder Scratch. *Significant at p<0.05

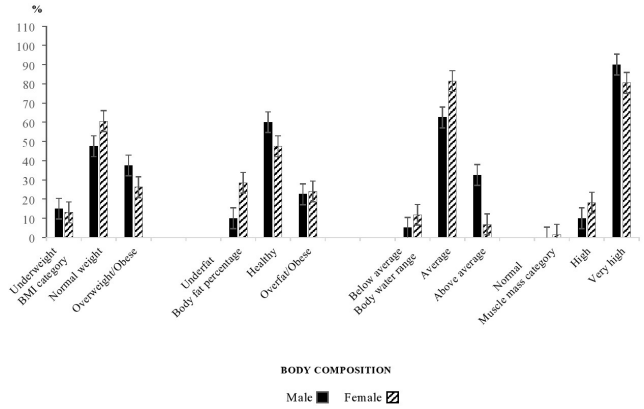

Figure 2: Bar chart of the distribution of male and female participants in BMI category, body fat percentage, body water and muscle mass. Data are presented as mean ± standard error. Abbreviation: BMI, body mass index

mass (100% in males and 99% in females).

Table II reports the findings for muscular endurance, muscular flexibility and cardiorespiratory fitness in all 261 participants in relation to their gender-specific normative values. Both genders demonstrated poor abdominal muscular endurance (17 vs. 24 and 7 vs. 18 repetitions in males and females, respectively), but good upper limb muscular endurance (20 vs.18 repetitions and, 11 vs. 7 repetitions in males and females, respectively). In term of muscular flexibility, both genders demonstrated flexible upper limb (0.7 cm in males and 0.8 cm in females vs. "+ve value"). The BSSR, a test for determining the lower limb muscular flexibility was scored below average only in female students (10±3.0 for right side and 11±3.1 for left vs. 12 inches). For the three-min step test, HRR in both genders were higher than their normative values (102 bpm vs. 95 - 100 bpm and 114 bpm vs. 104 - 110 bpm in males and females, respectively), thus indicating a below average cardiorespiratory endurance of the students.

Table II: Comparison of muscular endurance, muscular flexibility and Cardiorespiratory Fitness with gender-specific norms

Gender/ Variables	♂ (n=40)		♀ (n=221)	
	Actual score	Normal range	Actual score	Normal range
Muscular endurance				
Curl-up, rep	17±11.2	≥24	7±8.7	≥18
Push-up, rep	20±12.2	≥18	11±7.7	≥7
Muscular flexibility				
SS Right, cm	5±5.5	Flexible: '+'ve value	4±4.1	Flexible: '+'ve value
SS Left, cm	0.7±8.8	Flexible: '+'ve value	0.8±6.3	Flexible: '+'ve value
BSSR Right, inches	10±2.8	8	10±3.0	12
BSSR Left, inches	10±3.1	8	11±3.1	12
Cardiorespiratory Fitness				
3-min step test HRR, bpm	102±21.8	95-100	114±19.9	104-110

Data are presented as Mean ± Standard Deviation. ♂: Male, ♀: Female. Abbreviations: BMI, Body Mass Index; bpm, beat per minute; BSSR, Back-saver sit and reach; HRR, Heart Recovery Rate (measured between 5 and 20 seconds after the completion of the 3-min step test); SS, Shoulder Scratch

Levels of physical fitness between males and females

There were significant differences in muscular mass, body fat %, and body water %, abdominal and upper limb muscular strength and endurance and cardiorespiratory fitness between male and female students (Table I). For body composition, males demonstrated with higher muscle mass and body water % when compared to females (t=17.3; p= 0.001 and t=9.3, p=0.001, respectively). Females, on the other hand, demonstrated higher body fat % when compared to males (t=-6.8, p=0.001). For abdominal and upper limb muscular strength and endurance, males demonstrated a higher number of repetitions when compared to females (t=6.5, p=0.001 and t=6.0; p=0.001, respectively). Both genders were not significantly different in term of upper limb and lower limb flexibility (t=1.0, p=0.304 and t=-1.0; p=0.279, respectively). For cardiorespiratory fitness, males had a lower HRR when compared to females (t=-3.5, p=0.001).

DISCUSSION

The present study found that majority of the participants were under both normal BMI and body fat % category, followed by being overweight/obese/overfat and underweight/under-fat. As high as 38% and 26% of the male and female students were either overweight or obese. This finding is considered important given that physiotherapist, as a profession that prescribe exercise to others should have portrayed themselves as someone who are fit and not overweight or obese. Importantly, earlier studies have demonstrated that physical condition of program personnel (e.g., being overweight) significantly influenced the patient's/ client's compliance towards the treatment (3, 4). Other than that, being overweight/obese has been shown to be associated with increased risk of developing health issues such as dyslipidaemia, type 2 diabetes, hypertension, cancers and musculoskeletal disorders (16). In fact, high prevalence of musculoskeletal disorders (MSDs) has been reported among physiotherapists with a BMI over 25kgm-2 when compared to those with normal or underweight BMI categories (80% vs. 70% vs. 56%) (17). The number of students in the present study with overweight/obese BMI category is also greater than the other two earlier studies (2, 5) that reported only 13% (2) and 16% (5) of the physiotherapy students in India and Ukraine, respectively were either overweight or obese. The inconsistency may be explained by the difference in ethnicity, culture, and level of physical activities of the participants between the studies. For example, the prevalence of inactive Malaysian as reported in 2012 was almost doubled than that reported among Indian and Ukrainian (>50% vs. 19.9% vs. 20-29%) (18).

Higher muscular mass and lower fat mass in males in comparison to females in the present study are consistent with previous studies that also reported higher skeletal muscular weight (males 33.7 kg vs. females 21.8 kg) (19) and lower fat mass (males 13.2% vs. females 24.3%) (6) in males physiotherapy students. From a physiological point of view these differences can be explained by the sex typical differences of the endocrinological and metabolic situation during adolescence. However, there is also relationship between behavioral factors and body composition independent of gender. For instance, previous studies have found that body composition parameters were also associated with the level of physical activity and some components of body composition, specifically the body fat mass independently of gender was negatively associated with physical activity (20). Lean body mass in contrast, was positively associated with physical activity. These results indicate that physical activity independent of gender typical physiological parameters may also influenced body composition (21). Male, on the other hand has been frequently demonstrated to adopt to a more physically active lifestyle compared to females (21, 22).

Both genders in this study demonstrated poor abdominal muscular endurance. Poor abdominal muscular endurance in physiotherapy students may predict future occurrences of MSDs because the nature of work of either a physiotherapist or the training for physiotherapy students involves frequent transfer of patient and lifting, and demand prolonged standing (e.g., during clinical training at the hospital) (2). Thus, weakness of abdominal muscles may predispose the students at higher risk of MSDs such as low back pain and knee injury. A study conducted among physiotherapy students in Australia demonstrated a high prevalence of low back pain among the students, and the risk was associated with increased contact hours with patients during clinical training at the hospitals (23). The findings in the present study are inconsistent with a study by Balogun, J.A. (24). In his study, physiotherapy students' muscular endurance was scored average. However, direct comparison between studies may not be possible given that abdominal muscular strength and endurance was tested using 1-minute curl-up test in the previous study while students in the present study were asked to repeat the curl-up movement at comfortable speed until fatigue. Of note, the number of curl-up repetitions in the previous study was almost triple than that reported in the present study (26±1 vs. 9±10 repetitions). The fact that no time factor was imposed during the curl-up test in the present study could have in part explained the poor performance in this test in the present study, and the instruction to repeat the movement "until fatigue" where "fatigue" could have been perceived very differently between individuals may explained the great variations (i.e., the width of the SD) in the curl-up scores between students in the present study. Both male and female students demonstrated a good upper limb muscular endurance. This finding may be explained by the student's substantial involvement in hands-on activities such as joint mobilisation, PNF techniques, and manual muscle testing during academic time that have indirectly increased their upper limb muscle performance. According to McWhorter (6), the physiotherapy students spent almost 10 hours practising hands-on techniques every week.

In this study, all students demonstrated good upper limb and lower limb flexibility (only for male). Optimal muscular flexibility is necessary for physiotherapists to work efficiently, as deterioration may lead to musculoskeletal disorders. For example, poor hip and low back flexibility are known factors that contribute to the gradual development of muscular related low back pain (25). Consistent with Multani et al. (2), physiotherapy students in India also demonstrated good lower limb flexibility (i.e., 77% of the students able to touch their toes or remain at least in the range of ≥ 10 cm above the toes on toe touch test). Although female students in the present study demonstrated slightly below average lower limb flexibility when compared to their normative data, their lower limb flexibility were similar ($p>0.05$) when compared to the male students who scored good muscular flexibility (Table I). The higher normative values for flexibility in female when compared to male can be explained by the difference in the proportion of muscle viscoelastic properties between males and females. Females are stipulated to have greater muscle viscoelastic properties, allowing their muscles to be lengthened and deformed at a greater range, and therefore present with greater muscular elasticity than males (26-28).

Heart recovery rate in both male and female students fall under the category of "below average" (102±22 bpm vs. 95-100 bpm for "average" category and 114±20 bpm vs. 104-110 bpm for "average" category, respectively). Our result was consistent with Bello, Bonney & Opoku (4) who also reported a HRR that is higher than the "average" among Ghanaian physiotherapists. In our case, it may be due to the commitments of the students in academic sessions. McWhorter (6) suggested that the overwhelming schedules of classes and tutorials are responsible for the significant deterioration in cardiorespiratory fitness among the students. A direct comparison between the finding of the present study with those reported earlier was somehow challenging due to the discrepancies in the measurement methods between the studies. Previous studies had used a variety of measurement tools that include the three min step test (4), 100m, 1500m, or 12 minutes run test (2, 29), Harvard step test (2) and Physical Working Capacity (30). When compared between gender, males had significantly lower HRR than females, despite both genders scored under "below average" category. The finding may be explained by the fact that female students usually are less active than male students at the university. For example, one earlier study (22) found that females

were 19% less active than their male colleagues. Females were also found to have lower participation in extracurricular events and reported significantly lower perceived competence on physical education at school than males (22).

CONCLUSION

The level of physical fitness among physiotherapy students in public universities in Malaysia was below average. Measures to create awareness and subsequently improve and maintain the physiotherapy students' level of physical fitness is needed during their academic years. This can be achieved by introducing physical fitness screening at program enrolment and implementing yearly fitness screening to the students. Disseminating the results of the present study to the students may promote fitness culture early. This is important later in their career life especially when physiotherapist is always being looked forward as an ambassador of active lifestyle. Future research should be tailored towards the establishment of appropriate levels of physical fitness for enrolment into physiotherapy study.

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