

## Health-Related Physical Fitness Components in Saudi Female Physical Education and Sport Sciences University Students

Mohammad Ali Alahmadi\*

*Department of Physical Education and Sport Sciences, College of Education, Taibah University, Madinah, Saudi Arabia*

**\*Corresponding Author:** Mohammad Ali Alahmadi, Department of Physical Education and Sport Sciences, College of Education, Taibah University, Madinah, Saudi Arabia.

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### Abstract

In Saudi Arabia, physical fitness as an indicator of health and well-being among Saudi females remains poorly investigated compared to physical activity or sedentary behaviour. Therefore, this study aimed to measure health-related physical fitness components (cardiorespiratory fitness, body fat, muscle strength, and flexibility) among Saudi female Physical Education and Sport Sciences (PESS) students at Taibah University in Madinah city, western Saudi Arabia. Forty female students (mean  $\pm$  standard deviation, age  $18.7 \pm 0.6$  years; body mass  $54.7 \pm 10.8$  kg; height  $156.9 \pm 5.5$  cm) performed QCST to estimate maximal oxygen consumption (VO<sub>2</sub>max). Body fat percentage was determined using a bioelectrical impedance analyzer. Hand grip strength was measured using a hand grip dynamometer, and flexibility was determined using the sit and reach test. The mean ( $\pm$  standard deviation) of the estimated VO<sub>2</sub>max was  $36.3 \pm 3.7$  (ml.kg.min). The mean ( $\pm$  standard deviation) of body fat percentage, hand grip strength, and flexibility were  $32.3 \pm 7.8$  (%),  $17.5 \pm 5.0$  (kg), and  $16.6 \pm 3.0$  (cm), respectively. It is concluded that a high body fat percentage combined with poor hand grip strength indicates poor physical fitness outcomes. These indicators should both be targeted as a means of improving health status among Saudi female PESS students at Taibah University.

**Keywords:** *Physical Activity; Exercise Training; Flexibility; Muscle Strength; Obesity; Saudi Arabia*

### Abbreviations

BMI: Body Mass Index; CVD: Cardiovascular Disease; VO<sub>2</sub>max: Maximal Oxygen Consumption; PESS: Physical Education and Sport Sciences; PE: Physical Education; QCST: Queen's College Step Test; SD: Standard Deviation

### Introduction

The prevalence of obesity and overweight status in Saudi Arabia is worrying and it has escalated substantially in recent decades to become a country with one of the highest rates of obesity and overweight people in the world [1,2]. Additionally, the high prevalence of physical inactivity, especially among Saudi females, has become a major public health issue [3-5]. Findings from a new research indicated that more than 91% of Saudi females did not engage in any type of physical activity [6]. For several decades, physical education (PE) was not offered to Saudi females in public schools. However, Saudi Arabia recently introduced PE for schoolgirls, with PE classes for girls in public schools beginning in the 2018 academic year. This new Saudi policy emphasizing PE, sports, and physical activity for girls is regarded as a significant step in the right direction. Accordingly, the new Physical Education and Sport Sciences (PESS) major for Saudi females recently launched at several Saudi Universities, including Taibah University in Madinah city, western Saudi Arabia. To the best of our knowledge,

no previous study has measured physical fitness components among female university students in the field of PESS. Physical fitness as an indicator of health and well-being among Saudi females also remains poorly investigated compared to physical activity [7-17]. To date, only one study has addressed health-related physical fitness components in Saudi female children aged between 8 and 15 years [18].

### Aim of the Study

The present study aimed to measure the main components of health-related physical fitness among Saudi female PESS students at Taibah University.

### Materials and Methods

#### Participants and study procedure

Forty female students (mean  $\pm$  SD, age  $18.7 \pm 0.6$  years; body mass  $54.7 \pm 10.0$  kg; height  $156.9 \pm 5.5$  cm) participated in this study. The female PESS students were selected and randomly chosen from Taibah University in Madinah city, western Saudi Arabia, during the first semester of the 2018 - 2019 academic year. All female students were already enrolled in the required Sport Sciences and Physical Activities program, a four-year bachelor's degree offered by the Department of Physical Education and Sport Sciences, College of Education at Taibah University. The study protocol and procedures conform to the ethical guidelines, and all participants signed an informed consent form. Participants were included if they answered "no" to all questions in the Physical Activity Readiness Questionnaire. Participants suffering from any musculoskeletal disorder and those with a history of cardiovascular disease (CVD) or other serious health concerns were excluded.

#### Measurements

##### Anthropometry and body composition

Body weight was estimated to the nearest 100 g using a body weight scale (Seca, Germany), and stature was estimated to the nearest 0.1 cm using a stadiometer (Seca, Germany). Body mass index (BMI) was determined based on stature and body weight using the following equation:  $BMI = \text{body weight}/\text{stature}^2$ .

Body fat percentage was measured using a bioelectrical impedance analyzer (OMRON, BF511 body composition monitor). In accordance with the manufacturer's instruction manual, the participants wore light clothes and no shoes, and the bioelectric impedance measurement was performed with the participants placing their feet together on the foot electrodes with their weight equally distributed. The participants held their knees and backs in a straightened position, with the arms extended forward and the hands holding the grip electrodes for a few seconds. The fat percentage readings appeared on the display unit and were recorded. Body fat percentages of 30% or greater were classified as obese in accordance with Okorodudu, *et al* [19].

##### Prediction of maximal oxygen consumption (VO<sub>2</sub>max) by Queen's College Step Test

VO<sub>2</sub>max was estimated indirectly using the Queen's College Step Test (QCST) with a box of 41.3 cm in height. The step rest was three minutes in duration, during which a metronome set to a rate of 24 cycles per minute was used. After the completion of the step test and during the recovery time, each student's carotid pulse rate was measured from the 5<sup>th</sup> to the 20<sup>th</sup> second and was then converted into beats per minute. To estimate VO<sub>2</sub>max, the following equation was used by McArdle, *et al*. [20]:  $VO_2\text{max (ml.kg.min)} = 65.81 - (0.1847 \times \text{pulse rate in beats per min})$ .

**Hand grip strength**

Maximal isometric handgrip strength was measured using a hand grip dynamometer (Takei Kiki Kogyo® dynamometer) adjusted to hand size. A single measurement was taken for each hand to obtain the maximal isometric handgrip strength values. Each subject was instructed to maintain maximal isometric contraction for three seconds during each measurement [21,22]. The participants performed the contractions with each hand and with both feet on the floor; their shoulders flexed at 90° and their elbows completely extended. Both hands were assessed, and handgrip strength was obtained from the preferred hand and rounded to the nearest 1 kg. The higher values were recorded and used for analysis.

**Flexibility**

Flexibility was determined using the sit and reach test. In this test, the participants sat with their knees straight, their feet flat against a bench, and their hands in front of them, with one on top of the other and palms facing downwards. Each participant then gradually inclined her trunk as far forward as possible. The participants were not permitted to bounce or lunge. Participants reached forward and held their position for two seconds. The distance was then recorded in centimeters (cm).

**Statistical analysis**

The data were analyzed using the statistical software package SPSS, version 21. Descriptive statistics are presented as mean values and standard deviation (SD).

**Results**

Forty female PESS students were assessed to determine the four main components of health-related physical fitness. Table 1 presents the average and SD values for the participants’ characteristics and the four health-related physical fitness components: cardiorespiratory fitness (expressed as VO<sub>2</sub>max), body composition (expressed as body fat percentage), muscle strength (expressed as hand grip strength), and flexibility.

Variable	Results
Age (years)	18.7 ± 0.6
Body mass (kg)	54.7 ± 10.8
Height (cm)	156.9 ± 5.5
BMI (kg/m <sup>2</sup> )	22.3 ± 3.8
VO <sub>2</sub> max (ml.kg.min)	36.3 ± 3.7
Body fat percentage (%)	32.3 ± 7.8
Hand grip strength(kg)	17.5 ± 5.0
Flexibility (cm)	16.6 ± 3.0

**Table 1:** Physical characteristics and health-related physical fitness components of female Saudi PESS students at Taibah University.

**Discussion**

The present study’s primary aim was to measure the main components of health-related physical fitness (cardiorespiratory fitness, body fat, muscle strength and flexibility) in a sample of Saudi female PESS students at Taibah University. To the best of our knowledge,

our study is the first of its kind to measure the four main components of health-related physical fitness in young Saudi female university students in the field of PESS. Assessment of health-related physical fitness components among Saudi females is rare and only one study to date has measured these components together in relation to BMI in a sample of young Saudi females aged 8 - 15 years [18].

The first component is cardiorespiratory fitness, which is recognized as an independent risk factor for CVD [23]. Studies have reported that low cardiorespiratory fitness levels are linked to the risk of developing type 2 diabetes and metabolic syndrome [24-26] and that high cardiorespiratory fitness levels are associated with better cardiovascular health indicators, such as normal blood pressure, favorable lipid profiles and reduced risk of morbidity and mortality in adulthood [27,28]. It is sometimes difficult to compare our results to reported findings regarding  $VO_2$ max obtained from different exercise protocols, although there are few studies performed in Saudi Arabia that measure cardiorespiratory fitness components using a standard exercise fitness test among Saudi females. Only one study exists, to our knowledge, measuring  $VO_2$ max directly using a gas exchange analyzer (COSMED system) in 70 Saudi female university students (aged 19 - 25 years) and found that Saudi female students with low  $VO_2$ max (< 28.9 ml.kg.min) have an increased risk of developing cardiovascular diseases, compared to those with high  $VO_2$ max (> 33ml.kg.min) [29]. Two studies used indirect measures and applied the Bruce Treadmill Protocol to predict  $VO_2$ max from the total time until exhaustion in young Saudi female university students and showed that the average  $VO_2$ max achieved was between 30.7 and 32.0 (ml.kg.min) [30,31]. Saudi female PESS students in the present study achieved higher cardiorespiratory fitness scores (36.3 ml.kg.min) than those previously recorded in the abovementioned studies conducted in a similar population. However, Saudi female PESS students achieved lower scores than those recorded in a study that used a similar exercise protocol to estimate  $VO_2$ max (38.6 ml.kg.min) in young Saudi females (aged 8 - 15 years) [18]. Moreover, the cardiorespiratory fitness level scores achieved by Saudi female PESS students in our study were similar to those reported elsewhere using comparable tests to predicate  $VO_2$ max, namely QCST [32,33]. Das., *et al.* [32] reported that the average  $VO_2$ max score in young females aged between 16 and 20 years was  $35.3 \pm 2.6$  (ml.kg.min). A recent study also found a similar  $VO_2$ max score of  $38.5 \pm 8.2$  (ml.kg.min) in young females (aged 16 - 18 years) [33]. Finally, it is important to note that the differences in the  $VO_2$ max protocols used (i.e. gas exchange analyzer, the Bruce Treadmill Protocol, QCST, etc.) may explain the discrepancies in cardiovascular fitness components among the abovementioned studies.

The second component of health-related physical fitness is body composition, namely body fat. In Saudi Arabia, the prevalence of obesity and overweight status is alarming, and it has increased dramatically in recent decades to become one of the highest overweight status and obesity prevalence rates worldwide [1,2]. The average body fat percentage (32.3%) in Saudi female PESS students in our study was lower than that of Saudi female adults (aged 36.7 years, ranging from 20 to 62 years) (40.4%) estimated using a bioelectrical impedance analysis, as reported by Habib., *et al* [34]. Our study also indicated that 57.5% of female PESS students were classified as overweight/obese based on their body fat percentage (> 30%). In Saudi female adults aged 36.7 years, the prevalence of obesity is reported to be 47% according to the BMI criteria ( $BMI \geq 30 \text{ kg/m}^2$ ) [34]. In younger Saudi female university students (ages ranging from 18 to 25 years), body fat was determined by using the skinfold measurement, and the prevalence of overweight obesity was 30.6% [35]. Body fat percentage in Saudi female PESS students is considerably high, indicating a substantially increased risk of disease, particularly when accompanied by an unhealthy lifestyle. High body fat percentage is known to be associated with poor lifestyle habits among young Saudi female university students. A cross-sectional study in Saudi female university students (aged  $22.5 \pm 10.3$  years) found that high body fat, determined by bioelectrical impedance analysis, was linked to poor sleep quality, low physical activity levels, and skipping breakfast [36].

The third component assessed in the present study was muscle strength. Muscle strength is a crucial indicator to measure since several health consequences have been observed in association with reduced muscle mass and muscle strength, including disability, morbidity, and mortality [37-39]. Furthermore, several studies have demonstrated that poor hand grip strength is associated with several adverse health consequences [40-43]. Low muscular strength can be a risk factor for major causes of death in early adulthood, such as CVD [44]. Hand grip strength is a particularly popular means of predicting health throughout an individual's lifetime [45] and is a field test that measures the maximum isometric strength of both hands' grip strengths in a large sample size [46]. Our study's findings revealed that the average hand grip strength of Saudi female PESS students is considerably low (17.5 kg) compared to that of older Saudi females (aged 60

- 64 years) whose grip strengths for the right and left hands were 20.9 kg and 19.3 kg, respectively [47]. The average hand grip strength observed in the Saudi female PESS students in the present study was even lower than the 25<sup>th</sup> percentile reported in a large study of 125,462 healthy adults (aged 35 - 70 years) conducted in 21 countries, including Saudi Arabia [48]. This study reported that the average, 25<sup>th</sup> percentile, and 75<sup>th</sup> percentile for hand grip (measured using a Jamar dynamometer) in Middle Eastern women (aged 35 - 40) were 26 kg, 22 kg and 30 kg, respectively [48]. Our results also showed that the average hand grip strength of Saudi female PESS students is considerably low (17.5 kg) compared to the hand grip strength norms of Hungarian females developed by Saint-Maurice, *et al.* [46], who reported that the 50<sup>th</sup>-percentile values resulted in a score of 29.2 kg for females aged 18 years.

The last component addressed here is flexibility, which is important for both fitness and health [49,50]. Flexibility of the lower back and hamstring areas has been linked to reduced risk of lower back pain and other musculoskeletal injuries [51]. High levels of flexibility in adolescence have also been found to reduce the risk of neck tension in older men [52]. Research further suggests that children who have high adiposity or low flexibility levels are more likely to continue to do so into adolescence, putting them at greater risk of developing diseases later in life [53]. We are not aware of any available studies that measure flexibility in Saudi female adults. Only one available study used a sit and reach test to assess muscle flexibility in Saudi female children (aged  $11.4 \pm 1.8$  years old) [18]. The present study's findings showed that the average flexibility value in Saudi female PESS students is  $16.6 \pm 3.0$  cm, which is lower than that found in a large study ( $29.0 \pm 9.6$  cm) conducted among 255 young female adults (aged  $17.2 \pm 1.2$  years) [54]. Our flexibility score was also lower than the average sit and reach test scores reported in young Brazilian females (age 17-18 years) ( $27.4 \pm 0.3$  cm) [55]. Since no normative data for sit and reach tests exists for Saudi females, the average flexibility scores of Saudi female PESS students obtained in our study are considered to indicate a reasonable flexibility level compared to Polish normative data of female children and adults aged 7 - 19 years developed by Dobosz, *et al* [56]. The 75<sup>th</sup>-percentile values for flexibility, measured using the sit and reach test, showed 14.8 cm for females aged 19 years old [56]. This indicates that the flexibility scores of the Saudi female PESS students in our study are considered to be in the healthy zone with respect to this component of physical fitness [57].

To conclude, our study is unique in measuring the main four components of health-related physical fitness-cardiorespiratory fitness, body fat, muscle strength, and flexibility-in Saudi female PESS students. Our findings also indicate that body composition and muscle strength should be targeted to enhance health status among Saudi female PESS students at Taibah University. Our participants' body fat percentages are also alarmingly high, indicating overweight status and obesity and increased health risk. Therefore, programs based on diet and exercise for weight loss are highly recommended for Saudi female PESS students to help reduce body fat. Additional strengthening exercise programs are also suggested for further health benefits such as increased muscle strength. We believe that the present study is the first to evaluate a set of health-related physical fitness components in a unique sample of Saudi female PESS students at Taibah University in Madinah, providing valuable information and baseline data regarding multiple components of health-related physical fitness. However, further research with larger samples of male and female university students is recommended.

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### Conflicts of Interest

The author declares no conflicts of interest.

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