

## Saudi Arabia's First Female Physical Education Teachers: A Study of Health-Related Physical Fitness

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### Abstract

*Background:* Girls in Saudi Arabian public schools have only recently (since September 2017) begun to receive physical education (PE) lessons. The aim of this study was to assess the health-related physical fitness components among the first cohort of Saudi female PE teachers.

*Design and methods:* Thirty-nine female PE teachers (mean  $\pm$  SD, age,  $22.9 \pm 0.83$  years; body mass,  $58.4 \pm 10.6$  kg; height,  $159.2 \pm 5.4$  cm) took part in this study. Cardiopulmonary fitness was determined using the Queen's College Step Test to estimate maximal oxygen consumption ( $VO_{2max}$ ). Using a bioelectrical impedance analyzer, body fat percentage (%) was determined, and a hand grip dynamometer was used to test hand grip strength. Finally, the sit and reach test was used to determine flexibility.

*Results:* The mean ( $\pm$  SD) of  $VO_{2max}$  was  $42.5 \pm 5.7$  (ml.kg.min). The mean ( $\pm$  SD) body fat percentage, hand grip strength, and flexibility were  $32.9 \pm 8.9$  (%),  $21.0 \pm 4.3$  (kg), and  $14.5 \pm 4.3$  (cm), respectively.

*Conclusions:* The study concluded that hand grip strength was lower while body fat percentage was higher among Saudi female PE teachers than their international counterparts, as reported in the literature. Weight loss intervention comprising physical activity (PA) and dietary modification is recommended for Saudi female PE teachers, and resistance training aimed at enhancing muscular strength should be the main component of fitness programs.

**Author's Contributions:** MA conceived the idea and designed the study; MA collected data from all study participants with the help from Dr. Amani Aljahani; MA and KM analyzed the data and wrote the paper.

### Introduction:

School-based physical activity (PA), largely implemented through physical education (PE) classes, ensures that young children are given the chance to be physically active during the school day (Bocarro et al. 2011). For this reason, PE classes are considered an important means of promoting PA and health as well as the improvement of motor skills and development, self-efficacy, general feelings of accomplishment, and the opportunity for children to interact socially with one another (Bailey 2006). A large study (12,575 adolescents) in Saudi Arabia demonstrated that several health risk indicators were widespread among Saudi male and female adolescents, including chronic health conditions (28%), symptoms suggestive of depression (14.3%), overweight status/obesity (30%), and vitamin D deficiency (95.6%) (AlBuhairan et al. 2015). About 59% of Saudi female adolescents did not engage in any type of PA, a significantly higher proportion than their male counterparts (32%) (AlBuhairan et al. 2015). This may be attributable to the fact that PA is limited among Saudi females owing to the complete absence or inadequacy of PE classes in girls' schools, particularly public schools. In fact, the provision of PE to girls has been a controversial issue in Saudi Arabia, with PE and fitness facilities largely unavailable for women (Hamdan 2005; Samara et al. 2015). However, while PE is not offered to girls in public schools, most private schools—mainly international schools—include PE in the curriculum for both boys and girls.

PE for schoolgirls was just established in Saudi Arabia, offering PE classes for girls enrolled in public schools in the 2018 academic year. The recent implementation of PE for girls in Saudi Arabian schools has seen the emergence of several prospective teachers from among nutrition and fitness graduates from Princess Nourah Bint Abdulrahman University in Riyadh, who will likely benefit considerably from the introduction of PE lessons in girls' public schools in Saudi Arabia. This has presented an ideal opportunity for female graduates to acquire positions as the first Saudi female PE teachers in public schools. Accordingly, several nutrition

and fitness graduates have sat the professional licensing test for teachers (a specialized test in PE), which is a requirement for obtaining a teaching license in Saudi Arabia. Therefore, the aim of this study was to assess health-related physical fitness components in the first female Saudi PE teachers in public schools.

### **Design and methods:**

#### **1- Participants and study procedure:**

A unique sample of 39 female PE teachers from Saudi public schools (mean  $\pm$  SD, age,  $22.9 \pm 0.83$  years; body mass,  $58.4 \pm 10.6$  kg; height,  $159.2 \pm 5.4$  cm) was chosen to participate in this study during the 2018–2019 academic year. All participants had a background in nutrition and fitness, had graduated from Princess Nourah Bint Abdulrahman University in Riyadh, and had completed the professional licensing test for teachers, mainly the specialized test in PE. The protocol and procedures of this study conformed to International Ethical Guidelines, and all participants signed an informed consent form. Participants who answered “No” to all questions in the PA Readiness Questionnaire were included, while patients who suffered from musculoskeletal disorders or had a history of cardiovascular disease or other major medical issues were not included.

#### **2- Measurements:**

##### **2.1 Anthropometry and Body Composition:**

Body weight was measured to the closest hundred grams using a handheld digital scale (Seca, Germany), and height was measured to the closest 0.1 centimeters by the use of a portable stadiometer (Seca, Germany). The body mass index (BMI,  $\text{weight}/\text{stature}^2$ ) was calculated from the height and weight measurements.

The participants' body fat percentages were determined using a bioimpedance analyzer (OMRON, BF511). To take the bioelectric impedance measurement, participants were required to place both feet together on the foot electrodes and have their weight be evenly distributed, as per the manufacturer's recommendations, while dressed in light clothing and without shoes. The participants' knees and backs were straightened, and their arms were extended forward as they held the grip electrodes for a couple of seconds. The fat % measurements were shown on the body composition monitor's display unit and were recorded.

##### **2.2 Prediction of $\text{VO}_2\text{max}$ using the Queen's College Step Test:**

A stool measuring with a height of 41.3 centimeters and a metronome with a rate of 24 cycles per minute were used to carry out the step test, which lasted three minutes in total. The subjects were instructed to remain standing after the test was completed, and their carotid pulse rate was recorded for seconds 5–20 of the recovery time. The beats per minute were calculated from the 15-second pulse rate. To estimate  $\text{VO}_2\text{max}$ , the following equation was used (McArdle Wd Fau - Katch et al. 1972):

$$\text{VO}_2\text{max (ml.kg.min)} = 65.81 - (0.1847 \times \text{pulse rate in beats per min})$$

##### **2.3 Hand grip strength:**

A hand grip dynamometer (Takei Kiki Kogyo® dynamometer) calibrated to the size of an individual's hand was used to measure maximum isometric handgrip strength. To determine the maximal isometric handgrip strength values, a single measurement was conducted for the dominant hand. The dominant hand was described as the one that was preferable for everyday tasks, such as writing, eating, and lifting heavy objects. For each measurement, the participants were asked to maintain maximal isometric contraction for 3 to 6 seconds (Kamimura and Ikuta 2001; Trossman and Li 1989). The participants carried out the contractions with their dominant hand, with their right and left feet on the floor, the shoulder bent at an angle of  $90^\circ$ , and the

elbow fully extended.

#### 2.4 Flexibility:

The sit and reach test was used to assess flexibility. During this test, the subjects sat with their legs straight and feet flat against a bench, their arms outstretched forwards with one hand above the other and palms facing downwards, and then each subject progressively leaned forward as far as possible. The participants were instructed not to lunge or bounce, as these movements are not permitted during the test. Each participant had to reach out and hold the position for 2 seconds, and the scores were recorded in centimeters (cm) to the nearest 0.5 cm using the scale on the reach indicator.

#### 3- Statistical analysis:

The statistical software tool SPSS version 25 was used to examine the data. Mean values and standard deviation (SD) were used to show descriptive statistics.

#### Results:

A total of 39 Saudi female PE teachers were evaluated to establish the four primary components of health-related physical fitness. The participants' mean ( $\pm$  SD) age was 23 ( $\pm$  0.8) years, ranging from 22 to 25 years. Table 1 presents the participants' characteristics and cardiorespiratory fitness levels measured using a predicted  $VO_2$ max; body fatness estimated by the use of a bioelectrical impedance analyzer; muscle strength by utilizing a hand grip dynamometer; and the sit and reach test was used to determine flexibility.

Table 1. Physical characteristics and health-related physical fitness components of Saudi female PE teachers

Variables	Mean ( $\pm$ SD)
Age (years)	22.9 ( $\pm$ 0.8)
Body mass (kilograms)	58.4 ( $\pm$ 10.6)
Height (centimeters)	159.2 ( $\pm$ 5.4)
BMI (kilogram/meter <sup>2</sup> )	22.9 ( $\pm$ 3.8)
Cardiorespiratory fitness (ml.kg.min)	42.5 ( $\pm$ 5.7)
Body fat percentage (%)	32.9 ( $\pm$ 8.9)
Muscular strength (kg)	21.0 ( $\pm$ 4.3)
Flexibility (cm)	14.5 ( $\pm$ 4.3)

#### Discussion

The assessment of the components of health-related physical fitness in adolescents and adults has received little attention in research. To the best of our knowledge, this is the first study of its kind to determine the four major components of health-related physical fitness in a unique sample of Saudi female PE teachers in public schools in Riyadh, the capital of Saudi Arabia.

It is well known that improved cardiorespiratory fitness may contribute to improved cardiovascular health metrics, including but not limited to healthy blood pressure levels, acceptable lipid profiles, and a lower risk of morbidity and death throughout adult life (Harber et al. 2017; Lang et al. 2017). The current study's main finding was that the mean cardiorespiratory fitness level among Saudi female PE teachers was 42.5 (ml.kg.min). This value is higher than those previously observed in similar studies, which range from 32.8 to 38.1 (ml.kg.min) (Chatterjee, Chatterjee and Bandyopadhyay 2005; McArdle Wd Fau - Katch et al. 1972). In Saudi Arabia, only one study to date has assessed the components of health-related physical fitness in a sample of Saudi girls 8–15 years of age and found that Saudi girls achieved lower cardiorespiratory fitness scores ( $38.6 \pm 2.8$  ml.kg.min), as estimated using the Queen's College Step Test (Al-Asiri and Shaheen 2015). A similar study using the Queen's College Step Test to predict  $VO_2$ max in female athletes and non-athletes (17–22 years) showed a significantly higher

level of  $VO_2\max$  in female athletes (39.6 ml.kg.min) than in female non-athletes (23.5 ml.kg.min) (Shete, Bute and Deshmukh 2014). However, Chatterjee *et al* (2005) found that predicted  $VO_2\max$  that was approximated using the Queen's College Step Test in 40 female students aged  $21.9 \pm 3.2$  years was higher (35.5 ml.kg.min) than the measured  $VO_2\max$  (32.8 ml.kg.min), although, on average, the overestimation was just 2.7 (ml kg.min). Notably, 10 of the 39 participants in the present study did not complete the step test because of knee joint and lower back pain, and although  $VO_2\max$  as a measure of cardiorespiratory fitness has been determined as the international standard of physical capacity (Fleg *et al.* 2000; Fletcher *et al.* 1995), many means of directly and indirectly determining  $VO_2\max$  are available. This makes comparison of outcomes more difficult, and the results should be interpreted cautiously.

Body composition, mainly body fat percentage, is the other major component or constituent of health-related physical fitness. Overweight status and obesity have been related to an elevated risk of diabetes, heart disease, and cancer, among other chronic illnesses (Deckelbaum and Williams 2001). According to epidemiological research, body fatness predicts morbidity and mortality, and even high levels of PA cannot completely negate the increased risk associated with overweight status and obesity (Hu *et al.* 2004; Stevens *et al.* 2002). Moreover, independently of cardiorespiratory fitness, a high body fat percentage is linked to an increased risk of cardiovascular disease (Christou *et al.* 2005). Body fat percentage has also been found to be a modifiable lifestyle factor that predicts gestational diabetes mellitus in women (Iqbal *et al.* 2007). In Saudi Arabia, the widespread presence of overweight status and obesity is alarming, as it has risen rapidly in past years to reach one of the highest prevalence rates worldwide (DeNicola *et al.* 2015; Habbab and Bhutta 2020). In the present study, although BMI levels among Saudi female PE teachers were within a normal range ( $22.9 \pm 3.8$  kg/m<sup>2</sup>), average body fat percentage was considerably high (32.9%). This was higher than the percentage reported by Shete *et al.* (2014) —29.3%, estimated using a skinfold caliper—but similar to another study that found an average body fat percentage of 30.8% that was also estimated using a skinfold caliper (Leyk *et al.* 2007). Body fat in this study, however, was measured directly using a bioelectrical impedance analyzer, which provides a more accurate body assessment than BMI for overweight status or obesity (Trang *et al.* 2019). The high body fat percentage found in Saudi female PE teachers is worrying, particularly in light of its similarity to that found in women with gestational diabetes mellitus, among whom the average body fat percentage, measured by utilizing a bioelectrical impedance analyzer (Tanita), was 32.2% (Iqbal *et al.* 2007).

The third component of health-related physical fitness is muscular strength. Hand grip strength is a field test that is used to measure the maximum isometric strength of both hands' grips (Cooper *et al.* 2011), and it is a common method of predicting health over an individual's lifespan. The normal hand grip strength range for Middle Eastern females (aged 35–40 years) is between 22 kg and 30 kg (Leong *et al.* 2016). Although our score (21 kg) was within the range reported by Leong *et al* (2016), our findings indicated that on average, the hand grip strength of Saudi female PE teachers was lower than that found (30.4 kg) in a study of 117 females (aged 39.5 years) (Mitsionis *et al.* 2009). The Saudi female PE teachers' score is also considerably lower than the muscle strength norms established by Saint-Maurice *et al.* (2015), which demonstrated that the 50<sup>th</sup>-percentile values resulted in 29.2 kilograms for girls aged 18 years. Interestingly, a recent study conducted among Saudi women ranging in age from 18 to 45 years ( $30.8 \pm 7.5$ ) found that muscle strength improved following vitamin D supplementation, with the hand grip mean for both hands showing higher values (13.2 vs. 17.8 kg) (Ewid *et al.* 2019).

Flexibility, the final primary component of health-related physical fitness, is important

for both fitness and health (Corbin and Noble 1980; Nuzzo 2020). Studies have demonstrated that flexibility in the areas surrounding the lower back and hamstring is associated with reduced incidence of lower back pain and other musculoskeletal issues (Fleg et al. 2000). Moreover, results from a scientific study suggest that children with poor flexibility levels have a higher chance of continuing to experience these issues into adulthood, placing them at risk for various illnesses later in life (Marshall et al. 1998). Although flexibility is considered an important component of physical fitness, research shows that genetic influences can account for about 18–55% of the variation in flexibility in children and young adults, as determined using the sit and reach test (Okuda, Horii and Kano 2005). Flexibility of Saudi girls (aged 13–15 years) has been shown to be associated with BMI in a study that found that the lowest flexibility scores were at the high and low BMI extremes (Al-Asiri and Shaheen 2015). The present study's findings revealed a flexibility value of  $14.5 \pm 4.3$  cm, which is lower than the figure reported in a large study that assessed 255 female young adults (mean age  $17.2 \pm 1.2$ ) and found that the mean flexibility value was  $29.0 \pm 9.7$  cm. (Schutte et al. 2016). The flexibility score of Saudi female PE teachers obtained in the present study is regarded as an adequate level of flexibility, according to normative data of children and adolescents aged between 7 and 19 years in a study by Dobosz *et al.* (2015), where the 75<sup>th</sup>-percentile values for flexibility, which were determined by utilizing the sit and reach test, yielded a score of 14.8 cm for girls aged 19 years.

Based on our findings, with the exception of cardiorespiratory fitness and flexibility components, we concluded that health-related physical fitness components among Saudi female PE teachers must be improved, particularly muscle strength. Moreover, body fat percentage in Saudi adolescents in Madinah is also worryingly high, suggesting overweight status and obesity as well as increased health risk. The present study's results highlight the need to address excessive adiposity in Saudi female PE teachers that cannot be obscured by adequate BMI and cardiovascular fitness profiles. Weight loss intervention through PA and dietary modifications targeting Saudi female PE teachers may be required. Saudi female PE teachers, like most adults, may also benefit from additional fitness programs aimed at increasing their health-related physical fitness, particularly muscle strength. Thus, resistance training aimed at increasing muscle mass and muscular strength should be the main component of fitness programs. Although our study is the first to have been conducted among female PE teachers in Saudi Arabia using validated measurements for collection of data and to ensure the accuracy of the results, further research involving larger samples that include both men and women is recommended.

#### **Significance for public health:**

Components of health-related physical fitness are of primary importance to public health, particularly as they affect health outcomes. The present study provides valuable information on health-related physical fitness components among the first cohort of female PE teachers in public schools in Saudi Arabia.

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