

Gender Differences in Health-Related Physical Fitness Components of Young Adults in Saudi Arabia

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Abstract: To compare the health-related physical fitness components, by gender, of young adults in Saudi Arabia.

Design and methods: Sixty nine young adults (34 male, 35 female), aged 18-20 years, participated in our study. Cardiorespiratory fitness was estimated with maximal oxygen consumption (VO₂max), hand grip strength was evaluated with dynamometer, muscle endurance was estimated by push-up test, and flexibility was evaluated with the sit and reach test.

Results: Males significantly outperformed their female counterparts on cardiorespiratory fitness (36.4 ml/kg/min vs 41.3, $p = 0.033$), right hand grip strength (28.7 kg vs 17.6, $p < 0.001$), left hand grip strength (27.7 kg vs 16.2, $p < 0.001$), and muscle endurance (22 repetitions vs 16, $p = 0.003$). Mean flexibility was not significantly different (31.5 cm vs 32.0, $p = 0.815$).

Conclusions: In this cohort of young adults in Saudi Arabia, males had greater health-related physical fitness, as measured by cardiorespiratory fitness, grip strength, and muscle endurance, than females. Interventions should be aimed at increasing physical fitness and awareness among Saudi females.

Keywords: Physical Fitness; Sport; Exercise; Physical Activity; Gender Differences

الفروق بين الجنسين في اللياقة البدنية المرتبطة بالصحة بين الشباب في المملكة العربية السعودية

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الملخص: مقارنة عناصر اللياقة البدنية المرتبطة بالصحة، حسب الجنس، لدى الشباب في المملكة العربية السعودية. الطريقة والأدوات: شارك في دراستنا تسعة وستون شاباً (34 ذكراً و 35 أنثى) تراوحت أعمارهم بين 18 و 20 عاماً. تم تقدير اللياقة القلبية التنفسية بواسطة اختبار الإستهلاك الأقصى للأكسجين، وتم تقييم قوة قبضة اليد باستخدام جهاز قياس قوة القبضة، وتم تقدير عنصر التحمل العضلي عن طريق اختبار الضغط باليدين، وتم تقييم المرونة من خلال اختبار الجلوس والوصول.

النتائج: تفوق الذكور بشكل ملحوظ على نظرائهم الإناث في اللياقة القلبية التنفسية (36.4 مل/كجم/دقيقة مقابل 41.3، مستوى الدلالة = 0.033)، وفي قوة قبضة اليد اليمنى (28.7 كجم مقابل 17.6، مستوى الدلالة = 0.001)، وفي قوة قبضة اليد اليسرى (27.7 كجم مقابل 16.2، مستوى الدلالة = 0.001)، وفي القدرة على التحمل العضلي (22 تكرار مقابل 16، مستوى الدلالة = 0.003). ولكن، لم يكن متوسط المرونة مختلفاً بشكل كبير بينهما (31.5 سم مقابل 32.0، مستوى الدلالة = 0.815).

الاستنتاجات: في هذه العينة من الشباب في المملكة العربية السعودية، كان لدى الذكور مستوى لياقة بدنية مرتبطة بالصحة أكبر مقارنة بالإناث، وذلك حين تم قياس اللياقة القلبية التنفسية وقوة القبضة والتحمل العضلي. لذلك يجب أن تهدف التدخلات إلى زيادة اللياقة البدنية والوعي لدى الفتيات السعوديات.

INTRODUCTION

Physical activity improves a variety of facets of one's health, including disease prevention, as well as mental and psychosocial health (Lloyd-Jones et al. 2010). The most common and generally used definition of physical activity (PA) developed in Caspersen and colleagues who defined the term "physical activity" as "any bodily movements produced by skeletal muscles that result in energy expenditure". Physical fitness is defined as the ability to achieve certain performance standards in PA and is a result of habitual physical activity or exercise (Freedson, Cureton and Heath 2000; Tuero-del-Prado, de paz and Márquez 2001). It is thus critically important to distinguish between PA and physical fitness.

It is yet undetermined whether PA or physical fitness is more important for health benefits (Blair, Cheng and Holder 2001). One study showed that PA and cardiorespiratory fitness have distinct cardiovascular disease risk implications (Williams 2001). It demonstrated that having a high level of cardiorespiratory fitness was associated with a greater reduction in cardiovascular disease risk than merely having a high PA level, despite both being highly essential (Williams 2001). This finding has been confirmed by other studies (Sassen et al. 2009; Williams 2008). For example, higher cardiorespiratory fitness, independent of PA, lowers the risk of hypertension, hypercholesterolemia, and diabetes, and is a significant risk factor independent of physical activity (Williams 2008). Moreover, another study showed that low cardiorespiratory fitness was linked to an increased risk of obesity, regardless of PA (Brien et al. 2007).

Evaluation of physical fitness in young adults is particularly important, as low fitness levels may prognosticate several health problems in later adulthood (Chen et al. 2005; Heitzler et al. 2006; Sato et al. 2005). Higher levels of physical fitness are associated with a lower risk of cardiovascular disease and cancer (Guerra et al. 2006; Lacombe et al. 2019). Moreover, there is substantial evidence demonstrating that the risk factors found in adult cardiovascular disease may be present since childhood, and preventive measures taken during childhood and adolescence may be key in mitigating these risk factors in later life (Shrestha and Copenhagen 2015). Moreover, physical fitness may help students cope with stress (Guszkowska 2005).

Earlier studies have defined several health-related physical fitness components, including cardiorespiratory fitness, muscle strength, endurance, and flexibility (Cvejic, Pejović and Ostojic 2013; Secchi et al. 2014). A recent study found that high cardiorespiratory fitness combined with high muscular fitness was positively linked to improved health-related quality of life in adolescents (Evaristo et al. 2019). Moreover, several earlier studies have measured cardiorespiratory fitness among adolescents, showing that the declining levels across age groups might be the result of a physically sedentary lifestyle throughout adolescence, which should alarm health advocates and public health specialists (Ekblom, Oddsson and Ekblom 2005; Morinder et al. 2007). Enhancement of cardiorespiratory fitness during adolescence is known to be associated with better cardiovascular health indicators in adulthood (Harber et al. 2017; Lang et al. 2017).

In Saudi Arabia, health-related physical fitness receives less research attention than PA (Aljuhani and Sandercock 2019; AlQuaiz et al. 2019; Zaidi 2020). Few studies have addressed health-related physical fitness among Saudi girls (Al-Asiri and Shaheen 2015; Alahmadi 2021b), Saudi boys (Alahmadi 2021a), and Saudi females adolescents (Alahmadi 2021c). Moreover, awareness of physical fitness and PA is not as prevalent among females. One study found that 59% of Saudi female adolescents do 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 absence or inadequacy of physical education (PE) classes in female schools, particularly public schools.

The provision of PE to females has been a controversial issue in Saudi Arabia, with PE and fitness facilities largely unavailable to them (Hamdan 2005; Samara et al. 2015). However, Saudi Arabia introduced PE for females in public schools in the academic year 2018. This has brought several health benefits for females, which will likely be of great benefit to their PA and physical fitness. Therefore, it is important to understand gender differences in physical fitness among young adults in Saudi Arabia. The aim of this study is to compare the health-related physical fitness components between male and female young adults in Saudi Arabia.

DESIGN AND METHODS

Participants and study procedure

Sixty-nine young adults (34 males, 35 females), aged 18–20 years, participated in this study. All participants were selected and chosen from Taibah University in Madinah, Saudi Arabia, in August of 2021. All students were recently graduated from high school and 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's protocol and methods conformed by the International Ethical Guidelines, and all participants were made to sign an informed consent form. Participants who answered "No" to all questions in the PA Readiness Questionnaire were included, while participants who suffered from musculoskeletal disorders or had a history of heart disease or other major medical issues were not included.

Measurements

Anthropometry

Body mass 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) was then calculated. BMI is the ratio between weight in kilograms to height in meters squared.

Cardiorespiratory fitness

Predicted maximal oxygen consumption (VO_2max) was estimated by using the Queen's College Step Test. The participants should be familiar with the exercise testing procedure, and if not then participants were given an opportunity to practice the test. In this test, participants are required to step on a box (41.25 centimeters) at a rate of 24

steps per min for males and 22 steps per min for females. The step test lasts three minutes in total. The students are instructed to remain standing after the test is completed, and their pulse rate is recorded after 5 seconds of recovery time, using a Pulse Oximeter (Beurer PO40). To estimate $VO_2\max$, the following equation was used by McArdle WD:

For males:

$VO_2\max$ (ml/kg/min) = 111.33 - (0.42 × pulse rate in beats per min)

For females:

$VO_2\max$ (ml/kg/min) = 65.81 - (0.1847 × pulse rate in beats per min)

Hand grip strength

A hand grip dynamometer (Takei Kiki Kogyo, Yashiroda, Japan) was calibrated to the size of the participant's hand. To determine the maximal isometric handgrip strength, a single measurement was conducted for each 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 participant was asked to maintain maximal isometric contraction for 3-6 seconds (Kamimura and Ikuta 2001). The participants carried out the contractions with their feet on the floor, shoulder bent at an angle of 90°, and elbow fully extended.

Muscle endurance

To evaluate the endurance of upper body muscles, participants were asked to perform the maximum number of push-ups possible without rest. The push-up endurance test was conducted according to the procedures of the American College of Sports Medicine (ACSM) (ACSM, 2013). Different methods were used for the push-up tests, with the legs in the extended position for males and in the bent knees position for females. Participants in the push-up test were required to lower their chests to the ground until their elbows reached an angle of 90°, then return to the starting position with their backs straight and legs extended, and the feet positioned outside shoulder width. The total number of repetitions performed with proper form was recorded. The push-up test was stopped when the participant strained forcibly or was unable to maintain the proper form within two repetitions.

Flexibility

The sit and reach test was used to assess flexibility, according to ACSM procedures (ACSM, 2013). Participants were instructed to sit on the ground with their legs fully extended against a standard reach box (Baseline Sit & Reach Testing Box, model number: 12-1086) with 23 cm marked at the level of the feet. They were then asked to reach smoothly forward and hold this extreme reach position for two seconds. The scores were recorded in centimeters (cm) to the nearest 0.5 cm using the scale on the reach indicator (ACSM, 2013).

Statistical analysis

The Statistical Package for Social Sciences (SPSS Ins., Chicago, IL, USA) version 23 was used for data analysis. Descriptive data were reported as mean and standard deviation. Mean group differences in components of health-

related physical fitness by gender were compared using Student t-test.

RESULTS

A total of 69 Saudi young adults were evaluated for health-related physical fitness. The participants' mean age (SD) was 18 (0.3) years, ranging from 18 to 20 years. Significant differences between genders were observed in weight, height, and BMI, each greater in males than females (Table 1).

Males achieved significantly higher mean values of cardiorespiratory fitness ($VO_2\max$, $p=0.033$), grip strength (both hands, $p<0.001$), and muscle endurance ($p=0.003$). The mean (SD) $VO_2\max$ was 36.4 ml/kg/min (10.1) for males and 41.3 (7.9) for females. Four females did not complete the cardiorespiratory fitness test because of knee joint and lower back pain. The mean hand grip strength on the right was 28.7 (3.8) kg for males and 17.6 (3.4) for females, and on the left was 27.7 (3.1) for males and 16.2 (3.7) for females. Mean muscle endurance was 22 (9) repetitions for males and 16 (8) for females (Table 1).

On the other hand, males and females achieved similar values in flexibility. Mean flexibility was 31.5 cm (5.8) for males and 32.0 (8.4) for females ($p = 0.815$). The difference was not statistically significant ($p = 0.815$) (Table 1).

Table (1). Physical characteristics and health-related physical fitness components of Saudi young adults

Variable	Mean (SD)		t score	p-value
	Males	Females		
Age (years)	18.2 (0.5)	18.2 (0.4)	0.324	0.74
Body mass (kg)	64.9 (10.7)	50.4 (9.0)	6.03	<0.001
Height (cm)	170.4 (5.7)	160.7 (4.5)	7.66	<0.001
BMI (kg/m ²)	22.4 (3.4)	19.5 (3.5)	3.52	0.001
Resting heart rate (beats/min)	92 (14)	96 (14)	-1.24	0.216
Heart rate after 3 min (beats/min)	165 (20)	176 (14)	-2.40	0.019
Cardiorespiratory fitness ($VO_2\max$, ml/kg/min)	41.3 (7.9)	36.4 (10.1)	2.17	0.033
Right Hand Grip strength (kg)	28.7 (3.8)	17.6 (3.4)	12.68	<0.001
Left Hand Grip strength (kg)	27.7 (3.1)	16.2 (3.7)	13.84	<0.001
Muscle endurance (repetitions)	22 (9)	16 (8)	3.09	0.003
Flexibility (cm)	31.5 (5.8)	32.0 (8.4)	-0.23	0.815

DISCUSSION

In comparison to PA, the measurement of physical fitness for health in Saudi Arabian adolescents and young adults has received less attention in the literature. To the best of our knowledge, this is the first study of its kind to compare the major elements of health-related physical fitness in a sample of Saudi male and female young adults. The results here suggest that the differences between genders in health-related physical fitness were greater in

cardiorespiratory fitness, muscular strength, and endurance, but not in flexibility. These findings support previous research which demonstrates predominance of males over females in measures of cardiorespiratory fitness, muscular strength, and endurance (Hands et al. 2009; Malina 2007; Marta et al. 2012).

Improved cardiorespiratory fitness may contribute to improved cardiovascular health metrics, including healthy blood pressure levels, acceptable lipid profiles, and a lower risk of morbidity and mortality throughout adulthood (Harber et al. 2017; Lang et al. 2017). Moreover, high levels of cardiorespiratory fitness during adolescence are associated with better cardiovascular health indicators in adulthood (Harber et al. 2017; Lang et al. 2017).

The findings here demonstrate a gender difference in aerobic fitness, with higher cardiorespiratory fitness among males (VO_{2max} , 41.3 ml/kg/min) than females (36.4 ml/kg/min). This agrees with the literature, and may be attributable to variables such as higher levels of PA, lower fat mass, and the size and oxygen-carrying capacity of the heart among males (Dencker et al. 2007; Hands et al. 2009). For males in this study, cardiorespiratory fitness was comparable with a published study of Saudi males whose cardiorespiratory fitness was evaluated via the use of a maximal multistage 20 meter shuttle run test (VO_{2max} 41.1 ml/kg/min) (Alahmadi 2021a). This is almost higher than previous studies of young adults, which included both genders, among whom the VO_{2max} ranged 26-41 ml/kg/min (Ekblom, Oddsson and Ekblom 2005; Morinder et al. 2007).

In the present study, females have attained similar scores in regard to their cardiorespiratory fitness (36.4 ml/kg/min) compared to other studies of Saudi females, aged 15-18 years, using the same protocol (VO_{2max} 36.3-39.5 ml/kg/min) (Al-Asiri and Shaheen 2015; Alahmadi 2021b; Alahmadi 2021c). And they performed similarly compared to one cohort of non-Saudi females aged 16-20 years, using the same protocol (VO_{2max} 35.3-38.5 ml/kg/min) (Das, Ghosh and Gangopadhyay 2010; Nagajothi, Rajkumar and Prasanna 2020).

The health-related physical fitness assessment also included muscular strength, endurance, and flexibility. Hand grip strength is a field test used to measure the maximum isometric strength of bilateral hand grip (Cooper et al. 2011), and is a common method for predicting health over an individual's lifespan (Koopman et al. 2015). In this study, males demonstrated higher mean hand grip strength in each hand, compared to females. Average hand grip strength among males in this study (27.7-28.7 kg) is lower than that reported in similar Saudi studies of adolescent Saudi males (33 kg) (Alahmadi 2021a).

The hand grip strength among females in this study (16.2-17.2 kg) is within the range of previously published studies of Saudi females aged 17-25 years (16.5-24.2 kg) (Alahmadi 2021b; Alahmadi 2021c; Shaheen, Omar and Ali 2021). This is lower than the hand grip strength reported for Middle Eastern females aged 35-40 years (22-30 kg) (Leong et al. 2016).

In this study, the ACSM push-up test demonstrated higher muscle endurance among males (22 repetitions) than females (16 repetitions). This agrees with the literature, which supports higher muscle endurance among males

(Lubans et al. 2011; Marta et al. 2012). This may be attributable to two factors, high PA level and high lean muscle mass. Males may participate in more PA, such as resistance training, (Haerens et al. 2007; Singh et al. 2009) which causes both muscle fiber hypertrophy and neural improvements. (Paddon-Jones et al. 2010). Multiple studies have demonstrated that lean muscle mass is associated with hand grip strength (Chalhoub et al. 2018; Charlton et al. 2015; Goodpaster et al. 2006), which is due to the higher proportion of skeletal muscle mass rather than fat mass, resulting in greater overall body strength.

Flexibility, which is of significant importance in both fitness and health (Nuzzo 2020), was found to be not significantly different between genders in this study. 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, recent studies have shown that poor flexibility in childhood is associated both with poor flexibility in adulthood (Marshall et al. 1998), and with BMI at the high and low extremes (Al-Asiri and Shaheen 2015). In the present study, the average flexibility in males and females was 31.5 cm and 32.0 cm, respectively. This is higher than the reported literature, which ranges 7.1-15.8 cm in males (Alahmadi 2021a; Dobosz, Mayorga-Vega and Viciano 2015) and 10.3-16.6 cm in females (Alahmadi 2021b; Alahmadi 2021c; Dobosz, Mayorga-Vega and Viciano 2015). Although there was no gender difference detected here, a number of studies have found that females achieve better flexibility levels than males. For example, in a study of 243 male and 255 female adolescents (mean age 17.2 (1.2) years), females demonstrated greater flexibility (29.0 cm vs 19.8) (Schutte et al. 2016). This may be because females have a greater range of motion compared to males, who have more passive gastrocnemius medialis muscle stiffness (Floría and Harrison 2014; Morse 2011).

Limitations

Males are known to have, on average, greater lean body mass and higher PA levels than females (Pienaar, Wilders and Lennox 2008), however these factors were not measured in this study.

CONCLUSION

Saudi young adult males performed significantly better than their female counterparts on tests of health-related physical fitness, including cardiorespiratory fitness, hand strength, and muscle endurance.

RECOMMENDATIONS

The relatively lower physical fitness level among Saudi young adults supports the need to implement interventions. Such interventions should focus on increasing the health-related physical fitness of Saudi female young adults, and promoting awareness of PA as a means to achieve physical fitness. Further research should be conducted to identify strategies and interventions that could accomplish such goals in Saudi females.

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