

# Assessment of aerobic fitness and its correlates in Omani adolescents using the 20-metre shuttle run test A pilot study

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## قياس اللياقة الهوائية في الإناث والذكور من الشباب العماني من سن ١٥-١٦ سنة، باستعمال فحص ٢٠ متر عدو متردد: دراسة مبدئية

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**الملخص: الهدف:** قياس اللياقة الهوائية في الشباب العماني من الإناث والذكور من سن ١٥-١٦ سنة ومقارنة ذلك مع بعض العوامل التي تؤثر عليها. **الطريقة:** تم اختيار ٨٣ بنتا و ٤٦ ولدا بطريقة عشوائية من مدرستين منفصلتين في محافظة مسقط. بدأ الفحص بتعبئة استبيان معلومات خاصة باللياقة البدنية للطالب ولإسرتة، ثم شارك الطلاب في العدو لمدة ٣٠ مترا مترددة لكل دقيقة في البداية مع زيادة السرعة كل دقيقة حتى الإرهاق بحيث لا يستطيع المشارك مواصلة العدو بعدها. واعتبر آخر شوط هو القياس لأقصى جهد يحتاج لاستعمال الأوكسجين. **النتيجة:** قضى الأولاد ٣,٤ ساعة في الأنشطة الرياضية في الأسبوع مقارنة مع ١,٧ ساعة للبنات. وقد استغرقت مشاهدة التلفزيون وألعاب الحاسب الآلي لدى الأولاد ١٦,٩ ساعة بالمقارنة مع ١٢,١ ساعة للبنات. كانت البنات أكثر بدانة من الأولاد (٢١,٦ إلى ١٩,٧ كلغ/م<sup>٢</sup>) ولياقة جهد الأوكسجين كانت أكثر لدى الأولاد (٤٤ إلى ٣٦,٥ مل/كلغ). **الخلاصة:** كانت اللياقة الهوائية أعلى في الأولاد منها في البنات، وتأثرت في الجنسين بقوة بنشاطهم الأسبوعي. وثبت أن فحص العدو المتزايد لعشرين مترا هو فحص بسيط ورخيص و يمكن إستخدامه على نطاق واسع.

**ABSTRACT. Objective:** To assess aerobic fitness in male and female adolescents using the multistage 20-metre shuttle run test and correlate it with selected fitness variables. **Method:** The subjects comprised 83 girls and 64 boys aged 15–16 years, randomly selected from two segregated government schools in Muscat. After the pupils filled in a short questionnaire on their personal leisure time activities of the preceding week, their heights and weights were measured. Aerobic fitness was assessed by estimating each pupil's minimal oxygen uptake levels (VO<sub>2max</sub>) using the multistage 20-metre shuttle running test (20-MST). **Results:** Boys spent more time than girls on leisure physical activities, television, computer and video games and the Internet. The estimated VO<sub>2max</sub> in both boys and girls showed high correlation with their weekly physical activities. The time spent on television and computer negatively correlated with VO<sub>2max</sub> in girls but not in boys. Girls had higher body mass index (BMI) and less VO<sub>2max</sub> compared to boys; BMI showed a negative correlation with VO<sub>2max</sub> in girls but not in boys. **Conclusion:** Aerobic fitness in this sample was higher in boys than in girls and was strongly influenced by weekly physical activities in both genders. The 20-MST has proved a simple and inexpensive field test for aerobic fitness that could be implemented on a wide scale.

**Key words:** shuttle run test, aerobic fitness, leisure time activities, VO<sub>2max</sub>, adolescent, Oman

POSITIVE HEALTH IS A MULTIFACETED CONCEPT that comprises more than mere absence of disease. Functional capacity, one aspect of which is aerobic capacity (the body's ability to do heavy sustained work), is an important criterion of health. Aerobic capacity, measured by determining the body's maximal rate of oxygen consumption, is dependent on the ability of the cardiovascular system to deliver blood to working muscles and the cellular ability to take up and utilize this oxygen in energy production. Maximal oxygen uptake (VO<sub>2max</sub>) is the most

important indicator of physiological fitness, and is positively correlated with cardiovascular health.<sup>1,2</sup>

In developed nations the declining physical activity of children and adolescents has become a public health issue. Programs such as the Eurofit<sup>3-7</sup> have been designed to combat the alarmingly low fitness and increased fatness in children and adolescents caused by a sedentary lifestyle primarily attributable to the time spent on television, video and computer games and the Internet.<sup>8-14</sup> Very few similar studies have been carried out in developing countries.<sup>15</sup> To

our knowledge no such study has been conducted in the Arab countries, where physical fitness receives little attention from authorities and families. This has been compounded by the recent affluence with its sedentary lifestyle that has led to an alarming increase in obesity and associated diseases in both children and adults.<sup>16-18</sup> The most vulnerable here is the female gender, who are targeted most by an ancient yet actively practised culture that promotes and values a sedentary way of life and obesity in women.<sup>19-21</sup>

## METHOD

Two large segregated government secondary schools in a semi-urban area in the capital city of Muscat were selected for their proximity to Sultan Qaboos University. Each grade comprises 10 classes with 30-35 boys or 40-45 girls each. Two classes of tenth graders (boys and girls aged 15-16 years) were randomly selected from each school. Eighty-three girls and 64 boys participated in the study, indicating a response rate of 85%. All tests were carried out between 07:30 and 09:00 hours.

Each pupil filled a short questionnaire on his or her personal leisure time activities during the preceding week. Weights and heights were then taken, with sports clothing and without shoes, by an observer of the same gender. Body mass index (BMI) was expressed as the weight in kilogram divided by the square of height in metres ( $\text{kg.m}^{-2}$ ).

### THE 20-METRE SHUTTLE RUN TEST (20-MST)

The 20-MST is an incremental maximal running test that has been validated by several studies as a suitable field test of aerobic fitness.<sup>22-25</sup> The subject starts at a walking speed of  $8.5 \text{ km.h}^{-1}$  and proceeds by increments of  $0.5 \text{ km.h}^{-1}$  each minute (step) to reach a maximum speed of  $18.5 \text{ km.h}^{-1}$ . The speed of each step is controlled by audio signals played from a tape recorder, announcing the step number. The maximal speed achieved corresponds to the last step. Performing the test, one runs a 20-metre course back and forth endeavouring to touch the end of the track by her/his foot while maintaining synchrony with the audio signal for each step. The test ends for each participant when she/he can no longer reach the marker in time for the audio signal for that step. The last step number announced is used to predict the maximal oxygen uptake ( $\text{VO}_{2\text{max}}$ ,  $\text{Y}$ ,  $\text{ml.kg}^{-1}.\text{min}^{-1}$ ) from the speed ( $X$ ,  $\text{km.h}^{-1}$ ) corresponding to the step number ( $\text{speed}=0.5 \text{ step number}$ ) and age using the equation  $\text{VO}_{2\text{max}}, \text{Y}=31.025+3.328X-3.248A+0.1536AX$ , where  $X$  is speed and  $A$  is age.<sup>22</sup>

Each pupil's test was supervised by one trained observer of the same gender and 4 pupils were tested at a time.

## STATISTICAL ANALYSIS

Statistical analysis was carried out using SPSS 6 statistical package for Windows. The difference between the groups was ascertained using the independent sample T-test. Correlates of personal variables were compared using Pearson's sample correlation coefficient, which was used for a two-tailed test of the hypothesis of no correlation. A  $p$  value of  $<0.05$  was considered significant. The Z test was used to test the difference between means of the  $\text{VO}_{2\text{max}}$  of this sample and the samples in other studies on similar age groups.

## RESULTS

Table 1 shows the main characteristics of the participants and results of the fitness variables measured. The girls had significantly higher BMI than the boys ( $p<0.05$ ). The

**Table 1.** Average characteristics of boys and girls and personal fitness variables

	Boys (n=64)		Girls (n=83)	
	Mean	SD	Mean	SD
Age (years)	15.5	$\pm 0.53$	15.7	$\pm 0.60$
BMI ( $\text{kg.m}^{-2}$ )	19.7	$\pm 1.8$	21.6	$\pm 2.1^*$
$\text{VO}_{2\text{max}}$ ( $\text{ml.kg}^{-1}.\text{min}^{-1}$ )	44.0	$\pm 6.3$	36.5	$\pm 4.5^{**}$
Weekly activity (hours)	3.4	$\pm 1.5$	1.9	$\pm 0.9^\#$
Weekly TV, computer (hours)	16.4	$\pm 8.4$	12.2	$\pm 3.3^{**}$

\* $p<0.05$ , \*\* $p<0.001$ , # $p<0.0001$ .

estimated  $\text{VO}_{2\text{max}}$  was significantly higher in boys than in girls ( $p<0.001$ ). The boys spent significantly more of their weekly leisure time on physical activities ( $p<0.001$ ) as well as on television/computer games and the Internet ( $p<0.001$ ) than the girls did.

Table 2 shows the correlation between the estimated  $\text{VO}_{2\text{max}}$  and personal fitness variables. Weekly physical activities showed the highest correlation with  $\text{VO}_{2\text{max}}$  in

**Table 2.** Pearsons correlation coefficients of  $\text{VO}_{2\text{max}}$  of boys and girls and relevant personal variables.

	$\text{VO}_{2\text{max}}$ Boys (n=64)		$\text{VO}_{2\text{max}}$ Girls (n=63)	
	r	p	r	p
Body mass index	0.10	NS	0.342	$<0.001$
Weekly sports activities	0.438	$<0.0001$	0.415	$<0.0001$
T.V/Computer time	0.16	NS	0.202	$<0.05$

r = Correlation Coefficient, NS = not significant

both genders ( $p < 0.001$ ). BMI showed a significant negative correlation with  $VO_{2max}$  in the girls ( $p < 0.001$ ) but not for the boys. Weekly television and computer time showed a significant negative correlation in the girls ( $p < 0.5$ ) but not in the boys.

## DISCUSSION

To our knowledge this is the first study in the Middle East that seeks to describe the level of physical fitness in adolescents and how it relates to personal variables. In this preliminary study, aerobic fitness is seen to be significantly higher in boys than in girls. Similar gender differences in aerobic fitness were reported in other studies<sup>25,26</sup> and were probably due to the higher BMI of girls who have relatively more body fat than boys.<sup>10,12,13</sup> The higher BMI in girls may also explain the significant negative correlation between their BMI and  $VO_{2max}$ .

Physical activities in personal leisure time, in our sample and in other studies, have the strongest influence on aerobic fitness in both genders and is believed to influence physical fitness through adulthood and across the lifespan.<sup>27-33</sup> Physical activity of the girls was apparently less than that of the boys probably because we did not include household activities in our questionnaire. In Oman, girls of this age customarily participate in all aspects of household activities to help their mothers cope with the large family size.

The boys spent more time watching television, playing video and computer games and on the Internet. Even in this semi-urban area of the Middle East, the number of hours the boys spent on these activities was the same as their age-matched counterparts in urban North America.<sup>34,35</sup> A recent study showed that television viewing and video/computer games are the major causes of physical inactivity, and an emerging public health hazard.<sup>9</sup> Furthermore it has been shown that reducing television viewing leads to a reduction in obesity.<sup>14</sup> In our study, the hours spent on television and virtual games had no effect on boys' aerobic fitness, but did have a significant negative impact on that of girls, who spent less hours on these activities. While we do not have an explanation for this difference, it is possible that the boys' recall of time was much higher than the girls (16.4±8.4 versus 12.2±3.3 hours).

Using the 20-MST to estimate  $VO_{2max}$  in girls and boys of same age in two separate studies, Omani girls had significantly lower estimated  $VO_{2max}$  values than Tasmanian and Irish girls (36.5 versus 40.6 ( $p < 0.05$ ) and 42.6 ml/kg<sup>-1</sup>.min<sup>-1</sup> ( $p < 0.01$ ) respectively). The boys also had significantly lower  $VO_{2max}$  values than their Tasmanian and Irish counterparts—44.0 vs 50.4, ( $p < 0.01$ ) and

53.3 ml/kg<sup>-1</sup>.min<sup>-1</sup> ( $p < 0.001$ ) respectively. In both genders Tasmanian adolescents had similar BMI as the Omanis but their sample size in that national study was much larger.<sup>25</sup> In the Irish study both genders had higher BMI than the Omanis but they were smaller groups selected to validate fitness tests.<sup>36</sup> We postulate that the main reason for the reduced aerobic fitness in Omani adolescents is probably due to the very small component that physical education occupies in Omani schools curricula as well as the complete lack of extracurricular physical activities in all government schools.

The strengths of this pilot study are derived from the fact that it was performed randomly and without prior notice on adolescents of the same age and gender, and from the high response rate of both genders. One potential weakness is the retrospective recall of weekly activities rather than having a record of daily leisure time activities during the study. The 20-MST will, however, need to be validated in the laboratory in both genders if a more accurate prediction of aerobic fitness is to be estimated in the national study.

In conclusion, although our sample was small and was not representative of all Oman, we have demonstrated that the 20-MST, if validated can be used to estimate aerobic fitness in both genders.

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