

# **Academic Exposure to Benefits of Physical Fitness Does Not Give Medical Students an Edge over Students from Non-Health-Related Disciplines**

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## **Abstract**

Undergraduate study imposes rigorous study regimes, which may compromise engagement in physical activities among students. This study compares physical fitness parameters between students from medical and non-health-related programs. The VO<sub>2</sub>max, heart rate (HR), and blood pressure (BP) were assessed in 80 men aged 18–25 years who performed the shuttle run test (SRT). HR and BP were measured before and after the SRT; HR was also measured during the test. A t-test was performed to compare the mean VO<sub>2</sub>max and baseline and recovery period measurements between groups and by the year of study (first or fourth). Fourth-year medical students had a higher baseline HR than those from other disciplines ( $p = 0.02$ ). First-year medical students had a higher VO<sub>2</sub>max than their fourth-year counterparts ( $p = 0.02$ ). Medical students had a higher HR after the sixth ( $p = 0.02$ ) and seventh ( $p = 0.03$ ) minutes of the SRT. Further, the medical students had a higher diastolic BP in the first ( $p = 0.03$ ) and second ( $p = 0.02$ ) minutes after exhaustion. Medical students have poorer fitness levels than students from non-health-related disciplines. This is possibly because the intense academic rigor prevents them from engaging in regular exercise.

**Keywords:** Physical activity, Exercise, Shuttle run test, Medical students

## **1 Introduction**

Individuals who have low levels of physical activity (PA) and a predominantly sedentary lifestyle are more likely to have lower levels of cardiorespiratory fitness [1, 2]. This is a cause for concern because physical inactivity among the youth and young adults is associated with an increased risk of ill health [3, 4]. Studies show that generally, society has become increasingly less physically active, with marked downturns in the reported levels of PA during adolescence, young adulthood, and through college worldwide [5-8]. Only 29% of individuals aged 18 to 24 years globally have been shown to

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engage in regular, vigorous exercise activities [9]. This age range includes the bulk of college-going students who face the challenge of a sedentary lifestyle because they lack the time to devote to PA, given their college-work demands [5, 10, 11].

Results on the effects of study time on exercise and PA are conflicting. While some studies show that study time is associated with fewer opportunities for PA [12], others [13] report that competing demands on time are unrelated to participation in PA.

It also remains unclear whether awareness of the benefits of physical fitness (PF) necessarily translates to higher levels of exercise and fitness. Most studies suggest no association. A study conducted in Hungary showed the prevalence of low fitness levels among female medical students, and these levels did not differ from those among relatively sedentary university students or the average young adult population [14]. Among Nepalese medical students, the proportions of individuals with poor, average, good, very good, and excellent fitness levels were found to be 10.4%, 23.6%, 39.6%, 17.9%, and 8.5% respectively [15], indicating that 73.6% of these students did not appear to have been influenced by academic exposure to the importance of PF. Further, a study on trainees in health-related fields showed that the percentage of nursing students with a sedentary lifestyle was higher (50%) than the percentage of age-matched students from other disciplines with a sedentary lifestyle (47%) [16].

A study conducted in Thailand [17] on male medical students of mean age  $22.3 \pm 0.7$  years and average body weight  $56.8 \pm 11.9$  kg showed that among these students, the average  $VO_{2max}$ , an indicator of the aerobic capacity, was  $38.1 \pm 8.6$  ml  $kg^{-1} min^{-1}$ . This value is significantly lower than the expected normal average of  $44$  ml  $kg^{-1} min^{-1}$  for individuals of this age [18, 19], which disproves the assumption that such individuals have high levels of fitness.

Although medical students, during their years of clinical practice, are exposed to the benefits of PF, it is as yet unclear how they compare to students without this exposure. By comparing individuals from different disciplines in the first and fourth years of undergraduate study, the current investigation aimed to ascertain homogeneity in baseline data among these individuals and to compare various fitness parameters among the fourth-year students, at which point medical students are already adequately exposed to the benefits of PF.

## 2 Materials and Methods

This study comprised 80 men attending Moi University, Kenya, at 2000 meters above sea level. It was approved by Moi Teaching and Referral Hospital, and the subjects provided written informed consent for participation. A qualified first aider remained on standby throughout data collection. Forty participants from the school of medicine and 40 from non-health-related disciplines (education, fisheries, social sciences, tourism, and wildlife management) were randomly sampled; 20 each were sampled from first- and fourth-year students. Their ages ranged from 18 to 25, and all students had to pass a complete physical examination. Those with cardiorespiratory or other physical ailments were excluded. Data were collected from February to May 2011. It was hypothesized that medical students would have a lower heart rate (HR) and blood pressure (BP) at all levels during the protocol as well as higher  $VO_{2max}$  values.

A questionnaire on reported PA and exercise patterns was administered at the start of the study, after which baseline measurements were taken, including the participants' height, weight (CAMRY Mechanical scale, BR9012, Shanghai, China), blood pressure (BP; EKRA Erkameter 3000, Germany), and heart rate (HR). The students were then subjected to the 20-m shuttle run test (SRT). The BP was also measured once every minute for the first 5 min during the rest period immediately following the run test. An ActiTrainer™ accelerometer (Actigraph, Pensacola, FL, USA) worn at waist level enabled continuous measurement of HR on a minute-to-minute basis during the run and the subsequent rest period. The SRT involves incremental endurance exertion: starting at a speed of 8.5 km/h at level 1, the speed is increased by 0.5 km/h every minute; pre-recorded beeps trigger the speed increase. This increase in speed is achieved by progressively reducing the intervals between beeps, thereby gradually increasing the number of shuttles and distance that has to be covered each minute. The SRT is a valid proxy for predicting laboratory  $VO_{2max}$  and is sufficiently reliable for testing PF among healthy male adults [20]. Each test level lasts approximately 1 min.

The  $\text{VO}_{2\text{max}}$  was estimated using the beep test score calculator developed using published Ramsbottom tables [8]. When the participants failed to increase their speed twice according to the beeps twice in a row, which signified exhaustion, they were asked to abandon the test. The collected data were analyzed using STATA version 10 (StataCorp, College Station, Texas, USA). A two sample *t*-test was performed to compare the mean  $\text{VO}_{2\text{max}}$  and the baseline and recovery period measurements between the medical students and those from other disciplines. A  $p < 0.05$  was considered significant. Further, data of the first-year group were compared with those of the fourth-year group, which is the year in which students from other disciplines complete their undergraduate studies. This helped evaluate the role that exposure to the benefits of PF among medical students plays in their PA behavior.

### 3 Main Results

Except for the baseline HR in the fourth-year group, all other biodemographic data were statistically similar between the medical students and students from non-health-related disciplines. The baseline HR was significantly higher among students from non-health-related disciplines than among medical students ( $76.2 \pm 8.1$  vs.  $72.0 \pm 4.1$  bpm,  $p = 0.02$ ). The table summarizes the mean biodemographic data of the participants.

Sixty percent of the fourth-year medical students ( $n = 20$ ) reported being involved in PA/exercise (at least one exercise activity in the last 3 weeks), while 90% of fourth-year students from non-health-related disciplines reported this ( $n = 20$ ). In contrast, 95% ( $n = 20$ ) of the first-year medical students reported being involved in PA. However, in the case of the students from non-health-related disciplines, only 85% of the first-year students reported engaging in PA.

No statistical difference in  $\text{VO}_{2\text{max}}$  was observed between students from the two disciplines but from the same year of study ( $p > 0.05$ ). However, first-year students had significantly higher  $\text{VO}_{2\text{max}}$  values than their fourth-year counterparts in the case of both disciplines. First-year medical students had a  $\text{VO}_{2\text{max}}$  of  $43.2 \pm 4.5$  ml  $\text{kg}^{-1} \text{min}^{-1}$ , while their fourth-year counterparts had a  $\text{VO}_{2\text{max}}$  of  $39.2 \pm 6.2$  ml  $\text{kg}^{-1} \text{min}^{-1}$  ( $p = 0.02$ ). Similarly, the mean  $\text{VO}_{2\text{max}}$  values for the first- and fourth-year students from non-health-related disciplines were  $46.1 \pm 4.9$  ml  $\text{kg}^{-1} \text{min}^{-1}$  and  $41.5 \pm 4.1$  ml  $\text{kg}^{-1} \text{min}^{-1}$ , respectively ( $p = 0.002$ ) (Figure 1).

The HR at the end of the first 5 minutes of the run in the SRT was similar ( $p > 0.05$ ) among fourth-year subjects from different study disciplines. However, while all the subjects ( $n = 40$ ) completed the first three levels of the SRT, more medical students reached exhaustion earlier. By the end of the fifth minute, 15% of the medical students ( $n = 20$ ) had already dropped out of the test, while none from the non-health-related disciplines ( $n = 20$ ) had. The HR for the medical students was significantly higher in the sixth ( $p = 0.02$ ) and seventh ( $p = 0.03$ ) minutes, by which time 30% and 55% of the students had dropped, respectively. In contrast, 15% and 30% of the students from the non-health-related disciplines had dropped out by these time points. By the end of the eighth minute of the SRT, 75% medical students and 70% students from non-health-related disciplines had dropped out because of exhaustion, and all their  $\text{VO}_{2\text{max}}$  levels were less than  $43.6$  ml  $\text{kg}^{-1} \text{min}^{-1}$ .

No significant difference was observed in the systolic BP at exhaustion and throughout the subsequent recovery phase between fourth-year medical students and their counterparts from non-health-related disciplines ( $p > 0.05$ ). However, the diastolic BP among medical students was higher at the end of the first ( $p = 0.03$ ) and second ( $p = 0.02$ ) minutes immediately following exhaustion (Figure 2).

#### 4 Labels of Figures and Tables

Table 1: Biodemographic data of subjects (n = 80).

Means (SD)				
<u>First year</u>			<u>Fourth year</u>	
<u>Variable</u>	<u>Medical school</u>	<u>Other schools</u>	<u>Medical school</u>	<u>Other</u>
Age (years)	19.7 (0.9)	19.9 (1.1)	23.0 (0.5)	23.1 (0.7)
Height (cm)	180.3 (6.9)	177 (5.8)	175.2 (8.3)	176.1 (6.8)
Weight (kg)	65.8 (7.2)	64.2 (6.9)	63.4 (7.7)	66.6 (7.2)
Baseline HR	72.4 (2.7)	71.0 (3.4)	76.2 (8.1)*	72.0 (4.1)
Baseline SBP	111.6 (8.8)	113.8 (7.3)	114.4 (5.9)	114.2 (8.4)
Baseline DBP	72.2 (6.2)	71.6 (7.2)	74.1 (6.0)	72.3 (7.7)

HR, heart rate in beats per min (bpm); SBP and DBP, systolic and diastolic blood pressure in mmHg, respectively.

\* indicates significant difference.

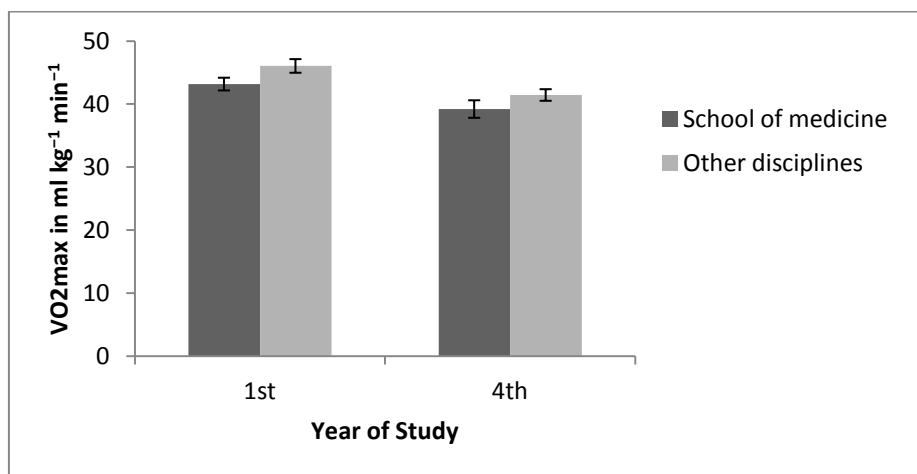


Figure 1: Mean VO<sub>2max</sub> levels of subjects from different disciplines and in different years of study. The error bars represent the standard error of mean.

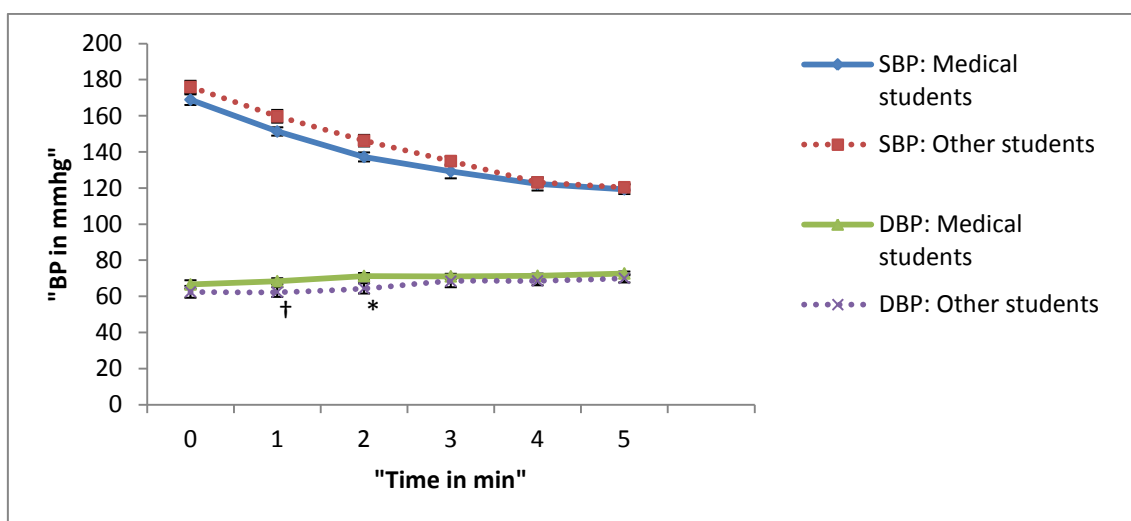


Figure 2: Comparison of blood pressure during the SRT for students from different disciplines. The error bars represent the standard error of mean.

†p = 0.03. \* p = 0.02

## 5 Discussion

Although the age- and year of study-matched participants had similar biodemographic data regardless of their disciplines of study, the fourth-year medical students had a higher resting HR compared to their counterparts from non-health-related disciplines. This is indicative of poor fitness levels [21], because there is a demonstrable negative correlation between resting HR and cardiorespiratory fitness [22]. The higher resting HR among fourth-year medical students may be a result of the observed increase in sedentary lifestyles. Perhaps, medical students have much higher academic demands as opposed to other students, because of which must forgo exercise and PA.

Fourth-year medical students are assumed to be more knowledgeable about the importance of PA and PF because of the scope of the medical school curriculum. Despite this, a lower percentage of these students participate in exercise activities. Further, their  $VO_{2max}$  was significantly lower than that of their counterparts from other disciplines, suggesting that exposure to the benefits of PF does not necessarily influence involvement in activities that improve fitness. In fact, it suggests the opposite, and this is probably related to the increased study time demand. Similar below-average fitness levels have previously been reported among medical students in Thailand [22]. Further, the demonstrably higher  $VO_{2max}$  among first-year students compared to fourth-year students from both disciplines (after age was controlled for) indicated that academic exposure to the importance of PF may not necessarily help improve PF levels.

The medical students in the present study showed lower physical endurance upon exertion in the SRT. They reached exhaustion earlier than students from non-health-related disciplines, and their pulse rate on settling in the run was higher, indicating a lower fitness index. Further, since 75% of the fourth-year medical students had  $VO_{2max}$  levels lower than the acceptable average of  $44 \text{ ml kg}^{-1} \text{ min}^{-1}$  for their age category [19], it is clear that their academic exposure to the benefits of PF did not serve to raise their fitness levels. Instead, they seem to be more affected by increased college-work demands and have fewer opportunities to engage in Pas [5, 11, 12].

For most young men, the early diastolic BP decay is enhanced during and immediately following exercise, which allows the stroke volume to increase despite an increase in the diastolic viscoelastic resistance and chamber stiffness [23, 24]. Therefore, the higher diastolic BP in the first 2 min of the SRT among the medical students in this study compared to students from other disciplines further suggests poorer fitness levels among the former. While it is known and taught in the medical curriculum that PA helps maintain a normal lipid profile and regulate BP through its effect on blood vessel elasticity [16, 21, 25], it seems that this awareness among medical students does not translate into practice. Because of their poor fitness levels, these students are more likely to have higher lipid deposition in their blood vessels, which reduces vessel elasticity. This is a possible contributor to their higher DBP at exhaustion, when the metabolic demand in the tissues is the maximum.

Although valid and reliable, the method used to estimate  $VO_{2max}$  in the present study (SRT) [8, 19, 26], may have greater variability than a more direct measure, namely, the doubly labeled water method [27]. Another limitation of the SRT is its inability to distinguish performance driven by motivation to participate in the field test from performance related to actual fitness. Therefore, some students may have achieved  $VO_{2max}$  values that did not commensurate with their actual fitness levels.

## 6 Conclusion

The results of this study underlie the conclusion that medical students have poorer fitness levels than those from other non-health related disciplines. It is apparent that their chosen course of study does not necessarily enhance their pursuit and attainment of higher fitness levels. This is possibly because the intense academic rigor prevents them from engaging in regular exercise. It is evident that fitness levels among medical students need to be improved, and this could be achieved by encouraging their participation in exercise regimes.

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