Do medical students' knowledge and attitudes about health and exercise affect their physical fitness?

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This study examined the relationship between unselected first-year medical students' knowledge and attitudes about health or exercise and their personal physical fitness. The 131 subjects performed a maximal exercise test to determine physical fitness by measuring maximal oxygen consumption (V\text{O}_2\text{max}), underwent hydrostatic weighing to assess body fat content (percent body fat), and completed a questionnaire to measure their knowledge and attitudes about health promotion/disease prevention and exercise. Many independent variables were significantly associated with V\text{O}_2\text{max} in bivariate analyses, but only percent body fat, resting systolic blood pressure, and perceived barriers to health promotion/disease prevention and exercise were significant predictors of V\text{O}_2\text{max} (mL×kg\textsuperscript{-1}×min\textsuperscript{-1}) in the multivariate analyses. The absolute V\text{O}_2\text{max} (L×min\textsuperscript{-1}) can be predicted from percent body fat, weight, and perceived barriers to health promotion/disease prevention. Freshmen medical students' attitudes toward health promotion/disease prevention and exercise constitute one of three strong predictors of physical fitness levels and should be determined, along with percent body fat and resting systolic blood pressure, when estimating fitness levels in a medical student population.

(Key words: Maximal oxygen uptake, health and exercise behavior, attitudes and knowledge, preventive medicine, cholesterol, body composition)

Trends in medical school curricula to include elective courses on exercise, physical fitness, and disease prevention have been reported.\textsuperscript{1-4} Greenland and coworkers,\textsuperscript{5} observing freshmen from eight medical schools, found that their personal behavior toward cardiovascular disease prevention tended to parallel their positive attitude toward the importance of health promotion/disease prevention. Positive attitudes and beliefs about physical activity were also found to be closely related to beliefs about how behavior can affect health status.\textsuperscript{6} The prevalence of risk factors for chronic disease and changes in health behavior were associated with the belief that health outcomes can be controlled by an individual's behavior.\textsuperscript{7} In a study regarding health knowledge as it relates to attitudes
and changing behavior, Rimer and Glassman\(^8\) suggested that one should measure both what people say (that is, attitudes and knowledge) and what they do (that is, behavior).

Increasingly, the health benefits of physical activity for adults are becoming evident. These benefits include preventing or delaying morbidity and mortality from premature cardiovascular disease,\(^9,10\) preventing obesity,\(^11\) and enhancing physical fitness.\(^32\) Obesity has been shown to have strong positive associations with hypertension and non-insulin-dependent diabetes mellitus in adults.\(^13,14\)

The potential for early prevention and intervention of coronary heart disease and other preventable chronic diseases involves education and behavioral modification to adopt health-enhancing lifestyles and behavior. These healthy lifestyles include eating a prudent diet, participating in regular physical activity or aerobic exercise, and maintaining a regular schedule for screening and detecting early signs of obesity, hypertension, diabetes, and hyperlipidemia. Among these healthy lifestyles, increased personal fitness or physical activity is of greatest importance as it has been identified as an independent risk factor for coronary heart disease.\(^10,12,15\)

Little research has been conducted to determine the relationships between physical fitness levels and health and exercise knowledge, attitude, and behavior. The purpose of this study was to examine such relationships in a medical student population.

**Methods**

Data were collected as part of a longitudinal study, involving more than 260 osteopathic medical students, on how medical students’ health and exercise attitudes and knowledge influence their personal health behaviors, and whether the health-enhancing lifestyles will influence their practice of preventive medicine in the clinical setting.

All the 1990 and 1991 entering classes of first-year medical students (\(N=131\)) were recruited to participate as subjects for this study. A 100% participation rate was obtained. The subjects gave informed consent before all experimental studies. Data collected were kept confidential. There were 75 men and 56 women, aged 21 to 47 years (mean and SD=25.3±5.7 years).

After a comprehensive medical history and physical examination, the subjects were found to be healthy and free of any illnesses or injuries. Their dietary habits and physical activity level were determined through a health history questionnaire.

**Experimental measurements**

- **Maximal exercise test**—Each subject performed a 12-lead electrocardiographically monitored maximal exercise test with expired gas collection for determining oxygen consumption (\(\text{Vo}_2\)). Maximal \(\text{Vo}_2\) (\(\text{Vo}_2\max\)) determination was obtained from a multistage treadmill testing protocol described by Bruce\(^16\) (for the men), and by Naughton\(^17\) (for the women). These test protocols were selected to elicit treadmill exercise time comparable to our subjects, for example, as regards age and gender. The exercise test was performed in an environmentally controlled laboratory at least 1 hour after eating and 4 hours after other exercise. The test was conducted by an exercise physiologist and supervised by a physician. Test endpoints included volitional fatigue, intolerable dyspnea, angina pectoris, ventricular tachycardia, or exercise-induced ischemic S-T segment depression or elevation.\(^17,18\)

**Maximal oxygen consumption determination**—With the use of the open-circuit method and an automated oxygen uptake system, expired air was collected and analyzed for oxygen and carbon dioxide (model S-3A oxygen analyzer and model CD-3A carbon dioxide analyzer, Ametek, Pittsburgh, Pa). Values for \(\text{Vo}_2\) (measured in \(\text{mL} \times \text{kg}^{-1} \times \text{min}^{-1}\)), absolute \(\text{Vo}_2\) (in liters \(\times \text{min}^{-1}\)), minute ventilation, and respiratory exchange ratio were obtained every 30 seconds with the Oxygen Uptake System software (OCM1, Ametek, Pittsburgh, Pa) interface with an IBM-PC computer and a printer. The \(\text{Vo}_2\) value was used to represent the subjects’ aerobic power, which is a conventional measurement of cardiovascular fitness.\(^19,20\)

The criteria for the attainment of \(\text{Vo}_2\max\) were as follows: (1) a plateau of \(\text{Vo}_2\) values with further increment of treadmill workload, for example, a difference of less than or equal to 2.5 \(\text{mL} \times \text{kg}^{-1} \times \text{min}^{-1}\) between two successive increasing treadmill workloads with maximal efforts\(^19,20\), (2) a respiratory exchange ratio greater than 1.0; and (3) a heart rate greater than 95% of the predicted maximal value.

**Body composition measurement**—Body composition was determined by the underwater weighing technique described by Pollock and coauthors.\(^18\) Body composition was measured in percent body fat (\(\%\text{BF}\)). Residual lung volume was estimated from regression equations for men\(^21\) and for women.\(^22\) Both equations have high correlation coefficient (\(r\)) values of 0.80 (standard error of estimate (SEE=0.53)) and 0.70 (SEE=0.39), respectively. Thirty randomly sampled measurements of residual lung volume, obtained by the helium washout method, were done to test the accuracy of the two regression equations. These residual lung volume measurements were determined on land with the subject seated. At least two measurements of residual lung volume were done for each subject. The two residual lung volume values differing by less than 50 \(\text{mL}\) were averaged and used for comparing the values estimated from the regression equations. In the study population, \(r=0.62\) (SEE=0.72 L) for these two procedures. Body fat in \(\%\text{BF}\) was converted from body density according to the Brozek equation.\(^23\)

**Blood lipid and glucose determinations**—Specimens of 12-hour-fasting blood were obtained in the
morning. The total cholesterol (TC), high-density-lipoprotein cholesterol (HDL-C) and triglyceride (Trgl) levels were determined by a hospital-based clinical laboratory certified in accordance with the standards of the Centers for Disease Control and Prevention (CDC) for lipid analysis. The ratio of TC to HDL-C was calculated. Low-density-lipoprotein cholesterol (LDL-C) was calculated by the following formula based on the Lipid Research Clinics\textsuperscript{24} data: 

$$LDL-C = TC - HDL-C - (Trgl/6.5).$$

**Resting blood pressure and heart rate determinations**—Resting blood pressure and heart rate were obtained before the exercise test. The participants were seated with feet resting flat on a surface and arm at heart level. The appropriate cuff was placed around the upper arm. By use of a standard mercury sphygmomanometer (Labtron Standing Model with V-Lok cuffs), two resting pressure determinations were made by rapidly inflating to the maximum inflation level and deflating at a rate of 2 mm Hg/s, with a 30-second rest between each determination. The first appearance of two consecutive heart beats determined the first Korotkoff sound as systolic pressure, and the point at which the sound disappeared determined the fifth Korotkoff sound as diastolic pressure. Heart rate value was determined after a 30-second rest by counting the number of R-R intervals for 15 seconds from a 12-lead electrocardiogram strip, and then converted to beats per minute.

**Pulmonary function test**—Breathing capacity was measured by spirometry. Forced vital capacity (FVC), forced expiratory volume at 1 second (FEV\textsubscript{1}), and the ratio of FEV\textsubscript{1} to FVC were determined.

**Knowledge and attitude questionnaire**—The subjects completed a 58-item Exercise and Attitude (EXAT) questionnaire on knowledge, attitudes, and behavior regarding health promotion/disease prevention and exercise. The subjects were asked to complete the questionnaire the same day they performed the exercise test. The EXAT questionnaire data were scrutinized, item by item, by a personal, follow-up interview with the subjects to verify their responses and complete any missing items.

The rationale for generating test items on knowledge and attitudes involved three types of meaning: (1) "psychological," which refers to the learners' ability to relate the information to their life and understand its personal implications; (2) "operational," which refers to their ability to use the information; and (3) "lexical (dictionary)," which refers to their ability to define key concepts and words of a health or exercise message.\textsuperscript{8} Health-promotion behavior was defined as any activity undertaken by persons, who believe themselves healthy, for the purpose of attaining an even greater level of health (for example, "wellness behavior") or for the purpose of preventing illness or detecting it in an asymptomatic state (for example, "disease-preventive behavior").\textsuperscript{25}

Briefly, the test items on the EXAT questionnaire were generated by reviewing health education and health behavior literature,\textsuperscript{1,5,7,8,25} and by consulting with specialists in health behavior research. The 74 test items generated through this strategy were circulated to three persons who rated each item on content and clarity. The raters were a senior author (H.T.D.) of this study, a PhD educational psychologist, and a family medicine resident knowledgeable in exercise and preventive medicine. Only items that were rated as clear and representative of knowledge and attitudes about health and exercise by three raters were retained.

The resulting 58 items were put into the test inventory and grouped as follows: (1) attitudes toward health promotion/disease prevention and exercise, 16 items; and (2) knowledge of health promotion/disease prevention and exercise, 42 items. The attitude test items were further regrouped as follows: attitudes and beliefs regarding health promotion, 7 items; perceived barriers to health promotion/disease prevention, 3 items; and perceived barriers to exercise, 6 items. The knowledge test items were subgrouped as follows: knowledge of health promotion/disease prevention, 8 items; knowledge of exercise, 17 items; and knowledge on expectancy for health-related outcomes from exercise, 17 items.

This questionnaire was pilot-tested in a group of practicing physicians (N=25) interested in exercise or disease prevention (or both). They were asked to complete the EXAT questionnaire and to note any unclear or ambiguous items. The several items on the test inventory they reported as unclear were reworded or rewritten.

Each test item was scored with a 5-point scale, between "strongly agree" (5 points) and "strongly disagree" (1 point), the higher score representing a good fund of knowledge or positive attitude. Internal consistency of the test items ranges from $r=0.94$ to $r=0.99$.

**Statistical analysis**

The dependent variable was VO\textsubscript{2 max} measured in both the absolute term (Lxmin\textsuperscript{-1}) and the relative term (mLxkg\textsuperscript{-1}xmin\textsuperscript{-1}). The independent variables were as follows: %BF, resting and maximal heart rates, resting and peak systolic and diastolic blood pressure, FVC, FEV\textsubscript{1}, age, TC, HDL-C, Trgl, ratio of TC to HDL-C, knowledge of health promotion/disease prevention and exercise, perceived barriers to health promotion/disease prevention; perceived barriers to exercise; and knowledge on expectancy for health-related outcomes from exercise.

Data were analyzed by univariate, bivariate, and multivariate (stepwise approach) methods. With the use of the SPSS statistical software, logistic regression models were fit to examine association between dependent and independent variables. The univariate procedures were used to obtain means and standard deviations. The bivariate methods (Pearson correlation coefficients) were used to describe the relationships between each independent variable and the dependent variable. To describe any linear relationships between (continued on page 1024)
Table 1

Characteristics of the Subjects (N = 131)

<table>
<thead>
<tr>
<th>Variable</th>
<th>All (N = 131)</th>
<th>Men (n = 75)</th>
<th>Women (n = 56)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>• Age, y</td>
<td>25.3 ± 5.7</td>
<td>25.0 ± 4.6</td>
<td>25.6 ± 7.1</td>
</tr>
<tr>
<td>• Height, cm*</td>
<td>170.3 ± 9.0</td>
<td>174.9 ± 7.4</td>
<td>163.0 ± 6.0</td>
</tr>
<tr>
<td>• Weight, kg*</td>
<td>69.6 ± 13.7</td>
<td>74.9 ± 9.0</td>
<td>61.4 ± 15.7</td>
</tr>
<tr>
<td>• Body fat, %</td>
<td>21 ± 8.5</td>
<td>17 ± 6.4</td>
<td>27 ± 7.7</td>
</tr>
<tr>
<td>• VO\textsubscript{max} (mL x kg\textsuperscript{-1} x min\textsuperscript{-1})*</td>
<td>42.08 ± 9.9</td>
<td>47.8 ± 7.1</td>
<td>33.4 ± 6.7</td>
</tr>
<tr>
<td>(L x min\textsuperscript{-1})*</td>
<td>2.92 ± 0.47</td>
<td>3.52 ± 0.57</td>
<td>2.00 ± .37</td>
</tr>
<tr>
<td>• Heart rate, beats per minute</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resting</td>
<td>70.4 ± 8.1</td>
<td>69.2 ± 7.5</td>
<td>70.1 ± 8.4</td>
</tr>
<tr>
<td>Maximal</td>
<td>191.0 ± 8.9</td>
<td>191.6 ± 8.5</td>
<td>190.1 ± 9.6</td>
</tr>
<tr>
<td>• Resting blood pressure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic, mm Hg</td>
<td>124 ± 10.7</td>
<td>127 ± 10.6</td>
<td>119 ± 8.8</td>
</tr>
<tr>
<td>Diastolic, mm Hg</td>
<td>79 ± 7.9</td>
<td>80 ± 7.4</td>
<td>76 ± 8.4</td>
</tr>
<tr>
<td>• Peak blood pressure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic, mm Hg*</td>
<td>166 ± 18.5</td>
<td>173 ± 16.4</td>
<td>154 ± 15.5</td>
</tr>
<tr>
<td>Diastolic, mm Hg</td>
<td>76 ± 11.6</td>
<td>75 ± 12.6</td>
<td>76 ± 9.9</td>
</tr>
<tr>
<td>• Total cholesterol, mg/dL</td>
<td>169 ± 30.1</td>
<td>169 ± 25.8</td>
<td>169 ± 36.2</td>
</tr>
<tr>
<td>• HDL-cholesterol, mg/dL</td>
<td>49 ± 10.6</td>
<td>47 ± 10.3</td>
<td>52 ± 10.8</td>
</tr>
<tr>
<td>• Total cholesterol/HDL cholesterol ratio</td>
<td>3.1 ± 0.99</td>
<td>3.2 ± 1.0</td>
<td>2.9 ± 0.89</td>
</tr>
</tbody>
</table>

*P < .05, significant difference between men and women.

Results

Table 1 shows the subjects' physical characteristics, body composition, VO\textsubscript{max}, heart rate, blood pressure, and blood lipid values. The men were significantly taller (P<.05) than the women. Male students' VO\textsubscript{max}, FVC, and peak systolic and diastolic blood pressure values were also higher (P<.05) than those of the female students. The men had lower %BF, (P<.05) than the women. However, resting and maximal heart rates, resting systolic and diastolic blood pressure, FEV\textsubscript{1}, TC, HDL-C, and ratio of TC to HDL-C in men were not significantly different than those in women. The subjects' resting and exercise blood pressures and their fasting blood lipid values were within normal limits for healthy men and women of similar age. During and after the exercise test, no significant electrocardiographic changes were seen in the participants.

Table 2 presents values for both genders for perceived barriers to health promotion, perceived barriers to exercise, knowledge on expectancy for health-related outcomes from exercise, attitudes and beliefs regarding health promotion/disease prevention, knowledge of health promotion/disease prevention, knowledge of exercise, and the sums of all test items related to attitudes and to knowledge. Among these variables, knowledge of health promotion/disease prevention was higher in the men than in the women (3.86 vs 2.97, P<.05).

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Male students also reported a higher level of physical activity or exercise compared with that of the female students (data not shown).

The Pearson correlation coefficients between the subjects' VO₂ max and the various measured independent variables are presented in Table 3. The strongest linear associations with VO₂ max were %BF, peak systolic pressure, resting systolic
blood pressure (SBP_{rest}), resting diastolic pressure, height, weight, perceived barriers to health promotion/disease prevention, perceived barriers to exercise, knowledge of health promotion/disease prevention, the sum of all test items related to knowledge, and the sum of all test items related to attitudes. Each of these variables was significantly associated with VO_{2max}.

Multiple regression analysis shows that the dependent variable VO_{2max} (mL x kg^{-1} x min^{-1}) is strongly associated with the following independent variables: %BF (P=0.0000), perceived barriers to exercise, (P=0.0068), and SBP_{rest} (P=0.0098) (Table 4). For predicting absolute VO_{2max} (L x min^{-1}), the strongest predictive variables are as follows: weight (P=0.0000), %BP (P=0.0000), and perceived barriers to health promotion/disease prevention (P=0.005) (Table 4). The test questions on perceived barriers to exercise and to health promotion/disease prevention are shown in the Figure.

**Discussion**

Most studies dealing with physical fitness of a specific population did not actually measure the VO_{2max} of their subjects; instead, VO_{2max} values were frequently estimated from treadmill walking time or extrapolated from heart rates during a sub-maximal bicycle exercise test. Studies have shown that increased treadmill performance time did not correspond to an increase in VO_{2max}. Aerobic power measured in VO_{2max} is the standard measurement of cardiovascular fitness.

For those subjects older than 30 years (N=14), VO_{2max} values were adjusted for age of the study population. The VO_{2max} value obtained for the men (47.8 ± 7.1 mL x kg^{-1} x min^{-1}), was similar to that of the untrained college men (47.0 ± 2.6 mL x kg^{-1} x min^{-1}). For the women, VO_{2max} (33.4 ± 6.7 mL x kg^{-1} x min^{-1}) was slightly lower than that of untrained college women (37.2 ± 5.9 mL x kg^{-1} x min^{-1}). Because of small sample size in this study, data for men and for women were combined and analyzed as a single group, except when descriptive statistics are used to show physical and physiologic characteristics of both genders (Table 1). Although many variables were significantly associated with VO_{2max} in the bivariate analyses (Table 3), only %BF, weight, SBP_{rest}, perceived barriers to exercise, and perceived barriers to health promotion/disease prevention were identified as being strong predictors of VO_{2max} in the multivariate linear analyses that adjusted for confounding variables.

Using only two categories of the EXAT ques-

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**Table 4**

Multiple Regression Analyses for Maximal Oxygen Consumption (VO_{2max}) With Significant Independent Variables

<table>
<thead>
<tr>
<th>Significant independent variables</th>
<th>B value</th>
<th>SE</th>
<th>β</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent body fat</td>
<td>-0.78</td>
<td>0.095</td>
<td>-0.670</td>
<td>0.00001</td>
</tr>
<tr>
<td>Perceived barriers to exercise</td>
<td>3.89</td>
<td>1.389</td>
<td>0.228</td>
<td>0.0068</td>
</tr>
<tr>
<td>Resting systolic blood pressure</td>
<td>0.18</td>
<td>0.068</td>
<td>0.198</td>
<td>0.0098</td>
</tr>
<tr>
<td>(constant)</td>
<td>20.70</td>
<td>10.252</td>
<td>...</td>
<td>0.048</td>
</tr>
</tbody>
</table>

Multiple R = 0.81; adjusted R^2 = 0.64; SEE = 0.588; F = 40.22 (P = 0.0001); df = 3126.

<table>
<thead>
<tr>
<th>Significant independent variables</th>
<th>B value</th>
<th>SE</th>
<th>β</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent body fat</td>
<td>-0.059</td>
<td>7.187</td>
<td>-0.565</td>
<td>0.0000</td>
</tr>
<tr>
<td>Weight</td>
<td>0.041</td>
<td>4.353</td>
<td>0.631</td>
<td>0.0000</td>
</tr>
<tr>
<td>Perceived barriers to health promotion/ disease prevention</td>
<td>0.294</td>
<td>0.116</td>
<td>0.175</td>
<td>0.014</td>
</tr>
<tr>
<td>(constant)</td>
<td>0.247</td>
<td>0.487</td>
<td>...</td>
<td>0.619</td>
</tr>
</tbody>
</table>

Multiple R = 0.87; adjusted R^2 = 0.75; SEE = 45; F = 64.54 (P = 0.0000); df = 3126.
Instruction: circle only one numerical number to represent your best answer based on your present knowledge or belief.

<table>
<thead>
<tr>
<th>Question</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Undecided or don't know</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Do you believe that your previous work (job) or study (school) left you little free time to exercise three times per week?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. Do you believe that regular exercise routine would keep you from your family or friends?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. Do you believe that exercise would cause you to be sleepy and fatigued?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. Do you believe that attending medical school classes will leave you too little free time to exercise three times per week?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. Do you believe that exercise would increase your appetite?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. Do you believe that you will have time to improve your physical fitness after you have completed your medical education?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. If you were presently in a busy clinical practice, you would heavily concentrate on disease-oriented medicine because there is little time left for other types of practice.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8. This year, you are unlikely to follow a disease-prevention program for yourself because of your busy medical school schedule.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9. Do you believe that a physician’s good health behavior will be more likely to motivate patients to achieve a healthy behavior?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Figure. Test items on perceived barriers to exercise participation and health promotion/disease prevention activities.
tionnaire (for example, perceived barriers to exercise participation and health-promotion/disease-prevention activities [PBH]), along with SBP_{rest} and BF values, one could predict fitness with the following regression equation:

\[
\mathrm{Vo}_{2\text{max}} (\text{mL} \times \text{kg}^{-1} \times \text{min}^{-1}) = -3.89 \times (\%\text{BF}) + 0.78 \times (\text{SBP}_{\text{rest}}) + 20.70.
\]

This regression equation accounted for 64% of the total variance in the multivariate analysis with a very high multiple \( R = 0.81 \) and adjusted \( R^2 = 0.64 \) (Table 4). All the independent variables identified in this regression equation are readily measurable. Because this regression equation was derived from a homogeneous sample of first-year medical students, it is not applicable for extrapolation to different populations.

Persons regularly trained with intense aerobic exercise usually have a lower resting heart rate and a larger cardiac stroke volume, compared with their sedentary counterparts. From the bivariate analyses, resting heart rate was not significantly associated with \( \mathrm{Vo}_{2\text{max}} (r = 0.27) \) and was not identified as a strong predictor for aerobic power or fitness in the multiple regression analysis. Ambiguity and inconsistency in the determination of resting heart rate may affect its value as a strong factor for predicting \( \mathrm{Vo}_{2\text{max}} \). For example, resting heart rate can be determined while subjects are quietly sitting in their home for a reasonable length of time, before they get up in the morning after a restful sleep, quietly in the testing laboratory where test anxiety is often very high, or simply before other heart-rate measurement. However, the foregoing does not imply that resting heart rate may not be an important factor influencing \( \mathrm{Vo}_{2\text{max}} \).

Serum HDL-C concentration has been reported to be positively related to individual fitness levels. However, this relationship may be confounded by persons with already elevated HDL-C levels being more willing to participate in a physically active lifestyle. Martin and associates speculated that preexisting high HDL-C values may be associated with high fitness levels. Because the values obtained in the present study are relatively high for HDL-C (49 \( \pm \) 10.6 mg/dL) and low for TC (169 \( \pm \) 30.1 mg/dL) in both men and women, we were not surprised to find that HDL-C and TC were not identified as significant discriminants for predicting fitness.

Attitudes toward preventive care have been suggested as one of the most important outcomes of medical education. Perhaps medical schools should consider the inclusion of courses such as health promotion/disease prevention as well as exercise physiology and fitness. These courses might improve medical students’ attitudes and promote health-enhancing behavior, which, in turn, might encourage more physicians to employ preventive medicine in their clinical practice.

Conclusions and recommendations

Among first-year medical students, knowledge and attitudes about exercise and health promotion/disease prevention (perceived barriers to exercise and perceived barriers to health promotion/disease prevention test items in the EXAT questionnaire), \%BF, and \text{SBP}_{\text{rest}} are strong predictors of fitness. We recommend that all test items related to perceived barriers to exercise and perceived barriers to health promotion/disease prevention (nine questions) be included in the questionnaire.

Data collection is in progress at our institution to determine whether a high level of fitness, estimated from these predictors, could influence medical students’ personal health and exercise behavior before they enter postgraduate clinical training. We are also trying to determine whether positive attitudes toward health promotion/disease prevention and exercise and the health-enhancing behavior and lifestyle could significantly influence their practice of preventive medicine in the clinical setting.

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References