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Body Composition, Muscular Strength and Cardiovascular Strength of the Second-Year Medical Students at Faculty of Medicine Siriraj Hospital, Mahidol University

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ABSTRACT

Objective: This study was conducted to evaluate Siriraj medical students' fitness thereby obtaining data for promoting greater physical fitness in Siriraj medical students.

Methods: Physical fitness among second-year medical students academic year 2008 was measured by methods including body mass index (BMI) and waist to hip circumference ratio in determining body composition, hand grip dynamometer in determining muscular strength, heart rate as well as blood pressure before and after performing a YMCA step test in determining cardiovascular strength and a questionnaire in determining the lifestyle of medical students.

Results: Average BMI and cardiovascular strength of both male and female medical students were within normal range compared to those of Thai. However, muscular strength of both male and female medical students was relatively low compared to those of average Thai as sixty-six per cent of them had exercise less than twice a week.

Conclusion: Siriraj medical students need more physical exercises to improve their physical fitness. It is important to persuade medical students to pay more attention to their health, which will eventually make them to be healthy doctors in the future.

Keywords: Physical fitness, Medical students, Faculty of Medicine Siriraj Hospital

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Doctors as well as medical students have to improve their medical knowledge throughout their lives. As a result of the continuation in medical technology development and biomedical research, medical students should be enthusiastic in learning in order to achieve their goals. This makes them neglect their health. Consequently, they will probably suffer from various diseases in the future. As role models for health promotion, this problem should not occur in both doctors and medical students.

Physical fitness is the suitable parameter for determining an individual's health. Body composition, muscular strength and cardiovascular strength are important measurements of physical fitness. This study was conducted in order to evaluate Siriraj medical students' fitness in the academic year 2008 to gain information about their fitness as data from this study will be used for the development of a health promotion campaign among medical students.

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MATERIALS AND METHODS

Populations

The study was approved by the Siriraj Institutional Review Board (SIRB) and recruited 150 second-

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year medical students during the academic year 2008 who were willing to enter the study and to give informed consent for participation in the study.

Measurement of body composition

In order to measure the amount of body fat, body mass index (BMI) and waist to hip circumference ratio were measured in the population. The body weight and height of each medical student was measured and BMI was calculated as body weight in kilogram/(height in meter).[2] The data were interpreted by using normal Asian values. BMI between 18.5 and 23 was considered to be normal. BMI, which was less than 18.5 and more than 23, were considered to be underweight and overweight, respectively.[1] In addition, waist to hip circumference ratio, which reflects abdominal obesity, was obtained by measuring the circumferences at the waist (the midpoint of length between the costal margin and the anterior superior iliac spine) and hip (anterior superior iliac spine), respectively. The waist circumference as well as waist to hip circumference ratio was compared with the normal values of Asian populations. Waist circumferences of at least 80 cm in females and 90 cm in males are the risk factors for metabolic syndrome.[2] Moreover, a waist to hip circumference ratio of more than 0.8 in females and 1 in males are risk factors for cardiovascular disease.

Measurement of muscular strength

Hand grip strength was performed by using a hand grip dynamometer (Takei model TKK 5401). Subjects had to grip the dynamometer with their maximal forces for at least 5 seconds. After that, data were collected and compared to normal values of the Thai population.

Measurement of cardiovascular strength

Cardiovascular strength, was evaluated by measuring heart rate as well as blood pressure before and after performing a step test technique for indicating physical fitness index (PFI). YMCA - 3 minutes step test[3]-was performed by moving up and down using the 10 inches height platform. After both feet of subjects were on the platform, they immediately moved their feet down to the ground. These actions were performed repeatedly at the rate of 20 times per minute for 3 minutes. After finishing the test, subjects were asked to rest for 3.5 minutes. Then heart rate was measured for three times at 1-1.5 minutes, 2-2.5 minutes and 3-3.5 minutes. A physical fitness index (PFI) was obtained by using the equation below and interpreted by the criteria in Table 1[3].

TABLE 1. Relationship between PFI and physical fitness.

PFI	Physical fitness
<40	Very poor
41-50	Poor
51-60	Average
61-70	Good
71-80	Very good
81-90	Excellent

$$PFI = \frac{\text{duration of step test (180 seconds) x 100}}{\text{2 x summation of heart rate (3 times)}}$$

Questionnaire

All subjects answered the questionnaires before physical fitness was measured. The questionnaires focused on three topics including exercise (type, frequency, duration, attitude, and reason for exercise), leisure time and diet (number of meals and type of diets), respectively.

Statistical analysis

Descriptive statistics was used to analyze the results. Prior to the calculation, the distribution of data was tested. Mean and standard deviation were used for reference values in data that were normally distributed whereas median was used for reference values in non-normal distributed data. The values were compared with normal values in the Thai population[4] using Chi-square for categorical data and t-test for continuous data.

RESULTS

Physical fitness of second-year medical students was evaluated by five parameters including BMI, waist to hip circumference ratio, hand grip strength test, and YMCA-3 minutes step test, and life style questionnaires.

Firstly, the average BMI in male and female medical students were 21.11 ± 3.19 and 20.61 ± 2.80 kg/m^2, respectively (Table 2). The average BMI in male medical students was not significantly higher than that of female medical students. When compared with the average BMI in Thais, which was 18.5-24.9, average BMI in both male and female medical students were within normal range (Table 3).

Secondly, the mean waist to hip ratio in male medical students was 0.806 ± 0.045 while that of female medical students was 0.752 ± 0.043 (Table 3). There was a significant difference between the average waist to hip ratio of male and female medical students (p-value < 0.0001). In addition, when compared with the

TABLE 2. Characteristics of male and female second year medical students.

Parameters	Male medical students	Female medical students	P-value
Age (years)	19.58 ± 0.546	19.44 ± 0.500	0.126
Weight (kg)	63.19 ± 9.72	53.26 ± 7.88	0.0001
Height (cm)	173.08 ± 6.45	160.65 ± 5.28	0.0001
BMI (kg/m^2)	21.11 ± 3.19	20.61 ± 2.80	0.320
Resting heat rate (bpm)	75.18 ± 9.87	74.66 ± 10.53	0.731
Systolic blood pressure (mmHg)	119.14 ± 11.98	106.23 ± 12.56	0.0001
Diastolic blood pressure (mmHg)	78.06 ± 10.29	70.00 ± 9.325	0.0001
Sleep time (hours)	5.75 ± 1.27	6.09 ± 1.14	0.082
Waist circumference (cm)	75.49 ± 8.06	69.27 ± 6.87	0.0001
Hip circumference (cm)	93.53 ± 5.77	92.05 ± 5.52	0.112

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TABLE 3. Physical fitness of second year medical students compared to normal Thais.

Parameters	Male		Female	
	Medical student	Thai population	Medical student	Thai population
Body mass index (BMI) (kg/m^2)	21.11 ± 3.19	18.5 - 24.9	20.61 ± 2.80	18.5 - 24.9
Waist to hip circumference ratio	0.806 ± 0.045	0.83 - 0.88	0.752 ± 0.043	0.71 - 0.77
Hand grip strength (kg/body weight in kg)	0.65 ± 0.10	0.67 - 0.79	0.49 ± 0.11	0.49 - 0.59
Heart rate after performing YMCA Step Test (bpm)	82.05 ± 11.74	91 - 97	82.94 ± 11.96	110 - 116

mean waist to hip circumference ratio in the general Thai population of the same age and sex (0.83-0.88 and 0.71-0.77 in male and female, respectively), the average waist to hip circumference ratio in male medical students was lower than that of the average Thai whereas that of female medical students was in the normal range (Table 3).

Thirdly, the mean hand grip strength in male and female medical students were 0.65 ± 0.10 and 0.49 ± 0.11 kg per body weight in kg, respectively (Table 3). The average hand grip strength in male medical students was significantly higher than that of female medical students (p-value < 0.0001). Although mean hand grip strength in female medical students was in the normal range of that of the female Thai population (0.49-0.59 kg per body weight in kg), the mean hand grip strength in male medical students was lower than that of the male Thai population of the same age (0.67-0.79 kg per body weight in kg) (Table 3).

Fourthly, average heart rates after performing a YMCA step test in male and female medical students were 82.05 ± 11.74 beats per minute and 82.94 ± 11.96 beats per minute, respectively (Table 3). There was no significant difference between heart rates in male and female medical students. However, the average heart rate after performing YMCA step test of both male and female medical students was lower than those of the Thai population at the same age and sex (91-97 beats per minute in males and 110-116 beats per minute in females) (Table 3).

Finally, according to the questionnaires that were returned by second year medical students, the mean age of the students was 19.51 ± 0.528 years and the mean sleeping time was 5.91 ± 1.217 hours (Table 2). Medical students have adequate sleep but they hardly perform exercise regularly. Sixty-six per cent of them did an average number of exercises less than twice per week. Thirty-one per cent of them claimed that lack of time was a cause of their insufficient exercise and 28.48% of them mentioned that exhaustion from medical class was the cause of their insufficient exercise. However, laziness brought about inadequate exercise in this group for 23.63%.

DISCUSSION

Physical fitness among second-year medical students was measured by five methods. The first two methods included body mass index (BMI) and waist to hip circumference ratio which were used to determine body composition. The third method, which was measured by hand grip dynamometer, was used to determine muscular strength. Fourthly, heart rate as well as blood pressure before and after performing a YMCA step test was recorded to determine cardiovascular strength. Finally, a questionnaire on lifestyle of medical students was collected and analyzed. Frequency distributions of body mass index (BMI), physical fitness index (PFI) and mean muscular strength (MMS) categorized by percentiles is shown in Table 4.

According to the result of the body composition test, it is clear that the average BMI's of both male and female medical students were within normal range. Furthermore, the averages waist to hip circumferences of male medical students and female medical students were normal when compared to those of normal Thais. This implies that medical students looked after their health very well by avoiding habits of excessive eating.

The muscular strength test of medical students showed the opposite result to that of the body composition test. Although the mean hand grip strength of female medical students was in the normal range of Thai females, it was within the lower limit of this normal value. However, the average hand grip strength of male medical students was lower than those of average Thai males. This study showed that the muscular strength of medical students was low compared to those of normal Thais. This data agree with a previous study of physical fitness of Siriraj medical students for the academic year 2000, which, although it used different tools to measure physical fitness, determined that Siriraj medical students need more physical exercise, especially those involved in muscular strength, in order to improve their fitness.[5] To improve muscular strength, the best way is to get involved in an exercise training program, especially resistive strength training. In Puerto Rico, after an 8 week-exercise training program including a warm up session for 5 minutes, aerobic training for 20 minutes at an intensity of 60-80% of heart rate maximum, progressive resistive strength training and cool down period for 5 minutes, the Puerto Rico medical students decreased their percent of body fat, resting heart rate, resting systolic blood pressure, and increased their hand grip strength.[6]

Heart rate after performing a YMCA step test was the best physical fitness parameter of both male

TABLE 4. Frequency distributions of body mass index (BMI), physical fitness index (PFI) and mean muscular strength (MMS) categorized by percentiles.

Ranges of percentiles	BMI (N=150)	PFI (N=150)	MMS (N=150)
≤ 5th percentile	7	7	7
5th-10th percentile	8	9	8
10th-25th percentile	22	22	22
25th-50th percentile	38	39	38
50th-75th percentile	38	40	38
75th-90th percentile	22	18	22
90th-95th percentile	8	9	8
≥ 95th percentile	7	6	7

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and female medical students in this study. Male medical students had a significantly lower average heart rate compared with the average Thai male. The result of the cardiovascular fitness test of female medical students showed itself as predominately better than that of the average Thai female. As a result, the cardiovascular fitness of the second-year medical students in this group was better than those of average Thais. Similarly, a majority of medical students in Nepal had good physical fitness[3]. However, a longitudinal study of USA military medical students showed that their cardiovascular fitness dropped obviously over a two-year period and dropped more quickly than the normal population[7]. Therefore, a cohort study for Siriraj medical students should be performed to monitor their physical fitness until they graduate from the Faculty of Medicine Siriraj Hospital.

CONCLUSION

Siriraj medical students need more physical exercises, especially muscular strength training. Persuading medical students to pay more attention to their health will eventually create, and ensure healthy doctors for the future benefit of both themselves and society.

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