Aerobic Capacity of Fifth-Year Medical Students at Chiang Mai University

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Objective: *To study the level of aerobic capacity using maximal oxygen consumption (VO_2max) in the fifth-year medical students at Chiang Mai University.*

Material and Method: *This was a retrospective study in which data were collected from the database of the fifth-year medical students who attended the rehabilitation medicine course at Department of Rehabilitation Medicine, Faculty of Medicine, Chiang Mai University between January 2003 and December 2004. The level of aerobic capacity was evaluated by maximal oxygen consumption (VO_2max), which was calculated using sub-maximal exercise test on a bicycle ergometer (Astrand-Rhyming test).*

Results: *During two-year period, 226 medical students performed 226 Astrand-Rhyming submaximal cycle ergometer tests. The mean age was 22.3 $\pm$ 0.7 years (range 21-26 years) and average body weight was 56.8 $\pm$ 11.9 kg (range 30-125 kg). The number of male and female students was comparable (male 44.7% and female 55.3%). Average VO_2max of the students was 38.1 $\pm$ 8.6 ml/kg/min (range 18.5-76.7 ml/kg/min) and there was no statistical significance between sex (VO_2max of male = 38.4 $\pm$ 7.6 and female = 37.9 $\pm$ 9.4 ml/kg/min, $p = 0.636$). When standard VO_2max value of Thai people was compared, 39.4% was categorized in low health fitness group, 40.7% was in health fitness group, and only 19.9% was in high health fitness group. However, 65% of the fifth-year medical students exercised 0-1 sessions per week (group 1), 24.3% exercised 2-4 sessions per week (group 2) and only 10.7% exercised > 4 sessions per week or everyday (group 3). Mean VO_2max in group 2 (40.3 $\pm$ 9.1 ml/kg/min) and 3 (43.2 $\pm$ 8.4 ml/kg/min) are more than group 1 (36.5 $\pm$ 8.4 ml/kg/min) significantly ($p < 0.001$ and $p < 0.001$ respectively) but there was no significant difference between group 2 and 3 ($p = 0.16$). The two most popular exercises were jogging and aerobic dance, 48.7% and 31.9% respectively. There was no significant difference of VO_2max between methods of exercise ($p = 0.132$) and between the single and combination of exercises (38.9 $\pm$ 9.3 and 37.9 $\pm$ 7.4 ml/kg/min respectively, $p = 0.4$).*

Conclusion: *VO_2max in most of the medical students was in poor to average range when compared to the standard value of Thai population. This information should prompt medical educators to address this problem, consider promoting exercise and corporate physical fitness into the medical school curriculum.*

Keywords: *Aerobic capacity, Maximal oxygen consumption, VO_2max*

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Research findings in the last three decades have shown that physical inactivity and a negative lifestyle has seriously threatened health and hastened the deterioration rate of the human body. A sedentary lifestyle is the most prevalent modifiable risk factor for cardiovascular diseases, and this is particularly important in view of the mounting evidence that physical activity and regular exercise may reduce the risk for the chronic diseases and death especially from coronary heart disease[1,2]. In fact, medical professionals should provide stimulating and effective instruction on the benefits of maintaining good health habits. Unfortunately, there is some evidence that a heavy academic workload in medical school make it difficult for medical students to maintain a regular exercise

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program[3]. The aim of the present study was to obtain data on the level of aerobic capacity and the exercise habits of a group of fifth-year medical students at Chiang Mai University. The information obtained might be utilized to develop a physical exercise program for promotion of exercise and physical fitness among medical students.

Material and Method

This was a retrospective study in which data were collected from the database of the fifth-year medical students who attended a rehabilitation medicine course at Department of Rehabilitation Medicine, Faculty of Medicine, Chiang Mai University between January 2003 and December 2004. All of the students were invited to complete survey questionnaires and their cardio-respiratory fitness was evaluated. Exclusion criteria were as follows: 1) known cardiovascular disease 2) known limited joint problem in the lower extremities.

A baseline questionnaire was completed by each subject before the fitness test. Collected information included basic demographic data, medical problems, and exercise habits. The fitness test was performed by the instructors of Rehabilitation Medicine Course. The level of aerobic capacity was evaluated by maximal oxygen consumption (VO_2max) calculated after sub-maximal exercise test on a bicycle ergometer (Astrand-Rhyming test)[4]. Before the test, body weight, resting heart rate, and resting blood pressure were measured. The bike seat was adjusted so the knees were almost completely extended as the foot went through the bottom of the pedaling cycle. Test duration was 6 minutes and pedal revolutions were to be kept around 50 revolutions per minute. The preliminary workload was selected for the bike based on gender and age. Then the load was adjusted until the heart rate reached over 120 beats per minute. Exercise heart rates were recorded every minute, during the last 10 seconds of each minute and the final two heart rates (5^{th} and 6^{th} minutes) were averaged. If the heart rate continued to climb significantly after the 5^{th} minute then the test was terminated. Based on the average heart rate of the final 2 minutes and known workload, maximal oxygen uptake (VO_2max) could be estimated. This VO_2 max value was corrected using published correction factors and was expressed in ml/kg/min. The level of aerobic capacity was determined by comparing the standard value of Thai people[5] (Table 1).

Descriptive statistics were expressed as mean $\pm$ standard deviation (SD). Independent 2-tailed *t*-test was performed between the single and combination of exercises groups based on VO_2max to determine the effect of combination of exercises to VO_2max. Comparisons of VO_2max between exercise behaviors were done with one-way analysis of variance. A p-value of less than 0.05 indicated statistical significance.

The present study was reviewed and approved by the Research Ethics Committee, Faculty of Medicine, Chiang Mai University (reference number 226/2005).

Results

During a two-year period, 226 medical students

Table 1. Aerobic capacity classification according to maximal oxygen consumption (VO_2max) in Thai people[5]

		Fitness classification (based on VO_2max in ml/kg/min)				
Gender	Age	Poor	Fair	Average	Good	Excellent
Men	17-19	$\leq$ 35.7	35.8-40.6	40.7-50.5	50.6-55.4	$\geq$ 55.5
	20-29	$\leq$ 33.4	33.5-37.9	38.0-47.0	47.1-51.5	$\geq$ 51.6
	30-39	$\leq$ 27.5	27.6-31.4	31.5-39.3	39.4-43.2	$\geq$ 43.3
	40-49	$\leq$ 24.0	24.1-27.3	27.4-34.0	34.1-37.3	$\geq$ 37.4
	50-59	$\leq$ 20.9	21.0-24.1	24.2-30.6	30.7-33.8	$\geq$ 33.9
	60-72	$\leq$ 19.3	19.4-22.1	22.2-27.8	27.9-30.6	$\geq$ 30.7
Women	17-19	$\leq$ 31.4	31.5-35.5	35.6-43.8	43.9-47.9	$\geq$ 48.0
	20-29	$\leq$ 30.0	30.1-33.9	34.0-41.8	41.9-45.7	$\geq$ 45.8
	30-39	$\leq$ 24.8	24.9-28.6	28.7-36.8	36.9-40.1	$\geq$ 40.2
	40-49	$\leq$ 22.0	22.1-25.4	25.5-32.3	32.4-35.7	$\geq$ 35.8
	50-59	$\leq$ 20.3	20.4-22.9	23.0-28.2	28.3-30.8	$\geq$ 30.9
	60-72	$\leq$ 18.6	18.7-21.6	21.7-27.7	27.8-30.7	$\geq$ 30.8

performed 226 Astrand-Rhyming submaximal cycle ergometer tests. The mean age was 22.3 ± 0.7 years (range 21-26 years) and average body weight was 56.8 ± 11.9 kg (range 30-125 kg). The number of male and female students was comparable (male 44.7% and female 55.3%). Average VO_2max of the students was 38.1 ± 8.6 ml/kg/min (range 18.5-76.7 ml/kg/min) and there was no statistical significance between sex (VO_2max of male = 38.4 ± 7.6 and female = 37.9 ± 9.4 ml/kg/min; p = 0.636). The results of aerobic capacity classification according to maximal oxygen uptake (VO_2max) are shown in Table 2. When these VO_2max data were compared to standard value of Thai people, the authors classified physical fitness of medical students into three groups[4,6]. The present study found that 39.4% of medical students were in the low health fitness group (poor-fair), 40.7% were in the health fitness group (average) and only 19.9% were in the high health fitness group (good-excellent).

Exercise behaviors are summarized in Table 3. There was a statistically significant difference of VO_2max between the three groups according to the frequency of exercise ($p < 0.001$). Mean VO_2max in group 2 and 3 are more than group 1 significantly ($p < 0.001$ and $p < 0.001$ respectively) but there was no significant difference between group 2 and 3 ($p = 0.16$). Unfortunately, 65% of the fifth-year medical students exercised 0-1 session per week, 24.4% exercised 2-4 sessions per week and only 10.7% exercised more than 4 sessions per week or everyday. Most of the subjects (34.5%) enjoyed a combination of activities such as jogging, aerobic dance, swimming, cycling, racquet sports, and soccer. The two most popular exercises were jogging and aerobic dance (48.7% and 31.9% respectively). There was no significant difference of VO_2max between methods of exercise ($p = 0.132$) and between the single and combination of exercises (38.9 ± 9.3 and 37.9 ± 7.4 ml/kg/min respectively; $p = 0.4$).

Table 2. Aerobic capacity classification according to maximal oxygen consumption (VO_2max)

Fitness classification (based on VO_2max in ml/kg/min)	Cases (%)	Mean VO_2max ± SD (ml/kg/min)
Poor	43 (19.0%)	28.1 ± 3.6
Fair	46 (20.4%)	33.6 ± 2.3
Average	92 (40.7%)	39.6 ± 3.4
Good	22 (9.7%)	45.2 ± 3.1
Excellent	23 (10.2%)	53.4 ± 11.5
Total	226 (100%)	38.1 ± 8.6

Table 3. Exercise behaviors and maximal oxygen consumption (VO_2max)

Exercise behaviors	Cases (%)	Mean VO_2max ± SD (ml/kg/min)
Frequency of exercise		
Group 1: 0-1 sessions per week	147 (65.0%)	36.5 ± 8.1
Group 2: 2-4 sessions per week	55 (24.4%)	40.3 ± 9.1
Group 3: > 4 sessions per week	24 (10.7%)	43.2 ± 8.4
Mode of exercises		
Jogging	110 (48.7%)	37.7 ± 8.4
Aerobic dance	72 (31.9%)	40.0 ± 9.8
Racquet sports	42 (18.6%)	37.9 ± 7.1
Swimming	30 (13.3%)	37.8 ± 7.7
Soccer	23 (10.2%)	36.7 ± 9.1
Cyclin	15 (6.6%)	35.9 ± 8.7

Discussion

An impressive accumulation of research data over the past three decades has documented that regular exercise is important for health and well-being. The salutary effects of physical activity and fitness are widespread and include positive effects ranging from alleviation of mental stress to improved bone density[6]. Besides, there are research data addressing evidence that regular exercise creates a protective effect against the complications of cardiovascular diseases[2]. In addition, there is a consistent inverse relationship between physical activity levels and mortality, regardless of age and other risk factors[1].

It is important to recognize that a rationale should be developed for the promotion of physical activity and fitness in the general population as a mean of diminishing the impact of these illnesses. This rationale should be promoted to improve the exercise habits of people through physical education programs and the health professional's advice. Although physicians often have a great interest in health promotion, many are unable to change their patient's adverse lifestyles. Glanz et al reported that less than one-quarter of physicians exercise regularly[7] and previous reports have indicated a decline in regular exercise among medical students during the medical school period[3,8]. It seems reasonable to postulate that if medical students maintain positive health-related attitudes and practices in their own lives, they will be more likely to impart these attitudes to their patients.

In the present study, up to 40% of the fifth-year medical students have poor to fair physical fitness level. As reported in previous published issues, promoting exercise and physical fitness in the medical school curriculum should be more emphasized to motivate the medical students to maintain long-term exercise habits and physical fitness[9]. The authors found a statistical difference of VO_2 max between medical students who exercised $\geq$ 2 sessions per week (group 2 and 3) and who exercised 0-1 session per week (group 1) but there was no difference between group 2 and 3. This is because the additional benefits of more frequent training (more than 3-5 times per week) appear to be minimal, where as the incidence of lower extremity injuries increases abruptly[10]. Nevertheless, most of the medical students have a physically inactive lifestyle. It is possible that advances in modern technology have almost completely eliminated the necessity for physical exertion in daily life. Another possibility is that the heavy demands of medical school may cause medical students to be exhausted or lack of time to exercise.

The present study reported here also shows that any activity or combination of activities provide maximal oxygen uptake similarly. The preferred activity should be based on personal discretion and individual physical limitations. Aerobic exercise is regarded as an exercise of choice in general for cardio-respiratory endurance development. It is any exercise that uses large muscle groups, continuous and rhythmic in nature. Ideally, a person should regularly exercise 3-5 times per week at moderate intensity and all exercise sessions should be sustained about 30 minutes[10,11]. To be mentioned, the limitation of the present study is that a resultant low VO_2max in some medical students might be caused by inadequate rest as the fitness tests were conducted on the same day as the rehabilitation class examination. Thus, in further study, an appropriate test time should be considered and a pre- and post-physical fitness lecture class VO_2max should be compared in order to get responses on medical students' attitude towards exercise.

In conclusion, the present study showed that VO_2max in most of the medical students was in the poor to average range when compared to the standard value of Thai people. The authors hope that this information should prompt medical educators to address this problem, consider promoting exercise and corporate physical fitness into the medical school curriculum.

References

1. Blair SN, Kohl HW III, Paffenbarger RS Jr, Clark DG, Cooper KH, Gibbons LW. Physical fitness and all-cause mortality. A prospective study of healthy men and women. JAMA 1989; 262: 2395-401.
2. Paffenbarger RS Jr, Hyde RT, Wing AL, Steinmetz CH. A natural history of athleticism and cardiovascular health. JAMA 1984; 252: 491-5.
3. Levy BS, Goldberg R, Rippe J, Love D. A regular physical exercise program for medical students: learning about prevention through participation. J Med Educ 1984; 59: 596-8.
4. Hoeger WWK, Hoeger SA. Cardiorespiratory endurance assessment. In: Hoeger WWK, Hoeger SA, editors. Principles and labs for physical fitness. 3rd ed. Ontario: Wadsworth; 2002: 143-62.
5. Sport Authority of Thailand. Physical fitness norms of Thai population. Bangkok: Sports Science Sector, Sport Science Department, Sport Authority of Thailand; 2002.
6. Hoeger WWK, Hoeger SA. Why physical fitness. In: Hoeger WWK, Hoeger SA, editors. Principles and labs for physical fitness. 3rd ed. Ontario:

Wadsworth; 2002: 1-26.
7. Glanz K, Fiel SB, Walker LR, Levy MR. Preventive health behavior of physicians. J Med Educ 1982; 57: 637-9.
8. Green SA, Miyai K. The impact of medical school on the student with respect to interpersonal relationships and life-styles. J Med Educ 1986; 61: 177-8.
9. Cohen JD, Drury J, Wright JR. Promoting exercise and physical fitness in the medical school curriculum. J Med Educ 1988; 63: 438-41.
10. Balady GJ, Berra KA, Golding LA, Gordon NF, Mahler DA, Myers JN, et al. General principles of exercise prescription. In: Franklin BA, Whaley MH, Howley ET, editors. ACSM's guidelines for exercise testing and prescription. 6th ed. Philadelphia: Lippincott Williams & Wilkins; 2000: 135-64.
11. Hoeger WWK, Hoeger SA. Principles of cardiorespiratory exercise prescription. In: Hoeger WWK, Hoeger SA, editors. Principles and labs for physical fitness. 3rd ed. Ontario: Wadsworth; 2002: 163-200.

ความทนทานของระบบไหลเวียนโลหิตของนักศึกษาแพทย์ชั้นปีที่ 5 คณะแพทยศาสตร์ มหาวิทยาลัยเชียงใหม่

สยาม ทองประเสริฐ, ภัทรา วัฒนพันธ์

วัตถุประสงค์: เพื่อศึกษาความทนทานของระบบไหลเวียนโลหิตโดยใช้ค่าความสามารถใช้ออกซิเจนสูงสุดของนักศึกษาแพทย์ชั้นปีที่ 5 คณะแพทยศาสตร์ มหาวิทยาลัยเชียงใหม่

วัสดุและวิธีการ: การศึกษาวิจัยเชิงพรรณนาแบบย้อนหลัง รวบรวมค่าความสามารถใช้ออกซิเจนสูงสุดจากการใช้จักรยานวัดงานโดยวิธีการของ Astrand และ Ryhming ของนักศึกษาแพทย์ชั้นปีที่ 5 ที่ผ่านกระบวนวิชาเวชศาสตร์ฟื้นฟู ระหว่างเดือนมกราคม พ.ศ. 2546 ถึงเดือนธันวาคม พ.ศ. 2547

ผลการศึกษา: มีนักศึกษาแพทย์เข้าร่วมการศึกษาทั้งหมด 226 คน อายุเฉลี่ย 22.3 $\pm$ 0.7 ปี (21-26 ปี) น้ำหนักตัวเฉลี่ย 56.8 $\pm$ 11.9 กิโลกรัม (30-125 กิโลกรัม) เป็นเพศชายร้อยละ 44.7 เพศหญิงร้อยละ 55.3 ทั้งหมดผ่านการวัดค่าความสามารถใช้ออกซิเจนสูงสุดจากการใช้จักรยานวัดงานคนละ 1 ครั้ง ค่าเฉลี่ยค่าความสามารถใช้ ออกซิเจนสูงสุด 38.1 $\pm$ 8.6 มล./กก./นาที (18.5-76.7 มล./กก./นาที) ไม่พบความแตกต่างระหว่างเพศชายและเพศหญิง (38.4 $\pm$ 7.6 และ 37.8 $\pm$ 9.4 มล./กก./นาที ตามลำดับ; $p = 0.636$) เมื่อนำค่าที่ได้เทียบกับเกณฑ์มาตรฐานของประเทศไทย พบว่าร้อยละ 39.4 อยู่ในเกณฑ์ต่ำ ร้อยละ 40.7 อยู่ในเกณฑ์ ปานกลาง และร้อยละ 19.9 อยู่ในเกณฑ์ดี นักศึกษาแพทย์ร้อยละ 65 ออกกำลังกาย 0-1 ครั้งต่อสัปดาห์ (กลุ่มที่ 1) ร้อยละ 24.3 ออกกำลังกาย 2-4 ครั้งต่อสัปดาห์ (กลุ่มที่ 2) และร้อยละ 10.7 ออกกำลังกายมากกว่า 4 ครั้งต่อสัปดาห์ (กลุ่มที่ 3) ค่าเฉลี่ย ค่าความสามารถใช้ออกซิเจนสูงสุดของกลุ่มที่ 2 (40.3 $\pm$ 9.1มล./กก./นาที) และกลุ่มที่ 3 (43.2 $\pm$ 9.1มล./กก./นาที) มากกว่ากลุ่มที่ 1 (36.5 $\pm$ 8.1 มล./กก./นาที) อย่างมีนัยสำคัญทางสถิติ ($p < 0.001$ และ $p < 0.001$ ตามลำดับ) แต่ไม่พบความแตกต่างระหว่างกลุ่มที่ 2 และกลุ่มที่ 3 ($p = 0.16$) การออกกำลังกายที่นิยม 2 อันดับแรกคือ การวิ่งเหยาะ และการเต้นแอโรบิค (ร้อยละ 48.7 และ 31.9 ตามลำดับ) ไม่พบความแตกต่างของค่าความสามารถใช้ออกซิเจนสูงสุดเมื่อจำแนกตามประเภทของการออกกำลังกาย ($p = 0.132$) และการออกกำลังกายเพียงประเภทเดียวหรือหลายประเภทร่วมกัน (38.9 $\pm$ 9.3 และ 37.9 $\pm$ 7.4 มล./กก./นาที ตามลำดับ; $p = 0.4$)

สรุป: นักศึกษาแพทย์ส่วนใหญ่มีค่าความสามารถใช้ออกซิเจนสูงสุดอยู่ในเกณฑ์ปานกลางถึงต่ำมากเมื่อเทียบกับเกณฑ์มาตรฐานของประเทศไทย ดังนั้นควรมีการส่งเสริมการออกกำลังกายและสอดแทรกเนื้อหาเรื่องการออกกำลังกายและสมรรถภาพทางกายเข้าไปในการเรียนการสอนของนักศึกษาแพทย์