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Can We Promote Physical Fitness among Medical Students by Educational Program?

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The purpose of this study was to assess the changes of physical fitness level among medical students after educational program. Pretest and posttest fitness evaluation were given including: Body mass index, Anterior trunk flexibility test, 12 min run test, Sit ups test, Standing long jump test, Sargent's jump test, Ruler drop test, Paper ball pickup test and 45 m run test. Twenty five healthy medical students were trained for 10 weeks performing progressive resistance training 1 session per week and they were recommended to practice with other 1-2 training sessions per week. There was a significant difference between pretest and posttest in health related fitness (muscular endurance, muscular strength, cardiovascular fitness, flexibility) and also in agility and power ($p<0.05$). There were no interventional effects on other fitness variables including reaction time and speed. In multivariate analysis, we found only a significant statistical interventional effect on cardiovascular endurance, agility and power only in students with BMI<25 ($p<0.05$). One time per week for 1.5 h training including specific exercise for each fitness criteria can improve physical fitness in students.

Key words: Flexibility, cardiovascular fitness, medical students, power, BMI

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INTRODUCTION

Physical activity and fitness level of youth, in the last decade, are on a steady decline, with one third to upwards of two-thirds of the young population being unfit and the most rapid declines appear to occur during late adolescence and early adulthood[1,2]. Recent data also showed a steep decline during the high school and university years[3,4].

The inception of physical educational programs in Iranian universities refers to 45 years ago. These courses generally focus on the physical development, health needs, promoting physical activities in students and have been called physical activities program, exercise or sport course. Generally, students trained in two-semester courses in the first or second year. However, there is evidence that physical education is not adequately taking this role and don't effectively prepare students for transition to self-directed physical activity. Since many young medical students study very hard and have less access to group activities, the university setting can provide to participate of students in regular physical activity or exercise through sport and fitness programs, physical education course and intramural sports programs with ample opportunities. We suggest well-designed physical educational programs have produced significant health benefits that experienced in other studies[5,6]. Because people begin to acquire and establish pattern of health related behaviors during childhood and adolescence, thus they should be encouraged to participate in exercise program and developing their own activity[7].

Physical fitness is a set of attributes that are either health- or skill-related[7]. Health related fitness includes cardiorespiratory endurance, muscular strength and endurance, flexibility, and body composition and skill-related fitness includes balance, agility, anaerobic power, reaction time, speed and coordination[7,8]. The American College of Sports Medicine (ACSM) supports 4 major areas of fitness (health related fitness): cardiorespiratory endurance, body composition, muscular strength and muscular endurance[9,10]. There are several fitness tests that can be used to evaluate each components of health-related or skill-related fitness and we noted some controversies about how to measure fitness variables in our search of the literature[11,12].

Clinicians measure cardiorespiratory endurance by estimating maximal oxygen uptake, which involves the ability to perform large-muscle, dynamic, moderate-to- high intensity exercise for prolonged periods[9]. It is commonly evaluated in practical field tests, such as a 12 min run test for a specific duration, 1.5 mile run test, a 3 mile walk test and cycle ergometry or treadmill run protocols[9].

Muscular strength refers to the maximal force that can be generated by a specific muscle or muscle group measured by isotonic, isometric and isokinetic muscle contractions[9,13]. Muscle strength decline with age and always evaluated together with muscular endurance[14]. Although not easily extrapolated to define overall muscle strength, push-up test, Benech press, leg press, Biceps Curl, shoulder press and handgrip test or standing broad jump are commonly used to measure upper and lower extremity strength, respectively[8,11,15,16].

Muscular endurance is the ability of a muscle group to contract repeatedly over a sufficient period of time to regress from maximum torque to one half maximal torque values[3,9,11]. It is commonly tested as, sit ups test, push-ups test, hand and shoulder rise test[11] side leg raise test[8].

Body composition refers to the proportion of body fat to lean body tissue[11]. It is measured by assessing skin fold thickness at anterior thighs in men and women and sometimes in abdomens or triceps. If it doesn't have a skin caliper, Body Mass Index (BMI) offers an alternative way to define obesity and to calculate by simply, dividing weight (kg) by height (m) squared[11].

Flexibility is the movement of a joint through its full range of motion. Flexibility is important to general health and physical fitness. A number of factors, such as weight, height, sex, age, gender, habitual physical activity and disease affect flexibility[11,15]. Flexibility is evaluated by sit and reaches test, truck lift test, anterior trunk flexibility test and Schober test[11,15,17].

Anaerobic power is the ability of a muscle group to mobilize strength in a short period of time. On the other hand, power is performance of work expressed per unit of time and is a prime factor in athletic success[11,15]. There are a lot of tests for evaluation of power, e.g. Sargent's jump test (vertical power jump or leg power test) and Margarita-Kalamen power test, leg power test[15,17,18].

Agility is the ability to change direction of the whole body quickly and accurately while in movement[15,19].

Speed is the repetitive movement of body limbs related to the coverage of distance or periods of time as quickly as possible that is evaluated by sprinting speed (e.g. three 40 or 45 m run) and double heel click[8,18,18].

Some studies are available that report fitness level of college students[4,20,21], but we found a few studies that report investigations of physical fitness level of medical students[22-24]. We have found no studies of physical fitness program assessment in medical students. Medical students and other university students must pass two

physical education credits in two semesters in Iran. The role of these courses is unclear in physical activity promotion. The purpose of this study was to assess changes in physical fitness level in medical students after an educational program.

MATERIALS AND METHODS

This study was performed during 2002. Subjects were 25 healthy medical students of Tehran University of Medical Sciences. They were trained for 10 weeks to perform progressive resistance training 1 day per week and they were recommended to practice with interval training 1-2 days per week.

In pervious study, mean difference between pretest and posttest and standard deviation were 0.4 and 0.5, respectively. So the sample size of survey was calculated 24 persons. Inclusion criteria were included: male healthy medical students, plan to graduate physical activity course and no regular exercise activity before the study and exclusion criterion was included absence in more than 10% educational program.

The students had to attend in 1 session physical educational program each week and were encouraged to practice with other 1-2 training sessions per week. This study was approved by the Sport Medicine Research Center, Tehran University of Medical Sciences' and all students provided informed consent.

A pretest fitness evaluation was given that included: anthropometry, weight, height, BMI, cardiorespiratory endurance, muscular strength/endurance, flexibility, speed, power, reaction time and agility. A post test fitness evaluation was administered upon completion of the 10 week fitness program. All students completed the series of tests in a similar order. In each stage, tests were separated by at least a 5 min recovery period, but participants were allowed more rest if required so.

We tested cardiorespiratory endurance in practical field by 12 min run for a given duration; muscular strength by standing vertical jump test, flexibility by anterior trunk flexibility test and muscular endurance by sit ups test. Furthermore power is evaluated by standing long jump test, reaction time by ruler drop test, agility by Paper ball pickup test and speed by 45 m run (Table 1 and 2).

Physical education was taught by physical education specialists. Education program consisted of 1.5 h of physical training; 1 day/week and included: a warm up session (25-30 min), physical activities education (30-45 min), free sport activity (10-15 min) and cool down period (3-5 min). During the 30-45 min activity segment, students participated in aerobic, anaerobic, strengthening, speed, agility and flexibility activities. Activities included walking, running, jogging, resistance exercise and whole body stretching and relaxation. This segment began with lower intensities and duration of physical activity and increased gradually. Free sport segment included football, basketball, volleyball and ping pong.

We used the Epi info software and the SPSS statistical package for windows, release 10.0, to analyze the data. To compare differences in physical fitness measures on each of the fitness parameters between before and after education, we used paired t-test, with an alpha level of 0.05.

RESULTS

In this study 26 medical students were evaluated. One student was absent in educational program, so a total of 25 students were included in this study. The demographic characteristics of the students are shown in Table 3. Twenty-four students (96%) were 19-23 years old and 6 students (24%) had BMI more than 25 (overweight) and 76% were normal (BMI<25).

A cursory review of Table 4 indicates that there is a significant difference between pretest and posttest in health related fitness (muscular endurance, muscular strength, cardiovascular fitness, flexibility) and in agility and power ($p<0.05$).

There were no interventional effects on two tests of the physical fitness including reaction time and speed.

Table 1: Health related criteria and methods of assessment

Criteria	Test	Description of test	Measurement
Flexibility	Anterior trunk flexibility test	The participant lies on a mat in a prone position (face down). Toes are pointed, and hands are placed under thighs. The participant lifts the upper body off the floor to a maximum height. The movement should be performed in a very slow and controlled manner, with the bottom of the chin parallel to the floor the position is held long enough to allow the tester to measure the distance from the participant's chin to the floor	Centimeter
Cardiovascular endurance	12 min	Run for 12 min (in place or ground)	Mile
Muscular endurance	Sit ups test	Sit down on the floor , back upright, hands clasped behind neck, knee bent at 90° heals and feet flat on the mat. Then Lie down on back, shoulders touching the mat and return to the sitting position with elbows out in front so that touch knees. Keep hands clasped behind neck the whole time. Repeat this action as rapidly for 60 sec.	Number in 1 min
Muscular strength	Standing long jump	Stand with the toes behind a line. Using no run or hop step, jump as far as possible.	Centimeter
Body composition	Body mass index	Height and weight were measured in stocking feet	Kg/m^2

Table 2: Skill related criteria and methods of assessment

Criteria	Tes	Description of test	Measurement
Anaerobic power	Sargent's Jumm test	Subject's standing height was measured with their arms fully extended above their head. Subjects were required to jump as high as possible up against a wall. The difference between the subject's stretched height recorded while standing and high achieved after drop jump was recorded.	Centimeter
Reaction time	Ruler drop	Have a partner hold a ruler so that the side edge is between thumb and index finger, about the width of hand from the top of the ruler, when partner drop the paper, catch it before it slips through the thumb and finger.	Centimeter
Agility	Paper ball pickup test	Place two wadded paper balls on the floor 9 m away. Run, pick up the first ball and return both feet behind the starting line. Repeat with the second ball	Second and millisecond
Speed	45 m run	The participant should be instructed to run 45 m at the fastest pace possible. Run 45 m and time is measured	Second and millisecond

Table 3: Descriptive variables

	Minimum	Maximum	mean	SD*
Age (year)	19.00	34.00	21.00	3.60
Height (cm)	165.00	185.00	174.13	6.20
Weight (kg)	52.00	94.00	71.80	10.50
Body Mass Index	18.65	29.10	23.59	2.86

*Standard Deviation

Table 4: Results of tests before and after educational program

		Pretest		Posttest		
	Criteria	Range	Mean (SD*)	Range	Mean (SD)*	p-value
Health-related	Flexibility	18-50	35.44±7.10	33-60	45.92±6.52	0.0005
	Cardiovascular endurance	0.975-1.385	1.84±0.93	1.069-1.613	1.350±0.124	0.0005
	Muscular endurance	33-60	44.2±6.2	40-73	55.5±7.8	0.0005
	Muscular strength	1.78-2.67	2.228±0.233	2-2.80	2.332±0.198	0.001
Skill-related	power	40-60	48.40±5.65	40-70	54.32±8.21	0.001
	Reaction time	1-15	6.34±3.71	1-13	6.74±2.88	0.641
	Agility	8.88-11.76	10.22±0.716	7-11	9.716±0.832	0.0005
	Speed	5.70- 8.30	6.959±0.634	6-8	7.036±0.601	0.488

*Standard Deviation

Table 5: Results of physical fitness criteria in subjects with normal and high body Mass Index

	Criteria	p-value in BMI*=25	p-value in BMI>25
Health-related	Flexibility	0.0005	0.0277
	Cardiovascular endurance	0.0005	0.0796
	Muscular endurance	0.0005	0.0277
	Muscular strength	0.002	0.2449
Skill-related	Power	0.0431	0.007
	Reaction time	0.878	0.1422
	Agility	0.0005	0.4631
	Speed	0.624	0.7532

*BMI: Body Mass Index

We analyzed differences between pretest and posttest in overweight students and normal students. The individuals who had BMI more than 25 increased physical fitness similar to normal weight student but in multivariate analysis, we found only a significant statistical interventional effect on cardiovascular endurance, agility and power in students with BMI<25 ($p<0.05$) and there were no interventional effect in BMI>25 (Table 5). Other analysis didn't show any difference between two groups (BMI>25 and BMI<25).

DISCUSSION

The purpose of this study was to assess changes of physical fitness level in medical students after an educational program for physical fitness. As professionals concerned, medical students should learn in their academic careers that optimal health includes nutrition, stress management and physical fitness as part of a comprehensive wellness program. To achieve public health goals, physical educational programs should promote physical activity during physical educational course as well as in extracurricular activity. Although Proper *et al.*[24] in a meta analysis study didn't find conclusive evidence for effectiveness of worksite physical activity programs on cardiorespiratory fitness, muscle strength, flexibility and body composition, in many controlled studies, it has been shown that quantity and quality of physical educational programs have a significant positive impact on health-related fitness of children and youth[25,26]. In this study we evaluated 8 criteria out of 11 criteria in two parts (health and skill related). In this study, educational program was associated with significant improvements in all of the health related components of fitness. The efficacy of

duration, frequencies and intensities of exercise on fitness is difficult to determine and depends upon the purpose of the study and improvement is directly related to frequency, duration and intensity[14]. In other study, subjects were trained three days per week for 12 weeks[21,27], once per week for a period of six months[28], three sessions per week for 8 weeks[29]. Michael *et al.*[14] believe a 15 to 20 week length may be an adequate minimum standard.

Although general exercise intervention resulted in improvement in cardiovascular fitness and muscular endurance[30] this study showed one session per week for 1.5 h including specific training for every fitness criteria can improve physical fitness.

In a few studies some skill related criteria and the effect of education on that in athletic have been evaluated[16,31]. Out of 4 criteria of skill related, we observed significant improvement before and after training in two, anaerobic power and agility. Flaff 's *et al.* reported[31], military training had a significant effect in anaerobic power in army recruits with low value of power before the study, but this result was not seen in all the subjects and subjects with high and medium values of power.

The participants were younger adults whose mean age was 21 years. Although, in the past, some investigators believed that there is no difference in the response to training in any age especially in aerobic endurance or resistance[32-35], this has not been confirmed by all investigators and seems younger adults need shorter periods of time to progress and adapt to fitness training[36,37]. Thus, explanation of the differences found in the present study and previous studies may be due to different age of participants.

In this study from educational program point of view, no differences were observed for flexibility, muscular endurance and power between normal BMI and over weight students. In investigation by Westerstahl *et al.*[38], there was an increase in flexibility and power when BMI had increased and Chen's *et al.*[39] study did not show any significant effect among different BMI groups in flexibility criterion. Explanation of the differences found in these studies may be due to different tests for assessment of flexibility.

These results indicate that while educational program were significantly effective for the cardiovascular endurance, agility and muscle strength in normal BMI, it was not effective in overweight students. Similar to this study, most studies have demonstrated an inverse relationship between high BMI and health-related fitness tests[38,40]. In a study on 878000 children and adolescents by Chen *et al.*[39], they reported a significant relationship between BMI and cardiorespiratory endurance, muscular strength and endurance tests.

There were no interventional effects on reaction time and speed. One explanation for this result is that many students were at an early stage of changes in regard to increasing their physical activity and they may have needed more duration to make fitness. Other explanation is that, this educational planning was not proper for these two items.

The limitations of the study include its restriction to a gender (male) and possible self- training bias due to students interested in exercise and sport. Thus we didn't assess other factors that may have contributed to or detracted from participants' performance on the tests we used e.g. individual activity levels, exercise programs and nutritional statement during the study. The study was performed only in one university and it is therefore difficult to extrapolate our findings to all medical students.

This study showed one session per week exercise for 1.5 h including specific training for every fitness criteria can improve physical fitness in medical students. Students with normal BMI will make a profit more than overweight students from educational program.

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