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Participation in Educational Physical Training Program: Physical Fitness, Exercise Physiology Knowledge and Fitness Satisfaction in Inactive Male College Student

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Abstract

If physical activity interacts by proper teaching of its implications, it can have better results. In this work has been examined the effects of a educational physical training program on physical fitness component, exercise physiology knowledge (EPK) and fitness satisfaction of 138 college students (aged 21.5±2.42 yr). The subjects voluntarily took part and they divided into educational physical training (EPT) and control (CON) groups, randomly. The EPT group participated in this program for 8 weeks (3d; $pdwk^{-1}$) and received physiology concepts coupled with active aerobic, resistance and flexibility exercises and recreational self-direct activities. Exercise intensity was considered about moderate workout. Physical fitness, body composition, EPK and physical satisfaction were measured before and after 8 weeks EPT: VO_{2max} by 2-mile running test; body fat from 3-site skin fold measurement; flexibility by a sit and reach test; muscular strength by bench press and leg press for upper and lower bodies, respectively; muscular endurance by push up and sit up tests, EPK and fitness satisfaction via two self-administered questionnaires. The analysis of co-variance (ANCOVA) test showed that the VO_{2max} ($p=0.079$); bench press ($p=0.001$), leg press ($p=0.004$) push up ($p=0.002$), sit up ($p=0.038$), flexibility ($p=0.044$), EPK ($p=0.029$) and fitness satisfaction ($p=0.04$) in EPT were significantly more than the CON; although body fat percentage (BFP) tended to decrease ($p=0.062$). Findings indicated this conditioning program integrated with health-related concepts and exercise activities may result a significant improvements in physical fitness, exercise physiology knowledge and satisfaction in sedentary college students.

Keywords: Exercise training program; Physical fitness; Physiology knowledge

Abbreviations: EPK: Exercise Physiology Knowledge; EPT: Educational Physical Training; CON: Control; ANCOVA: Analysis of Co-Variance; BFP: Body Fat Percentage; ACSM: American College of Sports Medicine; SD: Standard Deviation

Introduction

Since health and enjoyment from a healthy life is one of the main goals for human beings, therefore it is necessary to be considered. During the last decades, there has been increasing interest in physical activity as a tool for maintaining good health status [1]. In these conditions, the students and other inactive people are required to achieve a good status of fitness and health; it can be achieved through regular physical activities. College students and young adults are a population that should greatly benefit from health promotion program so that the formation of healthy lifestyle practices is facilitated [2]. Although college students are educated about the importance of benefits of exercise, many do not engage in health promotion behaviors [3]. In the recent years with the raised population, the numbers of Iranian students were also increased. A great number of them are sedentary and do not acquire enough physical activities. It seems plausible to target physical fitness promotion strategies toward this group of the Iranian population.

Many epidemiological studies have demonstrated that people with good health have a lower mortality rate than those reporting poor health, and this has been shown to be valid for various ages, and ethnic and national groups [4,5]. Physical fitness level has also been shown to be closely associated with mortality and functional limitation in both middle aged and older people [6-9]. Having a higher level of physical fitness, results in a low risk of mortality [10,11], and functional limitation. Risk factors related to a sedentary lifestyle include increased fat deposition and weight gain and decreased functional aerobic capacity, muscular fitness, bone density, and mass [12]. Anecdotal data suggest that physical activity was more common 20-30 years ago than it is today [13,14]. Most of the previous studies designed to improve

physical fitness have been incorporated, and have shown modest or inconclusive result [15,16]. Thus, an alternative approach was investigated, in which the principles of exercise physiology and physical activity effects on health were integrated into a fitness program, coupled with active physical exercise, to reinforce concepts learned in EPK base.

Fitness training according to the American College of Sports Medicine (ACSM) should include exercise to improve the cardio respiratory system, muscle strength and endurance, flexibility, and maintain optimal body composition [17]. Several studies have demonstrated a close positive correlation between regular physical activity and increased level of fitness in sedentary people [18]. Low levels of endurance, muscle strength and flexibility can impose limitations on individuals. Reduced strength and endurance in the abdominal muscles and lack of hamstring extensibility have been reported in patients with back pain compared with controls [19]. However, the resistance trainings are recommended by allied health professionals to enhance physical fitness and overall health.

Participation in a regular exercise program has been shown to be an effective intervention to increase a number of physical fitness components [20]; and a fitness program integrated with exercise physiology theory and exercise activity enhanced physical fitness components and sport physiology knowledge [21]. If the exercise programs were simple and practical, students and sedentary people would be more active and increase their knowledge. The importance of this matter, urged us to design an applicable model that needs simple and available equipments in order to enhance physical conditioning, fitness satisfaction and EPK of non-athletes, and to present a practical program.

Methods

Subjects

After approval from the Institute's Ethics Committee, 138 sedentary male college students were volunteered to assess the effect of an 8 weeks fitness program (Table 1). Advertisements were placed in a variety of location in the university. Sedentary students were participating (EPT) or act as controls (CON). Prior to participating, volunteers were made fully aware of the benefits and stresses of the program. All subjects given both verbal and written instructions outlining the experimental procedure and written informed consent was obtained before screening. Subjects were questioned on use of medications and reasons for visit to physician in the 6 months to eliminate subjects with acute or chronic disease. The subjects were divided with randomized sampling to two equal experimental (educational physical training) and control groups. Both groups were fairly similar with respect to age, body weight, and height at the beginning of the study. They had not participated in any type of regular exercise for the two years prior to the study. They were recommended not to change their diet, physical activities and other aspects of their lifestyle. They all used the canteen foods of the university. All procedures were reviewed and approved by the University of Guilan Institutional Review Board.

Table 1: Characteristics of EPT and CON groups in baseline.

Variables	EPT	CON	Significance
Age (yr)	22.34±2.76	21.67±2.02	0.131
Weight (kg)	72.66±7.70	73.11±8.66	0.507
Height (cm)	175.01±7.52	174.36±7.35	0.349

Data is shown with average ± SD

Abbreviation: EPT: Educational Physical Training; CON: Control.

EPT Program

Following baseline assessment of physical fitness levels, the subjects participated in the fitness program for 8 weeks (3 days per week). The program was designed to improve aerobic capacity, muscular fitness, flexibility, and body composition and exercise physiology knowledge. Each session workout was segmented as follows: warm-up and stretching, aerobic conditioning, upper/lower resistance exercises and body weight drills, recreational self-direct activities and cool-down. Scheduling of the training was instituted so that progressive improvement would be made during the entire course of the training period. It was in a way that the first session of educational physical training program took 60 minutes and the last session took more than 90 minutes. Every two weeks, 10 minutes were added to every sessions of the program (Table 2).

Table 2: Educational physical training program*.

Activity	Exercise	Intensity	Duration
Warm-up	light aerobics and running	50% HRmax	5 min
Specific Stretching	focused on bigger muscles, partner assisted	moderate to relative pain threshold	5-10 min
Cardiovascular conditioning	jogging, running (interval, fartlek), roping, circuits	60-80% HRmax	20-30 min
Resistance and muscular endurance	weight trainings, body weight exercises such as crunches and push up,	40-60% 1-RM	15-20 min
Recreational self-direct activities	recreational soccer, volleyball, badminton, jumping ropes, etc	self admini-strated without rest	20 min
Cool-down	light jogging or walking, stretching	low intensity	5 min
Exercise physiology challenge	relations of physical activity, fitness and health, muscle fitness, aerobic capacity, flexibility, healthy nutrition and weight control	10-15 min	

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*This program is designed based on ACSM recommendation that described at the ACSM resource manual for guidelines for exercise testing and prescription, 2001.

Program planning was in way that eight sessions of theoretical class were held. These classes were noted for knowledge enhancing about physiological concepts of physical activity and its effects on health. These classes were held in an interval periods of time. The content of these classes included the following materials: the relationship between physical activity, fitness and health, muscle-skeletons and cardio respiratory adaptation with the exercise, advantages and disadvantages of the exercise, obesity and its side effects such as diabetes, cardiovascular diseases, hypertension, osteoporosis, etcetera, weight management via nutrition and exercise prescription.

Measurements

Physical fitness components were evaluated before and after the 8 weeks exercise training program by graduated trainer in exercise physiology. Efforts were made to have the same examiner for each participant on all of the before and after training tests. Choosing appropriate measurements of aerobic capacity, muscle endurance, flexibility and body composition were affected by time and monetary constraints, so that in all cases valid and reliable tests were chosen, which could be performed in a timely and efficient manner while remaining within budgetary limitations. If students were absent on the day of before or after testing, the investigators returned on subsequent days for testing.

Evaluations

Body weight was determined using a mechanical scale (Seca Scale, Model 3p7044, and Jericho, NY) to the nearest 0.1 kg. Height was measured to the nearest 0.5 cm with a wall-mounted stadiometer.

Body Fat Percentage: Body fat calculations were completed with the method described by Heyward [6]. A skinfold caliper (Laffayette Caliper, Model 01127, USA) was used to measure subcutaneous fat in three sites on the right side include abdominal, chest and thigh sites.

VO_{2max}: Maximum oxygen capacity was estimated from the 2-4 km running test. This test took place in a track and field court. Amount of VO_{2max} was estimated using pre-programmed age-specific and gender-specific norm that described by Mackenzie [22].

Muscular Strength: Changes in muscular strength were evaluated before and after 8 weeks PE program. The muscular strength was measured by two tests for upper and lower body muscles. For upper body, bench press 1-RM test and for lower body, leg press 1-RM tests were performed. In bench press, the subjects were administrated 4-6 repetition and their 1-RM calculated by an equation that has been developed by Dophoney et al. [23].

4-6 RM: -24.62 + (1.12 x weight) + (5.09 x number of reps)

For leg press, an equation that has been proposed by Reynold was applied in 2006 [24].

1RM LP = (1.09703 × [5RM, kg]) + 14.2546

Muscle Endurance. Muscle endurance of the upper body was assessed using of one minute test for pushups and bent knee sit ups. The total numbers of push up and sit up were used for analysis.

Flexibility: It was determined from a classic sit and reach test using a standard sit and reach box. The best value in centimeter was used for data analysis.

Exercise Physiology Knowledge: An applied exercise physiology questionnaire designed and served as an index of knowledge in exercise physiology. The questionnaire was a 30-question multiple-choice test graded to 100%, which was developed specifically for this program by a university professor in exercise physiology. In order to obtain content validity, 3 different content areas were identified, and 6 questions were developed for each content area. The Cronbach's alpha coefficient was obtained α=0.84 for different categories.

Fitness Satisfaction: The satisfaction of various fitness components were measured by a self-administrated questionnaires that contained 30 multiple choice questions. The questions were considered about the self satisfaction of strength, aerobic capacity, flexibility, body composition, and general fitness. For each question, one score was considered. The total score for each questionnaire was 30. Cronbach's alpha coefficient for the questionnaire was α=0.77.

Statistical Analysis: Results for all components were presented as average ± standard deviation (SD). The homogeneous of data in pre test was evaluated by a Kolmogorov-Smirnov Z test. A paired sample t-test was used to assess changes within groups. Indeed, mean differences between independent groups were analyzed with ANCOVA test. Statistical operations were performed with the SPSS software ver. 13. For all statistical analysis, $p<0.05$ level of significance was accepted.

Results

Physical fitness components were measured at pervious and after program, whereas EPK was measured at final only. Results of our initial evaluation showed no significant differences between experimental and control groups in physical fitness components at before testing. Shown in Table 3 are the compared physical fitness scores and in EPT and CON groups. Because each of components showed no significant initial differences, an ANCOVA test was performed on all physical fitness components for compare the groups in baseline scores. ANCOVA test showed that after training, the EPT compared to the CON group was better in the VO_{2max} (average=40.05±3.75 vs. 35.83±2.84 ml. kg^{-1}. min^{-1}; P=0.079 for EPT and CON groups, respectively), and sit

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ups (average=48.97±6.60 vs. 38.08±6.22 no; P=0.038 for EPT and CON groups, respectively). In addition, the EPT compared to the CON groups achieved higher values on the pushups (average=34.01±6.16 vs. 28.10±5.11 no; P=0.002 for EPT and CON groups, respectively), sit and reach (average=40.69±6.90 vs. 37.04±4.81 cm; P=0.044 for EPT and CON groups, respectively), body fat percentage (average=17.33±5.05% vs. 19.02±5.51%; P=0.062 for EPT and CON groups, respectively. In bench press, we observed a massive weight (average=54.39±9.88 vs. 47.54±10.37 kg; P=0.001 for EPT and CON groups, respectively) similar to leg press (average=94.21±15.73 vs. 88.13±17.09 kg; P=0.004).

Table 3: physical fitness component before and after ET program.

	EPT		CON	
	Before	**After**	**Before**	**After**
BMI (kg/m^2)	23.72±1.02	23.04±0.95	24.14±1.05	24.11±1.01
Body fat (%)	¬¬18.89±5.37	17.33±5.05†	19.18±5.42	19.02±5.51
VO_{2max} (ml. kg^{-1}. min^{-1})	36.26±3.66	42.05±3.75†*	35.51±2.74	35.83±3.84
Bench press (kg)	48.64±10.37	54.39±9.88†*	46.88±11.41	47.54±10.37
Leg press (kg)	86.81±17.83	94.21±15.73	89.45±16.67	88.13±17.09
Pushups (no.)	26.04±6.42	34.01±6.16†*	27.84±5.52	28.10±5.11
Sit ups (no.)	38.85±8.22	48.97±6.60†*	37.26±5.45	38.08±6.22
Sit and reach (cm)	35.01±6.83	40.69±6.90†*	36.78±4.54	37.04±4.81
Systolic BP (mmHg)	115.03±0.49	114.62±0.38	109.22±0.54	110.47±0.51
Diastolic BP (mmHg)	79.12±0.39	79.07±0.84	82.05±0.54	81.24±0.69

Data is shown with average ± SD.

*ANCOVA for independent and †paired t-test for paired groups were used.

Abbreviation: BMI: Body Mass Index; BP: Blood Pressure; EPT: Educational Physical Training; CON: Control.

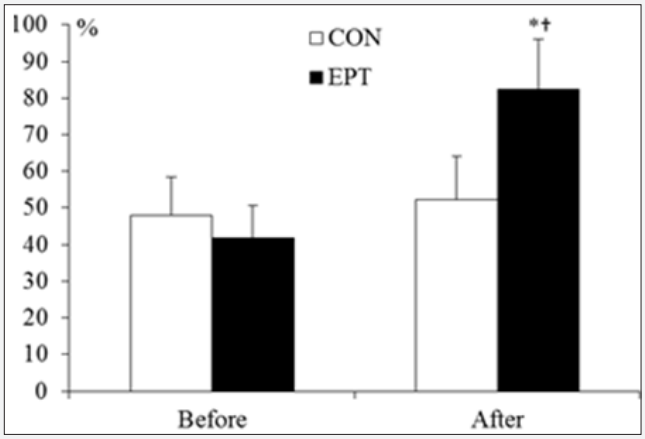

Figure 1: The score of physiology knowledge. Data is shown with percentage (%).
*ANCOVA for independent and †paired t-test for paired groups were used.
EPT: Educational Physical Training; CON: Control.

In addition, the EPT compared to the CON groups achieved higher relative score (%) on EPK test after eight weeks training (average=82.35±2.67% vs. 52.16±1.98%; P=0.029 for EPT and CON groups, respectively). ANCOVA test indicates higher knowledge in the EPT compared to the CON group after eight weeks; (Figures 1 & 2), similar to fitness satisfaction (average=21.1±2.24 vs. 16.87±1.89; P=0.04).

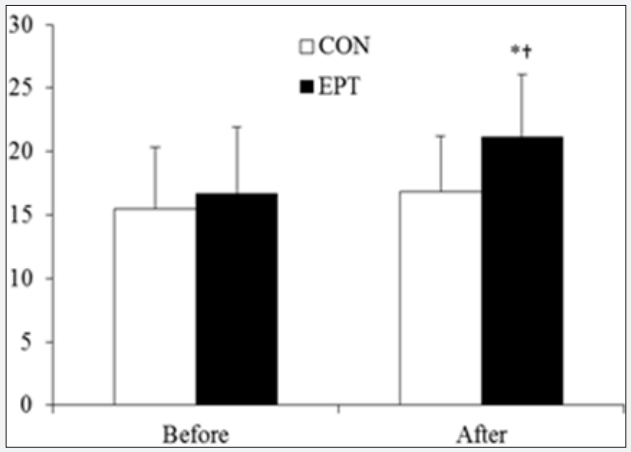

Figure 2 : The score of fitness satisfaction. Data is shown with absolute score.

*ANCOVA for independent and †paired t-test for paired groups were used.

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Discussion and Conclusion

The purpose of this study was to evaluate the effects of a fitness program (exercise training and theory concepts about physical activity) on physical fitness and exercise physiology knowledge. The experimental group went through the program in exercise physiology designed to increase college student awareness of exercise physiology concepts, improve ability to understand physical activity effects, and enhance physical fitness. The control group doesn't any program. As can be seen in Table 3, after program, the experimental group also showed significantly higher values in physical fitness components after training. Additionally, the experimental compared with the control group showed greater levels of EPK after training. Although percentage of body fat did not change significantly (it did, however, display a strong tendency to decrease), in summary, the experimental compared to the control group showed greater levels of general physical fitness, as indicated by better results in physical fitness tests. Significant difference in the VO_{2max} is an agreement with prior reports indicating that VO_{2max} can increase with a fitness program and initial valued [25,26]. Some previous studies pointed out that changing the maximal oxygen uptake is unlikely to short time period's programs [27,28]. This is in contrast to findings of other investigators [29], who all reported modest or inconclusive results in their men and women participants.

According to the ACSM [12], "health-related fitness is a state characterized by an ability to perform daily activities with vigor, and a demonstration of traits and capacities that are associated with low risk of premature development of the hypo kinetic diseases". VO_{2max} is the accepted measure of cardio respiratory fitness [12]. Aerobic training is an effective mode for increasing aerobic power. Grant et al. [18] reported that 10 weeks university fitness program increased VO_{2max} by 20% in sedentary males. Douris et al. [20] reported that middle-aged martial art practitioners (twice a week for three years) had a 31.8% greater VO_{2max} than the sedentary group. An investigation conducted by Makrides et al. [30] reported increases in aerobic power. Their high-intensity training program included participation for 1 h; pdd^{-1}, 3 d; $pdwk^{-1}$, 12 weeks. Two groups of subjects participated in that study: a group (n=10) of young (20-30 yr), sedentary, healthy men; and a second group (n=10) of older (60-70 yr), sedentary, healthy men. The young subjects experienced a 28% increase in their VO_{2max}, whereas the older subjects experienced a 38% increase in their VO_{2max}. It is apparent that components results can be expected from endurance training programs, and factors such as age, initial fitness level, and other activities that may coincide with the training may affect outcomes.

An investigation conducted by Mannix et al. [31] reported increases in VO_{2max} similar to that of the present study. They induced an 11% increase in VO_{2max} in 10 competitive figure skaters using a 33 min; pdd-1, 4 d; $pdwk^{-1}$ for 10 weeks, high-intensity cycle ergo meter interval training program. In the present study the experimental group displayed significantly greater VO_{2max} than the control group (13.5%). For comparison, Roberts et al. [16] induced a 28% increase in aerobic capacity in firefighter recruits after a supervised exercise-training program. Their program included participation for 1 h; pdd^{-1}, 3 d; $pdwk^{-1}$, 16 weeks. One group of subjects participated in that study (n=115). Perhaps the shorter duration of the present study (8 weeks) played a role in the lower increase in VO_{2max}. Another potential factor is that these students were also practicing self-direct physical activity; researchers did not control intensity of this segment. The training intensity of experimental group appears to provide adequate stimulus to increase cardio respiratory fitness in participants. That is important to note that the fitness program improved other components of physical fitness as well, including muscle endurance and flexibility. Although BFP did not change significantly, those did, however, display a strong tendency to decrease (p=0.062).

Muscle endurance is the ability of a muscle group to execute contractions over a period of time sufficient to cause muscular fatigue. The push up is a simple field test to evaluate the endurance of the upper body. The EPT group displayed significantly greater muscle endurance by performing an average of 34.01 pushups compared with 28.10 pushups for the CON group, a 30% difference. The sit up evaluates the endurance of the abdominal muscle groups. The EPT group averaged 48.97 sit ups compared with 38.08 sit ups for the CON group, as 26% difference. Our results are also comparable to those of Perry et al. [21]. They reported that high school adolescents to have greater abdominal muscle endurance than matched control group, (67.05 vs. 51.21 sit ups for experimental and control groups, respectively). Indeed, our subjects showed an increase in upper and lower body strength. We examined their strength with bench and leg press. The findings showed that a significant elevation in both of upper and lower body strength after 8 weeks in EPT group compared to CON. This change was hypothesized. Because, young non-athlete men can increase your strength with weight training during first weeks similar to muscle hypertrophy and endurance.

One of the unique things about this program was that the physical activities were made to sequentially follow the exercise physiology concepts. In addition, students were exposed to different protocols in cardiovascular training and flexibility, as well as muscle endurance training. In view of the growing prevalence of overweight among adolescents and the indication that total energy and fat intake have stabilized or even decreased, activities encompassed both aerobic and resistance training as fundamental practices necessary to improve exercise awareness and fitness levels of students. The integration of physiological concepts and physical activity was one of the major goals of the fitness program designed to enhance student motivation. As expected, the experimental group scored higher on the EPK questionnaire after training than the control group (average=82.35±2.67% vs. 52.16±1.98%; P=0.029 for experimental and control groups, respectively).

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Perry et al. [13] reported that high school adolescents to have greater physiology knowledge than control group after training, (average=65.36±1.25% vs. 44.37±2.81% for experimental and control groups, respectively). Significant difference in the EPK can be related to motivation of the experimental group for learning of physiology concepts and perhaps more motivated to improve their health habits. They also may have had greater common knowledge in exercise physiology and have better lifestyle, whereas, the control group did not receive any information about physical activity and fitness concepts during the program.

Flexibility is the ability of joint or multiple joints to move through the complete range of motion. Loss of flexibility can significantly impair a person's ability to perform exercise and accomplish activities of daily living as well as other important functional activities [32]. The sit and reach test is commonly used to assess hamstring, low back, and hip joint flexibility. The experimental group was significantly more flexible than the control group, as is evident in the 16% difference between the groups (40.69 cm. vs. 37.04 cm for experimental and control groups, respectively). Our results are comparable to those of Douris et al. [20] and Hong et al. [33], who in studies have shown tai chi practitioners to have greater trunk flexibility than matched sedentary controls. The greater flexibility of the experimental group may be attributed to the stretching exercises in warm-up and cool-down.

Interestingly, the experimental group showed no better results in their body fat percentage compared with the control group. It was known, however, may be subjects ate more or exercised less outside of program time; whereas, they were recommended not to change their diet and physical activities. For comparison with the present study, Grant et al. [18] reported a decrease in percentage of body fat in experimental group than controls after 10 weeks university fitness program (21.6% vs. 22.2% for experimental and control groups, respectively). In order to, improvements in aerobic fitness and muscle endurance were observed in the experimental group in the absence of body fat changes.

Nonetheless, our analysis showed that volunteers could obtain superior results in their fitness levels and physiology knowledge base after an 8 weeks intervention program compared with a CON group. The results provide evidence that the fitness program is an effective intervention that may reduce or prevent a number of functional and physiological declines associated with a sedentary lifestyle. Future studies may take a longitudinal approach rather than the cross sectional approach. This study should be replicated with women or older practitioners with larger samples. These results suggest that inactive persons should be aware of alternative modes of exercise delivery for increasing the health-related fitness and EPK of adolescents. Indeed, an increase was observed after this educational exercise program in fitness satisfaction. This finding was one of major results for us. Because, the students were well educated during this program, we thought that the EPT can be effective for fitness satisfaction of the subjects. The results show this our perception. It can due to increasing of muscle strength, VO2max, flexibility and endurance, as well as improving physical activity knowledge [34].

Practical Applications

The results of this study indicated that the inclusion of exercise physiology information coupled with regular physical activities might be an effective way to enhance physical fitness components and EPK in volunteer college students. Although students were volunteers who may have had greater baseline knowledge, our results indicated that student's volunteers of predominately minority descents might represent a nucleus of adolescents benefiting from innovative sport physiology programs integrating theory with practice. In conclusion, the present results indicate that whether the physical fitness components and EPK of sedentary young college-age males can be modified by the recommended conditioning program.

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