

# **The Effects of a Fitness Program on Endurance and Fitness – Related Knowledge in Sedentary School Boys**

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## **Abstract**

For promoting and maintaining health of school students this study was designed. Further we examined the effects of a fitness program on aerobic power, muscular endurance and fitness-related knowledge of 140 young school boys (aged 16 to 18 yrs.) The subjects volunteered themselves to be the part of study. They were divided equally into experimental and control groups by using random sampling method. The experimental group participated in the fitness program for 8 weeks (3 days per week) and received theoretical fitness-related knowledge coupled with aerobic and muscular endurance exercises and self-directed activities. The control group did not perform any specific type of exercises. Aerobic power and muscular endurance were measured at pre- post tests and fitness-related knowledge only at post test. The parameters used in the study were VO<sub>2</sub> max ( $P < 0.0001$ ), push up ( $P < 0.0001$ ), Sit up ( $P < 0.0001$ ), and fitness – related knowledge ( $P < 0.0001$ ) in experimental group were significantly more than the subjects of control group. Findings indicated that a fitness program integrated with fitness-related concepts and exercise activities may result in significant improvements in aerobic power, muscular endurance and fitness – related knowledge in sedentary school students.

**Key words:** Aerobic power, Muscular endurance, Education.

## **Introduction**

Health and enjoyment are the main goal for general human beings. During the last decades, there has been an increasing interest in exercise as a tool for maintaining a good health status (Correa et al, 1996). Young adults are greatly benefited from health promotion program (Fish et al, 1996). In the recent years with the rise of population, the number of Iranian students was also increased. A great number of them are inactive and sedentary and do not acquire a suitable physique for strenuous activities.

Physical fitness level has also been shown to be closely associated with mortality and functional limitations in both middle aged and older people (Milonpalo, et al, 1997; Hung, 1998; Hapane, et al, 2000; and Olano, et al, 2003). Higher level of physical fitness results in a low risk of both mortality (Sawada et al, 1998) and functional limitations (Hung et al, 1998). Risk factors related to a sedentary lifestyle include increased fat deposits and weight gain and decreased functional aerobic capacity, bone density and mass (ACSM's, 2001). Physical activity and cardiovascular endurance are related to the risk of cardiovascular disease (Morrow et al., 1995). Several studies have demonstrated a close positive correlation between regular physical activity and increased level of fitness in sedentary people (Grant et al, 1992; Roberts et al 2002; and Rahmain-Nia and Hodhati, 2005). Low levels of endurance and muscle strength can impose limitations on individuals (Grant et al, 1992). Reduced strength and endurance in the abdominal muscles have been observed in patients with back compared with controls (Faulkner et al, 1989). Improvement in muscular endurance, reduces the risks of back pain, increases functional capacity, improves posture and enhances the ability to conduct daily activities (Morrow et al, 1995).

Participation in a regular exercise program has been shown to be an effective intervention to increase a number of physical fitness components (Grant et al, 1992; and Douris, et al, 2004); and a fitness program integrated with exercise physiology theory and exercise activity enhances aerobic power, muscular endurance and fitness –related knowledge (Perry et al, 2002). Active individuals have largely conserved the high level of fitness (Rahmain–Nia and Hodjati, 2005), and if the exercise programs were simple and practical, students and sedentary people would have been more active and increased their knowledge. The purpose of this study was to assess the effectiveness of a fitness program on aerobic and muscular endurance, and fitness - related knowledge in sedentary males.

## **Material and Methods**

**Subjects:** The 140 sedentary male school students (mean age 16 to 18 years) volunteered to assess the effect of 8 weeks fitness program. Sedentary students were either participating in the experiment or acted as control groups. Prior to participating, volunteers were made fully aware of the benefits and stressed of the program. All subjects were given both verbal and written instruction outlining the experimental procedure and written informed consent was obtained before screening. The 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 random sampling to two equal experimental and control groups. Both the groups were fairly similar with respect to age, body weight, and height at the beginning of the study (table 1). They had not participated in any type of regular exercise for two years prior to the study. They were recommended not to change their diet and physical activities. They all used the canteen foods of the university. All procedures were reviewed and approved by the Guilan University Research Committee.

## **Training 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 endurance and fitness – related knowledge. Each session workout was segmented as follows: warm – up, aerobic conditioning, upper/ lower muscular endurance exercises cool down, and self – directed activities. Periodization of 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 training took 50 minutes and the last session took 90 minutes. Every two weeks, 10 minutes were added to every session of the program.

Program planning was made in such a way that six theoretical sessions were held. These classes were meant for enhancing the knowledge of the participants about physiological concepts of physical activity and its on health. These classes were held in different intervals. The content of these classes included the following materials: the relationship between physical activity, physical fitness and health, physiology of musculoskeleton and cardio – respiratory systems, weight control and stress management. Please refer to table 2 for a more detailed description of the fitness program.

## **Measurements**

Aerobic power and muscular endurance were evaluated immediately before and after the 8 weeks training program by trained personnel in exercise physiology. Efforts were made to have the same tester for each participant on all of the pre and post training tests. Choosing appropriate measurements for aerobic capacity, and muscular endurance were affected by time and monetary constraints. In all cases valid and reliable tests were chosen which could be performed in time. A total of 6 subjects in the experimental and control groups were eliminated from the program after pre testing and they were not included in the final data analysis. If subjects were absent on the day of pre testing or post testing, the investigators returned on subsequent days for testing.

## **Characteristics**

Body weight was determined using a mechanical scale (Seca Scale, Model 3p 7044, Jericho, NY) to the nearest 0.1kg. The subjects were instructed to wear comfortable exercise clothing (light clothing) and to make a note of their clothing choice so that the same clothing could be worn during pre and post testing determinations. Each participant removed his sneakers and stepped onto the nearest 0.5 cm with a wall – mounted stadiometer. Skin fold thickness was measured with a Laffayette caliper (model 01127, USA) at three sites (abdominal, chest, and thigh). All measures were made in duplicated on the right side of the body and the standing position. Body fat calculations were completed with the method described by Heyward (Heyward, 2002).

## **Aerobic Power (VO<sub>2</sub> max)**

To characterize the subject's aerobic power and maximal oxygen consumption ( $\text{ml} \cdot \text{Kg}^{-1} \cdot \text{min}^{-1}$ ) the one – mile running test was used to estimate the above said (Nieman, 1990). This test took place in a track and field court. Six testers were considered in order to perform the test. The subjects were divided into seven groups for measurements. With the whistle sound and chronometer start, the subjects started to move and ran to one- mile distance. The time spent as records of the subjects were written down, and the amount of VO<sub>2</sub> max were estimated using pre – programmed age – specific and gender – specific norms developed to improve the validity of the measurements, that was described by Niemen (Niemen, 1990) ; and used for data analysis.

## **Muscular Endurance**

It was assessed by using the one minute timed test for push up (Niemen, 1990), and bent knee sit up (ACSM's, 2001). For the sit up test, the subjects were asked to sit on the floor with their knee bent at a comfortable angle and arm contact with the chest, while a partner secured their feet to the floor and counted the number of sit ups. The subjects were required to lift their scapulae of the floor in order to complete each sit up. The total number of sit ups was documented and used for data analysis.

For the push up, the test was administered in the standard “up” position (hands slightly wider than shoulder – width apart, back straight, head neutral, the toes used as the pivot point). Verbal instructions included the directive that the subject must lower the body until the chin touches the mat, the stomach should not touch the mat, the back must be kept straight, and that the subject must push up to a straight – arm position. The total number of push ups were documented and used for data analysis.

### **Fitness – Related Knowledge**

An applied exercise physiology questionnaire was designed and served as an index of fitness – related knowledge. The questionnaire contained 15- question of 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 5 questions were developed for each content area. Many university professors in exercise physiology reviewed the questionnaire, with suggested modifications. Finally necessary revisions were made before administering it to the subjects. The questionnaire was administered to both experimental and control group at post test. The correct answers to questions were documented and used for data analysis.

An investigation conducted by Mannix, et al. (Mannix, et al, 1996) reported increase in VO<sub>2</sub> max similar to that of the present study. They induced an 11% increase in VO<sub>2</sub> max in 10 competitive figure skaters using four days per week for 10 weeks high – intensity cycle ergometer interval training program. In the present study, the experimental group displayed significantly greater VO<sub>2</sub> max that the control group (13.5%). For comparison, Roberts et al. (Roberts, et. al., 2002) induced a 28% increase in aerobic capacity in firefighter recruits after a supervised exercise – training program. Their program included participation for the three days per week for 16 weeks. One group of subjects participated in that study (n-120). Perhaps the shorter duration of the present study (8 weeks) played a role in the lower increase in VO<sub>2</sub> ma. Heyward (Heyward et al, 2002) believed that for the average person, aerobic training program would generally produce a 5% to 20% increase in VO<sub>2</sub> max. Although our fitness program intensity was low to moderate, but the initial aerobic power of our subjects was low (Niemen, 1990), and this is the most important factor to improve aerobic power (Rahmain–Nia and Hodjati, 2005). Another potential factor is that these students were also practicing self- direct physical activity; researchers did not control the intensity of this segment. The training intensity of the experimental group appears to provide adequate stimulus to increase cardio respiratory fitness in participation.

It is important to note the fitness program improved muscular endurance and fitness – related knowledge. Muscular endurance is the ability of a muscle group to exert sub maximal force for extended periods (Heyward, 2002). The push up is a simple field test to evaluate

the endurance of the upper body (triceps, anterior deltoids, and pectorals major (Nieman, 1990; and ACSM's 2001). The experimental group displayed significantly greater local muscular endurance by performing an average of 34.01 push up compared with 28.10 push up for the control group, a 30% difference. The sit up evaluates the endurance of the abdominal muscle groups. The experimental group averaged 48.97 sit up compared with 38.08 sit up for the control group, as 26% difference. Our results are also comparable to those of Perry et al. (Perry et al, 2002). They reported that high school adolescents have greater abdominal muscle endurance than matched control group, (67.05 vs. 51.21 for experimental and control groups, respectively).

One of the unique things about this program was that the physical activities were made to sequentially follow the health-related fitness concepts. In addition, the subjects were exposed to different protocols in endurance training (cardio respiratory and muscular conditioning). 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 (Perry et al, 2002). The integration of fitness-related concepts and endurance activities was one of the major goals of the fitness program designed to enhance student motivation.

As expected, the experimental group scored higher on the fitness-related knowledge questionnaire at post testing than the control group (=86.91  $\pm$  2.67% vs. 48.57  $\pm$  1.98 %;  $P < 0.0001$  for experimental and control groups, respectively.) (Perry, et al., 2002) reported that high school adolescents have greater physiology knowledge than control group at post test, (= 65.36  $\pm$  1.25 % vs. 44.37  $\pm$  2.81 % for experimental and control groups, respectively). Significant difference in the fitness-related knowledge can be related to motivation of the experimental group for learning of health-related fitness concepts and perhaps more motivated to improve their health habits. They also may have had greater common in fitness-related knowledge and have better lifestyle, whereas the control group did not receive any information about physical activity and fitness concepts during the program.

Nonetheless, our analysis showed that volunteers could obtain better results in their fitness levels and fitness-related knowledge after an 8 weeks intervention program compared with a control 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 exercise knowledge of adolescent.

**Table-I**  
**Physical Characters of Experimental (E) and Control Group**  
**at Pre Testing Using  $\bar{x} \pm SD$**

Variable	E(n=70)	C (n=70)	t- value	P- value
Age (years)	16.37 $\pm$ 1.88	17.85 $\pm$ 1.81	-1.516	0.1314
Body weight (kg)	50.66 $\pm$ 7.70	51.11 $\pm$ 8.65	0.322	0.7415
Height (cm)	170.01 $\pm$ 7.35	168.55 $\pm$ 7.88	-0.345	0.7240
Body fact (%)	17.40 $\pm$ 5.84	17.18 $\pm$ 5.42	1.882	0.7171

Deter mind using independent t- test for unprepared samples

**Table-II**  
**Fitness Program**

Activity	Drills
<ul style="list-style-type: none"> <li>• Warm up</li> <li>• Cardiovascular conditioning</li> <li>• Muscular endurance</li> <li>• Self-direct activity</li> <li>• Cool -down</li> <li>• Theory session</li> </ul>	<ul style="list-style-type: none"> <li>• Light running , and stretching</li> <li>• Jogging, running (interval, fartlek)</li> <li>• Situps, pushup and abdominal crunches</li> <li>• Recreational game (football, basketball )</li> <li>• Light jogging or walking stretching</li> <li>• Relationship between physical activity , fitness and health , muscle fitness aerobic capacity , nutrition weight control</li> <li>• and stress management</li> </ul>

**Table-III**

**VO<sub>2</sub> Max, Push Up and Sit Up at Pretest and Post Test Using  $\bar{x} \pm SD$**

Variable	Group	$\bar{x} \pm SD$ pre post	T value	P- value
vo <sub>2</sub> max	E	35.26 $\pm$ 3.66 40.05 $\pm$ 3.75	7.453*	0.0001
(ml.kg .min <sup>-1</sup> )	C	35.51 $\pm$ 2.74 35.83 $\pm$ 2.84		
Sit up (no)	E	38.85 $\pm$ 8.22 48.97 $\pm$ 6.60	9.965*	0.0001
	C	37.26 $\pm$ 5.45 38.08 $\pm$ 6.22		
Push up	E	26.04 $\pm$ 6.24 34.01 $\pm$ 6.16	6.132*	0.001
	C	27.84 $\pm$ 5.52 28.10 $\pm$ 5.11		

**Table- IV**  
**Fitness – Related Knowledge Score in Experimental and Control Groups**

Variable	Group	$\bar{x} \pm SD$	t- value	p value
Fitness Related	Experimental group	86.91 $\pm$ 2.67	9.123*	0.000
Knowledge (%)	Control group	48.57 $\pm$ 1.98		

**Practical Applications:** The results of this study indicated that the inclusion of health – related fitness information coupled with regular physical activities might be an effective way to enhance aerobic power, local muscular endurance and fitness – related knowledge in volunteer school 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 fitness programs integrating theory with practice. In conclusion, the present results indicate that whether the endurance and fitness – related knowledge of sedentary young school – age school females can be modified by the recommended fitness program.

### Statistical Analysis

In the present study, the independent variable was the fitness program. The dependent variables were the VO<sub>2</sub> max; push up; sit up, and fitness – related knowledge. Results for all variables were presented as mean  $\pm$  standard deviation (SD). Post testing values were compared to experimental and control groups by independent t- test. For all statistical analyses, P= 0.05 level of significance was accepted.

### Results

Although the investigators tried to complete the necessary measures of aerobic power, muscular endurance, and fitness – related knowledge on all subjects, there were up to 3 absences in the experimental group and up to 3 absences in the control group for several measured components. These absences were treated as missing data in the statistical analysis. Aerobic power and muscular endurance were measured at previous and after program whereas fitness – related knowledge was measured at post test only. The results of our initial evaluation showed on significant differences between experimental and control groups in aerobic power and local muscular endurance at pre testing.

Table 1 shows the physical characteristics of the experimental and control groups. Independent t – test showed on significant differences between the experimental and control groups for any physical characteristics at the baseline.

Shown in table 3 are the compared endurance scores in experimental and control groups. Because each of the components showed on significant initial differences, an independent t- test was performed on all variables for comparing the groups in pre test scores. Independent t – test showed that at post test, the experimental in comparison with the control group performed better not the VO<sub>2</sub> max (= 40.05 ± 3.75 ml, kg. min vs. 35.26 ± 2.84ml. kg. min; p < 0.0001 for experimental and control groups, respectively), sit up (=48.97 ± 6.60 no. vs. 38.85 ± 6.22 no P< 0.0001 for experimental and control groups, respectively) and push up (= 34.01±6.61 no; vs. 26.04 ±5.11no; p< 0.0001 for experimental and control groups, respectively). In addition, table 4 shows the experimental in comparison with the control groups achieved higher score on fitness- related knowledge test ( = 86.91±2.67%vs. 48.57±1.98%p < 0.0001 for experimental and control groups, respectively).

## Discussion

The purpose of this study was to evaluate the effects of a fitness program (exercise training and theoretical concepts about physical activity) on endurance and fitness – related knowledge. The experimental group went through the program in exercise physiology designed to increase school student awareness of health – related fitness concepts, improve ability to understand physical activity effects, and enhance endurance. The control group did not undergo any program. As can be seen in table 3 after the program, the experimental group also showed significantly higher values in endurance components at post testing. Additionally, the experimental group was compared with the control group showed greater levels of fitness- related knowledge at post testing. Significant difference in the VO<sub>2</sub> max is an agreement with prior reports indicating that VO<sub>2</sub> max can increase with a fitness program and initial values (Hurley et al, 1991; Grant et al, 1992; and Suzuki et al, 1998). Some previous studies pointed out the changing the maximal oxygen uptake is unlikely to short time period's programs (Ready et al, 1991; Lamarch et al, 1992; and Rahmani–Nai and Hodjati, 2005). This is in contrast to findings of other investigators (Pate et al, 1997; and Roberts et al, 2002), who had reported modest or inconclusive results in their men and women participants.

According to the American School of Sports Medicine (ACSM's, 2001), " 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 or premature development of the hyperkinetic disease". VO<sub>2</sub> max is the accepted measure of cardio-respiratory fitness (ACSM's 2001) and defined "as the greatest rate at which oxygen can be consumed during exercise (Nieman, 1990). Aerobic training is an effective mode for increasing aerobic power (Heyward, 2002; and Hurley et al, 1991). Grant et al. (Grant et al 1992). Reported that 10 weeks university fitness program increase VO<sub>2</sub> max by 20% in sedentary male students. Douris, et al. (2004) reported that middle – aged martial art practitioners (twice a week for three years) had a 31.8% greater VO<sub>2</sub> max than the sedentary group. An investigation conducted by Makrides, et al., (Makrides, et al, 1990) reported increase in aerobic power. Their high – intensity training program included participation using three days per week for 12 weeks. Two groups of subjects participated in that study: a group (n=10) of young (16 to 18 yrs), sedentary, healthy men student and a second group (n=10) of older (60-70 yrs), sedentary, healthy men. The young subjects experienced 28% increase in their VO<sub>2</sub> max, whereas the older subjects experienced 38% increase in their VO<sub>2</sub> max. It is apparent that variable results can be expected from endurance training programs, and factors such as age, initial fitness level, and over activities that may coincide with the training may affect the outcomes.

## Conclusion

Nonetheless, our analysis showed that volunteers could obtain better results in their fitness levels and fitness – related knowledge after an 8 weeks intervention program compared with a control 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 personas should be aware of alternative modes of exercise delivery for increasing the health – related fitness and exercise knowledge of adolescent.

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