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Physical performances Adaptation during concurrent high-intensity continuous training in adolescents

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Abstract
Introduction: The statement emphasizes the value of exercise in decreasing the risk of several chronic diseases and enhancing general health. Obesity, hypertension, diabetes, and cardiovascular disease have all been linked to a lack of physical activity. Exercise is therefore advised as a helpful strategy to counteract inactive lifestyles and enhance health results. Different types of exercise training can have varying impacts on cardiovascular responses, body composition changes, and ultimately physical performance. By identifying the activity that yields the greatest positive impact, it becomes possible to provide practical recommendations for implementing high-quality physical activity interventions that will benefit adolescents and improve their physical activity levels and capacity indicators. This study aims to investigate the impact of high-intensity continuous training on physical performance. This information can be valuable in designing targeted interventions and strategies to promote regular physical activity and improve health outcomes among the population, specifically focusing on adolescents.
Material and Methods: The present study is based on a descriptive and comparative plan. The participants were composed of 22 healthy students (11 males and 11 females) recruited from Nakhon Phanom University, Thailand. Participants were required to complete all workouts conducted 3 times a week for 8 weeks. The tests were used to assess physical performance, such as body weight, body mass index, the sum of four skinfolds (Σ4 skinfolds), muscular strength, and oxygen consumption were determined before and after exercise training. A paired t-test has been used to examine impairment in physical performance in adolescents.
Results: Twenty-two volunteers male and female, aged 18.55±.51 years, with a height of 163.52±6.46 cm, a body weight of 55.70±3.94 kg and a body mass index (BMI) of 20.92±1.61 kg/m^2 took part in this study. The study shows that there was a significant difference before and after continuous high-intensity workouts in body weight (P=.04), body mass index (P=.00) body fat (%), (P=.00) muscle strength (p=.07), and oxygen consumption (P=.00).
Conclusion: Continuous high-intensity training has a positive effect on body weight, body mass index, body fat, muscle strength, and the cardiovascular system. Therefore, it is suggested to consider these elements as a guide in the planning of aerobic training, in order to better physical performance. In the component of cardiovascular health, and adiposity on overweight adding in adolescents.

Keywords: Physical fitness, muscular strength, oxygen consumption

1. Introduction
Numerous studies have demonstrated that being physically inactive increases the likelihood of developing chronic diseases such as high blood pressure and cardiovascular disease, as well as the likelihood of dying from them. Previous research suggests that cardiovascular risk factors continue to be monitored from infancy to adolescence [1]. The development of the disease started at the time of childhood and teenagers. However, heart disease can be detected in middle-aged and elderly people [2]. Previous studies have shown that pre-clinical risk factors for cardiovascular disease persist from infancy to adolescence**.** There was a strong connection to sedentary and overweight children [1, 3]. The development of cardiovascular disease starts in childhood and to progresses through life [2]. Although high cholesterol and hypertension are risk factors for atherosclerosis, efforts should be performed to prevent its aetiology in children and adolescents. Therefore, it is evident that increased physical activity is linked to a lower risk of cardiovascular disease [4, 5]. In both those with hypertension and those with normal blood pressure, high-intensity aerobic exercise has positive effects on lipids, or lipoproteins, and lowers blood pressure.

Promoting more physical activity among kids and teenagers is a crucial part of changing one's lifestyle to avoid cardiovascular disease. The soundness of the body's organs, such as the heart, lungs, and muscles, is a component of physical fitness. Physical activity factors that affect physical fitness are divided into biological and psychological factors. However, the body's natural function is what determines a person's level of physical fitness. Any movement of the body made by the skeletal muscles concerns our energy expenditure and is considered an expert physical activity. The suggested amount of time is for 60 minutes of moderate to intense physical activity, although it is emphasized that these minutes should be in addition to regular physical activity [3]. Although physical education classes frequently provide instruction time for exercise, this is rarely sufficient to achieve and maintain adequate physical health. The purpose of this study was to investigate the effect of high-intensity continuous training to develop physical performance. After identifying the activity that has the greatest positive influence on the population, it is possible to make helpful recommendations focused on a high-quality physical activity service to improve the physical activity and capacity indicators for teenagers.

2. Materials and methods

2.1 Research Design

This study was a controlled trial in human experimental research. After giving written, informed consent, 22 participants university students participated, 18-19 years of age. The selection of participants was made according to previously defined inclusion and exclusion criteria. The study's participants engaged in eight weeks of closely monitored instruction. Following the health screening, participants were health-related physical fitness tests. This study was conducted to investigate the effects of moderate-intensity continuous training on the development of health-related physical fitness. Testing at baseline/1 week and eight weeks was separated from the training by at least two days of recovery. The investigation was conducted according to the Declaration of Helsinki and was approved by the Nakhon Phanom University Research Ethics Committee, No. 67/64 Exp.

2.2 Participants

The study included participants were 22 people, (11 males, 11 females) who were recruited from students in Nakhon Phanom University, Thailand. The age of the participants ranged from 18 to 19 years, with male participants averaging 18.36±.51 years and female participants averaged 18.73±.48 years. Students were selected using the following criteria: being physically normal and able to perform normal activities of daily living. Students were excluded if they had injuries to their upper and lower limbs or a musculoskeletal problem that affected their upper and lower extremities.

2.3 Equipment for Measuring Anthropometric Parameters

The direct anthropometric measurements with subjects wearing only sportswear and without shoes. All the measurements were performed by a goods train. Body weight was measured to the nearest 0.1 kg using an electronically calibrated scale. The body height was recorded with a manual stadiometer to the nearest 0.1 cm. And while measuring height subjects were asked to look straight. The subjects stood straight with heels, buttocks and back touching the vertical limb of the wall. The body mass index was calculated to grade chronic energy deficiencies. The body mass index was calculated following the measurement of each participant's height and weight using the following formula;

$$\text{Body mass index (BMI)} = \frac{\text{Weight in kg}}{\text{Height in meter}^2}$$

2.4 Physical Fitness Tests

The percentage of Body Fat was calculated from skinfold thicknesses, and the measurement was done with a Lang caliper to the nearest 0.1 mm at the following four sites on all subjects, at the bicep, triceps, subscapular, and supra-iliac areas [8], along the right body side and measurement were repeated three consecutive times.

2.5 Muscular strength

Hand grip strength test; Using a typical adjustable handle mechanism, the force of the dominant hand's grip strength was determined. Takei's grip strength dynamometer (produced in Japan). For standardization, it was set at the second handle position for all participants. The standing position with the shoulder adducted, neutrally rotated, and elbow in full extension. Results were recorded as kilograms/body weight. In exams 1 and 2, strength is determined as the average of the best results in these 2 exams [9]. The participants' hand grip strength data were displayed as left or right, regardless of hand dominance. The testing order (dominant or non-dominant) was balanced. The dominant hand was determined by asking the participants with which hand they wrote.

2.6 Cardiorespiratory fitness

20-m Multistage fitness test (MSFT); The test requires participants to run 20 meters back and forth across a marked track, keeping time with beeps. The MSFT started at a speed of 8.5 km/h and increased by 0.5 km/h for each 1-minute stage completed. The running speed for this test was standardized by prerecorded auditory cues (i.e., beeps) played from a computer notebook connected through Bluetooth to a portable speaker. The speaker was located on the inside of the running area and positioned such that it would not interfere with the recruits. Participants will run back and forth for 20 meters and had to run at the speed set by the sound signal, which will increase every minute at 05 km/h. If the participant is unable to maintain the running speed according to the signal for two consecutive trips, the test shall be terminated.

2.7 Exercise-specific program

Exercise that primarily uses aerobic energy-producing systems, can improve the capacity and efficiency of these systems and is effective for improving muscle strength and cardiorespiratory endurance. The participants underwent different exercise intensities which are high-intensity interval training throughout 8 weeks of exercise duration for 3 times/week and lasted 80 minutes. The exercise protocol was designed to simulate a training program session. This program consisted of performing exercises whose intensity and volume were close to those of competitive. It consisted of high-intensity continuous training intermittent runs, such as 30 seconds of running at maximum speed followed by 30 seconds of passive recovery (jogging), followed by 15 seconds of running at maximum speed followed by 15 seconds of passive recovery (jogging). Body exercise, these exercise program uses body weight as resistance, such as push-up, sit-up, and half squats with a set of 15 repetitions

perform in 4 sets. Participants have a warm-up session for 10 minutes to increase heart rate reserve by 30%. Exercise for a period of 60 minutes. Work intensity was above 80% heart rate reserve. Cooling down the session for 10 minutes to reduce body temperature and heart rate while maintaining the blood circulation was commenced shortly after the training interval was finished [10, 11].

2.8 Statistical analysis
All the data will be analyzed using IBM SPSS Statistics version 27.0. The data are presented as mean and standard deviation (S.D.), which were used to describe the demographic variables of the participants such as age, height, weight, and body mass index. The level of significance was set at 0.05. The results of body weight, body mass index, body fat (%), muscle strength, and oxygen consumption showed a mean change from baseline. The comparisons of all variables within the group were analyzed with a paired-sample t-test to evaluate the acute effect of high-intensity continuous training.

3. Results and Discussion
Twenty-two participants qualified university students in health studies. In Table 3, the characteristics of the participants are presented, which are shown the values of the means, and standard deviations of the male and female gender in the variables age, height, weight, and body mass index.

Table 3: Baseline characteristics of the 22 adolescents evaluated

Evaluated variables	Measuring unit	Male		Female		Total (N=22)	
		Mean	SD	Mean	SD	Mean	SD
Age	Years	18.36	.51	18.73	.48	18.55	.51
Height	Centimetres	167.36	5.84	159.68	4.60	163.52	6.46
Body weight	Kilograms	56.58	4.87	54.81	2.66	55.70	3.94
Body mass index	Kg/m^2	20.29	1.35	21.55	1.65	20.92	1.61

SD = Standard Deviation

The effect of high-intensity continuous training (HICT) on physical fitness

A description of the effects of exercise on body weight, body mass index, body fat (%), Muscular strength (grip strength), and oxygen consumption is also presented in Table 4. It was measured before and after a high-intensity continuous training intervention for the participant group. A paired-sample t-test was conducted to evaluate the acute effect before and after high-intensity continuous training on physical fitness. Body weight, body mass index, and body fat (%) decreased significantly (p<0.05) compared to baseline. In addition, muscle strength performance increase was not significant (p>.05), and oxygen consumption increased was significantly (p<.05) after 8 weeks of high-intensity continuous training.

Table 4: Effect of high-intensity continuous training program for 8 weeks that induced on physical fitness

Variables	Before exercise training		After exercise training		T	Sig.	Mean difference
	Mean	S.D.	Mean	S.D.			
Body weight (kg)	55.70	3.94	54.84	4.53	2.17	.04*	.86
Body mass index (kg/m^2)	20.92	1.61	20.41	1.71	5.75	.00*	.51
Body fatst (%)	25.20	6.62	23.63	6.75	4.58	.00*	1.57
Muscle strength (kg/body weight)	.50	.09	.53	.11	1.90	.07	.03
Oxygen consumption (ml/min/kg)	24.63	2.46	25.76	2.85	4.08	.00*	1.13

*Significant difference compared to before exercise training, and after exercise E-training (p<0.05)

4. Conclusions
This study was designed to determine the way high-intensity continuous training influences the development of physical performance. The twenty-two individuals' anthropometric measurements revealed that their average age was 18.55±.51 years, their average height was 163.52±6.46 cm, their average weight was 55.70±3.94 kg, and average body mass index was 20.92±1.61 kg/m^2. Participants in the investigation had a typical body mass index of 18.5 to 24.9 kg/m^2.

4.1 Impact of high-intensity continuous training (HICT) on body weight, and body fat (%)
High-intensity continuous training has succeeded in stimulating the development of physical fitness. This was seen from the significant change in all variables from pre-exercise training to post-exercise training. Previous research has identified relatively similar trends based on the same modes of practice [12]. The resting metabolic rate and heart rate can be more chronically affected by high-intensity continuous training. Which, the trained subjects only had a higher resting metabolic rate than untrained subjects when there was a significant energy flux. This indicates that the resting rate of metabolism is affected by exercise, energy consumption [13]. This is a weight loss factor after an eight-week workout. In addition, carried out on an almost daily basis, seems to greatly improve oxygen consumption thanks to mechanisms that are likely to be independent of the changes related to the training of the cardiorespiratory condition. However, Després & Lamarche [12] suggested that emphasis should not be placed on increasing aerobic capacity through high-intensity exercise. But rather, on the production of a substantial increase in daily energy expenditure, which will eventually lead to weight loss and related improvements in carbohydrate and fat metabolism. The greatest amount of weekly exercise, with minimal weight change, had widespread beneficial effects on the lipoprotein profile. The improvements were related to the level of activity and not to the intensity of the exercise or the improvement of the physical state [6]. Additionally, the American College of sports medicine has recognized the quantity and quality of exercise needed to attain health-related benefits may differ from what is recommended for fitness benefits, and the potential health benefits of regular exercise performed more frequently and for a longer duration, but at lower intensities than prescribed in this position statement [16].

4.2 High-intensity continuous training (HICT) on muscle strength and oxygen consumption
Daily, prolonged HICT increases muscle strength, and oxygen consumption levels after exercise for 8 weeks. The muscular strength (grip strength = .53±.11 kg/body weight) was increased compared to baseline. In addition, it was found oxygen consumption that oxygen consumption performance increased compared to baseline was 25.76±2.85 ml/min/kg.

The increases in muscular strength after exercise training were significant. Considering that HICT is a potent stimulus to the neuromuscular system, enhanced neural function (beyond that weight training alone) could have contributed to the augmented upper and lower body strength improvement. The adaptation of muscles could contribute to improved performance and muscle activation during the concentric phase when preceded by eccentric muscle action [15]. The study showed that 8-week training can improve basic endurance, and running economy among students [16]. During high-intensity continuous training, there is an increase in oxygen consumption in order to sustain the increased energy requirements. Repeated periods of exercise can also have a more lasting effect on resting metabolism. Continuous endurance exercise, 20 min per session, at about 50-85% of VO2 max is a minimum prescription to induce significant cardiorespiratory improvements [16]. Successful programs typically involve continuous vigorous activity like 80% of maximum heart rate for > 30 minutes at least 3 days a week. Change with systematic training means of approximately 10% (3-4 ml/kg/min) [3]. Endurance workout responses include substantial increases in maximum oxygen consumption, cardiac output, and stroke volume. Since then, the endurance exercise has mostly produced a density charge on the left ventricle [17]. It has been demonstrated that physical activity has positive effects on cardiovascular risk factors in children. Increasing traditional moderate to vigorous levels of physical activity among youth is a health promotion and disease prevention strategy. Physical activity was based on a continuous workout of sufficiently high intensity to increase aerobic fitness. Previous studies have shown that different physical activities can have beneficial effects on the components of physical performance, thus reducing the risk of cardiovascular disease (CVD).

5. Conclusion

Fitness is an important health factor for young people. The result is regular high-intensity workouts to improve health-related physical fitness. It can be used for maintaining and enhancing one's health. However, the requirement for exercise depends on the quantity and intensity of the training. All training volumes become an important reference for improving physical performance. Therefore, the amount and duration of high-intensity continuous training is important to improve physical condition.

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7. References

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