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ORIGINAL ARTICLE

Effect of High-Intensity Interval Training on Cardiovascular Risk Factor Parameters

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ABSTRACT

Background: High-intensity interval training (HIIT) was thought to be effective on physiological parameters.
Aim: To determine the effects of high-intensity interval training on lipid profile and other physiological parameters predominantly in men.
Study design: Retrospective observational study
Place and duration of study: United Medical & Dental College Karachi from 1st August 2021 to 31st January 2022.
Methodology: One hundred and twenty six male subjects, either healthy or those with comorbid conditions like HTN and Type 2 DM, aged 20 to 70 years, and weighing ≥50 kg, were included. The subjects were required to complete pre and post-testing, which consisted of measures of body weight, blood glucose, lipid profile, serum glutamic pyruvic transferase (SGPT) and serum uric acid which were measured at baseline and 12 weeks after HIIT.
Result: The mean age was 47.66±7.52 years. Body weight, blood glucose, SGPT and lipid profile significantly improved after HIIT training ($p<0.05$), while there was only a mean decline of 0.20±1.33 mg/dL ($p=0.081$) in the serum uric acid after HIIT.
Conclusion: It was observed that 12 weeks with HIIT showed a significant change in blood glucose and lipid profile levels, indicating that HIIT might help reduce cardiovascular risk.
Keywords: High-intensity interval training, Lipid profile, Glucose, Body weight, Cardiovascular risk factors

INTRODUCTION

Exercise is a process that increases muscle dynamism and allows organisms to expend more energy than they would in their resting states. It is essential to differentiate physical activity from exercise. Exercise is a planned, structured, and repeated activity practiced to achieve specific objectives. On the other hand, physical activities such as working, playing games, travelling, etc., involve bodily movement carried out by skeletal muscles and require energy expenditure[1].

Besides physical activity and exercise, training involves a goal-oriented, planned, and structured procedure, the same as exercise. However, the most significant distinction between training, physical training, and exercise is performance efficiency. Training systematically prepares athletes to achieve peak performance[2]. Regardless of how they are conceptualized, the therapeutic effects of all three practices mentioned above on total body fat and the cardiovascular health, have been widely recognized.

High-intensity interval training regimen consists of repeated efforts for a short duration (10-30 seconds), at near-maximal to supra-maximal work rates, with intermittent recovery periods for 2-6 weeks. It is now a well-recognized alternative to the endurance training used traditionally, improving cardiorespiratory fitness[3-6] and demonstrating modifications in both oxygen-dependent and independent metabolism. Due to the shorter time commitment associated with HIIT, exercisers find it suitable compared to aerobic exercises.

Certain physiological demands emerge in organisms during and/or after exercise, resulting in the adoption of new regulations and adaptations. Interval training produces effective physiological changes. It improves VO_2 max, lowers blood pressure[7], increases the use of fatty acids as fuel[8], and aids in weight loss in obese adolescents[9]. Hence, the present study aimed to extend the previous findings on HIIT effects on lipid profile and other physiological parameters predominantly in men.

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MATERIALS AND METHODS

In this retrospective, observational study, 126 participants were included. Male subjects, either healthy or those with comorbid conditions like HTN and Type 2 DM, aged 20 to 70 years, and weighing ≥50 kg visited the United Medical & Dental College Karachi from 1st August 2021 to 31st January 2022 were enrolled. Patients >70 years, those with unstable angina, Canadian cardiovascular society grade-III (CCS-III) (moderate limitation), decompensated heart failure, or physical disabilities/ cerebrovascular accident (CVA) were excluded.

The training comprised short circuits of high-intensity aerobics like squats, jumping jacks, push-ups, straight leg raises, dolphin planks, scissors kicks, running, and skipping for 30 seconds, followed by 10 seconds of rest. Each circuit comprised 8 sets of different exercises, followed by 60 seconds of rest and repetition of the same circuit. A typical HIIT session comprises 5 circuits.

High-intensity interval training regimen was practiced by each subject in the presence of the principal investigator and other team members. They were instructed to abstain from intense exercise and ensure consumption of standardized food intake 24 hours before each training day, confirmed via written recalls. Additional time was provided to the subjects who could not initiate the subsequent exercise.

The subjects were required to complete pre, and post-testing assessments to measure the response to the training, which consisted of measurement of body weight, blood glucose, lipid profile, SGPT, and serum uric acid at baseline and 12 weeks of HIIT (48 hours after the last day of training). During training, the subjects were instructed to maintain their current physical activity regimen.

The data was entered analyzed through SPSS-23. The paired sample T-test was applied to assess the post-training vs. Pre-training weight and inflammatory markers, including HbA1c, Lipid profile, SGPT, and serum uric acid. Statistical significance was established significant as $p \le 0.05$.

RESULTS

The mean age was 47.66±7.52 years. Almost 80% of them were smokers. Table 1 showed the significant differences in the body weight, blood glucose, SGPT, and lipid profile after training (p<0.05). While there was only a mean decline of 0.20±1.33mg/dL (p=0.081) in the serum uric acid after HIIT.

Table 1: Pre and post-training differences in weight, blood glucose levels, lipid profile, and other biochemical indices

Variables		Pre-Training	Post-Training	Mean Difference	t	p-value
Weight (kg)		87.5±11.45	81.71±12.07	-5.78±9.44	6.869	0.000*
Blood glucose	FBS (mg/dL)	102.21±23.85	95.4±9.38	-6.80±20.66	3.694	0.000*
	RBS (mg/dL)	142.9±31.77	121.27±13.17	-21.63±26.60	9.127	0.000*
	HbA1c (%)	6.08±0.99	5.37±0.44	-0.70±0.55	11.323	0.000*
SGPT (U/L)		40.42±18.58	28.57±10.67	-11.84±13.78	9.646	0.000*
Lipid Profile	TC (mg/dl)	219.76±51.62	167.35±30.19	-52.41±41.20	14.280	0.000*
	LDL (mg/dL)	132.77±40.44	104.1±24.86	-28.66±28.05	11.471	0.000*
	HDL (mg/dL)	36.98±10.55	39.72±8.88	2.74±7.03	-4.382	0.000*
	TG (mg/dL)	190.16±69.07	150.77±30.86	-39.38±51.85	8.527	0.000*
Uric Acid; mg/dL		5.39±1.65	5.182±1.11	-0.20±1.33	1.760	0.081

*p<0.05 (Significant)

DISCUSSION

The goal of this study was to assess the HIIT effect on glycemic control, lipid profile, and weight loss. A statistically significant difference was observed in body weight post-HIIT training. Similarly, Mirghani et al[10] highlighted that HIIT practices were effective in reducing obesity as well as improving body composition and total body fat percentage. They practiced interval training with three groups (HIIT with distinct intervals). In intra-group pre and post-test comparisons, the researchers discovered significant differences in body weight between the two interval training groups. Participants aged 14 to 17 who did not engage in physical activities were divided into normal and obese/overweight group in a study conducted by Silva and colleagues[11] to assess the impact of the HIIT program (12 weeks) on body composition, lipid profile, physical agility, and endothelial functions. The obese group's pre- and post-test results revealed relatively significant improvements in BMI, skin-fold examination, body fat percentage, and abdominal circumference. They also stated that the physical fitness levels of the participants had improved.

Another focus of our research is whether HIIT alters the lipid profile. Total cholesterol, LDL, HDL, and TG levels declined post-HIIT training (p=0.000), indicating a significant effect of HIIT on lipid profile levels. In contrast, Oner et al[12] reported that no statistically significant difference was observed in pre and post-test comparisons of cholesterol, TG, HDL, and LDL levels. However, post-test comparisons of triglyceride levels between the training (8-week long HIIT) and control groups revealed significant differences, i.e., the group practicing HIIT displayed a significant reduction in the triglyceride levels compared to the control group. Another similar study reported that the level of total cholesterol, HDL, and LDL among normal-weight and obese/overweight subjects were similar after doing HIIT, with the exception that the obese subjects had higher levels of triglyceride pre-training as compared to post-training. The researchers linked body composition and lipid findings to poor dietary habits and suggested that this issue be addressed further in future studies[11].

Concerning the redox status, we found no significant change in the serum uric acid levels after HIIT training (mean change -0.20±1.33mg/dL; p=0.081). Similarly, Hellsten-Westing et al[13] reported reduced purine release from muscle to plasma with HIIT following intense exercise, resulting in a lower loss of muscle nucleotides. Ghanbari-Niaki et al[14] also observed a significant decline in uric acid levels (p=0.02). In contrast, a few studies also reported that high-intensity exercise increases purine nucleotide system activation, resulting in the formation of adenosine monophosphate, from which UA is formed due to hypoxanthine activation. Jamurtas et al[15] reported that the serum uric acid levels were significantly higher immediately and 24 hours after the HIIT protocol compared to traditional continuous aerobic exercise (CET).

Similarly, growing evidence suggests that HIIT improves glycemic control[16] Tjonna et al[17] found that the HIIT group had greater clinically significant improvements in blood glucose than the control group, with an effect size (d=1.43). Racil et al[18] also discovered significant reductions in blood glucose and insulin levels in HIIT and moderate-intensity protocols compared to a control group. The HIIT group showed a greater improvement in both measures. Blood glucose and insulin effect sizes were low to moderate (d=0.32) and large (d=0.82), respectively[19]. The present study findings were also consistent with the outcomes mentioned above with respect to improvements in blood glucose. Lastly, we found a significant decline in the SGPT levels, which are also supported by Ghorbani et al[20]. But their inclusion criteria required elite soccer players.

CONCLUSION

High-intensity interval training for 12 weeks is beneficial in improving cardiovascular risk. A significant weight reduction, improved glycemic control and lipid profile levels were observed after the HIIT training. However, in the future, such HIIT protocols can be used to prevent cardiovascular risk and identify predictors, allowing an effective training program for improved health and well-being to be designed.

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