

# Overview of High-Intensity Interval Training (HIIT)

Amit Das<sup>1\*</sup> Dr. Minakshi Pathak<sup>2</sup> Dr. Santanu Patar<sup>3</sup>

<sup>1</sup> Research Scholar, Department of Physical Education, Sri Satya Sai University of Technology & Medical Sciences, Sehore, M.P.

<sup>2</sup> Research Guide, Department of Physical Education, Sri Satya Sai University of Technology & Medical Sciences, Sehore, M.P.

<sup>3</sup> Principal, Model B.P. Ed College, Mohitnagar, Jalpaiguri (W.B.)

**Abstract – High-intensity interval training (HIIT), also known high-intensity intermittent exercise (HIIE) or sprint interval training (SIT), is a form of interval training, a cardiovascular exercise strategy alternating short periods of intense anaerobic exercise with less intense recovery periods. There is no universal HIIT session duration, these intense workouts typically last under 30 minutes, with times vary on a participant's current fitness level. The intensity of HIIT depends on the duration of the session. HIIT workouts provide improved athletic capacity and condition as well as improved glucose metabolism.**

**Keywords – Interval Training, Metabolism, Performance, Intensified, Participation, Athletes**

----- X -----

## I. HIGH-INTENSITY INTERVAL TRAINING (HIIT)

Athletic endurance success has been described in various ways. Within this article we explored the effect of high-intensity exercise not only on physical fitness performance but also on the fundamental changes in the aerobic energy system. Therefore, endurance refers to the continuous high-intensity behaviors powered primarily for our purposes by aerobic metabolism. Such events last around 30s or more.

Training for endurance athletes typically emphasizes participation in long-term exercise of low or moderate intensity during the foundation or training process of the season, with the addition of high-intensity shorter-duration activities as the competitive approaches. The effects of low- to moderate-intensity endurance training on aerobic performance are well known (Jones & Carter, 2000), but studies of high-intensity endurance training focused primarily on explaining the effects of resistance training, the effects of resistance training on runners, and the various forms of strength training used by athletes. Furthermore, the effects of high-intensity exercise on untrained or recreationally involved subjects have been reported in previous studies, and findings may not be unique to professional sportsmen.

Endurance training (ET) is recognized as an effective means of increasing eNOS gene expression, protein content, and NO growth in feeding and resistance arteries (McAllister & Laughlin, 2006), thus enhancing the vasodilator response to insulin (Rattigan et al., 2001) and flow-induced dilatation, and reducing the risk of developing hypertension and atherosclerosis (McAllister & Laughli). ET is also a conventional means of increasing the development of the endothelial vascular growth factor (VEGF) in the skeletal muscle, which generates a stimulating signal for NO-dependent angiogenesis (Andersen & Henriksson, 1977; Hood et al., 1998; Milkiewicz et al., 2005; Egginton, 2009; Wagner, 2011). However, it is not clear if ET increases the content of eNOS in the endothelial layer of the muscle microvasculature or its phosphorylation in the basal state at ser 1177 or in response to moderate intensity cycling exercise in humans. There was also no inquiry into the effect of ET on the microvascular NAD (P)Hox content in the muscle.

Interval training in endurance sports has been well established as a source of performance in both professional and untrained athletes (Laursen and Jenkins, 2002; Laursen, et al., 2002; Stepto et al., 1999). Advances in technology have contributed to the introduction of more affordable training aids, such as heart rate monitors and power meters. Laboratory and portable instruments were used

after interval training to assess or demonstrate improvements in main physiological variables (Ebert et al., 2006; Stepto et al., 1999). The popularity of these training devices has spawned a broad market, and the consumer press has produced training guides focused on their use (Allen & Coggan, 2006). The use of portable power meters in particular has been growing but the superiority of power-based training has not been established as opposed to other interval training methods.

High-intensity interval training (HIIT), also known as HIIE or sprint interval training (SIT), is an intensified form of interval training, an exercise technique that alternates short bursts of intense anaerobic exercise with less challenging recovery periods. HIIT is something of a cardiovascular workout. Normal HIIT sessions range from 4–30 minutes. These quick, intense workouts provide enhanced athletic capacity and strength, enhanced glucose metabolism and improved fat burning. A HIIT session consists mostly of a warm-up exercise loop, followed by three to ten repetitions of high intensity exercise, separated by medium intensity exercise for recovery, and finishing with a cool-down exercise period.

High intensity interval training (HIIT) is a type of cardio training in which short, very high intensity intervals are paired with longer, slower recovery intervals. Athletes used this form of training to boost performance, but it has also been shown that the average exerciser will benefit from it. HIIT training not only increases efficiency but also improves muscle fat burning capacity. A regular HIIT workout typically lasts about 20-30 minutes and involves a ratio of 2:1, which means that the remaining intervals are twice as long as the intervals for the work. An example would be 5-10 high-intensity sprints (working on this perceived exertion chart at a stage 8-9) lasting 30-60 seconds interspersed with recovery periods of 1-2 minutes (Paige Waehner 2010).

High intensity exercise should be done at the optimum level that is closest. The medium exercise would be about 50 per cent concentrated. The number of repetitions and the length of each depends on the workout, but with just 20 seconds of intense exercise, three repetitions can be as small as that. No unique formula is given for HIIT. Depending on one's level of cardiovascular development, the moderate level speed can be as slow as walking. For instance, 30–40 seconds of hard sprinting alternated with 15–20 seconds of jogging or walking is a common formula requiring a 2:1 ratio of work to recovery times. The entire HIIT session can last from four to thirty minutes, so it's considered an excellent way to optimize a time-limited workout (Perry, 2008; Laursen, 2002; Talanian, 2007; & Van Dusen, 2008).

High intensity interval training (HIIT) has been used by top athletes for decades. But it remains a methodology for research that is practically under investigation. Training at high intensity intervals

requires short intervals of exercise, approximating a maximum or supra-maximum strength. When the athlete gets maximum aerobic strength ( $vVO_{2max}$ ), pressure is calculated as a percentage of the reached velocity.

Research shows that HIIT is an effective and time-efficient technique for training against traditional endurance-based approaches in enhancing aerobic efficiency. Training time in open-loop team sports is often minimal, as several physical, tactical, and technological areas concentrate on demand within a short timeframe. In a youth development program, where the emphasis remains on learning and improvement for the future, it's even more relevant than being excessively focused on outcomes. Each performance-level training methodology implemented must be time-efficient, effective and have a positive effect on outcomes. Job in these areas tends to favor elite adult athletes, often engaged in endurance sports. Using HIIT exercise with young athletes also needs further study to improve aerobic strength and workload in a match sports team (Morgan & Williams, 2009; Edgecomb & Norton, 2006).

High intensity interval training (HIIT) has become a common method of exercise in elite athletes, recreationally trained individuals, and clinical populations. HIIT consists of short to moderate repetitive workouts at intensities above the anaerobic threshold, interspersed with brief intervals of low intensity or passive rest. The distinctive features of HIIT over aerobic constant rate training (CRT) are shorter training cycles and recorded improvements in both the oxidative and glycolytic energy systems (Laursen, 2002; Perry, C. G. R., 2008).

Athletes engaged in endurance sports like running, cycling, and cross-country skiing integrate four fitness concepts into their training program for athletic performance development. The first conditioning term is a low intensity exercise (HVT) maintained by high volume. The second is training at or below the lactate level (THR); the third is low-volume high-intensity interval training (HIIT) and the fourth concept is a variation of the "polarized" training (POL) concepts above. There is a debate as to which of these methods of training might be superior in optimizing low intensity (LOW) adaptations and efficiency. This form of exercise increases  $VO_{2peak}$  by the amount of stroke and plasma, and induces molecular adaptations for capillary and mitochondrial biogenesis, thereby enhancing the performance of metabolic key energy-fueling components. The aerobic energy system contributes significantly to certain behaviors at low to moderate levels of strength. Some of the major incidents occurring during a game involve single or repeated bouts of activity involving high running speeds and muscle strength. The duration of these high-intensity events is largely unpredictable since they are determined by the

style of playing and can vary greatly from player to player and from game to game. They rely primarily on the phosphagen and anaerobic glycolysis system and each system's relative contribution depends largely on the strength and duration of the high intensity activity and recovery periods. Although the phosphagen system can produce 3.6 moles of ATP per min or 1.6 kcal / sec, its maximum capacity is only 0.7 moles of ATP (11 kcal) due to small muscle storage capacity. During recovery the phosphagen reserves will be replenished from the energy released from ATP in coupled reactions. The ATP is generated primarily by the aerobic system through the O<sub>2</sub> consumed during the rapid portion of the recovery process. Hence, a high aerobic potential (O<sub>2</sub> max) increases the recovery in the short term from high-intensity activities. Hence a high O<sub>2</sub> max also decreases anaerobic glycolysis dependency. Studies involving soccer players have shown that a high O<sub>2</sub>max is correlated with increased play tempo, increased number of repeated sprints, increased ball involvement and greater distance covered by a game (Helgerud, J., Engen, L. C., Wisloff, U., & Hoff, J, 2001).

The racing distance for young athletes aged 9–11 usually ranges from 50 to 400 m, with an average racing time of about 30 s to 7 min depending on age and level of competition. Contrary to this comparatively short racing time, the amount of training in this age group inside and outside the pool, depending on the individual level of success, averages around 10–15 training hours per week (Sharp, 2000). Consequently, a significant portion of the weekly amount of instruction is typically done at lower intensity with higher volumes (Maglischo 2003; Mujika 1998; Sharp 2000).

Previously, the investigators first directly compared heart rate (HR)-based intervals and power-based intervals (Swart et al., 2009). Swart et al. in the analysis found that both types of well-trained cyclist interval training have been successful in improving performance and physiological fitness parameters. Neither strategy, however, has proven dominance. HR differential efficacy in recreational cyclists versus power-based interval training has not been studied by any research to date. The relatively large demand by the recreational cyclist for HR monitors and power meters, and the substantial cost difference between the two types of devices, are relevant factors in comparing the effectiveness of the system.

## REFERENCES:

1. Bell, G. J., Petersen, S. R., Quinney, H. A., & Wenger, H. A. (1988). Sequencing of endurance and high-velocity strength training. *Canadian Journal of Sport Science*, 13(4), pp. 214-9.
2. Billat, V. (2001a). Interval Training for Performance: A Scientific and Empirical Practice. Part1: Aerobic Interval Training. *Sports Medicine*, 31, pp. 13-31
3. Coelho, C. W., Hamar, D., & Araújo, C. G. (2003). Physiological responses using 2 high-speed resistance training protocols. *Journal of Strength and Conditioning Research*, 17(2), pp. 334-7.
4. Davis, W. J., Wood, D. T., Andrews, R. G., Elkind, L. M., & Davis, W. B. (2008). Concurrent training enhances athletes' strength, muscle endurance, and other measures. *Journal of Strength and Conditioning Research*, 22(5), pp. 1487-502.
5. Esteve-Lanao, J., Foster, C., Seiler, S., & Lucia, A. (2007). Impact of training intensity distribution on performance in endurance athletes. *Journal of Strength and Conditioning Research*, 21(3), pp. 943-9.
6. Ferrauti, A., Bergermann, M., & Fernandez-Fernandez, J. (2010). Effects of a concurrent strength and endurance training on running performance and running economy in recreational marathon runners. *Journal of Strength and Conditioning Research*, 24(10), pp. 2770-8.
7. Hartung, G. H., Smolensky, M. H., Harrist, R. B., Rangel, R., & Skrovan, C. (1977). Effects of varied durations of training on improvement in cardiorespiratory endurance. *Journal of Human Ergology*, (Tokyo), 6(1), pp. 61-8.
8. Hunter, G. R., Seelhorst, D., & Snyder, S. (2003). Comparison of metabolic and heart rate responses to super slow vs. traditional resistance training. *Journal of Strength and Conditioning Research*, 17(1), pp. 76-81.
9. Machek, M. A., Stopka, C. B., Tillman, M. D., Sneed, S. M., Naugle, K. E. (2008). The effects of a supervised resistance-training program on Special Olympics athletes. *Journal of Sport and Rehabilitation*, 17(4), pp. 372-9.
10. Jones, A. M., & Carter, H. C. (2000). The Effects of Endurance Training on Parameters of Aerobic Fitness. *Sports Medicine*, 29, pp. 373-386
11. Judelson, Laursen P.B., and Jenkins D.G. (2002). The Scientific Basis for High-Intensity Interval Training: Optimising Training Programmes and Maximising

Performance in Highly Trained Endurance Athletes. *Sports Medicine*, 32(1), pp. 53-73(21)

12. McAllister, R. M., & Laughlin, M. H. (2006). Vascular Nitric Oxide: Effects of Physical Activity, Importance for Health. *Essays Biochem*, 42, pp. 119–131.
13. Andersen, P., & Henriksson, J. (1977). Capillary Supply of Quadriceps Femoris Muscle of Man – Adaptive Response to Exercise. *Journal of Physiology*, 270, pp. 677–690.
14. Ebert, T. R., Martin, D. T., Stephens, B., & Withers, R. T. (2006). Power Output during a Professional Men's Road-Cycling Tour. *International Journal of Sports Physiology and Performance*, 1(4), pp. 324-335.

---

### Corresponding Author

**Amit Das\***

Research Scholar, Department of Physical Education, Sri Satya Sai University of Technology & Medical Sciences, Sehore, M.P.