

# HIIT and Moderate Intensity Training on the Latest Research Progress of Type 2 Diabetes

Qiu Nie<sup>1</sup>, Jian Chen<sup>2,\*</sup>

<sup>1</sup>Gaduate School, Wuhan Sports University, Wuhan, China

<sup>2</sup>School of Health Science, Wuhan Sports University, Wuhan, China

## Email address:

57247028@qq.com (Jian Chen)

\*Corresponding author

## To cite this article:

Qiu Nie, Jian Chen. HIIT and Moderate Intensity Training on the Latest Research Progress of Type 2 Diabetes. *International Journal of Diabetes and Endocrinology*. Vol. 3, No. 4, 2018, pp. 63-67. doi: 10.11648/j.ijde.20180304.12

**Received:** December 9, 2018; **Accepted:** December 25, 2018; **Published:** January 25, 2019

**Abstract:** HIIT and moderate intensity training for reducing the effect of blood sugar, blood lipid index in type 2 diabetes are remarkable, but for the improvement of mechanism, it remains to be further research. In this paper, compared with the mechanism and clinical efficacy of type 2 diabetes, it is pointed out that HIIT has time-saving and efficient characteristics and it is suitable for patients with mild diabetes. Moderate intensity training takes more time and it is suitable for patients with moderate or severe diabetes, providing guidance for the treatment of diabetes mellitus.

**Keywords:** High-Intensity Interval Training, Moderate Intensity Training, Type 2 Diabetes, Blood Sugar, Blood Fat

## 1. Overview of the Development of Diabetes

As people living standard rising, the incidence of diabetes, cancer has become the third categories of cardio-cerebrovascular disease serious diseases that endanger human body health, including type two diabetes, accounted for 90% of occurring among [1]. Type two diabetes is high blood glucose and lipid metabolism abnormality of chronic metabolic disorders, its typical clinical manifestations mainly for "more drinks, food, urine", thin body, accompanied by severe complications such as diabetic retinopathy, diabetic foot, leading to different degrees of patients function obstacle, affecting the patient's quality of life. Clinical diabetes will be divided into two categories, type one diabetes is caused by the autoimmune mechanism of islet beta cell function disorder, lack of insulin and insulin dependent diabetes mellitus. the etiology and pathogenesis of Type 2 diabetes stem from islet beta cell dysfunction are complex, and it needs further studies [2]. Traditionally for the rehabilitation of patients with diabetes mellitus (T2DM) is used more medication, but it has side effects, and it is easy to produce drug dependence, but studies have confirmed that sports can not only improve type two diabetes patients with sugar to adjust, and significantly

lower blood pressure, heart rate, improve endothelial diastolic function, reduce the occurrence of cardiovascular disease (CVD) [3].

## 2. High-Intensity Interval Training (HIIT)

### 2.1. Development of High-Intensity Interval Training

HIIT involves alternating short bursts of high-intensity exercise with recovery periods or light exercise [4]. Compared with low and moderate intensity training, HIIT can improve the blood glucose, lipid metabolism of patients and the quality of daily life of patients. In 1952, Emil Zatopek won the Olympic champion by using HIIT, and HIIT gradually became popular in medical rehabilitation and sports training [5]. As the "healthy China 2030" planning outline is put forward, and the development of the recovery technology, there are a lot of researches to use HIIT in the rehabilitation training of patients with type two diabetes, and the curative effect is distinct [6]. Clinical HIIT mostly adopts the treadmill and power bicycle for training and takes the subject's heart rate or maximum oxygen intake as the reference value of exercise intensity. In this article, through strict screening and analysis of the

existing literature, explore the HIIT for the effect of blood sugar, blood fat index and body composition in patients with type two diabetes, and puts forward Suggestions for further research.

### **2.2. HIIT for Mechanism of Type 2 Diabetes**

Type 2 diabetes is characterized by high blood sugar and insulin resistance, impaired due to islet beta cells, leading to high blood sugar and high free fatty acids, free radicals increased, damaged islet beta cell function, oxidative stress and inflammation reaction, further tissue damage, forming a vicious cycle [7]. Studies have pointed out that exercise intervention can improve T2MD, there are more and more research will continue for high-intensity intermittent training and sports training on blood vessel function, this paper compares and analyzes the HIIT and moderate intensity training on brachial artery blood vessel function respectively increased by 4.31%, 2.15 [8]. show that HIIT is more effective than moderate intensity exercise function improvement, analysis may be due to the HIIT for the traditional cardiovascular disease risk factors, oxidative stress, inflammation, and insulin sensitivity influential. Li Xiumin [9] 92 cases of T2DM patients after the intervention of HIIT confirmed this conclusion, oxidative stress indicators in serum malondialdehyde (MDA), reactive oxygen species (ROS), the content of fat cells factor resistance factor (resistin), blood sugar fasting plasma glucose (FPG), 2 h postprandial blood glucose (2 HFBG) are lower than the control group, showed that HIIT training can well regulate cytokine secretion, insulin resistance loss, lower blood sugar. Qiu-Ju wang [10] on indicates that HIIT not only enhance the activity of enzymes and the buffer hydrogen ions of adaptability, and phosphate reserves but also can Increase muscle fiber volume, Promote energy consumption, it has same results of other studies and meta-analyses. this results thought to be due to training to promote the amp-activated protein kinase (AMPK) activation of gamma peroxidase body proliferation auxiliary activated protein receptor 1 (PGC-1 $\alpha$ ) expression and mitochondrial gene transcription activation induced is associated with increased mitochondrial biosynthesis, Then promote myosin heavy chain (MHC) subtype transformation, studies have shown that acute HIIT can improve fast and slow muscle signaling pathways, but it does not promote the improvement of ability, and improve long-term HIIT fast and slow muscle oxidase activity at the same time, improve the proportion of fast I type and II type a and type slow muscle, the ability of aerobic and anaerobic metabolism [11], it is advantageous to the improvement of the movement of adaptive performance and sports ability.

### **2.3. HIIT Application in Type 2 Diabetes**

Due to the development of competitive sports and the evolution of sports training methods, the research and training focusing on competitive sports has gradually turned to HIIT. Due to its time-saving, efficient and easily accepted characteristics by patients, HIIT has gradually been favored by

the public, especially in T2DM. This can be confirmed in the research results of Soren Meller Madsen [12] et al. Compared with the control group (healthy people), after the low capacity and high intensity intermittent training for 8 weeks, patients with T2DM in the first period of blood sugar significant decreased from  $289.9 \pm 25.4$  mmol/L to  $265.3 \pm 23.9$  mmol/L, improving fasting glucose, 2 h postprandial blood glucose, glycosylated hemoglobin control, and the function of islet beta cells, the abdominal fat have obvious effect. Due to in the process high strength training the human body controls hormone secretion of sympathetic nerve, secreting more adrenaline and noradrenaline, also stimulating the body in a long time to maintain a higher level of physiological metabolism, blood sugar consumption, and the use of abdominal fat, and after high-intensity exercise, growth hormones and thyroid hormones also increase, explaining that HIIT for the regulation of blood sugar effect is remarkable. Similar results have also been confirmed in Ricardo Augusto Leoni De Sousa [13]'s study that HIIT training is not only conducive to consumption during exercise, but also to consumption after exercise. Short and intense exercise improves the transport of glucose transporter 4 (GLUT4) and promotes the transport of blood sugar to bone and muscle tissue. At the same time, after high intensity exercise can also help movement oxygen consumption (EPOC), increase the activity of carnitine palmitoyltransferase complexes, improve glucose transport, help to reduce weight loss, oxidative stress and adjust the action of inflammatory proteins, at the same time increase the synthesis of mitochondria, promoting oxidative metabolism, reduce insulin resistance, can significantly improve the symptoms of T2DM.

### **2.4. Effectiveness and Security of HIIT**

HIIT for treatment of type two diabetes has always been a controversial topic. Wang Juan, Wang Zhengzhen [14] and others according to the HIIT treatment (T2DM) and prediabetes (IGR) inclusion criteria and exclusion criteria, received a valid paper 12, the study shows that for a long time HIIT training can reduce the cardiovascular risk of T2DM and IGR, but its safety remains to be more research to confirm, we should put forward in the process of movement, paying more attention to taking active preventive measures. Li miaoran [15] also had the same conclusion. By comparing the advantages and disadvantages of HIIT and medium-low intensity training, HIIT intensity was too high, and the training tolerance and effectiveness of T2DM patients still need to be further studied. A certain amount of adaptive training was required before HIIT training. But HIIT is fun, time-saving and easy to popularize. In conclusion, HIIT is a good choice for the treatment of T2DM. Appropriate exercise intensity and exercise items should be selected according to individual differences and preferences. It is necessary to conduct ECG monitoring during training, observe general vital signs and take relevant preventive measures.

### 3. Moderate Intensity Training

#### 3.1. Medium Strength Training Mechanism of Type 2 Diabetes

##### 3.1.1. Reduce Inflammatory Response

Type 2 diabetes has long treatment time, slow effect, associated with more complications such as heart, brain, kidney, etc. Body function is weak, so the Moderate strength training is a good choice and has a significant effect, and it is easy for patients to adhere to it. Liu Long Bo [16] results performed on 81 T2DM patients performing a moderate intensity aerobic training show that blood sugar, triglyceride, total cholesterol, low-density lipoprotein cholesterol levels obviously decreased, but high-density lipoprotein cholesterol levels significantly increased, indicating that moderate intensity training can effectively reduce the T2DM blood sugar, blood fat index, so as to improve the symptoms of patients. Wang Yi and Mao Rongqiu [17] further confirmed by the rats with T2DM in different intensity aerobic training, compared with low intensity and high-intensity training, moderate intensity training significantly decreased fiber cell hyperplasia, liver cell degeneration and inflammatory cell infiltration in rats. Structure of hepatic lobule is disordered. Moderate intensity training not only effectively regulates sugar metabolism disorder, also can improve the inflammatory reaction of liver tissue and promote the recovery of liver. The effect significantly is better than that high strength and low strength training. This is consistent with the research conclusion of Ricardo Augusto Leoni De Sousa.

##### 3.1.2. Promote the Oxidation of Fatty Acids and Reduce Blood Glucose and Lipid

Li YuanYuan and Fang Fen et al. [18] pointed out that high-intensity training could better regulate blood glucose level and improve cardiopulmonary function. The analysis concluded that high-intensity training was not suitable for diabetic patients with high-risk cardiovascular risk factors, because the inclusion criteria of the experiment excluded severe diabetic complications. The study also showed that aerobic exercise can increase the activity of lipase and lipoprotein enzyme in skeletal muscle, thereby improving the utilization of fat and cholesterol, reducing the synthesis of endogenous fat, increasing the oxidation of fatty acids, improving lipid metabolism, and enhancing insulin resistance.

#### 3.2. Application of Medium Strength Training in Type 2 Diabetes

Moderate intensity refers to the intensity of 60-80% for aerobic or resistance training, five days a week, thirty minutes at a time. According to the individual hobby and the patient's condition we choose the training method like power bicycle, running, swimming and so on. Chang Feng [19] randomly selected 56 patients with type two diabetes, he combined aerobic exercise with squat resistance training, the results showed that resistance training can significantly reduce cholesterol, blood sugar and C peptide index, showing that resistance training and aerobic training can significantly

improve the patients' blood sugar, blood lipids and islet beta cell function. Studies have pointed out that compared with the single therapy, the effect of combination treatment is remarkable, the combination of 4 weeks aerobic exercise with the diet significantly lead to lower liver chemerin level in rats with diabetes, promote a variety of chemokine receptor like receptor 1 (CMLKRI) expression of immune cells, improve the infiltration of inflammatory cells, adhesion and migration, which have the effect of anti-inflammation, lower levels of cardiovascular risk factors and insulin levels, reduce blood fat, blood sugar, so as to improve the symptoms of diabetes. But the mechanism of action of CMLKRI remains to be further study. However, this also provides new ideas for the treatment of diabetes patients and a new reference for finding effective and practical rehabilitation schemes [20]. In addition, Cao Wen [21] also pointed out that this pill combined hypoglycemic rehabilitation exercise can significantly improve type 2 diabetes mellitus patients with symptoms, after thirty minutes of exercise every day, 4 days a week, glycosylated hemoglobin and islet beta cell function index (HOMA - beta) in combination group is better than single treatment group. In order to further explore the mechanism of pill combined with swimming exercise therapy, the result shows that it can adjust Sirtuin 1 (Sirt1) and serum adiponectin (APN) signaling pathway, effectively reduce the blood sugar level of type 2 diabetes in mice, Promote insulin secretion and protect beta cell function of the islet. Moderate intensity training is safe and effective, the effect of combined treatment is more remarkable than single treatment. The combination of exercise intervention method provides a new treatment thought, especially it offers a reliable reference for T2DM patients with severe complications.

#### 3.3. Medium Intensity Training for Application in Type 2 Diabetes Associated with Complications

There are many complications of diabetes, including acute complications and chronic complications. Acute complications occur rapidly. If it is not timely treated, the patient's life will be seriously threatened. Chronic complications present multiple, complex lesions, insidious onset, and no typical clinical manifestations, among which the more common ones, such as diabetic peripheral neuropathy, seriously affect the quality of patient's life, so it is particularly important to find effective treatment methods. Chang Zhan, Feng Gong [22] make a study on associated with diabetic peripheral neuropathy patients after 12 months of different intensity of exercise therapy, the results show that blood sugar, glycosylated hemoglobin, insulin resistance index, nerve conduction function are improved, and after moderate intensity training the scores of each index was superior to other groups, showing that appropriate training can improve the insulin receptor and insulin combination, reduce insulin sensitivity, promote glucose uptake and utilization. Meanwhile, it can also influence the expression of cytokines, promote the nerve fibers demyelination, axonal mutation, and the recovery of nerve conduction function. This is consistent with the

research conclusions of Liu Jing and Si Jing Mei [23]. Moderate intensity aerobic exercise can effectively improve the health, sensation and activity limitation of patients with diabetic peripheral neuropathy, improve nerve function and the quality of life. Moderate intensity training with moderate load is safe and interesting for patients with serious complications.

#### 4. Summarizes

Diabetes mellitus is a kind of chronic and progressive metabolic disease, traditional drug treatment cannot meet the needs, so it is urgent to find simple, efficient and safe treatment methods like exercises.

HIIT requires less time and acceptable, which has been confirmed by most studies. It can improve glucose and lipid metabolism in a shorter time. From the perspective of intervention effect, HIIT can effectively reduce the content of oxidative stress factor, promote the transformation of muscle fiber, skeletal muscle uptake, utilization of blood glucose. It also can enhance post-exercise consumption and reduce blood glucose. This training promotes the oxidation of fatty acids and reduces blood lipid, which is a best choice for diabetic patients with timeless for exercise and have low risk factors of cardiovascular disease.

Moderate intensity exercise can also improve symptoms in patients with T2DM. It regulates blood sugar, improves cardiopulmonary endurance. For patients with cardiovascular disease patients without toleration can choose this training, the training intensity is moderate, so it is easily accepted by patients. Moderate intensity exercise combined with dietary collocation can improve blood sugar management, being more effective than drug treatment. For diabetes mellitus with common chronic complications such as diabetic peripheral neuropathy, moderate intensity training can promote the recovery of nerve function and improve the quality of life.

In conclusion, both training methods can reduce blood glucose and blood lipid and improve the symptoms of T2DM patients. Of course, according to the age of patients, their own preferences, occupation, physical function, sports condition, training conditions, complications and so on, it is necessary to make a reasonable training program in the training, and the corresponding medical supervision of the training process. Further studies are needed to accurately grasp the duration and intensity of exercise, so as to improve the quality of life of patients with diabetes and the national health level.

#### 5. Conclusions

HIIT is time-saving and efficient, it is suitable for patients with mild diabetes. Moderate intensity training costs more time, but it is suitable for patients with moderate or severe diabetes, so we should choose treatment program according to the degree of the disease.

#### References

- [1] Teixeira-Lemos E, Nunes S, Teixeira F, et al. Regular physical exercise training assists in preventing type 2 diabetes development: focus on its antioxidant and anti-inflammatory properties. *Cardiovasc Diabetol*, 2011;10 (1) :12.
- [2] Zhang Yan yong-zhe li. research progress of type 2 diabetes. *Journal of jilin institute of chemical technology*, 2012;29 (2):38-45.
- [3] Anne Cathrine Thorup. Functional and structural vascular adaptations following 8 weeks of low volume high intensity interval training in lower leg of type 2 diabetes patients and individuals at high risk of metabolic syndrome, *Archives of Physiology and Biochemistry*, 2015;5:178-186,
- [4] Kassia S Weston, Ulrik Wisløff, et. High-intensity interval training in patients with lifestyle-induced cardiometabolic disease, *sports medicine*, 2014;48(16):1227-1234.
- [5] Wang jingjing, zhang haifeng. Research progress on fitness effect of high-intensity interval training exercise prescription , *Chinese journal of sports medicine*, 2013;3:246-254.
- [6] Durrer, Cody. Francois, Monique. et al. Acute high-intensity interval exercise reduces human monocyte Toll-like receptor 2 expression in type two diabetes. *American Journal of Physiology*, 2017;312 (4):529-538.
- [7] Jonathan P. Little and Monique E. High-Intensity Interval Training for Improving Postprandial Hyperglycemia. *Research Quarterly for Exercise and Sport*, 2014;85(4):451-456.
- [8] Joyce S Ramos. Lance C. Dalleck. et al. The impact of high-intensity interval training versus moderate-intensity continuous training on vascular function: a systematic review and meta-analysis. *sports medicine*, 2015;45:679-692.
- [9] Li xiumin. Effect of high-intensity intermittent exercise on blood glucose control, fat cytokine secretion and oxidative stress in T2DM patients, *journal of human medical college*, 2008; 34(5):589-592.
- [10] Wang qiuju. Study on high-intensity interval training and its mechanism. *Sports time and space*, 2015;(8):125.
- [11] Sun yi, zhu rong, liang y q. regulation of high-intensity interval training on the metabolism and distribution of different types of muscle fibers, *journal of guang zhou institute of physical education*, 2008;38(1):82-89.
- [12] Soren Meller Madsen et. al, High Intensity Interval Training Improves Glycaemic Control and Pancreatic  $\beta$ Cell Function of Type 2 Diabetes Patients, *Research Article*, 2015;10(8):1-24.
- [13] Ricardo Augusto Leoni De Sousa. Brief report of the effects of the aerobic, resistance, and high-intensity interval training in type 2 diabetes mellitus individuals. *Int J Diabetes Dev Ctries*, 2017;38(12):1-8.
- [14] Wang Juan, wang zhengzhen et al. Efficacy and safety of high-intensity interval training in reducing the risk of type 2 diabetes and pre-diabetes cardiovascular disease, *Chinese journal of medicine*, 2016;35(6):561-567.
- [15] Li Miaoran. High intensity intermittent training in the application of two diabetes exercise therapy, *sports science*, 2017;5A:151.

- [16] Liu l b. effect of moderate intensity aerobic exercise on blood glucose and lipid body weight in patients with type 2 diabetes, xi 'an university of physical education, 2013;1-30.
- [17] Wang yi, MAO rongqiu et al. Effect of aerobic exercise with different intensity on liver tissue morphology of type 2diabetic rats. Journal of guangxi medical university, 2015;32(1):11-14.
- [18] Li yuan yuan, fang f, et al., effects of different intensity aerobic exercise on blood glucose and cardiopulmonary endurance in patients with type 2 diabetes. Chinese journal of physical medicine and rehabilitation medicine, 2017;39(8):617-619.
- [19] Chang f. study on the effect of aerobic exercise combined with in-situ squatting resistance training program and intervention in middle-aged type 2 diabetes patients, health management, 2018;(27):2980-2986 .
- [20] XJ Lin, HF Yang, et al. Effect of aerobic exercise and diet control on chemerin and its receptor CMKLR1 in liver of type 2 diabetic rats, Chinese journal of applied physiology, 2017;33(5):426-435.
- [21] Cao wen, a study on the efficacy and mechanism of jiaotai pill combined with sports therapy in the treatment of type 2 diabetes, 2018.
- [22] Chang zhan, feng hong et al. Effect of different exercise intensity on patients with type 2 diabetes mellitus peripheral neuropathy, journal of integrated traditional Chinese and western medicine, 2017;26(9):963-964.
- [23] Liu jing, si jingmei. Effect of moderate intensity aerobic exercise on the quality of life of patients with type 2 diabetic peripheral neuropathy, 2017;36(1):40-44.