

Research Article

The effect of eight weeks of HOME-HIIT on glycemic control indicators in pediatric with type 1 diabetes

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Abstract

Type 1 diabetes is the most common non-communicable disease among children. This disease is associated with a lack of insulin secretion and imposes many complications on the affected person throughout his life. Sports activity can play a significant role in controlling this disease and reducing its complications. Therefore, the aim of this study is to investigate the effect of eight weeks of HOME-HIIT on glycemic control indicators in children with type 1 diabetes. In this semi-experimental study, 30 children with type 1 diabetes with an average age of 11.5 ± 2.17 and a body mass index of 19 ± 2.96 were randomly divided into two control groups (15 people) and an exercise group (15 people). The training program consisted of eight weeks and three HIIT training sessions every week with an intensity of 80-90% of the maximum heart rate. Blood samples were collected under fasting conditions during the pretest and posttest phases, or daily, to assess the study variables. Independent-samples t-tests were used to compare between-group differences. Repeated-measures ANOVA followed by Bonferroni post hoc tests, as well as paired-samples t-tests where appropriate, were used to examine within-group differences, with statistical significance set at $P < 0.05$. These cases were done using SPSS version 25 software with a $p\text{-value} < 0.05$. The results of this research showed that HOME-HIIT has a positive effect on the indicators of glycemic control in children with type 1 diabetes, and as a result, it can help reduce the complications of diabetes and improve the health of children with type 1 diabetes.

Key Words: High-intensity interval training, Diabetes mellitus type 1, Children's diabetes, Glycated hemoglobin, Glycemic control

Introduction

Type 1 diabetes (T1D) is a metabolic disease caused by the autoimmune-mediated destruction of the insulin-producing pancreatic beta cells, resulting in little to no insulin production. Dysglycemia, dyslipidemia, and, ultimately, insulin resistance have been identified as the major contributors to the development of long-term diabetic complications. Researches show that the prevalence of type 1 diabetes is on the rise worldwide (Mayer-Davis et al., 2017). Approximately 90% of diabetes cases in children and adolescents are type 1 diabetes. Every year, 96,000 children under the age of 15 are diagnosed with type 1 diabetes (Codner et al., 2018). Researches show that the age of onset of type 1 in children is lower. There is a strong possibility that non-genetic factors are effective in increasing the number of people with type 1 diabetes (Tuomilehto, 2013). Lifestyle changes in the last century with increased inactivity and changes in diet have caused epidemics such as obesity, diabetes and related diseases. These diseases are increasing rapidly because of inactivity and imbalance in diet. It causes the activation of latent genetic diseases in people (Wilcox, 2005). Physical activity at all ages promotes general health, helps prevent cardiovascular disease, and supports healthy weight control, but it is especially important in children with diabetes because these children are always at risk of cardiovascular disease. In addition to reducing cardiovascular risk factors, exercise helps control weight, well-being, improves growth and development, improves movement patterns, and improves lifestyle (Wilcox, 2005). Children with type 1 diabetes do not engage in regular physical activity due to the fear of low blood sugar or loss of blood sugar control, lack of self-confidence, lack of time and facilities, and as a result, due to inactivity, weight gain and The fat percentage of the disease is aggravated, the glycated hemoglobin level increases, and the daily insulin consumption also increases (Riddell et al., 2017). In a study, Valeria Calcaterra et al proposed an online exercise program to reduce sedentary behaviors in children with type 1 diabetes during the COVID-19 pandemic. Their research showed that the need for insulin increases with increasing inact-

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-ivity (Calcaterra et al., 2021). Regular exercise has been reported to reduce the daily need for insulin (Wilcox, 2005). Glucose transporter type 4 (GLUT4) play an essential role in the uptake of glucose into cells. Insulin and exercise activity stimulate the fast and intense transfer of GLUT4 to the cell membrane to cause glucose uptake into muscle cells. Based on the results, both types of moderate-intensity continuous and intense intermittent exercise can increase the expression of the glucose transporter gene in the fast and slow-twitch muscles of obese rats. This increase is dependent on the intensity of the activity, which means that the expression of the glucose transporter gene probably increases with the increase of the activity intensity (Tran & Galassetti, 2014).

Growing evidence shows that comparable or even superior improvements in skeletal muscle metabolic adaptations, cardiovascular fitness, vascular function body composition, and parameters related to glucose metabolism including insulin sensitivity and blood glucose control as a result of HIIT training compared with MICT are obtained (Jelleyman et al., 2015; Weston et al., 2014). Exercise training on diabetic rats showed that pancreatic beta cells proliferated more as a result of exercise than untrained rats, which shows that exercise activity leads to an increase in the transcription factors necessary for the growth of pancreatic cells. Exercise also reduces cell apoptosis. Islets isolated from rats subjected to exercise training of 1 hour of running per day for two months and 5 sessions per week were more resistant to cytokine-induced proinflammatory apoptosis than Islets isolated from rats without exercise. Also, by increasing anti-apoptotic proteins and decreasing pro-apoptotic proteins and increasing antioxidants, survival in pancreatic beta cells increases. The ability of the β cell to sense glucose is crucial for the subsequent response through insulin secretion. Inability to measure glucose is associated with prediabetes or type 2 diabetes. Following exercise activity in rats, it was shown that glucose transporter to pancreatic cells increased, and glucokinase enzyme, which equips cells with the ability to connect changes in physiological blood glucose concentration to changes in glycolytic flux, was also increased. These factors ultimately lead to an increase in the amount of insulin secretion. Exercise also increases insulin sensitivity. Therefore, low levels of peripheral insulin would be sufficient to maintain glucose homeostasis after a period of exercise (Curran et al., 2020). Amy Kennedy et al conducted a meta-analysis of whether exercise improves blood glucose control in type 1 diabetes. This study showed that glycated hemoglobin decreases due to exercise, but this amount is not statistically significant. They suggested that with high-intensity training and longer duration (at least 6 months), the results may become significant (Kennedy et al., 2013). In a study, Ching Hsiang Wong et al investigated the effect of aerobic exercise at home on children with type 1 diabetes. The

showed that 3 months of aerobic training at home had no significant effect on the levels of glycated hemoglobin and $VO_2\max$ (Wong et al., 2011). Sideravič iū tē et al. investigated swimming exercises on glycemic control indicators in diabetic and healthy children. The results of the research showed that the glycated hemoglobin index decreased in diabetic children and the blood glucose level decreased in all subjects (Sideravič iū tē et al., 2018). Therefore, sports activity can play a significant role in improving the indicators of blood sugar control, including glycated hemoglobin, blood sugar and the amount of insulin consumed in diabetic children, and also reduce the long-term complications of diabetes. Research shows that many people with type 1 diabetes are sedentary, and the lack of time, the cost of going to the gym, the fear of hypoglycemia, and the dislike of exercising in front of others in public places are known as the main obstacles to physical activity in these people. HIIT training overcomes these obstacles to a great extent. HIIT training improves cardiorespiratory function and reduces the amount of insulin consumption, and blood sugar does not drop during or after training (Scott et al., 2020). Therefore, according to the research conducted on the effect of sports activity in children with type 1 diabetes, the results have shown that sports activity can lead to a reduction in the long-term complications of diabetes in children, But the point that is important in this regard is the way of performing sports activities and the problems that children face in performing sports activities, Especially, the implementation of sports activities for children requires the presence of a coach or parents. In this regard, the implementation of sports exercises that lead to a stronger presence of parents can be effective. One of the exercises that can be mentioned in this regard is the implementation of HOME-HIIT exercises. In this type of exercise, intense intermittent activity is performed at home under the supervision of the trainer and the presence of parents, but this question is raised can the implementation of HOME-HIIT exercises be effective on blood glycemic control indicators in children with type 1 diabetes? Therefore, according to the fact that the research conducted on the effect of sports activity on the indicators related to diabetes in children with type 1 diabetes is different and also, the research that showed the effect of HOME-HIIT exercises on these indicators in children with type 1 diabetes was not found until the implementation of this research. The purpose of this research is to investigate the effect of eight weeks of HOME-HIIT training on glycemic control indicators in children with type 1 diabetes.

Materials and Methods

In this semi-experimental research, the statistical population was girls with type 1 diabetes in Isfahan city, aged between 8-15 years, who had been diagnosed with diabetes for a year. During the call announced by the Imam Hossein (AS) Children's Hospital

their readiness and after participating in the coordination meeting, the goals and methods of measurement were fully explained by the researcher and the subjects by completing the informed consent form and the medical history questionnaire, 30 people were randomly selected. After the first blood draw, the 30 participants (mean age 11.5 ± 2.17 years; mean BMI 19.0 ± 2.96 kg/m²) were randomly allocated to the control and training groups. The exercise program consisted of eight weeks and three sessions of HIIT HOME training each week, with remote supervision by the trainer and parental supervision, and with an intensity of 80-90% of the maximum heart rate (increasingly). The information obtained from the samples included: age, weight, height, time of onset of diabetes, type and dose of insulin received, and then the experimental group performed HIIT exercise for eight weeks.

HOME-HIIT exercise program

The training group first warmed up for 10 minutes with dynamic stretching movements. Then the main exercise was performed as HIIT, one minute of exercise (with an intensity of 80-90% of the maximum heart rate) and one minute of rest with 6-9 repetitions was done incrementally, then they cooled down for 5 minutes with static stretching movements. In the interval of one minute of training, 2 different training models (each training 30 seconds) were performed without rest with body weight at home (figure 1). The maximum heart rate was calculated with the formula $208 - (0.7 \times \text{AGE})$, which was suitable for the age group of 8-15 years (Machado & Denadai, 2011). Glycemic was between 90 and 250 mg/dl to start the activity, which was measured by a glucometer before and half an hour after the start of the exercise. In case of a change in glycemic in a way that was higher or lower than the allowed limit, sports training was stopped and glycemic was corrected. If the glycemic was less than 90, the activity was not performed and 10-20 grams of carbohydrates were consumed, and if it was higher than 250, insulin was consumed.

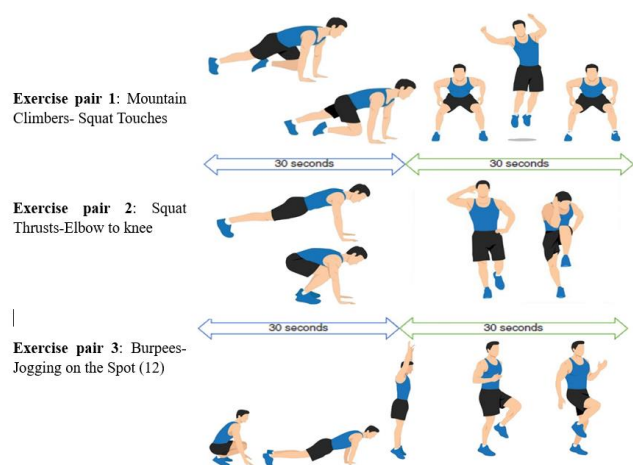


Figure 1. The presented exercises were performed in order from the top right and each exercise lasted 30 seconds.

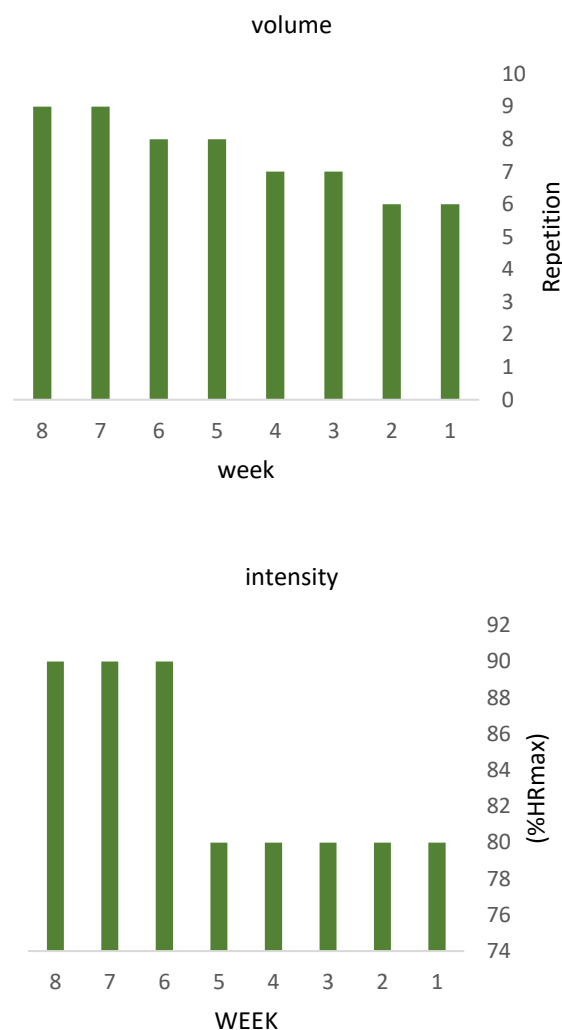


Figure 2. The intensity of training increased in the intervention weeks, b) The volume of training increased in the intervention weeks.

The method of measuring research variables

First, the anthropometric indices of height, weight and body mass of the subjects were measured. Height was measured using a wall-mounted height meter with an accuracy of ± 0.1 cm while standing next to the wall without shoes. In this evaluation, the shoulders were in normal conditions and the body weight was equally distributed on both legs. Also, the weight was measured using a digital scale with an accuracy of ± 0.1 kg without shoes and minimal clothing. Body mass index was calculated using the formula $\text{BMI} = \text{weight (Kg)} / \text{height (m)}^2$. ELISA method was used to check biochemical variables. Blood sampling was done after 12 hours of fasting and in two stages, 48 hours before the start of training and 24 hours after the last training session, after eight weeks of training, 2-hour postprandial blood sugar and glycated hemoglobin variables were checked. In both stages, 5 cc of blood were taken from the brachial vein of the subjects' left hand while sitting and resting. Then the subjects were randomly divided into

Table 1. Characteristics related to age, weight, height and body mass of subjects by group.

Specifications	Control group	Experimental group
height (m)	1.45±0.13	1.42±0.16
Weight (KG)	42.81±10.81	38.2±1.33
BMI	19.0±2.4	18.11±3.07
Age (year)	11.4±1.88	11.6±2.5

Table 2. Mean and standard deviation of insulin consumption, fasting blood sugar by group.

Variable	Insulin Dosage		fasting blood sugar	
group	Experimental	Control	Experimental	Control
Week1	49.5±6.44	50.51±10.59	168.26±36.86	166.06±34.33
Week2	49.18±6.25	51.98±10.44	164.29±34.27	167.44±34.64
Week3	48.2±6.30	50.42±10.17	160.13±35.09	167.06±34.85
Week4	45.26±5.92	50.72±9.78	156.93±33.4	166.18±33.47
Week5	43.70±5.73	50.93±11.04	152.46±30.14	164.50±33.17
Week6	42.01±5.40	50.53±10.84	148.00±31.27	165.60±32.93
Week7	39.50±5.06	50.44±10.13	145.13±27.60	159.86±35.66
Week8	37.27±4.83	50.96±10.92	141.4±24.04	165.20±32.20

The subjects of the experimental group practiced HOME-HIIT for eight weeks. During the eight weeks, both groups measured their fasting blood sugar daily with a home glucometer and recorded and reported the amount of insulin they consumed every 24 hours. The weekly average of fasting blood sugar and the amount of insulin used were used in the statistical analysis.

Statistical analysis

Descriptive statistics methods of mean and standard deviation were used to describe the data. The Kolmogorov-Smirnov test was used to check the homogeneity of the data in the basic state and to evaluate the difference between the sample and the target population. After proving the normality of the data, independent T-parametric tests were used to check the differences between groups. Parametric T-dependent test was used for 2-hour postprandial blood sugar and glycated hemoglobin, and analysis of variance with repeated measurements was used to analyze the amount of insulin consumption and fasting blood sugar. All calculations were done using SPSS version 25 statistical software and the significance level of the tests was $p < 0.05$.

Results

In this study, the effect of a HOME-HIIT exercise course on glycemic control indicators in children with type 1 diabetes was investigated. Table 1 shows the age, weight, height and body mass of the research subjects. Table 2 shows the amount of insulin consumption and the amount of fasting blood sugar during eight weeks and the amount of 2-hour postprandial blood sugar and glycated hemoglobin in the pre-test and post-test.

Kolmogorov-Smirnov test showed that the distribution of data in both groups is normal. The results of the research showed that the amount of insulin consumption in the experimental group decreased by 24.71% in the eighth week compared to the first week (Table 2). And this decrease was statistically significant and

in the control group there was an increase of 0.89%, which was not statistically significant. Also, the amount of insulin consumption in the experimental group decreased significantly during eight weeks, while no significant difference was observed in the control group. The difference in the amount of insulin consumption from the fifth week onwards compared to the first week in the experimental group was significant (Table 3). Fasting blood sugar in the experimental group decreased by 15.1% in the eighth week compared to the first week (Table 2), which was statistically significant and in the control group, it decreased by 0.52%, which was not statistically significant. Fasting blood sugar levels decreased during eight weeks in the experimental group, and this decrease was significant in the eighth week compared to the first week, while no significant changes were observed in the control group (Table 3).

2-hour postprandial blood sugar in the experimental group in the post-test decreased by 13.01% compared to the pre-test (from 285.2±39.2 in the pre-test to 248.1±34.1 in the post-test), which was statistically significant. And in the control group, it increased by 0.5% (from 298.53±44.52 in the pre-test to 291±28.21 in the post-test) (Chart 2), this increase was not statistically significant (Table 4). The glycated hemoglobin in the experimental group decreased by 17.9% in the post-test compared to the pre-test, this decrease was statistically significant and in the control group, it decreased by 0.47%, which was not statistically significant (Table 4).

Discussion

The present study was conducted by examining the effect of eight weeks of HOME-HIIT on glycemic control indicators in children with type 1 diabetes. The results showed that the effect of HOME-HIIT exercise on glycemic control indicators was significant. In this way, it caused a significant decrease in the amount of insulin consumption in the training group compared to the control group.

Table 3. In-group and out-group analysis of variables of insulin consumption and fasting blood sugar

Test	Independent-T									Analysis of variance with repeated measures			
	Variable	level of significance week1	level of significance week2	level of significance week3	level of significance week4	level of significance week5	level of significance week6	level of significance week7	level of significance week8	group	level of significance walks lambda	F	level of significance Mucly test
Insulin Dosage		0.756	0.390	0.480	0.078	0.037	0.013	0.001	0.001	experi mental	0.003	550.182	0.001
										Control	0.453	1.379	0.003
fasting sugar		0.867	0.708	0.548	0.428	0.343	0.165	0.075	0.034	experi mental	0.001	19.88	0.001
										Control	0.349	1.32	0.001

The result of this research is consistent with the research of Sam Scott and colleagues. They investigated the effect of high-intensity intermittent exercise at home on the amount of insulin and blood sugar in people with type 1 diabetes. In their study, due to the exercises in the exercise group, the amount of insulin consumption decreased, but there was no change in glycemic (Scott et al., 2019). Also, the results of this research are somewhat consistent with the research of Chiman et al. In a meta-analysis study, they investigated the effect of sports activity on type 1 diabetes. The results of their research showed that the amount of insulin consumption decreases after exercise, but no significant effect was found on glucose and glycated hemoglobin (Chimen et al., 2012). Also, the results of the study by Quirk et al., who investigated the benefits of exercise in children with type 1 diabetes in a meta-analysis study. Their research showed that exercise does not significantly change daily insulin consumption, but it reduces glycated hemoglobin, triglycerides, and total cholesterol, reducing the risk of cardiovascular diseases (Quirk et al., 2014).

Insulin is a hormone that is produced only by beta cells in the pancreas. This hormone allows glucose to be absorbed from the bloodstream into target tissues such as skeletal muscle and liver tissue. According to research evidence, in type 1 diabetes, insulin is not secreted enough in the patient's body, and the lack of insulin production is caused by antibodies that are produced endogenously. Then they attack the pancreatic beta cells and destroy them. This destruction of beta cells in the pancreas is caused by the infiltration of macrophages and T lymphocytes into the islets of Langerhans, and the destruction is only specific to beta cells (Liu & Liang, 2025). The findings show that exercise improves the mass and function of β cells. The improved function is mainly through increasing the insulin content of the β cell and increasing its ability to secrete insulin in response to a glucose stimulus, which increases the amount of insulin secretion through mechanisms of proliferation, survival and improved function, as

well as improving insulin sensitivity and This is followed by a lower need for exogenous insulin (Curran et al., 2020; Kumkum et al., 2026). Because insulin is key for the disposal of circulating glucose with meals as well as for the control of endogenous glucose production by the liver, individuals with type 1 diabetes become completely dependent on exogenous insulin administration for glucose homeostasis, typically from It is done through daily insulin injections, and after exercise, due to increased sensitivity to insulin, less insulin is needed to maintain glycemic (Tran & Galassetti, 2014; Victoria-Montesinos et al., 2026). The results of this study showed a significant decrease in fasting blood sugar and 2-hour postprandial blood sugar in the experimental group. The results of this study were consistent with the study of Reddy et al. They investigated the effect of aerobic and resistance training on adults with type 1 diabetes and the results of their research showed that resistance training reduces blood glucose (Reddy et al., 2019).

Also, the results of this study were consistent with the study of Michael Müller et al. In a study, they investigated the effect of exercise in 2 consecutive days on glycemic control, insulin needs and CHO intake in adults with type 1 diabetes, and the result of their research showed that the amount of insulin consumption can be reduced. Also, glucose decreased on the second day of training (Müller-Korbsch et al., 2021).In general, the transport of glucose and fructose is ensured by three consecutive pathways: 1) transport of glucose and fructose through the small intestine, 2) production of glucose in the liver, and 3) consumption of glucose by almost all tissues. The main cellular mechanism to absorb glucose from the bloodstream in the cell is carried out with the support of carrier proteins. that most transporter protein type 4, which is a glucose transporter in large amounts and is present in insulin-sensitive tissue (heart, skeletal muscle, adipose tissue), increases following exercise (Chadt & Al-Hasani, 2020).The results of studies have shown that the type 4 glucose transporter is activated by exercise and allows glucose to enter the target tissues from the bloodstream, and if regular exercise is performed

Table 4. The results of T-independent and T-dependent tests on 2-hour postprandial blood sugar and glycated hemoglobin.

Variable	T-independent		T-dependent			
	pre-exam	post-test	group	The significance level	Average difference	T
2-hour postprandial blood sugar	0.799	0.009	experimental	0.001	37.06	27.89
			Control	0.087	-1.46	-0.15
glycated hemoglobin	0.796	0.045	experimental	0.001	1.90	6.67
			Control	0.909	0.10	0.116

, the accumulation of the type 4 glucose transporter can be chronically increased (Curran et al., 2020). Exercise increases non-insulin-dependent uptake into muscle by transporting GLUT4 into cells. Thus, glucose uptake increases during exercise even when insulin levels are low. Glucose transporter type 4 protein turnover remains elevated during exercise recovery through unknown mechanisms that likely replenish muscle glycogen levels (Codner et al., 2018).

Increasing the transfer of glucose from the blood into the cell, either by increasing type 4 transporter protein or by increasing the amount of insulin produced in the body, causes a decrease in blood sugar. The results of this study showed a significant decrease in the amount of glycated hemoglobin in the exercise group. The results of this study showed a significant decrease in the amount of glycated hemoglobin in the exercise group, the results of this study were in line with the study of Sideravič i ū tē and colleagues. They investigated the effect of eight weeks of swimming on glycated hemoglobin and blood sugar, and the results of their research showed that glycated hemoglobin and blood sugar decreased in girls with type 1 diabetes (Sideravič i ū tē et al., 2018). Although the results of this research are inconsistent with the research of Ching Hsiang Wong et al. They investigated the effect of aerobic activity on glycated hemoglobin and blood sugar in children with type 1 diabetes. The result of their study showed that 3 months of aerobic training at home had no significant effect on the levels of glycated hemoglobin and VO₂max (Wong et al., 2011). The reason for the difference in the results can be related to the different training method in these two researches. The results of this research are somewhat consistent with the research of Angela S. Lee and colleagues. They investigated the effect of high-intensity interval training on blood sugar control in adults with type 1 diabetes. The results of their research showed that there was no significant change in glycated hemoglobin (Lee et al., 2020). Of course, a significant decrease in glycated hemoglobin was observed by 0.64% in the intervention subgroup that completed at least 50% of the prescribed HIIT exercises. That adherence to the exercise can affect the result. Glycated hemoglobin shows the average level of blood glucose in the last two to three months. This factor is the most widely used clinical test to estimate average blood glucose, which is used to diagnose diabetes and monitor treatment (Lutsker et al., 2026). There is a strong correlation between glycated hemoglobin and blood sugar

and 2-hour postprandial blood sugar levels, glycated hemoglobin will also decrease. Research shows that exercise training as an adjunctive treatment is associated with a decrease in glycated hemoglobin levels, catecholamine levels and systemic inflammation, which can cause clinical improvement in type 1 diabetes (Moser et al., 2020). In total, it can be said that eight weeks of HOME-HIIT training reduced insulin consumption and levels of fasting blood sugar, 2-hour postprandial blood sugar, and glycated hemoglobin. In other words, HOME-HIIT training is effective in improving blood sugar control and health of children with type 1 diabetes through different mechanisms.

Conclusion

In general, this study showed that the implementation of HOME-HIIT exercise for 8 weeks leads to a decrease in insulin consumption, fasting blood sugar, 2-hour postprandial blood sugar, and glycated hemoglobin in children with type 1 diabetes. Therefore, HOME-HIIT exercises can overcome the obstacles that keep people with type 1 diabetes, especially children, away from exercise, such as lack of time, fear of hypoglycemia, not having enough confidence to attend sports clubs, or the lack of availability of a familiar trainer. It eliminates the condition of the disease, and on the other hand, it can be a suitable and effective strategy in controlling diabetes in children, with ease of implementation and without the need for special equipment, and with the presence of parents by the side of the child.

What is already known on this subject?

Regular physical activity can improve glycemic control and reduce some metabolic and cardiovascular risk factors in children and adolescents with type 1 diabetes. High-intensity interval training (HIIT) has been shown to improve metabolic and cardiorespiratory outcomes and may reduce insulin requirements in people with type 1 diabetes. Home-based exercise programs can help overcome common barriers to physical activity, including lack of time, access to exercise facilities, fear of hypoglycemia, and the need for supervised exercise. However, evidence regarding the effects of a remotely supervised, parent-supported home-based HIIT program on multiple glycemic control indicators in children with type 1 diabetes remains limited. Previous studies of home-based aerobic exercise have also reported inconsistent effects on glycated hemoglobin and other glycemic outcomes.

What this study adds?

This study demonstrates that an eight-week HOME-HIIT program, performed three times per week at 80–90% of maximum heart rate with remote trainer and parental supervision, significantly improves several indicators of glycemic control in children with type 1 diabetes. HOME-HIIT significantly reduced daily insulin requirements and fasting blood sugar compared with the control condition, with insulin consumption decreasing by 24.71% and fasting blood sugar by 15.1% over eight weeks. The intervention also significantly reduced 2-hour postprandial blood sugar and glycated hemoglobin, with reductions of 13.01% and 17.9%, respectively. These findings suggest that a structured, equipment-free, home-based HIIT program supported by parents and remotely supervised by a trainer may provide a practical strategy for improving glycemic control while addressing important barriers to exercise participation in children with type 1 diabetes.

Organ Cross-Talk Tips:

- HIIT stimulates muscle GLUT-4 translocation for non-insulin-dependent glucose uptake, improves pancreatic β -cell survival and insulin secretion, and reduces hepatic glucose output lowering exogenous insulin needs.

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Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Compliance with ethical standards

Conflict of interest The authors declare that there is no conflict of interest in the present research.

Ethical approval The ethical principles of research by the principles of working with children were approved by the Ethics Committee of Qom University. (Ethical code: IR.QOM.REC.1402.001)

Informed consent Performed.

Author contributions

Conceptualization: M.A.B.,; Methodology: M.A.B., F.M.KH.,; Software: M.A.B., F. M.KH.,; Validation: M.A.B., F. M.KH.,; Formal analysis: M.A.B., F. M.KH.,; Investigation: M.A.B., F. M.KH.,; Resources: M.A.B., F. M.KH.,; Data curation: M.A.B., F. M.KH.,; Writing -original draft: M.A.B., F. M.KH.,; Writing-review & editing: M.A.B., F. M.KH.,; Visualization: M.A.B., F. M.KH.,; Supervision: M.A.B.,; Project administration: M.A.B., F. M.KH.,; Funding acquisition: M.A.B.,.

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