Research Paper

Effect of Chromium Picolinate Supplementation Combined With Resistance Training on Liver Enzymes Levels and Insulin Resistance in Patients With Type 2 Diabetes

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ABSTRACT

Objective The aim of this study was to investigate the effect of supplementation with chromium picolinate combined with resistance training on the serum level of liver enzymes and insulin resistance index (HOMA-IR) in male patients with Type 2 Diabetes (T2D).

Methods In this study, participants were 30 male patients with T2D (Mean±SD weight: 75.1±6.3 kg and BMI= 26.1±2.3 kg/m^2). They were divided into three groups (two experimental and one control). In addition to resistance training for 8 weeks, experimental groups consumed 400-mg chromium picolinate daily and placebo. Serum levels of liver enzymes, insulin and glucose were measured before and after the training period. Data were analyzed using one-way ACNOVA and Bonferroni correction test (P<0.05).

Results Both resistance training combined with chromium picolinate supplementation (P=0.04) and resistance training with placebo (P=0.11) significantly reduced HOMA-IR compared to the control group. They both also resulted in a significant decrease in Alanine Aminotransferase (ALT) and Aspartate Aminotransferase (AST) enzymes level compared to the diabetic control group (P=0.01). Resistance training along with chromium picolinate supplementation (P=0.01) significantly reduced the waist-hip ratio (P=0.04) and fat percentage (P=0.01) compared to controls.

Conclusion training combined with chromium picolinate supplementation is more effective in improving the liver enzymes level in T2D patients.

Extended Abstract

1. Introduction

There is much evidence to suggest the role of oxidative stress and subsequent production of free radicals in the pathogenesis of diabetes [3]. Eye, nervous system, kidney and liver failures have been identified as the leading causes of mortality in diabetic patients [4]. An increase in liver enzymes has been suggested to be a predictor of diabetes [6]. Diabetes increases the level of liver enzymes in the blood, which is mainly due to the increased oxidative stress in tissue areas and can be partly because of increased blood sugar [6].

Chromium deficiency is associated with glucose intolerance, increased serum insulin levels and decreased num-

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ber of insulin receptors which are the symptoms of Type 2 Diabetes (T2D) [9]. Studies have shown that serum concentrations of chromium picolinate in diabetic patients and in those with glucose intolerance are significantly lower than in controls [11].

Physical activity can enhance the skeletal muscle response to insulin by increasing the expression or activity of proteins involved in metabolism and insulin-signal transduction. Physical activity increases the glycogen synthase activity and expression of glucose transporter proteins. In diabetic patients with insulin deficiency, regular physical exercise can facilitate the entry of glucose into muscle cells and consequently, increase insulin sensitivity and cause the absence of insulin [13]. Overall, there is high controversy on the effects of chromium picolinate supplementation, and the beneficial effect of resistance training mechanism combined with chromium picolinate supplementation on liver enzymes is not clear yet.

2. Materials and Methods

The present study is a quasi-experimental study with pre-test/post-test design. Thirty-four middle-aged men with T2D referred to Shiraz Medical Center were voluntarily participated in this study. They were randomly divided into three groups of diabetic control (n=10), resistance training with placebo (n=12) and resistance training with chromium picolinate supplementation (n=12). The subjects' skinfold thickness was measured using a caliper (Seahan, South Korea) and the fat percentage was measured according to Pollock and Jackson (1976)'s method. Blood parameters including liver enzymes were analyzed using Pars Azmoon kits (Pars Azmoon Inc., Tehran, Iran). Fasting blood glucose was measured by a glucose assay kit (Pars Azmoon) with a sensitivity of 5 mg/dL. For serum insulin level measurement, ELISA kit (Monobind Co. US) with a sensitivity of 0.15 Mg/mL was used. To observe the overload principle, intensity of exercise program from 1-4 weeks was 40-50% of one Repetition Maximum (1RM), 2-3 sets each with 15-20 reps; from 6-8 weeks, the intensity was 75%-85% of 1RM intensity, 2-3 sets each with 8-10 reps [18]. Experimental groups received chromium picolinate supplementation at a dose of 400 mg per day for 8 weeks, twice per day after breakfast and dinner.

Statistical analysis was performed in SPSS V. 22 software by using ANCOVA and Bonferroni Post Hoc test at $P \leq 0.05$ after testing the assumption of normality by Shapiro-Wilk test and the equality of variances by Levene' test.

3. Result

ANCOVA results showed no significant difference in fasting blood sugar (F=6.48, P=0.66) between the study groups after intervention, but in terms of serum insulin levels (F=116.97, P=0.001) and insulin resistance index (HOMA-IR) (F=23.26, P=0.001) the difference between groups was significant after intervention. Based on Bonferroni test results, the serum insulin level (P=0.001) and HOMA-IR (P=0.001) in the training group with chromium picolinate

Table 1. Evaluation of glucose homeostasis and body composition indicators in the study groups

Variables	Phases	Mean±SD			P
		Diabetic Control	Training With Placebo	Training With Supplementation	
ALT (U/L)	Pre-test	15.60±6.48	18.30±3.36	19.70±4.58	0.001
	Post-test	24.10±11.90	18.01±4.02	14.50±4.07a	0.001
ALP (U/L)	Pre-test	258.2±49.08	241.71±45.2	252.20±54.82	0.001
	Post-test	277.9±66.2	218.71±19.02	235.36±56.41a	0.002
AST (U/L)	Pre-test	21.40±4.19	31.80±3.12	30.50±9.32	0.001
	Post-test	21.20±4.10	17.30±29.41	22.20±7.61	0.139
GGT (U/L)	Pre-test	28.60±11.75	52.95±29.41	33.18±20.64	0.002
	Post-test	26.63±9.49	40.90±9.89	27.78±16.84	0.666

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ANCOVA and Bonferroni post hoc test results. [a] compared to diabetic control group; [a] compared to training with placebo group; ALP: Alkaline Phosphatase; GGT: Gamma-Glutamyl Transferase supplementation, and HOMA-IR (P= 0.02) in the training group with placebo showed a significant decrease after intervention compared to the diabetic control group. Moreover, HOMA-IR level of the training group with chromium picolinate supplementation in post-test phase significantly decreased compared to the placebo group (P= 0.045).

Resistance training combined with chromium picolinate supplementation (P=0.04) and resistance training with placebo (P=0.11) resulted in a significant decrease in HOMA-IR compared to the control group. Also, resistance training combined with supplementation (P=0.01) significantly reduced the waist-to-hip ratio (P=0.04) and fat percentage (P=0.01) compared to diabetic controls. Resistance training combined with supplementation (P=0.01) and placebo (P=0.01) resulted in a significant decrease in Alanine Aminotransferase (ALT) and Aspartate Aminotransferase (AST) compared to diabetic controls (Table 1).

4. Conclusion

It was concluded that resistance training alone can have favorable effects on hepatic markers and improvement of body composition. Supplementation of chromium picolinate can improve hepatic markers in T2D men, while combination of resistance training with chromium picolinate supplementation has a significant effect on both body composition improvement and hepatic markers in men with T2D.

Less studies have been conducted on the effect of resistance training combined with chromium picolinate supplementation on the serum levels of enzymes and liver failures in T2D men. In order to clarify and confirm the effect of chromium picolinate supplementation along with physical activity on liver enzymes, other training methods are suggested in future studies.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Research Ethics Committee of Arak University of Medical Sciences (Code: IR.ARAKMU.REC.1397.172).

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Authors' contributions

Conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, writing–original draft Preparation, writing–review & editing, visualization, supervision, funding acquisition by all authors; Project administration by Mohammad Parastesh.

Conflicts of interest

The authors declared no conflict of interest.

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