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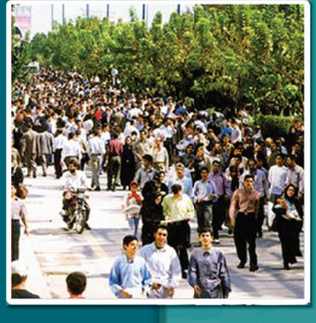

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Effect of Circuit Resistance Training on Glycemic Control of Females with Diabetes Type II

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ABSTRACT

Background: We aimed to assess effects of circuit resistance training (CRT) on glycemic control of females with Type II diabetes.

Methods: Twenty obese and overweight females with diabetes Type II were randomly selected in two groups (circuit resistance exercise and control). CRT performed in 3 days/week for 3 months, and the serum and body parameters were assessed. Data were analyzed by Mann–Whitney U-test and Wilcoxon Signed-Rank test in SPSS version 19.

Results: Mean age in the CRT and control group was 50.2 ± 4.89 years and 51.3 ± 6.63 years, respectively. Results showed significant changes in glycosylated hemoglobin (HbA_{1c}) and subcutaneous fat were noted in the CRT group ($P = 0.04$, $P = 0.002$, respectively). Also, findings indicated higher HbA_{1c} in CRT group after intervention in comparison with controls and results showed a significant difference ($P = 0.04$).

Conclusions: According to the positive effect of CRT, it seems that can be recommended for patients with diabetes Type II.

Keywords: Body composition, circuit resistance training, diabetes Type II, glycemic control

INTRODUCTION

Diabetes and obesity are global epidemic diseases.[1-3] Currently, The World Health Organization estimated that in 2030, half of people living with diabetes will be Asian.[4] According to the previous investigation in Iran, about 2 million adults (7.7%) aged 25–64 years had diabetes and among whom one-half were undiagnosed. Also, 4.4 million had impaired fasting glucose.[5] Inability to control blood sugar may induce serious complications such as heart and kidney diseases, stroke, nervous damages, blindness and poor quality of life.[6]

However, appropriate level of physical activity can manage Type II diabetes[7] and resistance training has been recently documented to be a safe and officious therapeutic mean for the treatment of various chronic diseases for obese individuals during elderly.[1] Improved glycemic control can note the positive effect of physical activity and glycosylated hemoglobin (HbA_{1c}) can be applied to measure long-term (120 days) control. Sufficient glucose control is indicated as <7.0% HbA_{1c} value.[7] Although, previous studies that assessed resistance exercise with combined resistance and aerobic exercise sessions, showed significant reductions in HbA_{1c}.[8-10] In contrast, Geirsdottir *et al.* did not experience favorable changes in fasting glucose or HbA_{1c} in patients with

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diabetes Type II.[11] Therefore, there is no consensus on the effect of circuit resistance training (CRT) in females with Type II diabetes. The aim of the present study was to examine the effects of CRT with moderate intensity and frequency on glycemic control of female with Type II diabetes.

METHODS

Subjects

This study was conducted on obese and overweight females with diabetes Type II attended in Ansari Hospital, Roudsar. Informed consent was obtained, and 20 participants were randomly divided into CRT and control groups. First group underwent 1-month dietitian regimen and 2 months CRT for 3 months. Dietary intake was individually prescribed by 3-day recall technique. The Human Studies Review Committee at Islamic Azad University, Rasht (679, 30 April 2014) approved the study.

Measurements body composition

The height, body weight, and waist circumference were measured at the enrollment and during the study. Standard calibrated scale and stadiometer were used to determine weight and height. Body mass index (BMI) was calculated by dividing body weight (kg) by the square of the height (m^2). Caliper measured subcutaneous fat in three areas (arm, super iliac and thigh). Waist circumference was measured at the midpoint of the lowest rib and the iliac. Hip circumference was taken at the maximum circumference of the hip. Also, waist to hip ratio (WHR) was measured.

Laboratory tests

At the beginning and end of the study, the patients' blood glycemic tests of the brachial vein were collected after 12 h fasting. Baseline blood glycemic tests including HbA_{1c} and fasting blood glucose (FBS) (mg/dl) were measured. FBS and HbA_{1c} were obtained by Pars Azmoon enzyme kits (Iran) and Biosystem auto-analyzer devices (Spanish), respectively.

Circuit resistance training protocol

As the one-repetition maximum (1-RM) adjusted the exercise intensity, an individualized CRT was designed for each participant. After 1-month regimen, the CRT protocol was initiated 3 days/week for 2 months [Table 1]. The training consisted of 10 min warm up and 10 min cooling. During first 1–3 weeks, participants involved in six stations with 40–50% 1-RM intensity. Then, for remaining period (4–8 weeks), eight stations with the 50–65% 1-RM (16, 27) were indicated. 1–2 sets and 2–3 sets were noted for the first 3 weeks and remaining 5 weeks, respectively. This program included eight different exercises with 8–12 repetition in each set and 3 min rest between sets. Exercises included bench press, seated row, lateral pull down, biceps forward, front thigh, back thigh, leg press and rowing [Table 1].

Statistical analysis

The normality of the data was indicated by Kolmogorov–Smirnov test. Descriptive statistics such as mean ± standard deviation was used, and data were analyzed by Mann–Whitney U-test, Wilcoxon Signed Rank-test and Chi-square in SPSS version 19 (SPCC Inc., Chicago, IL, USA). $P < 0.05$ was considered as statistically significant.

RESULTS

Twenty obese and overweight patients included in this study. Mean age in the CRT and control group were 50.2 ± 4.89 years and 51.3 ± 6.63 years, respectively. In the CRT group, significant changes in HbA_{1c} and subcutaneous fat were noted after intervention ($P = 0.04$, $P = 0.002$, respectively) [Table 2].

Although, findings indicated higher HbA_{1c} in CRT group after intervention and results showed a significant difference in two groups ($P = 0.04$) [Table 3]. However, there was no significant difference between groups regarding weight, BMI, WHR and FBS after intervention ($P > 0.05$).

DISCUSSION

This study demonstrated that a supervised CRT program was safe and well tolerated by obese and overweight patients with Type II diabetes. Although we found CRT involving eight upper and lower body exercises led to significant reductions in HbA_{1c} and Subcutaneous fat, BMI, body weight, and the WHR did not change significantly ($P \leq 0.05$) which was inconsistent with Bishay *et al*. and Chudyk and Petrella They showed CRT as an effective tool for improving body composition.[12,13] In addition, Kang *et al*. reported that 12 weeks CRT and aerobic exercise effectively increased glucose use and reduced the amount of insulin required.[14] Hazley *et al*. noted that 50–60% of 1-RM CRT for 8 weeks, can reduce waist circumference and WHR significantly, with no associated changes in the control group.

CONCLUSIONS

The resistance training program had little impact on metabolic risk factors in diabetics Type II.[15] However, some studies observed no effect. In a systematic review by Miller *et al*. which examined the combined effects of diet versus diet and exercise, the majority

Table 1. Timeline of intervention

Duration (week)	Time line (in minute) workout				Training frequency (Day/W)	Intensity description
	Warm-up	Resistance exercise	Cool down	Seated resting		
1st and 3nd week	10	30-35	10	1-2	3	40-50% 1RM 1-2 set, 8 reps* 6 stations
4st and 8nd week	10	40-45	10	2-3	3	50-65% 1RM 2-3 set, 10-12 reps 8 stations

Reps – Repetitions*

Table 2. Body composition and laboratory results at the initiation and their changes during intervention in CRT and control groups

	CRT (n=10)		*P* value	Control (n=10)		*P* value
	Pre	Post	Wilcoxon test	Pre	Post	Wilcoxon test
Weight (kg)	75.5±10.16	74.6±11.8	0.4	74.6±11.8	75.7±11.3	0.8
BMI (kg/m²)	30.16±3.6	31.3±4.8	0.4	30.5±4.8	30.3±4.8	0.8
Subcutaneous fat (mm)	32.8±47.3	29.68±2.62	0.002*	31.66±4.4	31.02±4.6	0.2
Waist-hip ratio	0.86±0.05	0.88±0.06	0.052	0.88±0.07	0.89±0.07	0.07
$HbA1_c$, mg/dl	7.1±1.1	6.1±1.1	0.02*	7.8±1.7	7.6±1.7	0.1
FBS, mg/dl	159.6±52.2	158.6±26.1	0.3	158.6±48.4	158±41.1	0.1

*Significant difference of $P \leq 0.05$

Table 3: Comparison of changes in body composition and laboratory results after intervention period

Variable	CRT (n=10)	control (n=10)	*P* value
Weight (kg)	75.7±11.3	74.6±11.8	0.4
BMI (kg)	31.3±4.8	30.3±4.8	0.5
Subcutaneous fat (mm)	31.02±4.6	29.68±2.62	0.001*
Waist-hip ratio	0.89±0.07	0.88±0.06	0.052
HbA1c, mg/dl	7.6±1.7	6.1±1.1	0.04*
FBS, mg/dl	158±41.1	26.1±158.6	0.2

Significant difference of $P \leq 0.05$*

of studies mentioned no significant difference in body composition when exercise was added to diet restriction.[16] Furthermore, Misra *et al*. assessed effect of 12 weeks progressive resistance-exercise training on body composition in patients with Type II diabetes. Resistance training produced an increase in fat-free mass and diabetic patients needed more resistance training to improve muscle mass as they got older. It seems that resistance training reduces subcutaneous fat and probably it causes increased muscle fiber that might be due to some factors such as frequency, duration and intensity of exercise.[8]

Church *et al*. Showed that the effect of resistance exercise on glycemic control in individuals associated with a 0.57% decline in absolute HbA_{1c} as compared with control.[9] Also, another study assessed resistance training and aerobic training in females aged between 40 and 70 years in two groups. They indicated improvement in HbA_{1c} in both groups after 4 months.[17] Another study showed that 12 weeks progressive moderate-intensity resistance exercise resulted in significant improvements in glycaemia in Indians with Type II diabetes.[18] This showed that the effectiveness of resistance training on improving HbA_{1c} in diabetes patients appeared to differ according to the intensity, frequency, and duration of training. As a result, CRT had a positive effect on HbA_{1c} in females with diabetics Type II. It seems that plasma membrane GLUT4 was increased in skeletal muscle from individual with Type II diabetes in response to an acute exercise. Also, lower resting plasma membrane GLUT4 content in insulin resistant subjects have been observed in some studies.[1]

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