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The Effect of Resistance Training on Sex Hormones of Women with Gestational Diabetes

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ABSTRACT

Aims Gestational diabetes mellitus (GDM) is an asymptotic disease and can lead to adverse outcomes before and during childbirth. The present study aimed to investigate the effect of resistance training (RT) on sexual hormones in women with GDM.

Materials & Methods In this quasi-experimental study, 22 women with insulin-treated GDM, with a gestational age of 24 weeks, were selected and according to body mass index were divided into equal groups of RT and control (C). During 6 weeks the RT group performed RTs for 3 sessions per week and C group only had daily activities during this time. To analyze the data, Kolmogorov-Smirnov, independent sample t-test, and repeated measure ANOVA test at $p \leq 0.05$ were used.

Findings Six weeks of RT significantly reduced estrogen ($p = 0.01$) and increased prolactin ($p = 0.001$) in women with GDM, however, had not significant effect on progesterone ($p = 0.34$).

Conclusion Six weeks of RT seems to improve the sexual hormones in women with GDM.

Keywords Resistance Training; Sex Hormones; Gestational Diabetes Mellitus

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Introduction

Gestational diabetes mellitus (GDM) diagnoses glucose intolerance for the first time during pregnancy. The physiological conditions of this disease resemble a set of underlying malformations, such as genetic and environmental causes of non-gestational diabetes [1]. If one is not able to secrete sufficient amounts of insulin, the disorders such as impairment in estrogen, progesterone, prolactin, and cortisol as well as increased lipid profile occur and as a result GDM develops [2]. Although the exact mechanisms of GDM are unknown, the role of insulin resistance is very important [3]. Insulin sensitivity decreases as pregnancy progresses and quickly returns to normal during childbirth [4]. Since gestational diabetes is unhealthy and causes unhealthy outcomes before and during childbirth, it does not lead to the production of type 2 diabetes in the future. Inflammatory disease is a treatment and medical intervention [5]. This is a marker of powerful intervention of hormones and named insulin-mediated phenomena, which particularly affected by placental lactogen, growth hormone, prolactin, and body steroid hormones (estrogen, progesterone, and cortisol) [4]. Therefore, insulin sensitivity in women with GDM should be increased through hormone therapy, proper nutrition, weight control, and physical activity to help the patients by appropriate plane and prevent form progression of disease [6]. Physical activity during pregnancy can cause physical injuries or adverse effects on the fetus and the mother [7]. However, clinical and epidemiological studies have shown that moderate-intensity exercises not only have a negative effect on the mother and fetus but also improve metabolic conditions in muscle and adipose tissues [1, 7]. Therefore, exercise is a suitable therapeutic approach for the prevention or treatment of GDM [8]. Zhang *et al.* reported that physical active women are at low risk of GDM in pre-pregnancy time [9]. Tobias *et al.* also showed that the prevalence of GDM was decreased with exercise activity before and during pregnancy [7]. It has been shown that an increase in glucose transporters (GLUT4), insulin sensitivity energy, and oxygen supply to muscle in pregnant women are achieved by resistance training (RT) like aerobic training [1, 3]. Exercise prevents excessive weight gain during pregnancy, thus indirectly preventing GDM. However, only about 50% of non-pregnant women are physically active and this number after pregnancy and that number are even lower after pregnancy [10]. Because GDM increases the likelihood of type 2 diabetes mellitus (DM) in mother, obesity and DM in adolescents, therefore, performing short-term exercises during pregnancy can lead to reduction of insulin resistance and DM in the future generations [11]. In addition, considering that pregnancy is very important and risky, industrialization of life cases decreases in physical activity and prevalence of DM. Therefore, research into the effects of exercise in women with GDM seems very important. Thus, the present study aimed to investigate the effect of RT on sex hormones in women with GDM.

Materials and Methods

In this clinical trial study 22 women insulin-treated GDM with a gestational age of 24 weeks, which referred to the Hafez Perinatology Clinic and Motahari Clinic affiliated to Shiraz University of Medical Sciences, Shiraz, were selected as statistical sample. All of the subjects had no history of physical activity and no systemic disease and no medical prohibition for any physical activity. All subjects were identified during daily referrals to Hafez Clinic. After thoroughly explaining the purpose of the study for participating and completing the informed consent form, the researcher interviewed and asked questions verbally, and gathered international physical activity questionnaires (IPAQ) as well as demographic data and medical history [12]. A One-hour glucose challenge test (OGCT) with 50g oral glucose was used to diagnose GDM. Pregnant women with plasma glucose levels greater than 130mg/dl were subjected to an oral glucose tolerance test (OGTT) for definitive diagnosis of GDM. Intravenous blood sampling was performed at 0, 1, 2, and 3 hours after receiving 100g oral glucose to assess blood glucose level. Blood glucose levels were equal to or greater than 95, 180, 155, and 140mg/dl, respectively, at least twice as often as GDM. The gestational age of the subjects was calculated on the basis of a reliable and regular first day of last menstrual period (LMP) and early pregnancy ultrasound. Subjects were divided into two equal groups of RT (11 persons) and control (C; 11 persons) based on the body mass index. The group RT performed RT protocol for six weeks and group C only did their daily activities during this period of the time. The ER protocol consisted of six weeks, three sessions per week, and each session with an average intensity of 50-70% of maximal heart rate. RT was performed using dumbbells and stretches and increasing the intensity of the exercises was done by control the weights. RT protocols were included movements for eight groups of main muscles (triceps, biceps, deltoid, quadriceps, hamstrings, shin, pectoral, and dorsal muscles). RT was done in eight stations with 15 repetitions per station and rest periods of 30 seconds to one minute in a circular method [11]. It should be noted that 90 minutes after a meal, blood glucose levels were measured by a glucometer before each intervention, if the blood glucose level was between 100-250mg/dl the subject was allowed to perform RT [11]. In order to measure the research variables in the pre-test and 48 hours after the last training session in post-test, all subjects were asked to be in the laboratory (for blood

sampling) at 7 am. Prolactin, estrogen, and progesterone were measured by ELISA methods. The present study was registered in the Iranian Registry of Clinical Trials with code number IRCT2016112027263N3. It should be noted that the sample size was selected according to the previous studies [13, 14]. Shapiro-Wilk test was used to check the normality of the findings. Independent sample t-test was used to compare the demographic characteristics of subjects in the pre-test. Repeated measure ANOVA test was applied to evaluate changes in progesterone, estrogen, and prolactin in the group RT and group C ($p \leq 0.05$). Statistical analysis was performed using SPSS 21.

Findings

The demographic characteristics of the subjects are presented in Table 1 as well as pre-test and post-test levels of progesterone, estrogen, and prolactin hormones in the RT and C groups are presented in Diagrams 1, 2, and 3, respectively.

Table 1) Demographic characteristic of subjects in pre-test (M±SD)

Variable	Group RT	Group C	p
Age (year)	30.27±4.149	29.18±4.33	0.55
Height (cm)	166.27±4.60	162.72±2.61	0.07
Weight (kg)	73.18±10.10	63.81±11.21	0.06
BMI	26.37±2.41	24.04±3.78	0.10

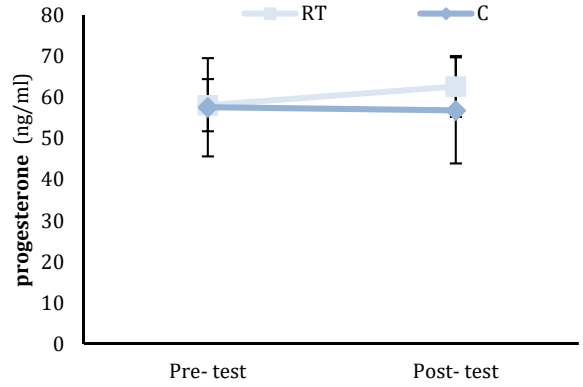

Diagram 1) The levels of progesterone in pre-test and post-test of RT and C groups

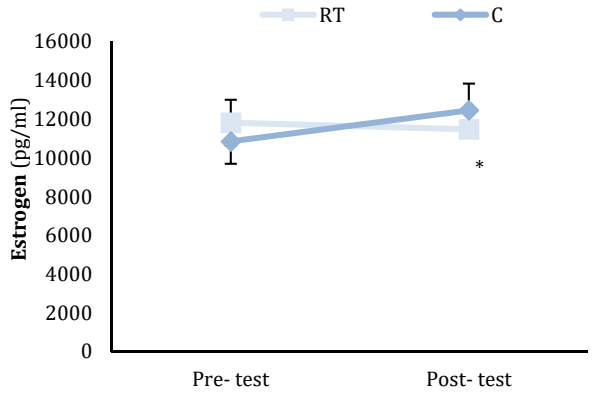

Diagram 2) The levels of estrogen in pre-test and post-test of RT and C groups; *: $p<0.05$, significant decrease in group RT rather than group C

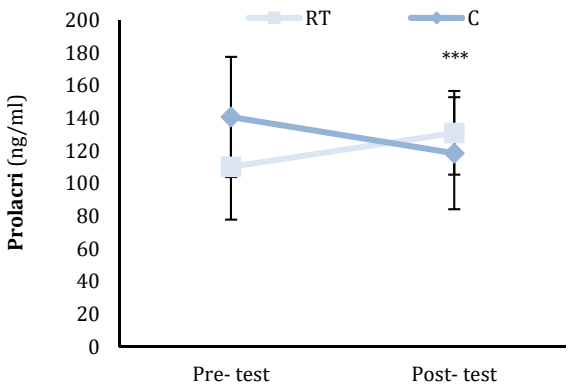

Diagram 3) The levels of prolactin in pre-test and post-test of RT and C groups; ***: $p<0.001$, significant increase in group RT rather than group C

Independent sample t-test results showed that there were no significant differences in age (p= 0.55), height (p= 0.07), weight (p= 0.06) and BMI (p= 0.10) of subjects at the beginning of the study period.

The results of repeated measure ANOVA in Table 2 depicted that for progesterone changes the effect of group factor (p= 0.40), measurement time (p= 0.52), as well as the interaction of group and measurement time (p= 0.34) was not significant (Diagram 1). For estrogen changes nevertheless the effect of group factor (p= 0.97) and measurement time (p= 0.14) was not significant however interaction of group and measurement time (p= 0.01) was significant so that estrogen levels in group RT were significantly lower than group C (Diagram 2). For prolactin changes, although the effect of group factor (p= 0.56) and measurement time (p= 0.89) was not significant, however interaction of group and measurement time (p= 0.001) was significant, so that prolactin levels in group RT were significantly higher than group C (Diagram 3).

Table 2) The results of repeated measure ANOVA test for review the effect of resistance training on sex hormones

Variable	F	P
Progesterone		
Group	0.75	0.40
Time	0.42	0.52
Interaction of group and time	0.97	0.34
Estrogen		
Group	0.001	0.97
Time	2.45	0.14
Interaction of group and time	9.04*	0.01
Prolactin		
Group	0.35	0.56
Time	0.01	0.89
Interaction of group and time	23.65*	0.001

* p≤0.05

Discussion

In the present study, six weeks of RT significantly reduced estrogen levels in women with GDM. Regarding the reduction of estrogen in the present study, it seems that by performing exercise, metabolic activity and blood flow to the liver increase and as a result estradiol production can reduce [11, 15]. Low to moderate-intensity physical activity enhances

metabolic function and transfers blood to the liver, as well as prolonged physical activity by cortisol production reduces estradiol secretion [14-16]. In addition, physical activity may affect circulating estrogen levels by decreasing adipose tissue such that it reduces the conversion of androgens to estrogens by aromatase or may be (independent of changes in adipose tissue levels) effective by lowering insulin levels, which in turn increases the level of sex hormone-binding globulin (SHBG) and decreases estradiol availability [17]. However, contrary to the results of the present study, some studies have not shown the effect of exercise on estrogen levels in non-diabetic subjects [14, 18]. The inconsistency of the above findings with the present study is probably related to the type of disease, disease conditions, and type of exercise.

The results of the present study also showed that six weeks of RT had no significant effect on progesterone levels in women with GDM. Previous studies have emphasized the beneficial effects of RT, which is an important part of treatment and preventive exercise programs for patients with GDM [19, 20]. It has been reported that the beneficial effects of exercise on GDM may be a result of chronic glucose-related adaptations in skeletal muscle and better tolerance of metabolic stress in pregnancy, but exercise should be performed regularly to obtain the best results [11]. Some researchers have compared the role of both aerobic and anaerobic exercise; which both types of activity increase estrogen and progesterone levels (contrary to the results of the present study) [21]. On the other hand, it has been reported that there is no relationship between exercise and serum progesterone levels [22] because progesterone is rapidly cleared from the blood. Therefore, examining the frequency, intensity, type, and duration of exercise is needed to elucidate the progesterone response, especially during GDM.

In addition, the results of the present study showed that six weeks of RT significantly increased prolactin levels in women with GDM. Exercise has been shown to activate the hypothalamic-pituitary axis in the brain by affecting multiple neural pathways and thereby increase prolactin hormone levels [23]. Prolactin regulates insulin sensitivity and glucose metabolism in the body by developing pancreatic beta cells [24]. During pregnancy, prolactin hormone, along with its receptors, increases pancreatic beta cells, stimulates insulin secretion (by inhibiting key caspases and glucose) to maintain the role of beta cells and glucose homeostasis [25, 26]. Given the importance of prolactin in maintaining glucose homeostasis during and after pregnancy, Wang *et al*. found that prolactin hormone is a potential mediator for occur the type 2 diabetes mellitus (T2DM) in women [25]. The decrease in insulin sensitivity during pregnancy and its return to normal at delivery time indicate the interplay of hormonal effects, and it's called the antagonistic effect of insulin. This is particularly affected by placental lactogen, growth hormone, prolactin, and body steroid hormones (estrogen, progesterone, and cortisol) [27].

Inability to control daily calorie consumption of subjects was one of the limitations of the present study. Therefore, it is suggested that future studies investigate the relationship between daily calorie consumption and sex hormone changes following RT. Considering that the duration of exercise may affect sex hormones, it is recommended that future studies investigate the effects of RT with longer duration.

Conclusion

According to the results of the present study, it seems that six weeks of RT can improve the sex hormones of women with GDM. Therefore, RT can be recommended as a therapeutic approach, reducing the complications and improving the GDM.

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Ethical permissions: The present study was registered in the Iranian clinical trials database with code number IRCT2016112027263N3.

Conflicts of interests: The authors declare that they have no conflict of interest.

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