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The Influence of Exercise Characteristics Before and During Pregnancy on Gestational Diabetes Mellitus

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Abstract

Background: Although exercise is recommended for preventing gestational diabetes mellitus (GDM), the situation has remained unclear regarding the characteristics and timing of the proper exercise.

Objectives: The aim of the present study was to compare exercise characteristics including volume, frequency, intensity and energy expenditure before and during pregnancy in diabetic and non-diabetic pregnant women.

Patients and Methods: Participants of the study included 137 pregnant women (80 diabetics and 57 non-diabetics) who were selected based on the inclusion criteria. Exercise activities of the participants were evaluated by interviews. Statistical tests of Mann-Whitney and Chi-square were used for data analysis.

Results: Participating in regular exercise activities was significantly higher in the non-diabetics compared to the diabetics during all stages including 8 and 1 years before pregnancy and during the 1st and 2nd trimesters of pregnancy ($P < 0.05$). However among the diabetics and non-diabetics who regularly exercised, there was no significant difference in terms of exercise characteristics (frequency, intensity, duration and energy cost).

Conclusions: Regular participation in exercise activities before and during pregnancy especially during the second trimester is important for preventing GDM. However, in few cases, similar exercise characteristics were found among diabetics and non-diabetics.

Keywords: Gestational Diabetes, Exercise Characteristics, Energy Expenditure

1. Background

Gestational diabetes mellitus (GDM) is one of the most important complications during pregnancy which affects about 7% of pregnancies in the US (1) and even more in other countries (2). GDM can induce several harmful effects on both the offspring and mothers. GDM can be associated with increasing risk of post pregnancy glucose intolerance and type 2 diabetes (3), higher risk of cesarean section (4), increasing labor complications (5) in mothers, developing diabetes mellitus and impairment of intellectual achievements in infants (6).

Several risk factors are associated with GDM which can be divided in two categories of modifiable and non-modifiable risk factors. Some non-modifiable risk factors include maternal age during pregnancy, ethnicity, previous GDM and macrosomia (7). Modifiable risk factors may be related to diet or physical activities (8, 9). Physical activity has been found to improve glucose hemostasis and insulin sensitivity through different mechanisms (10) during pregnancy. Physical activity can have a long term effect on improving insulin sensitivity through decreasing weight or increasing fat free mass (11, 12) in mothers. Therefore, long term physical exercises before pregnancy probably influence GDM. Exercise during pregnancy improves insulin sensitivity in mature rat offspring (13). Therefore, the overall relationship (14) or influence (15-17) of physical exercise and GDM has been reported in many studies. However, it seems that there are controversies regarding the influence of exercise on GDM related to the duration of exercise participation or its characteristics. The influence of exercise before (18) and during pregnancy (19) has been studied. Han et al. reported that there are limited studies regarding the influence of pre pregnancy exercises on GDM and no conclusive evidence is available regarding the exercises before pregnancy (18). Barakat et al. found that exercising in different trimesters can have different effects on GDM (19). Yin et al. in a review study concluded that there is insufficient evidence to suggest that physical activity during pregnancy reduces the risk of GDM (20). Studies have indicated that exercise volume and intensity is important in predicting its influence on insulin sensitivity (21, 22), and even persistence of insulin action is dependent on the characteristics of the performed exercise training (23). Also various exercise characteristics may have different effects on GDM.

2. Objectives

The aim of the present study was to evaluate the influence of exercise characteristics including frequency, duration, intensity and energy expenditure 1 and 8 years before and during pregnancy on GDM.

3. Patients and Methods

This study was a case-control investigation including 137 pregnant women (80 diabetics and 57 non-diabetics) at 30 to 35 weeks of pregnancy who referred to Hafez Hospital affiliated to Shiraz University of Medical Sciences, Shiraz, Iran for pregnancy health care from April to September 2013. Participants took part in this study voluntarily and signed a written informed consent. All volunteers completed a detailed questionnaire on family history of diabetes, any medication or treatment and personal information including age, parity, education and monthly income. Out of about 400 women who referred to Hafiz Hospital, 137 of the pregnant women met the inclusion criteria.

Exclusion criteria were pre-pregnancy types 1 or 2 diabetes, previous pregnancy GDM, not being able to perform physical activities because of orthopedic diseases before and during pregnancy, family history of GDM or diabetes mellitus and taking any medications which can cause GDM. Inclusion criteria were age of 30 - 35 weeks of pregnancy, maternal age of 18 to 35 years, GDM recognized at 28 to 30 weeks of pregnancy. The GDM diagnosis was based on the IADPSG HAPO study (2 hours, 75 g OGTT: fasting glucose $\geq$ 92 mg/dL or a 1-hour result of $\geq$ 180 mg/dL, or a 2-hour result of $\geq$ 153 mg/dL) (24).

Self-reported height and weight prior to pregnancy were used to calculate BMI (kg/m^2). Women were interviewed about their history of recreational physical activity, including moderate exercise activities or sports (i.e., brisk walking, golf, volleyball, cycling on level streets, recreational tennis, or softball) and strenuous exercise activities or sports (i.e., swimming laps, aerobics, calisthenics, running, jogging, basketball, cycling on hills, or racquetball) at 8 and one years before pregnancy and during the first, second and third trimesters of pregnancy. For each age interval and each type of activity (moderate and strenuous), information on exercise activity were recorded as duration of every session (in six categories from none to 3 hours per day or session), usual intensity of exercise in five categories (very light: ranging from being able to talk during exercise very easily, to very intensive: not being able to talk at all during exercise), frequency per week (ranging from one to 7 days a week), number of weeks in a month (ranging from one to 4) and number of months per year (ranging from 1 to 12). The volume of every activity during a year or semester was recorded by multiplying every session duration by frequency per week, month, semester or year. The computed number multiplied by energy cost or metabolic equivalent of (MET) of every activity (8.5 for strenuous activity and 5.4 for moderate activity) presented the total energy cost of physical exercise per semester (total score of one year was divided by 4 to compute the score of 3 months) (25).

Data were analyzed using SPSS software (version 16), and independent t-test, Mann-Whitney U and Chi-square statistical tests were used to compare differences between diabetics and non-diabetics while $P < 0.05$ was considered statistically significant.

4. Results

Table 1 shows descriptive characteristics of participants as mean and standard deviation.

Independent T-test was used to compare BMI (P = 0.003) and age (P = 0.001) in diabetic and non-diabetic women, which indicated that pre-pregnancy BMI and age were significantly higher in the diabetic than the non-diabetic women.

Chi-square analysis findings indicated that regular participation in exercise activities during 8 years before pregnancy was 40% (n = 32) in diabetics and 63.15% (n = 36) in non-diabetics (P = 0.008). On the other hand the respective values were 31.25 % (n = 25) and 61.40 % (n = 35), (P = 0.001) one year before pregnancy. In the first trimester, regular exercise activities were 21.25% (n = 17) in diabetics, and 42.10% (n = 24) in non-diabetics (P = 0.013). In the second trimester, however, such activities were found in 17.5% (n = 14) of the diabetics, and 56.14 % (n = 32) of the non-diabetics (P = 0.001), which was significantly higher in the non-diabetics than diabetics.

Using Mann-Whitney U test, no statistically significant difference was found in variables such as frequency (P = 0.427, 0.070, 0.910, and 0.888), intensity (P = 0.085, 0.934, 0.058, and 0.116), duration (P = 0.254, 0.485, 0.544, and 0.327) and energy expenditure(P = 0.056, 0.138, 1.000, and 0.215) between diabetics and non- diabetics who regularly participated in exercise activities during eight and one year before, first and second trimesters of pregnancy (Table 2).

According to partial evaluations of the study, there was no significant difference in education (P = 0.432), monthly income (P = 0.810) and parity (P = 0.517) between diabetics and non- diabetics.

Table 1. Descriptive Characteristics of Subjects[a]

Groups	Age, y	BMI Before Pregnancy, kg/m^2
Non-diabetic women (n = 57)	27.32 ± 4.36	21.38 ± 3.82
Diabetic women (n = 80)	30.26 ± 5.49	25.24 ± 2.29
P Value	0.001	0.003

[a]Data are presented as mean ± SD.

Table 2. Comparison of Exercise Characteristics in Diabetic and Non-Diabetic Pregnant Women

Period	Groups		P Values[a]			
	Non-Diabetics	Diabetics	Frequency	Intensity	Duration	Energy Expenditure
8 years before	36	32	0.427	0.085	0.254	0.056
One year before	34	25	0.070	0.934	0.485	0.138
First trimester	24	17	0.910	0.058	0.544	1.000
Second trimester	31	12	0.888	0.116	0.327	0.215

[a]Findings are based on statistical analysis by Mann-Whitney U test.

5. Discussion

The findings of the present study indicated that regular exercise during eight and one year before pregnancy and during the first and second trimesters of pregnancy were higher in non- diabetic compared to diabetic women. It can be concluded that regular exercise activities before and during pregnancy especially during the second trimester of pregnancy is important for preventing GDM. This was confirmed by some studies which indicated that participating in physical activity before pregnancy was associated with reduction in GDM (26).

Physical exercise during the first 20 weeks of pregnancy has been associated with a 50% reduction in GDM. Also, GDM was prevented by physical exercise before and during pregnancy (26). According to another study, exercise intensity of at least 60 percent of reserved heart rate reduces GDM (27). The more the intensity of the exercise, the less time required for it to take effect. Moderate exercise performed three times a week during pregnancy improved levels of maternal glucose tolerance in healthy, pregnant women (28). It has been suggested that pregnant women at risk for GDM may need to walk for 25 minutes per session at high intensity or for 35 to 40 minutes per session at low intensity and for at least 25 minutes at either low or high intensity to control or prevent GDM (29).

On the other hand some studies have shown that physical exercise cannot reduce or prevent the onset of GDM. For example, a review of the five randomized controlled trials in 2012 reported limited evidence on the effect of exercise during pregnancy to prevent pregnancy-induced hyperglycemia (18). A recent study conducted by Barakat et al. (19), indicated that moderate-intensity resistance and aerobic exercises (three times a week for 50 to 55 minutes per session), did not reduce the risk of developing GDM. Physical exercise can prevent and treat GDM through increasing insulin sensitivity, adipokines changes, and reduced oxidative stress related to antioxidant effect of exercise (23).

According to the study carried out by Cypryk et al. (30), there was no significant difference in exercise characteristics between diabetic and non-diabetic mothers who regularly performed exercise activities. Even partial findings of the study showed no significant difference in BMI and age between the diabetic and non-diabetic women who regularly performed exercise 1 year before pregnancy, excluding the the probable influence of BMI. Probably more important environmental risk factors of GDM include advanced maternal age, unbalanced diet, HBsAg carrier status and DM family history. On the other hand, HLA-DRB1*12, 16 genotype may be a protective genotype against GDM (30). Age, overweight and obesity, diabetes in the family, parity, macrosomia and a history of perinatal complications have been suggested as risk factors for GDM and no reliable method has been found to identify subjects at increasing risk of GDM (23). The findings of the study indicated that the number of diabetics was significantly lower than non-diabetics among women who regularly performed exercise during the second trimester of pregnancy. Exercising decreased significantly during the first trimester of pregnancy probably because of probable risk factors, which was in agreement with the results of the present study, so physical exercise in the second trimester may be more important in preventing GDM.

The strength of this study is considering various exercise characteristics in different periods before and during pregnancy. The limitation of the present study was its inability to control or measure other factors affecting GDM including diet, lifestyle and psychological status of women during different periods which can be the subjects of future investigations.

We conclude that regular physical activity before and during pregnancy especially in the second trimester is probably important for preventing GDM. Although regular exercise is important in preventing GDM, other effective factors including genetic predisposition may contribute to GDM is among the subjects deserving further investigation.

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Footnote

Authors' Contribution: All authors have been involved in all processes of the study including designing, conducting, and drafting the manuscript.

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