Exercise As Therapy for Gestational Diabetes: What’s the Evidence?

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ABSTRACT: Men and women differ greatly in their physiology; they are able to undertake different types and levels of activity, and also respond differently physiologically to aerobic and anaerobic exercise. Women have an additional capacity for pregnancy and their ability to undergo significant physiological change in a short period of time. They are, however, subject to further conditions that men are not susceptible to, such as gestational diabetes mellitus (GDM). This review will aim to analyse the recent literature regarding exercise and GDM and determine whether exercise can reduce the risk of developing GDM and any potential sequelae. Despite there being a lack of clear consensus on the subject, exercise is a useful adjunct in the treatment of gestational diabetes and may attenuate some of its more harmful sequelae.

KEY WORDS Exercise; Diabetes; Health benefits; Sports Medicine

INTRODUCTION

Men and women differ greatly in their physiology; they are able to undertake different types and levels of activity, and also respond differently physiologically to aerobic and anaerobic exercise. Comparatively, women have been shown to have smaller hearts with decreased stroke volume, smaller thoraces and reduced lung capacity as well as other respiratory measurements, in addition to decreased muscle strength and endurance [1]. Women have an additional capacity for pregnancy and their ability to undergo significant physiological change in a short period of time. They are, however, subject to further conditions that men are not susceptible to, such as gestational diabetes mellitus (GDM). GDM has many definitions, but is generally accepted as any degree of glucose intolerance during pregnancy; significant research has been completed to investigate potential benefits and risks of exercise during pregnancy, as well as the ability for exercise to reduce this risk [2]. This review will aim to analyse the
recent literature regarding exercise and GDM and determine whether exercise can reduce the risk of developing GDM and any potential sequelae.

METHODS
In order to find the required articles, a Web of Science search was conducted. The search terms entered were “Pregnancy”, “Exercise” and “Diabetes” and these were combined using the “AND” function. The search was limited to last the five years and English language to ensure up-to-date findings. This produced 360 results initially and a single author (RS) subsequently performed a review of the title and abstract. In order to ensure only studies with a significant level of evidence was included, case reports and series were excluded; this reduced the number of studies to 32 options, of which a further 10 were excluded following review of full article text. The final 22 papers were reviewed in the critical analysis section.

DISCUSSION
Several review articles have attempted to describe the relationship between exercise and gestational diabetes, either as a primary or secondary outcome in the ongoing discussion involving obesity and gestational diabetes. One group performed a literary review on diabetes and obesity in pregnancy and the common outcomes and concerns [3]. It was found that with increasing weight and rates of gestational diabetes, the number of obstetric and perinatal complications rises. These include: hypertension, pre-eclampsia, macrosomia and the need for obstetric intervention. In regards to exercise, the review stated that weight loss is not recommended, however many studies have recommended management of gestational weight gain, as well as enhancements of physical activity, with weight gain recommendations from 5-9 kg. Previous Cochrane reviews found studies did not supply enough significant high-quality evidence to infer significant risks or benefits of exercise to mother or infant, but regular aerobic exercise appears to improve fitness as an independent variable [3].

Another group more recently added to the role of exercise in reducing the risk of GDM in obese women [4]. This review provided an overview of the pathophysiology of GDM, as well as the normal cellular response to exercise. It stated that only recently (past 20-30 years) has there been a change in exercise recommendation in pregnant women and that several American, British and Canadian Obstetric and Gynaecological Colleges recommend a moderate exercise program in the management of gestational diabetes with the American body emphasizing that “individualised care and clinical judgement are necessary in the management of overweight or obese women”. Studies included in the review found that individuals in the exercise and healthy diet group had less gestational weight gain and macrosomic babies than their diet-only counterparts and that women in another study who engaged in mild ergometer exercise had better responses to oral glucose tolerance tests.

Indeed, it was concluded that pregnancy was an opportune time for lifestyle modification and that while there are several methodological and bias issues, there is compelling evidence that exercise and judicious dieting could reduce the
risk of GDM [3,4]. Another review attempted to add to the topic of exercise and gestational diabetes in 2014 [5], however like many other review publications and individual studies, it found that evidence was inconclusive and insufficient to influence clinical decision making. As a result, while theoretical benefits exist, none of the literature could conclusively support or deny the hypothesis [5]. Despite this, other reviews have supported the idea of exercise in all pregnant women and that those at risk should have tailored programs organised by sports medicine physicians [6].

Furthermore, the relationship between gestational diabetes and exercise was investigated in a meta-analysis that reviewed physical activity before and during pregnancy and the inherent risk reduction [7]. This study searched EMBase, Medline and Cochrane reviews and found eight suitable papers (seven pre-pregnancy papers and five early pregnancy papers) with 34,929 subjects. In the total pre-pregnancy physical activity studies a meta-analysis of relative risks demonstrated a 55% lower risk of GDM in the women with the highest level of activity compared to the lowest (pooled Odds ratio = 0.45 [95% CI 0.28-0.75 p= 0.002). In the five studies that reviewed early pregnancy figures there was a 24% lower risk between the highest and lowest activity group (OR 0.76 [0.70-0.83] P < 0.0001). While this study produced large numbers of subjects and statistically significant results it did suffer from only having eight suitable studies and including varying amount of data completed via self-reporting, thus leaving it open to misclassification. Despite this, the study strongly supported the benefits of exercise in pregnant women [7].

There are several studies that investigate the reduction of risk of GDM in pregnant women and provide a variable level of evidence [7,8]. A multi-centre randomised controlled trial reviewed women from nine countries [8] and compared physical activity and healthy eating in regards to the risk of GDM. The women were randomised into three groups with those undertaking five face-to-face and four optional telephone sessions for either exercises, healthy eating or both. It further reviewed outcomes such as gestational weight gain, fasting glucose and insulin sensitivity. Despite the multi-centre nature, only 150 high-risk women (BMI >29) were included in the study. Overall 32% developed GDM with a statistically insignificant difference between the groups. The healthy eating group was found to have lower gestational weight gain (-2.6kg [95% CI 24.9, 20.2]; P = 0.03) and lower fasting glucose (20.3mmol/L [20.4,20.1]; P = 0.01) compared to the physical activity group. Unfortunately this study lacked a control group for comparison in addition to being quite small and having no power, as it is a pilot study. This was similar to a 2012 study that found no difference in a number of maternal and foetal outcomes with exercise [9]. However, this study was also quite small (121 women) and suffered from poor compliance that made significant conclusions difficult to determine [9].

A further study compared a 12-week exercise program in pregnant women (n=429) against standard antenatal care (n=426) in 855 women [10]. In this case, those assigned to the intervention group were given one structured exercise program face-to-face and also recommended to undertake at least two moderate-to-high intensity exercise sessions at home. Variables were measured initially at the 18-22 week stage and subsequently at the 32-36 week point. Overall, there was 55% compliance in those with the exercise program (three days
of moderate-high intensity exercise), whereas 10% of the control group undertook exercise in a self-directed manner. At the end of the study, there was no difference in the prevalence of gestational diabetes between the activity and control groups (7% vs. 6% respectively) compared to initial numbers (1% vs. 0.2%) [9]. This study suffered from a low compliance rate and subsequent analysis of the protocol-adherent women found lower fasting insulin levels, but no change in diabetes prevalence [10]. A small United States based prospective study evaluated aerobic fitness programs in pregnant women and found no difference in rates of gestational diabetes and many measurements of physical, maternal and neonatal health. However, overall the included women did improve their fitness compared to the control group [11]. Similarly a small Australian study reviewed six-week training programs in women recently diagnosed with GDM and found no adverse maternal or foetal outcomes [12].

A large prospective study reviewed risk factors for the development of gestational diabetes in 14,437 pregnant women without chronic disease and 20,136 singleton births [13]. This study used the nurse health study II and reviewed the self-reported rates of gestational diabetes diagnosed by a physician, as well as other lifestyle factors. These surveys were initially performed in 1989 for baseline characteristics and then re-evaluated every two years. The final survey used for the study was the 2001 results with statistical analysis subsequently performed. Four factors were deemed to be low risk lifestyle factors, with these being: healthy body weight (BMI <25); healthy diet; regular exercise; and cigarette smoking abstinence. Independent of BMI, it was found that regular pre-pregnancy exercise less than the US physical activity guideline (150 minutes of moderate-to-vigorous activity) had a population attributive risk percentage of 10% for the development of GDM [13]. When all four factors were combined, there was a population attributive risk percentage of 47.5% with a relative risk of 0.48. This study, whilst powerful due to its size, encompassed a sample of health professionals rather than a representation of a normal population of pregnant women [13].

A much smaller study similarly tried to retrospectively review 284 women and their pregnancy exercise habits using an online survey. These women were classified into three groups: resistance and aerobic training; aerobic training; and no exercise. While the prevalence of gestational diabetes was lowest in the resistance and aerobic training group, this was not statistically significant [14]. When adjusted for the pre-pregnancy BMI and delivery age there was an odds ratio of 0.56 (P = 0.29) when compared to no exercise. Surprisingly, aerobic exercise had a higher adjusted odds ratio of 2.78 (P=0.08). Unfortunately, this study had several limitations with all the subjects being recruited retrospectively through a gym website [14]. Additionally, if subjects started exercising throughout their pregnancy due to the development of gestational diabetes or abnormal glucose tolerance, they were allocated to the exercise group that may have significantly altered the results of the study [14].

A Canadian study similarly reviewed gestational diabetes risk and a structured exercise program in 190 pregnant women (88 control, 102 intervention group) who were non-diabetic at time of enrolment [15]. The exercise group underwent three-to-five exercise sessions involving walking, aerobic exercise, stretching
and strength exercises for 30-45 minutes. Like other studies, this one found low rates of gestational diabetes development in both cohorts, however the results were not statistically significant. What was found, however, was that the exercising group had a significantly reduced prevalence of excessive gestational weight gain between the two groups (36% vs. 55% P=0.008) that is a significant risk factor for gestational diabetes [15]. This was similarly supported by another group that found in a study of 178 women with a BMI > 35 kg/m² that a pregnancy exercise and diet exercise program could significantly limit gestational weight gain (4.5 kg vs. 10.3 kg control), as well as have a significant reduction of the risk of other problems such as gestational hypertension [17].

Another group reviewed the outcomes of diet and exercise in pregnant women without diabetes in Beijing [17]. The study found that 2750 women developed GDM out of the 14,168 included subjects. Those with GDM who exercised had the lowest BMI increase during late and mid-pregnancy (ΔBMI 2.05 P <0.01) compared to those without exercise intervention and those without GDM. Additionally, this group had lower risk of preterm birth, low birth weight and macrosomia than those with GDM without exercise intervention. Despite this being a large study, the data was collected retrospectively and a significant portion was survey-based thus leaving it open to patient interpretation [17]. Building on these findings, a 2015 study conversely found a significant reduction of risk (90%, Odds ratio = 0.10, P = 0.09) for GDM, as well as a reduction in Oral Glucose Tolerance Test at 180 minutes post intake with the exercise group (intervention 98 mg/dL vs. 116.25 mg/dL Control) [18]. Overall this study was still relatively small and did not mention nutrition as an influence of outcomes [18]. Prior to this influential study, another group reviewed 1241 Hispanic women and reviewed self-reported exercise levels at pre-pregnancy, early and mid-pregnancy [19]. The study found early pregnancy moderate-intensity exercise (top quartile) decreased risk of abnormal glucose tolerance (Odds ratio = 0.48) compared to those in the lowest quartile as well as those with highest levels of occupational activity had a decreased risk of abnormal glucose tolerance compared to those were unemployed (Odds ratio = 0.48) [19].

Interestingly, another 2015 study had extremely comparable results while looking at individuals who were at risk of developing gestational diabetes [20]. Two hundred fifty one women in their first trimester were recruited if they were: 1) overweight or obese (pre-pregnancy BMI >25) with a family history of diabetes or 2) diagnosis of gestational diabetes in a previous pregnancy. These women were block randomized by age group, pre-pregnancy BMI, and ethnicity into either an exercise or health and wellness group. While the exercise group compared to the wellness group produced an odds ratio of 0.61 and 0.60 (adjusted for education and parity), these were not statistically significant. The study also found statistically insignificant differences between rates of impaired glucose tolerance and abnormal glucose screens [20].

While not reviewing an exercise program specifically a 2014 study reviewed rates of gestational diabetes against objectively recorded physical activity [21] This study recruited 759 women from multiple sites and were included if they met multiple geographic and linguistic criteria, as well as being <20 weeks pregnant. Health questionnaire was completed upon recruitment and glucose
tolerance testing performed at 28 weeks. It found physical activity in daily life in gestation was associated with a lower risk of GDM and that the adjusted odds ratio for GDM decreased by 19% per standard deviation (3159 steps) increase in steps per day [21]. This study built on previous work that found protective trends of increasing activity level for the development of gestational diabetes however these results were not statistically significant and thus could not further support the hypothesis [22]. This was similarly found in a 2015 study in a small, randomised control trial in overweight Hispanic women at risk of GDM [23,24].

There are a number of issues that arise from the reviewed studies. Whilst potentially the largest of the studies demonstrated a strong relative risk reduction of GDM in both the pre-pregnancy exercise and early pregnancy, this is not reproduced in many of the smaller studies. Despite there being a large number of studies from many different continents, many of the studies included have been small in overall size or poorly powered and subsequently produced results that are statistically insignificant. Additionally, many of the studies included resulted from questionnaires that were self-reported by patients and may have been misdiagnosed and thus incorrectly allocated to groups. The reviewed studies were not without their strengths. Many of them identified that exercise and exercise programs were associated with less gestational weight gain in addition to a lower risk of abnormal glucose tolerance test and improvements in fitness.

CONCLUSION

There has been a significant increase in literature in recent years regarding exercise in pregnancy and GDM. These have included several systematic and literature reviews in addition to several randomized control trials and prospective and retrospective cohort studies. From this review it is clear that exercise during pregnancy improved maternal health however there is minimal consistent evidence that exercise during pregnancy clearly decreased the risk of GDM. Moving forward there is a strong potential for significant research with well-designed and large randomized control studies, as well as prospective cohort studies to elucidate the clinical benefits.

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REFERENCES


