

Low Protein Diets for Pregnant Women and Its Association with Insulin Secretion and Resistance

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Abstract

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Gestational diabetes mellitus (GDM) complicates 3.5% of pregnancies in England and Wales and continues to show an increase in incidence each year. GDM can lead to diabetes postpartum, it is associated with an increased perinatal risk, and an increase in neonatal mortality. This review article looks at different studies regarding protein diets and their potential effects on GDM. We aimed to determine if a certain protein diet could potentially help protect against GDM using. We found that while a few studies have shown that increasing proteins in the diet of pregnant women, specifically that from poultry, whey, fish, nuts and legumes, may reduce the risk of GDM, there is certainly room for further research on the topic.

Introduction

Gestational diabetes mellitus (GDM) is defined as an impaired glucose tolerance within the onset and duration of pregnancy [1]. Around 3.5% of pregnancies in England and Wales are complicated by GDM [2] and after delivery; a cumulative incidence of diabetes from 2.6% to over 70% in several studies that followed women from 6 weeks to 28 years postpartum was reported, adding to the existing burden of diabetes on the NHS [3]. Furthermore, a pregnancy complicated with GDM is still associated with high perinatal risk and increased neonatal mortality and morbidity [4]. Much research has been undertaken to find potential ways of preventing the insulin resistance that can occur during pregnancy and our review looks at the evidence of low protein diets and its relationship with GDM.

The relationship between pregnancy and hyperglycaemia

GDM, much like the other types of hyperglycemia, is characterised by a pancreatic β -cell function that is insufficient to meet the pregnant body's insulin needs [5], [6], [7]. During a normal pregnancy, the growth of the fetus and placenta causes increases in growth hormone, cortisol, estrogen, progesterone, prolactin and human placental lactogen which all result in hyperinsulinemia, insulin resistance, fasting hypoglycaemia and postprandial hyperglycaemia [6], [7], [8], [9]. Subsequently, pancreatic beta cell function adapts to compensate for the decreased insulin sensitivity and the increased requirement [6], [7], [10]. To compensate for the increased insulin levels, peripheral muscle glucose is utilised, however, as gestation advances, these responses become inadequate to meet the demands of the fetus, and consequently, insulin resistance occurs [6], [7].

Adverse Maternal and Fetal Effects

Women with GDM have an increased risk for pregnancy-related morbidity and high risk of developing type 2 diabetes in the years following the pregnancy [3], [13]. Further to this, their offspring have a higher risk of perinatal morbidity and an increased risk of childhood obesity and early onset type 2 diabetes mellitus [13], [22]. Studies have also shown that the risk of spontaneous preterm birth increased with increasing levels of glycemia during pregnancy [16], [17], [18], [19], [21]. Moreover, GDM has been shown to increase the risk of gestational hypertension and preeclampsia [20], [23].

Interestingly, it has been hypothesised that women with decreased insulin sensitivity may increase nutrient availability to the fetus, thus accounting for the possible fetal overgrowth and adiposity, otherwise known as macrosomia, a frequent result of GDM [14], [15], [18]. Another frequent complication for the infant is neonatal hypoglycaemia.

Methods

We searched for articles published in English through PubMed and Embase using the following search phrases: "GDM and protein diets", "GDM and insulin sensitivity" and "insulin sensitivity and protein diets". We included only published articles, from no more than 20 years ago, that have reported protein diets that influenced insulin sensitivity, insulin resistance and insulin levels in both animal and human models. We also included large cohort studies that looked at the incidence of GDM following specific dietary patterns.

Studies on the Effect of High Protein Diets and GDM

One group hypothesised that feeding insulin resistant rats with a high whey protein diet (32%) (HWP) containing whey protein concentrate (WPC) would increase insulin sensitivity compared to a diet containing red meat (RM). They fed rats a high-fat diet (300 g fat/kg diet) for 9 weeks, then changed to a diet containing either 80 or 320 g protein/kg diet, provided by either WPC or RM, for 6 weeks. They found that dietary WPC reduced plasma insulin concentration by 40% ($P < 0.05$) and increased insulin sensitivity, compared to RM ($P < 0.05$). Thus, their findings support the idea that an HWP diet is more effective than red meat in increasing insulin sensitivity [24].

Another study tested 57 overweight volunteers with fasting insulin concentrations > 12 mU/L. The participants were fed either a high-protein diet of meat, poultry, and dairy foods (HP diet) or a standard-protein diet low in those foods (SP diet)

during 12 weeks. Interestingly, they found that among the volunteers on HP diet, there was significantly ($P < 0.03$) lowered postprandial glycemic response at weeks 0 and 16 compared to those on the SP diet. They concluded that replacing carbohydrate with protein from meat, poultry, and dairy foods has beneficial effects on glycemic response [25].

One group looked at pregnant patients with polycystic ovarian syndrome on a 1500-calorie/d, high-protein, diet, with 30% of calories as fat and metformin therapy, they found that women taking metformin along with the low-carbohydrate diet may have contributed to reduced development of gestational diabetes [26]. In another study, which included 21,411 pregnancies, they looked at prepregnancy low-carbohydrate dietary patterns in these women, and the subsequent incidence of GDM. They documented 867 GDM pregnancies, and their results showed that a prepregnancy low-carbohydrate dietary pattern with high protein and fat from animal sources is associated with an increased GDM risk, whereas a prepregnancy low-carbohydrate dietary pattern with high protein and fat from vegetable sources does not show a risk [27]. Interestingly, another paper also reported that, after adjustment for age, parity, nondietary and dietary factors, and body mass index (BMI), they found that the substitution of red meat with poultry, fish, nuts, or legumes showed a significantly lower risk of GDM [28].

One study examined the associations between dietary patterns and the risk of GDM in 3063 pregnant Chinese women. Their findings suggested that a vegetable-rich diet was associated with a decreased risk of GDM, while the sweets and seafood pattern was associated with an increased risk of GDM. They concluded that a high protein diet did not provide statistically significant findings on preventing GDM [29].

The Australian Longitudinal Study on Women's Health included 3,853 women without pre-existing diabetes who were followed-up between 2003 and 2012. They studied pre-pregnancy dietary patterns with the incidence of GDM. They suggested from their results general dietary recommendations for women of reproductive age, including consumption of a diet rich in vegetables, whole grains, nuts and fish, and low in red and processed meats and snacks [30].

Conclusion

Only a few published papers have studied the effects of a low protein diet on GDM, suggesting the need for further research in this, particularly topic. However, from the studies published, it is clear that selecting the right type of protein i.e. that from

poultry, whey, fish, nuts and legumes contributes to a reduced risk of GDM and it is important in maintaining a healthy lifestyle during pregnancy. It is also important to note that whilst the majority of studies here did show the benefits of increased protein from sources other than red meat, one study did show that a high protein diet had no significant effects on the risk of GDM.

Furthermore, it is important to discuss that the reasons for the protective effect against GDM may not necessarily be a direct result of increasing the right types of protein in the diet, but may be indirect, by decreasing a woman's consumption of other foods associated with an increased risk of GDM such as carbohydrates and fats [31], [32], [33], [34], [35].

To conclude, while a few studies have shown that increasing proteins in the diet of pregnant women, specifically that from poultry, whey, fish, nuts and legumes, may reduce the risk of GDM, there is certainly room for further research on the topic. Future studies should aim to determine the exact type of protein and their specific quantities using a large sample group of pregnant women that will eventually lead to a recommended diet plan to reduce the risk of GDM.

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