

# EFFECTS OF PISTACHIO INTAKE ON POSTPRANDIAL GLYCEMIC RESPONSE IN PREGNANT WOMEN

A randomized, controlled, crossover study

Principal Investigator

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# Objectives

The goal of this research was to study the effects of pistachios on pregnant women who:

- have impaired glucose tolerance, but are otherwise normal\* (n=30), or
- have been diagnosed with gestational diabetes\* (n=30)

on blood glucose response, insulin response and hormones related to glucose metabolism and satiety.

\*Note: Diagnosis to abnormal glucose tolerance is based on standards given in Standards of Medical Care in Diabetes—2014 formulated by the American Diabetes Association (ADA).

**In the two step approach, women were initially screened by measuring plasma glucose one hour after a 50g glucose load; women with glucose concentration  $\geq 7.8$  mmol/L undergo a 75g OGTT on a separate day. Gestational diabetes is made if the blood glucose  $\geq 10.0$  mmol/L at one hour or  $\geq 8.5$  mmol/L at two hours.**

## TARGET POPULATION

Pregnant women (age 25-35, at 24-28 gestational weeks)

## DESIGN

This research was a self-comparison study divided into two phases. Subjects participated in the two phases in random order:

Phase A: Subjects consumed 100g of whole wheat bread (about 240 kcal) for breakfast in ten minutes. Venous blood was collected at 0, 30, 60, 90, and 120 minutes following the breakfast.

Phase B: Subjects consumed 42g of pistachios (about 234 kcal) for breakfast in ten minutes. Venous blood was collected at 0, 30, 60, 90, and 120 minutes following the breakfast.

## TEST MEALS

1. Whole wheat bread (100g, 2 slices, about 240 kcal)
2. Pistachios (42g, about 234 kcal)

## MAIN OBSERVATION INDICATORS

- (1) Blood glucose
- (2) Insulin, GLP-1, GIP

# Summary Of Data

**Why was the study done:** Providing pregnant women with diabetes with appropriate nutrition is essential for the health of the mother and baby. Pistachios are a low Glycemic Index (GI) food with balanced nutrition. They are high in fiber, antioxidants and have a beneficial fatty acid profile. Studies in both healthy and pre-diabetic individuals have shown that nuts in general, and pistachios in particular, improve how cells use glucose and how insulin responds to a carbohydrate-containing meal. Investigators wanted to see if a 1.5 serving size of pistachios could also provide benefits to women with gestational diabetes.

**What was the objective of the study:** The goal of this research was to study the effects of pistachios on pregnant women with: a) impaired glucose tolerance, but otherwise healthy; and b) gestational diabetes on blood glucose response, insulin response and hormones related to glucose metabolism.

**Gestational Diabetes (GDM):** GDM develops during pregnancy (gestation). Like other types of diabetes, GDM affects how cells use sugar (glucose). GDM causes high blood sugar that can affect pregnancy and the baby's (infant) health. Expectant women can help control GDM by eating healthy foods, exercising, and if necessary, taking medication. Controlling blood sugar can prevent a difficult birth and keeps the mother and baby healthy. Uncontrolled GDM increases the risk of maternal hypertension (high blood pressure) and preeclampsia (onset of high blood pressure in pregnancy). While the true incidence of GDM is not known because there are no symptoms over the past 20 years, the prevalence of GDM has increased worldwide. According to the latest diagnostic criteria established by the International Association of Diabetes and Pregnancy Study Groups (IADPSG) in 2010.<sup>2,3</sup> The GDM prevalence was estimated at 9.8 – 25.5% worldwide and 9.3 – 18.9% in China.<sup>4,5</sup>

**Impaired glucose tolerance during gestation (GIGT)** Sometimes during pregnancy the body is unable to regulate blood glucose (sugar) levels normally because of hormonal changes. This is called 'gestational impaired glucose tolerance.' Impaired glucose tolerance means that blood glucose levels raise beyond normal levels after a glucose challenge but not high enough to warrant a diabetes diagnosis. While this is resolved after the baby is born, women with either GDM or GIGT have a greater risk of developing diabetes.

**Study design:** Two groups of pregnant women with GDM or GIGT ate either 42 grams of pistachios<sup>6</sup> or 100 grams of whole wheat bread<sup>7</sup> after an overnight fast on two occasions, separated by 7 days. Blood measures were taken after each meal every 30 minutes, up to 120 minutes. The pistachios and whole wheat bread were matched for calories.

## What investigators found:

**Blood Glucose:** Both groups of women (those with GDM and GIGT) had a significantly lower rise in blood sugar at every time point measured after the pistachio consumption than they did after eating the whole wheat bread. In fact, blood glucose barely increased above baseline levels after the pistachios. During the two hours following the consumption of pistachios, the total rise in blood sugar was much lower than after eating the whole wheat bread in both groups of women.

**Insulin Level:** The effect on insulin levels was even more dramatic. Blood insulin levels did not change during the 2 hours after eating the pistachios. Again, both groups of women had a significantly lower rise in blood insulin levels at every time point measured after eating the pistachios than they did after eating whole wheat bread.

**GIP (insulinotropic polypeptide) and GLP-1 (glucagon like peptide-1)** – These metabolic hormones, also called incretins, stimulate a decrease in blood glucose levels and a release after eating. They work by modifying insulin release from the pancreas. They appear to slow down the rate of absorption of nutrients in to the bloodstream and may reduce food intake. In both groups of women there was a higher rise in GLP-1 after eating the pistachios than after eating the whole wheat bread (at 60, 90 and 120 minutes for GIGT and at 90 and 120 minutes for GD). On the other hand, there was a greater rise in GIP levels after the whole wheat bread than the pistachios among GD women and the GIGT. This is probably because GIP secretion is stimulated by glucose in the intestinal tract.

<sup>2</sup> Metzger BE, Gabbe SG, Persson B, et al. International Association of Diabetes and Pregnancy Study Groups recommendations on the diagnosis and classification of hyperglycemia in pregnancy. Diabetes Care. 2010;33:676-82.

<sup>3</sup> Weintert LS. International Association of Diabetes and Pregnancy Study Groups recommendations on the diagnosis and classification of hyperglycemia in pregnancy: comment to the International Association of Diabetes and Pregnancy Study Groups Consensus Panel. Diabetes Care. 2010;33:e97. Author reply e8.

<sup>4</sup> Wei YM, Yang HX. Comparison of the diagnostic criteria for gestational diabetes mellitus in China. Chinese J Obst Gynecol. 2011;46(8):578-81.

<sup>5</sup> Wei Y, et al. International Association of Diabetes and Pregnancy Study Group criteria are suitable for gestational diabetes mellitus diagnosis: further evidence from China. Chin med J. 2013;127(20):3553-6.

<sup>6</sup> 42 grams = about 1-1/2 servings. One serving = about 49 nuts.

<sup>7</sup> Whole wheat bread is a recommended healthy food in the Balanced Diet Pagoda (Chinese Dietary Guidelines)

# GIGT (Gestational impaired glucose intolerant) Group

## Effects of Whole Wheat Bread and Pistachio on Blood Glucose in GIGT group

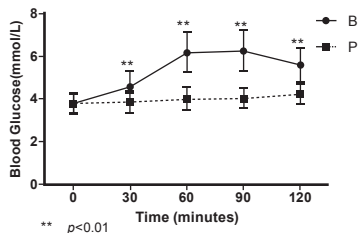


Figure 1: Changes in blood glucose levels within 2 hours after consumption of whole wheat bread and pistachios in GIGT group

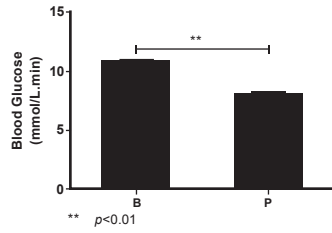


Figure 2: AUC<sub>glu120min</sub> of whole wheat bread and pistachios in GIGT group

## Effects of Whole Wheat Bread and Pistachio on insulin in GIGT group

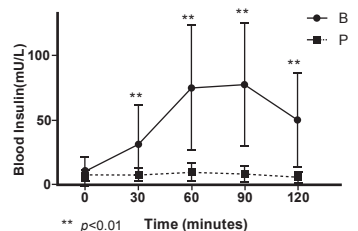


Figure 3: Changes in insulin levels within 2 hours after consumption of whole wheat bread and pistachios in GIGT group

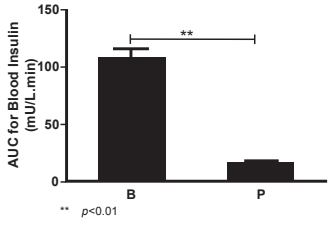


Figure 4: AUC<sub>ins120min</sub> of whole wheat bread and pistachios in GIGT group

## Effects of Whole Wheat Bread and Pistachio on GLP-1 in GIGT group

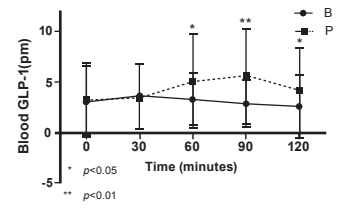


Figure 5: Changes in GLP-1 levels within 2 hours after consumption of whole wheat bread and pistachios in GIGT group

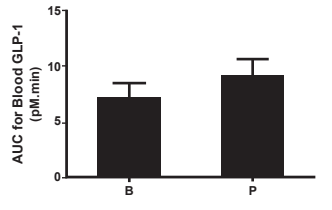


Figure 6: AUC<sub>GLP-1 120min</sub> of whole wheat bread and pistachios in GIGT group

# GDM (Gestational Diabetes Mellitus) Group

## Effects of Whole Wheat Bread and Pistachio on Blood Glucose in GDM group

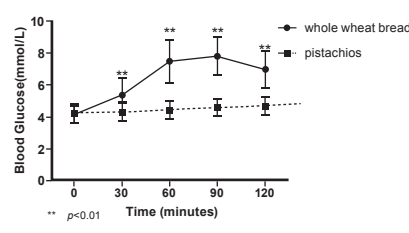


Figure 7: Changes in blood glucose levels within 2 hours after consumption of whole wheat bread and pistachios in GDM group

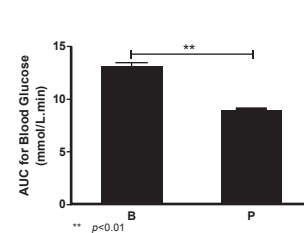


Figure 8: AUC<sub>glu120min</sub> of whole wheat bread and pistachios in GDM group

## Effects of Whole Wheat Bread and Pistachio on insulin in GDM group

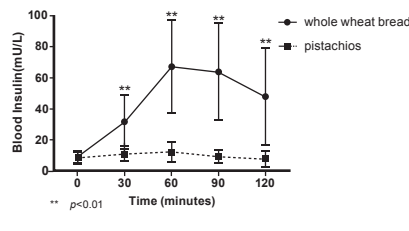


Figure 9: Changes in insulin levels within 2 hours after consumption of whole wheat bread and pistachios in GDM group

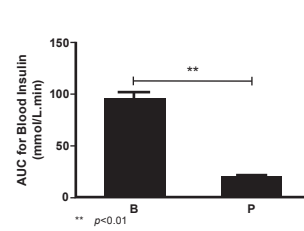


Figure 10: AUC<sub>ins120min</sub> of whole wheat bread and pistachios in GDM group

## Effects of Whole Wheat Bread and Pistachio on GLP-1 in GDM group

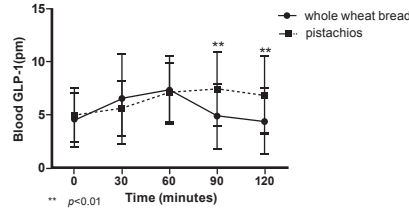


Figure 11: Changes in GLP-1 levels within 2 hours after consumption of whole wheat bread and pistachios in GDM group

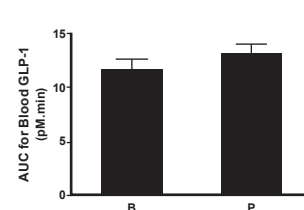


Figure 12: AUC<sub>GLP-1 120min</sub> of whole wheat bread and pistachios in GDM group

## What we learned from this study

A growing concern, gestational diabetes mellitus (GDM) prevalence is estimated at 9.8 – 25.5% worldwide. Elevated blood sugar during pregnancy not only impacts the mother's health, but it may also increase the baby's risk of developing diabetes. This study shows pistachios may help maintain postprandial blood glucose levels while providing essential nutrients to the mother and baby during pregnancy.

- ✓ There is a significantly lower rise in blood sugar at every time point measured after the pistachio consumption than after consuming whole wheat bread.
- ✓ Blood glucose increased minimally above baseline levels after the pistachios.
- ✓ Pistachios are a healthy snack for pregnant women with GIGT or GDM.





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Dr. Ge specializes in nutrition treatments for various diseases, including diabetes, kidney disease, and obesity. She is a Trustee of the Shanghai Nutrition Society; Council Member of the Chinese Nutrition Society; Vice-Chair, Nutrition Community, Chinese Medical Doctor Association; and Committee Member, Science Popularization Branch of Chinese Medical Association.

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