Impact of A Short-Term Antibiotic Cycle on Glucose Control in Adults with Overweight or Obesity

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Abstract

Background: Dietary fiber has been consistently associated with beneficial effects on body composition and insulin resistance in humans, potentially acting through alterations in the gut microbiota. Murine studies have shown fiber to be able to mitigate antibiotic-induced gut microbial perturbations and subsequent insulin resistance.

Objective: This study aims to investigate the effect of a short-term antibiotic cycle on glucose control. Furthermore, we will also explore potential associations between dietary fiber intake, glucose control, and body composition.

Methods: This preliminary analysis, derived from a larger randomized controlled trial, prospectively evaluated 11 adults with overweight or obesity, lacking a diabetes diagnosis. Glucose control and insulin resistance, measured via serum, fasting glucose, fasting insulin and HOMA index, were analyzed before and after a short-term antibiotic course (Vancomycin 500 mg/8h for 3 days) and analyzed at Bioreference Laboratories. Total dietary fiber intake was measured through 24h dietary records collected over six days and analyzed using ESHA Food Processor Nutrition Analysis Software. Body composition was evaluated through DEXA and BodPod scans at the TCU Applied Metabolic & Physiology Lab. SPSS was utilized for all statistical analyses. A p-value <0.05 was considered statistically significant.

Results: A 3-day antibiotic cycle of Vancomycin caused a significant increase in fasting insulin 1.50 $\pm$ 2.08 (p=0.037) and fasting glucose 5.67 $\pm$ 1.53 (p=0.023), but not HOMA-IR 0.17 $\pm$ 0.38. No significant correlations were found between fiber intake and chronic glucose control, antibiotic-induced glucose control changes, insulin resistance, or body composition. Participants consumed an average 15.58 grams of fiber per day with females (n=6) meeting 65.5% of fiber RDA for females (25 g/day) and males (n=5) meeting 38.5% of RDA (38 g/day).

Conclusion: The outcomes of this study illustrate the ability of a short-term antibiotic cycle, specifically Vancomycin, to induce harmful effects on glucose control in humans. These findings highlight the need for further research into understanding accumulated exposure risk as well as methods for the prevention and treatment of antibiotic-induced metabolic disruption.

Background

- **Overweight/obesity** and **insulin resistance** are chronic diseases that effect 73.5% and 40.3% of Americans, respectively[1,2]
- The **gut microbiome** produces metabolites that directly influence host metabolic health while **antibiotics** have been shown to significantly disrupt the gut microbiome composition and diversity[3]
- **Antibiotic use** frequency is associated with increased risk of obesity in human and animal studies and insulin resistance in animal studies[4-6]
- **Short-term antibiotic regimens** have been shown to either have no effect or harmful effects on insulin resistance, fasting glucose, and fasting insulin in humans[7-11]
- Murine research has shown **fiber** to protect against antibiotic-induced insulin resistance by acting through the gut microbiota[12-16]
- **Fiber intake** has been consistently associated with lower body fat mass and insulin resistance alongside higher lean mass[17,18]

Objectives

1.) Determine the effect of a short-term antibiotic regimen on markers of glucose control

2.) Describe the relationships between total dietary fiber intake with glucose control, insulin resistance, and body composition

Methods

Study Design: Pre-test/Post-test Design

Participants: 11 participants ages 18-50 with overweight or obesity (BMI $\geq$ 25 $\leq$ 40) and no diagnosis of diabetes

Intervention: 3-day antibiotic regimen of Vancomycin (500 mg every 8 hours)

Measured Outcomes:

- Changes in insulin resistance (HOMA), fasting glucose, and fasting insulin from pre- to post-antibiotic intervention
- Relationships between total dietary fiber intake with body composition parameters, insulin resistance, and chronic glucose control markers (HbA1c)

Figure 1 : Conceptual Framework

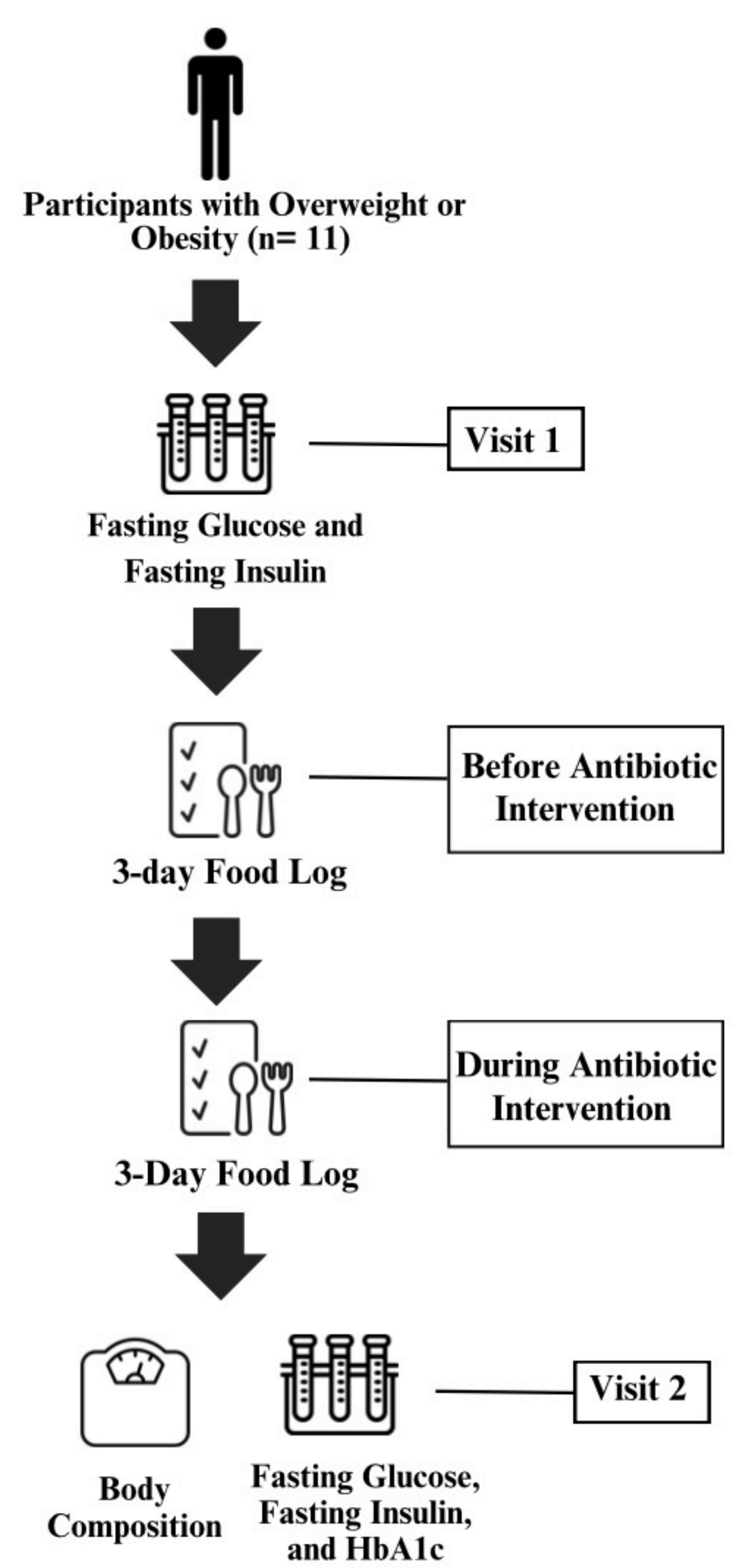

Figure 1. Conceptual framework. Using a pre-test/post-test, we analyzed the effects of a short antibiotic intervention on insulin resistance and whether these effects were modulated by fiber intake. Furthermore, we analyzed the relationships between fiber intake with body composition, insulin resistance, and glycemic control.

Results

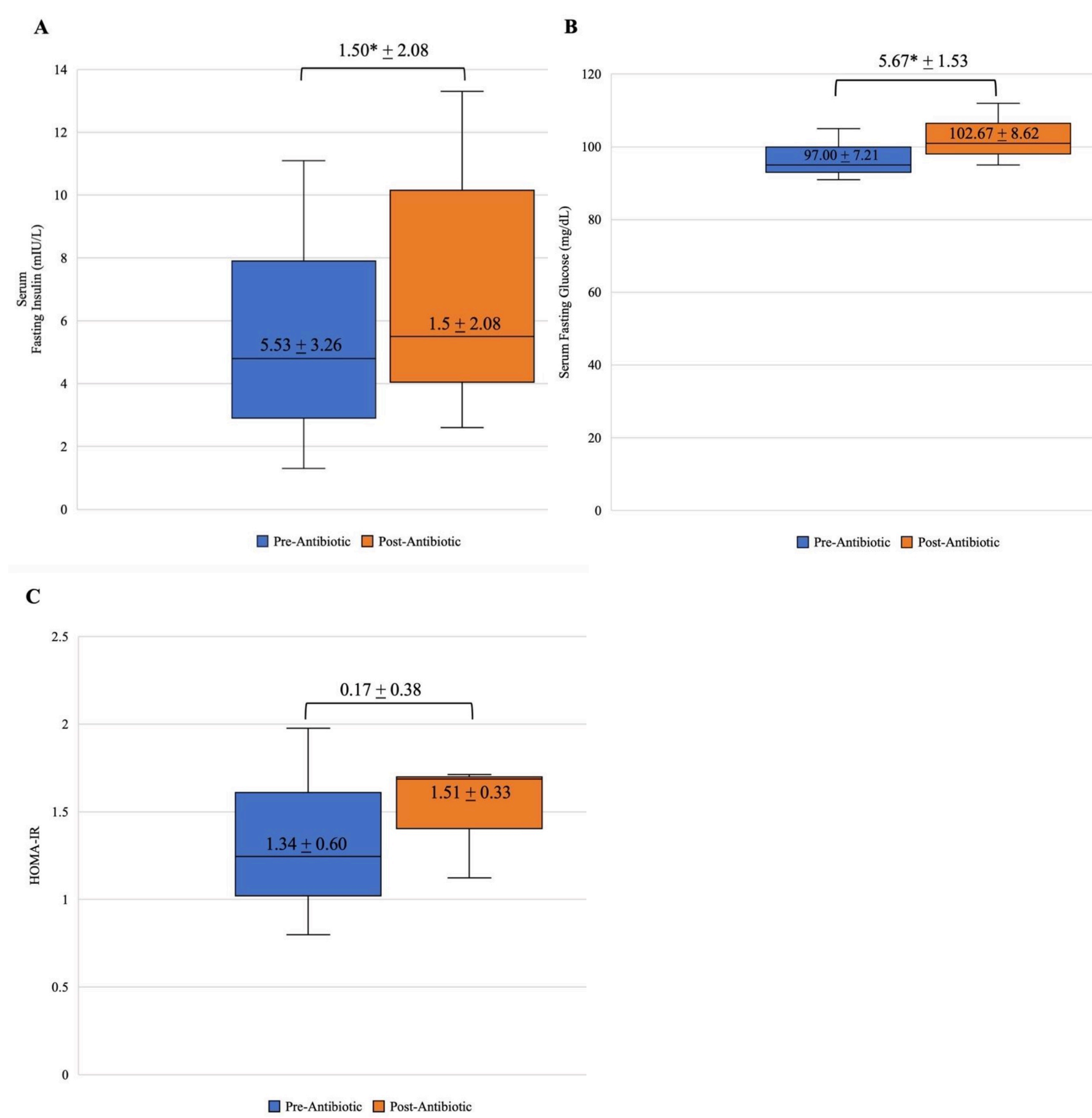

Figure 2: Effect of a 3 short-term antibiotic cycle on glucose control and insulin resistance. Pre-antibiotic (blue color) and post-antibiotic (orange color) levels of (A) fasting glucose (n=3), (B) fasting insulin (n=11), and (C) HOMA-IR (n=3) are shown. Values are given as mean $\pm$ SD.
*p <0.05

Table 1: Characteristics of Participants at Baseline

Baseline characteristic	Value (n= 11)
Gender	
Female	55%
Male	45%
Race	
White	55%
Hispanic or Latino	18%
Asian	9%
Two or more races	18%
Age (years)	27 $\pm$ 9.2
BMI (Kg/m^2)	28.6 $\pm$ 2.7
Fasting Glucose (mg/dL)	97.0 $\pm$ 7.2[a]
Fasting Insulin (mIU/L)	5.5 $\pm$ 3.3
HOMA-IR	1.3 $\pm$ 0.60[a]
HbA1c (%)	5.0 $\pm$ 0.61

[a] Sample size of 3

Conclusions

- **Vancomycin has significant acute harmful effects on acute glucose control** in adults with overweight or obesity without diabetes

- **Fiber intake did not show a significant relationship with antibiotic-induced changes** in glucose control parameters, baseline glucose control and insulin resistance, or body composition parameters. Continuation of the current study will allow for analysis of a larger sample size with strengthened statistical power to ascertain whether fiber intake induces protection against antibiotic-induced disruptions in glucose control in humans.

- Further research should be focused on determining the acute and accumulated long-term risks on metabolism caused by antibiotic cycles, and exploring methods for the prevention and treatment of antibiotic-induced perturbations in glucose control.

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This study 1) examined the effect of a 3-day antibiotic regimen on blood sugar control in people with overweight or obesity, and 2) explored the relationships between dietary fiber intake with body composition and blood sugar control.

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