

# Final Part 1

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## Abstract

Since previous studies have shown that the highly antioxidant beta-carotene (BC) is associated with a decreased risk of cancer, its pharmacokinetics needs to be better understood. In this study, we used generalized estimating equations (GEE) to confirmed these associations: BC supplementation impacts serum BC levels over time and it varies depending on dosage level, and, after BC supplementation is ceased, the rate at which patients return to baseline does not differ by dosage. It is estimated that the relative difference in mean serum BC comparing patients in the treatment group with patients in the placebo group throughout the 6 month treatment phase is 823.09 ug/mL (95% CI: [598.18, 1048.00]). This estimate increases to 1055.52 ug/mL (95% CI: [991.29, 1119.74]) after the potential outlier observations of patient 57 are removed. As secondary analyses, we explored the potential differences in effect of BC supplementation on serum BC levels over time by other covariates: gender, cholesterol, age, and body mass index (BMI). We also explored the effect of BC supplementation on serum vitamin E over time. Lastly, we created a predictive linear mixed effects model using Bayesian methods and provided some predictions for randomly chosen patients if they were to extend their duration of the BC supplementation. The biggest challenge with this study was that the data set was greatly unbalanced between those receiving treatment to those receiving placebo (4:1 ratio). These challenges may have affected our models and inferences made.

## Introduction

Statistics in the 2012 American Cancer Society journal predicted that by year 2030, there will be 21.7 million new cancer cases and 13 million cancer deaths worldwide. When you adjust for other environmental or lifestyle factors like smoking, diabetes, pollution, or fewer childbirths, the numbers can seem very daunting. Studies like this one help us move toward a better understanding of cancer and what we can do to prevent it. Many antioxidants like BC have been used to prevent and battle against cancer. It has been shown that BC is associated with a decreased risk of cancer, but that some physiological factors can affect the absorption, storage, and utilization of the drug, which could then affect the impact it has against cancer. Our analysis seeks to confirm that BC supplementation does significantly impact the serum BC levels over time and that that impact is magnified by higher dosages. We explore the effect of other covariates on the impact of the supplementation, and we also explore the effect that BC supplementation has on serum vitamin E levels over time. We were able to confirm these associations, but, we were unable to create a good predictive model. However, through our association analyses, we made some interesting discoveries that is worth further investigation.

## Methods

These data were collected over the course of 15 months that was split into three phases, which we will call *pre-treatment*, *treatment*, and *post-treatment* phase. from a double-bind study in whihc 46 volunteers were randomized to receive one of five doses of BC for a duration of 6 months (months 4, 5, 6, 7, 8, and 9). During months

**Results**

**Appendix A**

**Appendix B**