
The Fast Food Phenomenon:

Assessing Variations in Fast Food Consumption from 1996-2008

— Sajjan Patel and Max Tjen —

Background

- Fast Food: food ordered and paid by customer before receiving the food
- Fast food gaining popularity with accessibility, affordability and advertising
- From NHANES 2013-2016, 36.6% of adults consume fast food in a given day
 - Most frequent users: Age 20-39 years, non-Hispanic Blacks
- Short-term and long-term health effects due to high consumption
 - Short-term: Spikes in blood sugar, blood pressure, and inflammation
 - Long-term: Increased risk of obesity, insulin resistance, and type 2 diabetes

Rationale

- Adult males consume fast food more often than females
- Gap in literature with respect to patterns of fast food consumption by gender longitudinally
- Understand adolescent behavior can predict future utilization of fast food
- Previous studies have only compare changes in fast food intake over time by gender, separately
- Other studies look at cross-sectional data, as opposed to longitudinal

Research Questions

Using the National Longitudinal Study of Adolescent to Adult Health data from 1996-2008, how have habits of eating fast food changed over time by gender? Are body weight and history of daily smoking associated with these demonstrated changes?

Data Source

- National Longitudinal Study of Adolescent to Adult Health (Add Health)
- Nationally representative sample of 20,000 adolescents in grades 7-12 first interviewed in the 1994-1995 academic year
- Captures information such as demographics, familial relationships, physical health, etc.
- 5 waves of data, most recently occurred in 2016-2018
- Waves II, III, and IV used in this analysis
 - Wave II: 1996
 - Wave III: 2001-2002
 - Wave IV: 2008

Study Population

- Individuals followed during waves II, III, and IV
- Must have at least one wave of information on all variables of interest — fast food consumption, gender, body weight, and history of daily smoking
 - Assume excluded individuals had data missing at random (MAR)
- 2377 unique individuals
 - Wave II: 1457 participants
 - Wave III: 1972 participants
 - Wave IV: 2082 participants
- Unbalanced study design

Variables of Interest

- Outcome: Number of times an individual has eaten fast food in the past 7 days
 - Treated as binary variable
 - Daily Consumption: ≥ 7 times in past 7 days
 - Non-Daily Consumption: < 7 times in past 7 days
- Key Predictor: Gender
 - Treated as binary variable
 - Male
 - Female
- Key Predictor: Wave
 - Treated as multi-categorical variable
 - Wave II
 - Wave III
 - Wave IV
- Predictor: Body weight
 - Treated as quantitative variable
- Predictor: Ever smoked at least one cigarette every day for 30 days
 - Treated as binary variable
 - Yes
 - No

Statistical Assumptions

- General linear mixed effects models (GLMM) in this study will use the logit link function to predict daily fast food consumption
- Assumptions:
 - Outcome assumed to follow a Bernoulli distribution
 - Random intercept models with random intercept assumed to be normally distributed
 - Random effects assumed to follow multivariate normal distribution
 - Mean of zero vector, $(q \times q)$ -covariance matrix that characterizes among-individual variance and correlation
 - Residuals assumed to observe normality and homoscedasticity

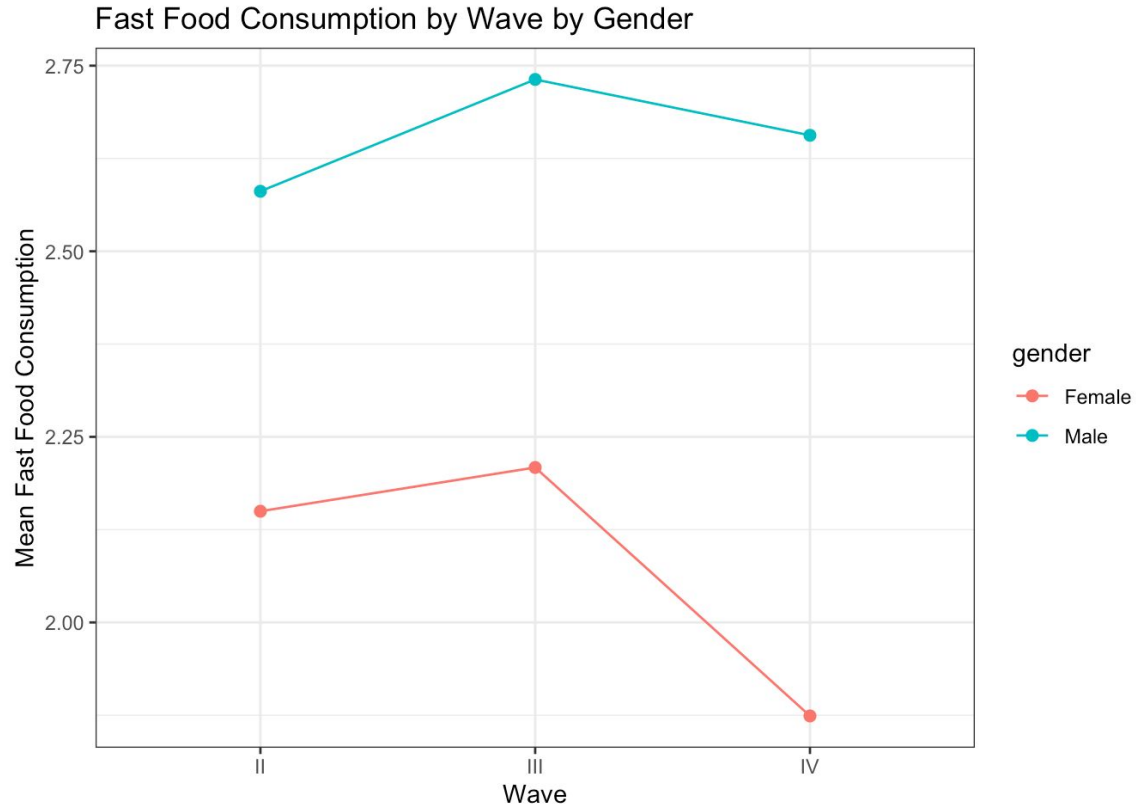
Analytic Approach

- Summary statistics of population
- Baseline logistic regression model
- General Linear Mixed Models (GLMM) to assess significance of interaction between time and gender
 - Main effects: wave and gender
 - Interaction: wave*gender
 - Likelihood Ratio Test to compare models
- General Linear Mixed Models (GLMM) to assess model improvement with weight and smoking history on training dataset
 - Winning model
 - Saturated - wave, gender, weight, and smoking history
 - Likelihood Ratio Test to compare models
- GLMM Validation of best model on testing dataset

Results - Summary Statistics

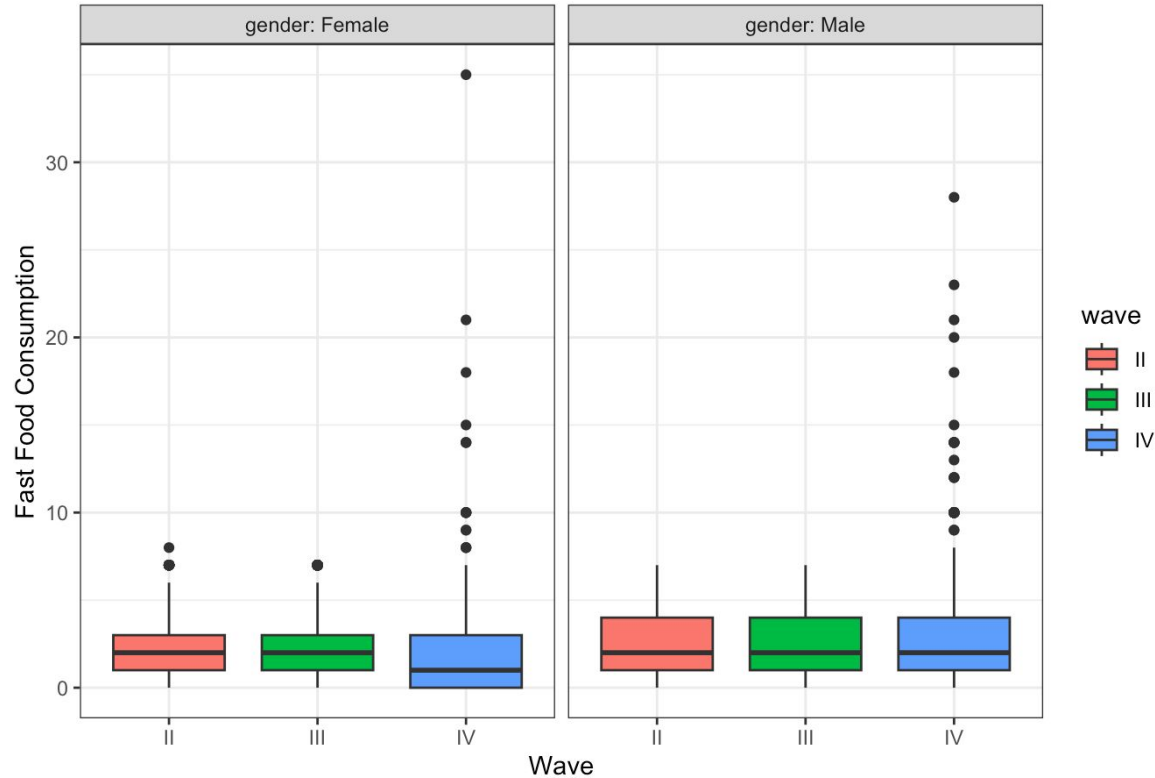
	Wave II (n = 1457)	Wave III (n =1972)	Wave IV (n = 2082)
Variables	N (col %)	N (col %)	N (col %)
Gender			
Male	656 (45.0)	942 (47.8)	1018 (48.9)
Female	801 (55.0)	1030 (52.2)	1064 (51.1)
Fast Food Consumption			
Daily	74 (5.1)	184 (9.3)	160 (7.7)
Non-Daily	1383 (94.9)	1788 (90.7)	1922 (92.3)
History of Daily Smoking			
Yes	658 (45.2)	1315 (66.7)	1429 (68.6)
No	799 (54.8)	657 (33.3)	653 (31.4)
Median Weight (in pounds) [IQR]			
	140 [123, 168]	162 [139, 190]	180 [150, 211]

Results - Summary Statistics



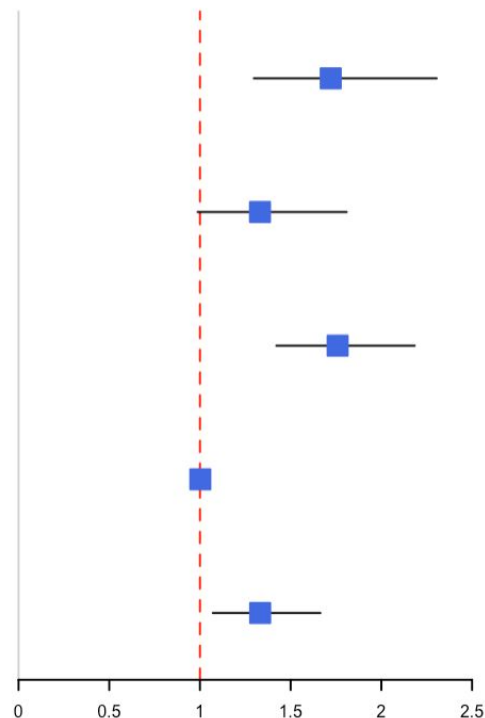
Results - Summary Statistics

Fast Food Consumption by Wave by Gender

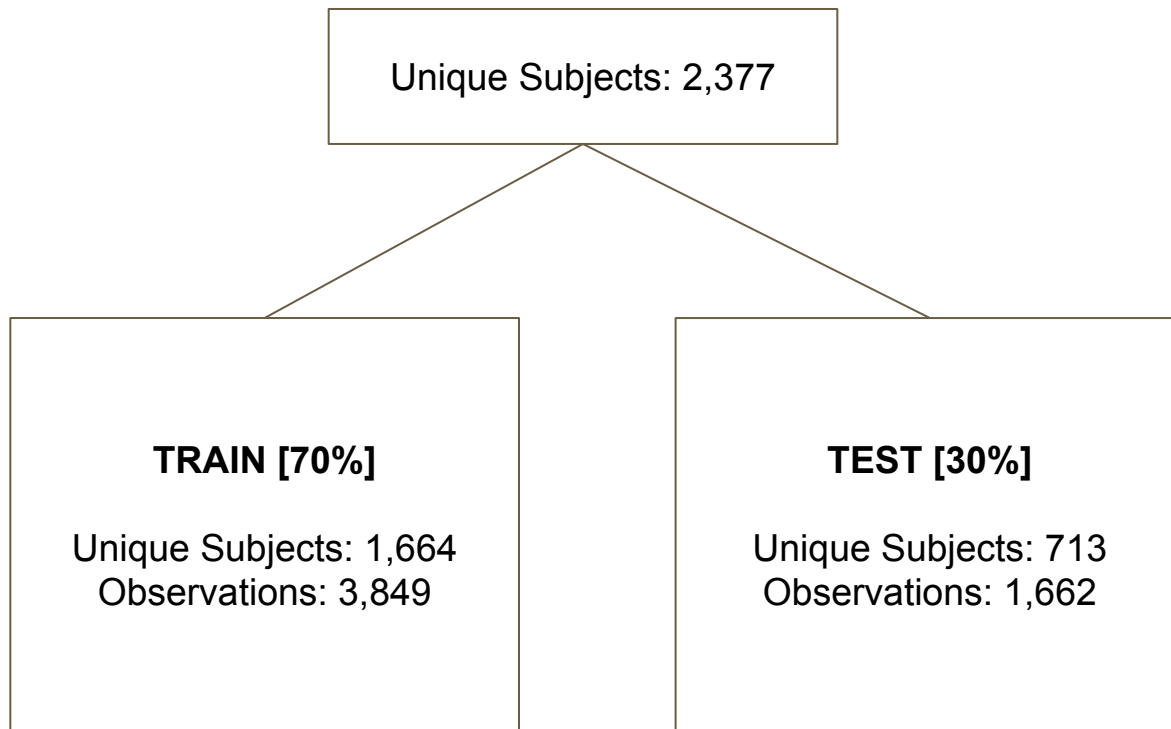


Results - Logistic Regression

Term	Estimate	95% CI	p-value
Wave III	1.721	(1.297, 2.305)	0.000
Wave IV	1.331	(0.987, 1.809)	0.063
Male	1.759	(1.421, 2.184)	0.000
Weight	1.002	(1.000, 1.004)	0.114
SmokerHx	1.332	(1.071, 1.664)	0.011



Results - Train/Test Split



Results - GLMM Interaction

Data: train_data

Models:

glmm_1: food ~ wave + gender + (1 | id)

glmm_0: food ~ wave * gender + (1 | id)

	npar	AIC	BIC	logLik	deviance	Chisq	Df	Pr(>Chisq)
glmm_1	5	1888.8	1920.0	-939.38	1878.8			
glmm_0	7	1892.6	1936.4	-939.32	1878.6	0.1238	2	0.94

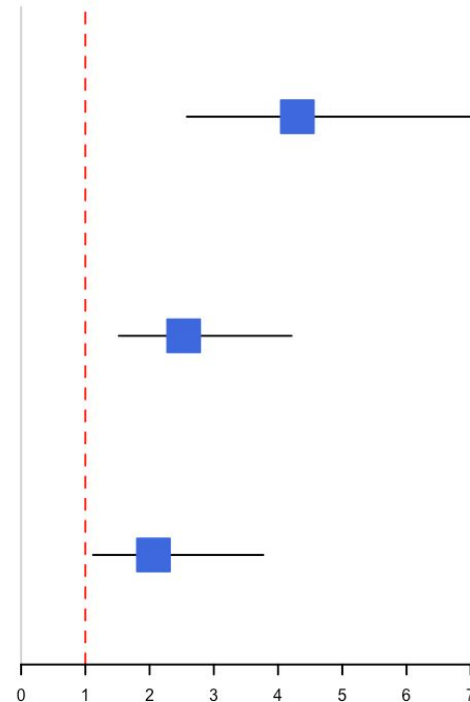
Results - GLMM I

Term	Estimate	95% CI	p-value
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Wave III	4.30	(2.58, 7.16)	0.000
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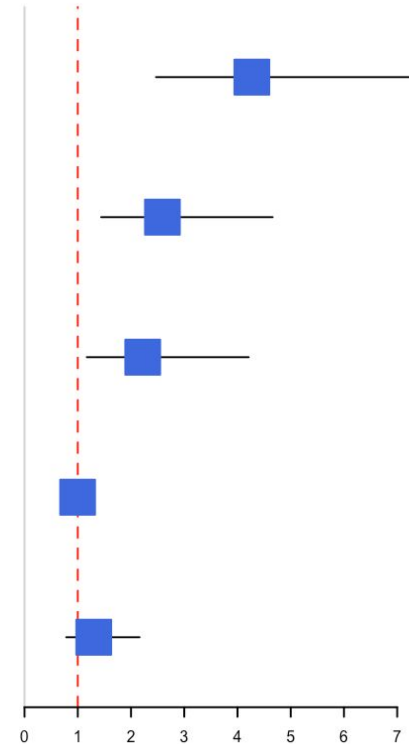
Wave IV	2.53	(1.52, 4.21)	0.000
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Male	2.06	(1.12, 3.77)	0.002
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Results - GLMM II

Term	Estimate	95% CI	p-value
Wave III	4.27	(2.47, 7.40)	0.000
Wave IV	2.59	(1.44, 4.66)	0.001
Male	2.22	(1.17, 4.21)	0.015
Weight	0.997	(0.991, 1.00)	0.460
SmokerHx	1.30	(0.784, 2.16)	0.308



Results - GLMM I v. II

Data: train_data

Models:

glmm_1: food ~ wave + gender + (1 | id)

glmm_2: food ~ wave + gender + weight + smoke + (1 | id)

	npars	AIC	BIC	logLik	deviance	Chisq	Df	Pr(>Chisq)
glmm_1	5	1888.8	1920.0	-939.38	1878.8			
glmm_2	7	1891.1	1934.9	-938.57	1877.1	1.6365	2	0.4412

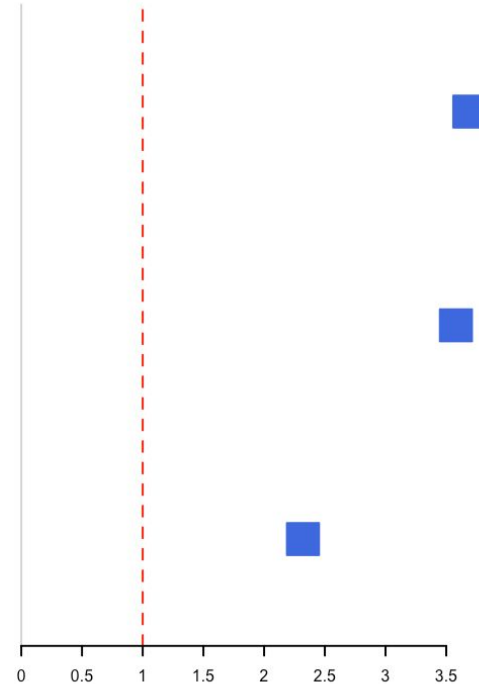
Results - GLMM I Validation

Term	Estimate	95% CI	p-value
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Wave III	3.69	(3.67, 3.71)	0.000
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Wave IV	3.58	(3.57, 3.60)	0.000
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Male	2.32	(2.31, 2.33)	0.000
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Results - GLMM I Validation

	R²	C Statistic
Train Data	0.526	0.976
Test Data	0.488	0.972

Discussion - Summary

- Add Health Dataverse (UNC)
- Fast food consumption patterns differ by time and gender
- Logistic regression model
- GLMM models
 - Interaction
 - Additional covariates
- Final model validation
 - $R^2 = 0.488$
 - $C = 0.972$

Discussion - Strengths

- Database strength
 - Captures lots of demographic and clinical information on adolescents
- Loss to follow-up mitigation
 - More subjects with each wave
 - Reduces bias
- Longitudinal data collection
 - Most fast food consumption data is cross-sectional
 - Trend over time

Discussion - Limitations

- Binary outcome
 - Count - more exact results
 - Splitting by daily consumption \Rightarrow small amount are daily
 - Amount of available degrees of freedom
- Predictor selection
 - Weight \Rightarrow adolescents age
- Older data

Discussion - Future Work

- Random slope and intercept
 - Subject specific variation
- Predictor variables
 - Geography, race, socioeconomics ...
- Validation of results
 - Sensitivity analysis