Cutting the Fat

The Effect of New York City's Artificial Trans Fat Ban on Obesity

Research on Public Policy Series

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Summary

This study examines whether legislation implemented by the New York City Department of Health and Mental Hygiene (NYC DHMH) in December of 2006, which effectively banned artificial trans fat from the food served in restaurants and other eateries located throughout New York City (NYC), reduced obesity among New Yorkers residing in the five boroughs. Obesity was determined by an individual's body mass index (BMI), which was derived by using self-reported measures of height and weight. Both a dichotomized (1 = obese and 0 = normal weight and overweight) and an interval obesity measure were analyzed. A statistical examination of surveys conducted before (2005) and after the implementation of the artificial trans fat ban (2008-2010) showed that the artificial trans fat ban had little effect on attenuating obesity in any of the five NYC boroughs. The gender and race/ethnicity of the survey respondent also failed to condition the relationship between the artificial trans fat ban and obesity. Based on the consistency of our null findings, the legality of artificial trans fat bans will most likely continue to be challenged until there is convincing empirical evidence that these types of bans are effective in improving public health.[1]

Keywords: New York City's artificial trans fat ban; obesity; body mass index (BMI)

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Background

Obesity continues to be a major problem in our society in that approximately 33.8% of Americans (78 million people) age 20 years or older are obese (Flegal et al., 2010). Obesity affects all segments of the U.S. population particularly minorities and the poor and is expected to grow progressively worse over time. About 42% of the U.S. is projected to be obese by 2030 (Finkelstein et al., 2012). The cost associated with an obese population is staggering. The direct medical cost of obesity in the U.S. in 2008 was estimated to be roughly $98 billion (Tsai et al., 2011). This figure is expected to grow to about $700 billion by 2030 (Wang et al., 2008).

Obesity is a precipitating causal factor in the death of approximately 100,000 Americans each year (Flegal et al., 2005). It is associated with Type 2 diabetes, coronary heart disease, cardiovascular disease, stroke and hypertension, Alzheimer's disease, and certain forms of cancer (Nordestgaard et al., 2012; Office of the Surgeon General, 2001; Pereira et al., 2005). The Surgeon General laments that if the current trend in obesity continues unabated "… overweight and obesity may soon cause as much preventable disease and death as cigarette smoking" (Office of the Surgeon General, 2001:XIII). In fact, the adverse health consequences associated with obesity may eventually outweigh the positive gains in the public's overall health engendered from declining smoking rates (Stewart et al., 2009).

Despite some exceptions, a large research literature finds that the consumption of an excessive amount of dietary fat, coupled with other factors such as the lack of regular physical exercise, engenders obesity (Bray and Popkin, 1998). However, while the amount of fat consumed by an individual is speculated to be an underlying cause of obesity, not all dietary fats are created equal. Artificial trans fat, namely partially hydrogenated vegetable oil and trans fatty acids, has no known benefit to human health (Institute of Medicine, 2005) and is potentially salient in the development of obesity in humans (Allison et al., 1999; Field et al., 2007; Koh-Banerjee et al., 2003) and in animals (Dorfman, et al., 2009; Kavanagh et al., 2007). Research also finds that a reduction of dietary fat in a person's diet, including artificial trans fat (Bray et al., 2002), results in significant weight loss (Astrup, 1999; Astrup et al., 2000). As Walter C. Willett, Chair of the Department of Nutrition at Harvard School of Public Health asserts, "There is now strongly suggestive information from both epidemiological and animal studies that these changes in type of fat [replacing trans fats with healthy fats] will have a beneficial effect on obesity rates" (Hendry, 2007:1).

Because the consumption of artificial trans fat is correlated with obesity and other health-related problems, a number of different strategies have been devised to help limit an individual's intake of artificial trans fat. These strategies include price incentives, restrictions on advertising of certain foods to children, the mandating of menu labeling, educational campaigns, and voluntary reductions by restaurants. One controversial approach that has gained traction in recent years is the legal requirement that the artificial trans fat contained in the food served in restaurants be eliminated. While it is already legally mandated that prepackaged foods be labeled to disclose the amount of artificial trans fat contained in the product (U.S. Food and Drug Administration, 2003a), restaurants are not typically obligated by governmental fiat to inform the public as to the amount of artificial trans fat contained in the food that they serve. This situation of nondisclosure is further exacerbated not only by the fact that the public obtains approximately one third of its daily caloric intake from the food served in restaurants (Guthrie et al., 2002), but that the public also generally underestimates the caloric content of this food (Variyam and Golan, 2002).

The banning of artificial trans fat in restaurant food is not without controversy, however. The restaurant industry as a whole opposes legally imposed artificial trans fat bans because they undermine freetrade and competition, they are costly to the restaurant industry in that the removal of artificial trans fat from foods is expensive and because they lessen the profits of restaurants by impacting adversely the taste and desirability of the food served (Gostin, 2007).

Yet despite the negative feelings expressed by the restaurant industry, the NYC DHMH (2006) decided in December of 2006 to establish a regulation that prohibited restaurants and other licensed food establishments in the city from serving food that contained more than 0.5 grams of artificial trans fat per serving. Dairy products and other foods such as beef that naturally contain trans fat were not affected by the ban. These types of food comprise about 21% of a person’s total trans fat intake (U.S. Food and Drug Administration, 2003b). In an effort not to overly burden restaurants in the city, the ban was implemented in phases. Artificial trans fat had to be eliminated from fry oils and spreads within six months and from all food within 18 months from the introduction of the ban in December of 2006. Restaurants were also furnished technical assistance to assist them in complying with the requirements of the ban. Fines for noncompliance ranged from $200 to $2,000 dollars.

A vexing question that remains unanswered is whether the artificial trans fat ban markedly improved the health of NYC residents (Satin, 2010). This ambiguity is somewhat disconcerting when one considers that the legal justification for the ban was rooted in the logic that the state can dictate what an individual eats in order to protect the health of its citizens (Kruk, 2010; Spivey, 2007). The only study conducted to date that we are aware of that evaluates the impact of the NYC’s artificial trans fat ban was an analysis of the fat content of French fries served in fast food restaurants before and after the effective date of the ban (Angell et al., 2009). Artificial trans fat is much more prevalent in fast food than in the food served in traditional restaurants. This study found that on average there was a 54% reduction in the amount of artificial trans fat and saturated fat contained in the French fries served in Wendy's, McDonald's, Arby's and White Castle fast food restaurants.

However, while the findings generated in this study indicated that the amount of artificial trans fat and saturated fat contained in French fries dropped precipitously following the establishment of the artificial trans fat ban, there still remains uncertainty as to whether this decrease actually enhanced the health of NYC residents as the ban had originally intended. It is entirely plausible that "… consumers knowingly or inadvertently offset the benefit of reducing trans fats from some sources by increasing consumption of other sources" or that they "… substitute[d] foods containing saturated fats or high-carbohydrate loads, which impose other adverse health effects" (Gerberding, 2009:137). The ban was also very limited in scope since it "… only applies to the 33% of foods purchased in restaurants, not to the 67% of food purchased in grocery stores and through wholesalers" (Kruk, 2010:874). Thus, because the trans fats naturally occurring in meat and dairy, the products sold in grocery stores containing trans fat and the trans fat products still in their original packaging and sold in restaurants were not regulated by the ban (Rules of the City of New York, 2007), it seems rather likely that such a narrowly targeted ban would have less of quantifiable impact on the health of New Yorkers than similar but more far reaching bans implemented in other countries (Tan, 2009). In sum, then, because previous research only demonstrated that NYC's artificial trans fat ban lessened the amount of artificial trans fat and saturated fat contained in the French fries served in fast food restaurants, there is no empirical evidence currently available that this reduction in trans fat engendered a commiserate improvement in the health of New Yorkers.

In the current study, we further investigate the impact of NYC's artificial trans fat ban. However, we do not aim to replicate the Angell et al. study that simply measured the fat content of French fries served in NYC's fast food restaurants before and after the enactment of the ban. Rather we contribute to the literature by analyzing survey data to ascertain whether the imposition of the artificial trans fat ban improved the health of NYC residents living in the five boroughs by curtailing obesity. We focus on obesity because it is widely regarded as a leading indicator of a person’s overall health (Chrvala and Bulger, 1999), because research shows that a decrease in the consumption of artificial trans fat results in weight loss (Bray et al., 2002) and because an elevated BMI is reported to be a precursor to coronary heart disease (Nordestgaard et al., 2012). Additionally, while NYC’s artificial trans fat ban was aimed primarily at attenuating the prevalence of heart disease among residents of the city (New York City Department of Health and Mental Hygiene, 2006), one of the reasons given by New York City's Health Commissioner for the ban was to deal with the problem of obesity among New Yorkers (Spivey, 2007).

We also felt it warranted to assess whether the influence of the ban on obesity varied by the gender or by the race/ethnicity of the individual. One might speculate that the ban's effect on obesity would be greater for men because women are more predisposed to retain adipose tissue (O’Sullivan, 2008). Thus, because a biological predisposition favors greater fat storage in females as compared to men, it is plausible that men experienced a greater reduction in obesity following the implementation of the ban. Investigating the possibility that race has a conditioning effect is also of salience not only because blacks are 1.4 times more likely than non-Hispanic whites to be obese (National Center for Health Statistics, 2012), but they are also much more apt to consume fast food (Pereira et al., 2005). Fast food consumption is also reported to be elevated among many Hispanic groups (Chatterjee et al., 2005). The artificial trans fat ban might therefore have a noteworthy effect on decreasing obesity among both blacks and Hispanics, notwithstanding whether or not the ban was effective in reducing obesity among New York residents generally.

Data

The demographic and health related data analyzed in this study were obtained from the NYC Community Health Survey for 2005, 2008, 2009, and 2010 (New York City Department of Health and Mental Hygiene, 2012). These surveys, which were conducted before (2005) and after the establishment of the 2006 artificial trans fat ban (2008-2010), employ a stratified sampling procedure to generate both citywide and neighborhood estimates for NYC residents. Survey respondents are non-institutionalized adults aged 18 or older randomly selected from households with a landline telephone. Individuals having cell phones were surveyed beginning in 2009. The sampling frame for each survey was constructed from a telephone number catalogue provided by a private vendor. Computer-assisted telephone interviewing (CATI) was used to collect information from one adult in each household. We combined the surveys and conducted our analyses within each of the five NYC boroughs: Bronx, Brooklyn, Manhattan, Queens, and Staten Island.

Obesity was determined by an individual's BMI, which is calculated by using the height and weight measures reported by respondents. We analyze two measures of obesity in this study. First, survey administrators coded the BMI scores into the appropriate categories for normal weight, overweight and obese. A person is overweight if he or she has a BMI score of 25 to 29.9, whereas an obese individual is someone with a BMI score greater than or equal to 30. We divided the BMI scores into two categories: 1 = obese and 0 = normal weight and overweight. We selected obese versus not obese as our first outcome measure because obese individuals are more inclined than normal and overweight individuals to experience weight loss with a change in diet (Astrup et al., 2000). Our second outcome is the respondent’s BMI, which is measured as an interval variable. We used logistic regression to analyze the dichotomized obesity measure and OLS regression for the interval BMI variable.

The dummy coded artificial trans-fat ban variable (0 = survey conducted in 2005 and 1 = surveys conducted in 2008, 2009 and 2010) represents the exogenous variable of theoretical interest. The expectation is that if the artificial trans-fat ban did effectively reduce obesity, the coefficient for the dummy coded artificial trans fat ban variable should be negative and statistically significant across the five boroughs in both the logistic and regression analyses. In the absence of a substantive and consistent relationship, no impact from the ban on obesity can be inferred.

A number of demographic and economic variables were also incorporated into the analysis as statistical controls. The demographic variables include the sex, age, race/ethnicity, marital status, education, employment status, whether the resident was surveyed by cell phone, and poverty level of the survey respondent. We also added neighborhood poverty level as a control variable. In regards to demographics, the majority of the respondents are female (61%). The average age of a survey respondent is approximately 51 years old. Blacks comprise 24% of the NYC population. The black population is smallest in Staten Island and largest in the Bronx and Brooklyn. Hispanics characterize 25% of the NYC population. Most Hispanics reside in the Bronx, while the Hispanic population is smallest in Staten Island. Only 39% of the respondents are married. Staten Island has the highest average number of married respondents. The remaining four boroughs are below the 50% threshold, suggesting that the typical respondent was not married in these boroughs. Approximately seven percent of the respondents report themselves to be unemployed. Most unemployed residents reside in the Bronx and the lowest number in Staten Island. The average education level in all of the boroughs except Manhattan is between high school graduate and some college or technical school. The average education level in Manhattan is slightly higher with respondents typically having some college or technical school. We also included a control for whether a resident was surveyed by cell phone because the NYC DHMH began surveying New York residents by cell phone in 2009.

Household income is measured as the annual household income from all sources by the poverty level. The average respondent in the Bronx and Brooklyn is between 100-199% of the poverty level. For Manhattan, Queens and Staten Island, the average level of poverty fell in the range of 200-399%. There was also a variable measuring neighborhood poverty level. Staten Island had the lowest resident poverty and highest income of the boroughs (2.57 average with a range of 2 through 3), while the Bronx represented the highest poverty and lowest income of the boroughs (1.42 average with a range of 1 through 2). Brooklyn, Manhattan and the Queens represented the middle of the range for neighborhood poverty and income levels.

There are also several control variables measuring the health status of the survey respondent. These variables include the general health status of the respondent, whether the respondent participates in physical exercise, the average number of sodas consumed per day, alcohol consumption, smoking behavior, whether the respondent has health insurance, whether the respondent has high blood pressure, whether the respondent is depressed, and whether the respondent is psychologically distressed. A majority of New Yorkers reported that they participated in some type of physical activity or exercise that was non-work related in the past 30 days and indicated that their health status on average was very good. On average respondents indicated that they drank less than one soda per day, excluding diet soda and seltzer. Approximately four percent of the respondents indicated that they were heavy drinkers of alcohol, whereas 16% reported that they were current smokers. Thirty-five percent of the subjects reported that they were told by their health care professional that they have high blood pressure. Approximately 88% of the respondents indicated that they have health insurance. Sixteen percent of respondents were informed by their health care professional that they were experiencing depression. Finally, psychological distress was a composite measure of six questions used to appraise a variety of psychological problems. We dichotomized this composite measure to determine the presence (coded 1) or absence (coded 0) of these symptoms. Six percent of the subjects in NYC reported experiencing some form of psychological distress. Table 1 reports the definitions, codings and descriptive statistics for all the variables.

Table 1. Description of Variables Used in the Analysis (N=36,069)

Variable	Mean (SD)	Coding	Definition
Obesity	.24 (.43)	1=yes, 0=no	Body mass index (BMI) is equal or greater than 30.
BMI	26.92 (5.99)	Interval (range 3.11-98.73)	BMI based on for self-reported height and weight.
Trans fat ban	.72 (.45)	1=after ban, 0=before ban	Based on whether the respondent was surveyed before (2005) or after (2008-10) the effective date of the artificial trans fat ban (12/5/06).
Male	.39 (.49)	1=yes, 0=no	Respondent male.
Age	50.83 (17.32)	Interval (range 18-100)	Age in years.
Black	.24 (.43)	1=yes, 0=no	Self-reported black.
Hispanic	.25 (.43)	1=yes, 0=no	Self-reported Hispanic.
Married	.39 (.49)	1=married, 0=otherwise	Currently married.
Education	4.77 (1.27)	1=never attended school or only kindergarten, 2=grades 1-8 (Elementary), 3=grades 9-11 (Some high school), 4=grade 12 or GED (high school graduate), 5=college 1-3 years (some college or technical school),	Highest grade or year of school completed.

		6=college 4 years or more (college graduate)	
Unemployed	.07 (.26)	1=yes, 0=employed/not in labor force	Currently unemployed.
Cell phone	.52 (.50)	1=yes, 0=no	Based on whether the respondent was surveyed before (2005, 2008) or after (2009-10) the CHS began including a cell-phone-only sample in 2009.
Household poverty	3.00 (1.47)	1=0-99%, 2=100-199%, 3=200-399%, 4=400-599%, 5=600+%	Household poverty level based on annual income.
Neighborhood poverty	1.96 (.79)	1=high poverty/low income, 2=median poverty/median income, 3=low poverty/high income	Low, medium and high poverty tertiles are calculated using percent of residents within a neighborhood who are at less than 200% federal poverty level, based on data from the 2000 U.S. Census.
High blood pressure	.35 (.48)	1=yes, 0=no	Told by health care professional that respondent has high blood pressure.
General health status	2.70 (1.16)	1=excellent, 2=very good, 3=good, 4=fair, 5=poor	Self-reported general health status.
Exercise	.71 (.45)	1=yes, 0=no	Participated in physical activities or exercise in past 30 days aside from regular job.
Daily sodas	.38 (1.05)	Interval (range 0-21)	Average number of sodas per day (excludes diet soda and seltzer).
Heavy drinker	.04 (.21)	1=yes, 0=no	More than two alcoholic drinks per day for men; more than one alcoholic drink per day for women.
Smoker	.16 (.36)	1=yes, 0=no	Current smoker.
Insured	.88 (.33)	1=yes, 0=no	Health insurance coverage.
Depression	.16 (.36)	1=yes, 0=no	Told by health care professional that respondent has depression.
Psychological distress	.06 (.23)	1=yes, 0=no	Non-specific psychological distress (NSPD) is a composite measure of six questions regarding anxiety, depression, and other emotional problems.

NOTES: Data are derived from the New York City Department of Health and Mental Hygiene. Community Health Survey 2005, 2008-10; public use dataset accessed on February 5, 2014: http://www.nyc.gov/html/doh/html/data/chs-data.shtml.

Results

We initially constructed two figures depicting the percent obesity and the mean BMI of residents in the five NYC boroughs before and after the artificial trans fat ban. Although only preliminary, a visual inspection of Figures 1 and 2 suggests that the ban had little effect on attenuating the growth of obesity among NYC residents. It appears that obesity increased rather than decreased following the enactment of the artificial trans fat ban in four of the five boroughs. Only in Manhattan did obesity among survey respondents show a slight decline following the establishment of the ban.

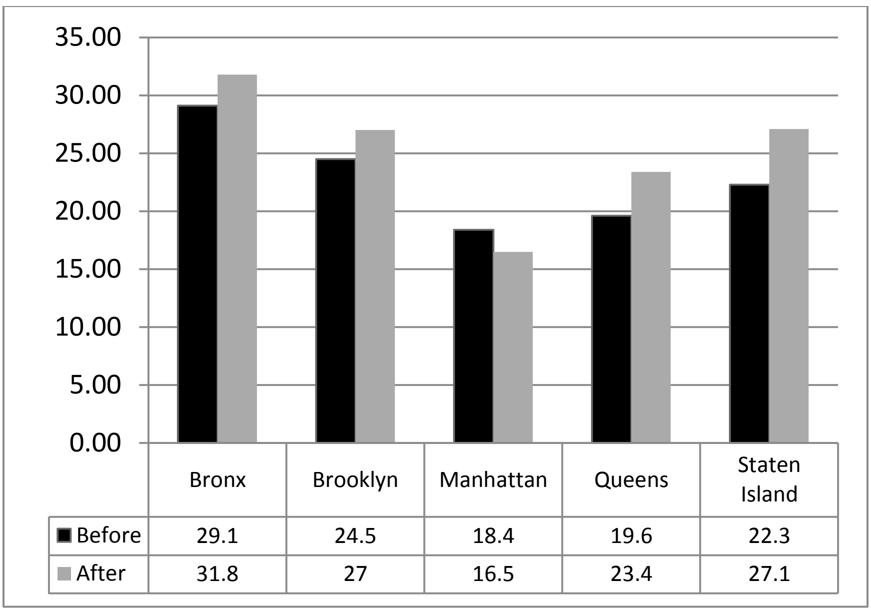

Figure 1. Percent Obesity in NYC’s Boroughs Before and After Artificial Trans Fat Ban

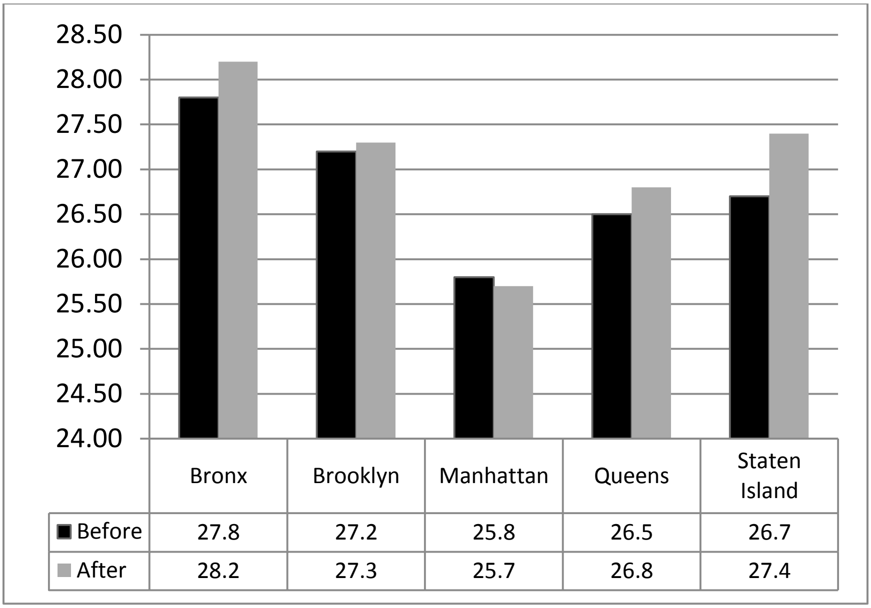

Figure 2. Mean BMI Scores in NYC's Boroughs Before and After Artificial Trans Fat Ban

Logistic Regression Analysis

We first used multivariate logistic regression to assess the effect of the artificial trans fat ban on the probability of a resident being obese in each of the five boroughs. Logistic regression is an appropriate statistical procedure for analyzing a dichotomous dependent variable and it allows utilization of both categorical and continuous independent variables. The regression coefficients from a logistic regression can also be readily translated into easily interpretable odds indicating the change in the likelihood of the dependent variable (probability of obesity) given a unit shift in an independent variable, holding other variables constant. The logistic regression results can be transformed to percent change in the odds of the dependent variable using the following formula for conversion: percent change in the Odds Ratio =

$\left(e^{\beta}-1\right)*100$. The .05 level of significance is the criterion that is used for identifying a salient association between an independent variable and obesity.

The logistic regression results for each of the five NYC boroughs are presented in Table 2. It is important for readers to understand that because of the large number of people surveyed in each of the five boroughs, relatively small differences in the probability of obesity among the independent variables may turn out to be statistically significant. Consequently, when evaluating a variable’s influence on the likelihood of obesity, emphasis should be placed on the direction, magnitude and consistency of the variable’s impact across the five boroughs.

The results reported in Table 2 fail to show a discernible negative relationship between the dummy coded variable measuring the artificial trans fat ban and the likelihood of obesity as defined by an individual's BMI score in any of the five NYC boroughs. Only in Queens is the effect substantive, but it is in the positive direction. One can interpret the small and generally consistent null effect of the dummy coded ban variable as evidence against the assertion that the artificial trans fat ban reduced obesity in the population to any substantial degree because NYC residents in each of the boroughs, controlling for other factors, were no less likely to be obese following the implementation of the artificial trans fat ban. This finding suggests that the ban had little effect on improving the general health of NYC residents.

However, while the effect of the artificial trans fat ban was not substantively negative in any of the estimated equations, a number of the other independent variables did have a discernible impact on the probability of a NYC resident being obese. As noted in Table 2, individuals taking blood pressure medication, those reporting a poorer health status, those less physically active and younger respondents were all more apt to be obese in each of the five boroughs. The probability of a resident on blood pressure medication being obese was

115% higher in the Bronx, 135% higher in Brooklyn, 142% higher in Manhattan, 98% percent higher in Queens, and 162% higher in Staten Island. The effects of general health status and physical activity level can be interpreted in a similar way. A respondent reporting that he or she had poor general health was 20% more likely in the Bronx, 24% more likely in Brooklyn, 30% more likely in Manhattan, 31% more likely in Queens, and 26% more apt in Staten Island to be obese. Physical activity was also associated with obesity in all the boroughs. Similar to the findings of previous research, the more frequently a person participated in physical activity the less likely he or she was to be obese. As physical activity rose, the likelihood of obesity was curtailed 19% in the Bronx, 29% in Brooklyn, 26% in Manhattan, 31% in Queens, and 28% in Staten Island. Finally, younger respondents have a greater proclivity to be obese in each of the five boroughs.

The depression and race variables also have relatively strong and consistent effects as shown in Table 2. These two variables were substantive in four of the five equations estimated. These effects are similar to those identified in previous research. In all the boroughs, except for the Bronx, depressed residents were more likely to be obese. Black residents also had a more pronounced chance of being obese in all the boroughs, except for Staten Island. When a respondent was black, the odds of he or she being obese was amplified by 82% in the Bronx, 70% in Brooklyn, 203% in Manhattan, and by 103% in Queens. A final and somewhat consistent effect was whether the respondent was Hispanic. The likelihood of obesity tended to be much greater for Hispanics in three of the five boroughs. Hispanics experienced a 56% elevation in the odds of obesity in the Bronx, 35% in Brooklyn, and 48% in Manhattan.

Finally, while the results generated in the logistic regression equations reported in Table 2 suggest that the ban had little effect on influencing obesity, one issue of salience is whether certain demographic characteristics of the survey respondent condition the relationship between the artificial trans fat ban and obesity. These potentially salient demographic characteristics include the gender and race/ethnicity of the resident. The most straightforward method for detecting an interaction effect is to include product terms in each of the equations. To determine whether the artificial trans fat affected males and females differently in regards to obesity, a gender x artificial trans fat ban product term was included in all five models.[2] Although such an interaction effect is plausible when one considers that women are more predisposed than men to retain adipose tissue, our results show little evidence of a conditioning effect because the artificial trans fat ban did not impact men and women differently. We also included a race x artificial trans fat ban product term and a Hispanic x artificial trans fat ban product term in all the estimated equations. The coefficient for the race product term also fails to reach statistical significance in any of the five equations, thereby casting doubt on the possibility that the effect of the ban reduced obesity among blacks more than it did among non-Hispanic whites. Lastly, our results show that the Hispanic x artificial trans fat ban interaction variable failed to reach statistical significance in any of the five equations. Such a finding casts doubt on the idea that weight loss was more pronounced among Hispanics living in NYC following the implementation of the ban.

[2] Dummy coded variables need not be centered prior to the creation of the multiplicative term.

Table 2. Logistic Regression Models Estimating the Effect of New York City's Artificial Trans Fat Ban on Obesity

	Model 1 Bronx	Model 2 Brooklyn	Model 3 Manhattan	Model 4 Queens	Model 5 Staten Island
Trans fat ban	.204 (.222)	.213 (.122)	-.025 (.175)	.275 (.133)*	.223 (.204)
Male	-.277 (.145)	-.128 (.106)	-.142 (.152)	-.056 (.126)	.269 (.213)
Age	-.013 (.002)***	-.006 (.002)**	-.010 (.003)***	-.010 (.002)***	-.011 (.004)**
Black	.600 (.214)**	.532 (.118)***	1.109 (.192)***	.711 (.149)***	.369 (.326)
Hispanic	.444 (.210)*	.298 (.138)*	.390 (.194)*	.195 (.154)	-.535 (.366)
Married	.006 (.076)	.062 (.059)	-.289 (.085)***	.026 (.063)	.056 (.112)
Education	-.033 (.031)	-.034 (.026)	-.050 (.036)	-.130 (.029)***	-.078 (.056)
Unemployed	.033 (.121)	.035 (.104)	-.040 (.145)	.179 (.121)	-.061 (.245)
Cell phone	.026 (.083)	-.003 (.070)	.069 (.092)	.063 (.075)	-.066 (.134)
Household poverty	.007 (.032)	-.021 (.023)	-.037 (.033)	.128 (.027)***	.022 (.047)
Neighborhood poverty	-.029 (.074)	-.013 (.044)	-.108 (.050)*	-.071 (.050)	-.201 (.112)
High blood pressure	.767 (.077)***	.853 (.063)***	.884 (.082)***	.683 (.069)***	.964 (.120)***
General health status	.181 (.034)***	.220 (.028)***	.267 (.037)***	.271 (.032)***	.235 (.054)***
Exercise	-.216 (.070)**	-.349 (.058)***	-.307 (.083)***	-.366 (.066)***	-.332 (.117)**
Daily sodas	.027 (.027)	.041 (.023)	.090 (.032)**	.029 (.032)	-.026 (.052)
Heavy drinker	-.082 (.179)	-.135 (.155)	-.046 (.149)	-.420 (.181)*	.253 (.254)
Smoker	-.206 (.090)*	-.077 (.075)	-.144 (.103)	-.189 (.090)*	-.287 (.141)*
Insured	.180 (.100)	-.025 (.082)	.005 (.124)	.044 (.096)	.365 (.229)
Depression	.155 (.092)	.163 (.079)*	.389 (.088)***	.426 (.089)***	.292 (.151)*
Psychological distress	-.128 (.128)	.134 (.110)	-.267 (.154)	-.271 (.139)*	-.373 (.257)
Trans fat ban x male	.035 (.165)	-.105 (.125)	.238 (.173)	-.023 (.143)	-.041 (.244)
Trans fat ban x black	-.023 (.241)	.002 (.137)	-.025 (.207)	-.084 (.171)	-.083 (.381)
Trans fat ban x Hispanic	-.090 (.232)	.080 (.159)	.082 (.203)	-.047 (.174)	.462 (.400)
Constant	-1.286	-1.613	-1.675	-1.523	-.983
Nagelkerke R^2	.087	.124	.202	.106	.118
Valid N	4633	7745	6418	6730	2083

NOTES:
$*p \leq .05$; $**p \leq .01$; $***p \leq .001$ (two-tailed tests).

Ordinary Least Squares Regression Analysis

We next employed Ordinary Least Squares (OLS) regression to discern whether the artificial trans fat ban influenced the BMI of NYC residents, while accounting for other factors theorized to be related to obesity. This statistical procedure is appropriate for analyzing an interval dependent variable. If the ban did reduce obesity, we would naturally expect to find a substantive and consistent negative effect of the intervention variable on a respondent's BMI across the five boroughs. Table 3 reports the results of the regression equations estimating the impact of the artificial trans fat ban variable, the control variables and the three interaction variables on a respondent's BMI in each of the five boroughs. Similar to the logistic regression results, there is no substantive negative relationship between the dummy coded variable measuring the implementation of the artificial trans fat ban and an individual's BMI in any of the five boroughs. The null effect of the dummy coded artificial trans fat ban variable furnishes further evidence that the ban did not reduce obesity among New Yorkers to any substantial degree. The effects of the control variables are also compatible with those reported in Table 2. BMI scores are higher for younger individuals, for black and Hispanic residents, for people taking blood pressure medication, for individuals with a poor general health status, and for emotionally depressed individuals. Results also show that the coefficients for the smoking and gender variables are now notable in several of the equations. Being a male and smoking all amplify a person’s BMI. None of the other variables is consistently salient across the models. The R^2s ranged from 7.4% to 17.6%. Overall, then, these findings are similar to those reported in Table 2 and buttress the position that the artificial trans fat ban had little effect on improving the general health of NYC residents.[3]

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[3] An examination of Variance Inflation Factors (VIF) for all the estimated models indicated that multicollinearity did not influence our results adversely.

Table 3. OLS Regression Models Estimating the Effect of New York City's Artificial Trans Fat Ban on BMI

	Model 1	Model 2	Model 3	Model 4	Model 5
	Bronx	Brooklyn	Manhattan	Queens	Staten Island
Trans fat ban	.266 (.547)	.155 (.279)	.219 (.278)	.365 (.276)	.305 (.452)
Male	-.632 (.390)	.363 (.246)	1.010 (.274)***	.543 (.263)*	1.685 (.467)***
Age	-.028 (.007)***	-.005 (.005)	-.016 (.004)***	-.022 (.005)***	-.020 (.009)*
Black	2.057 (.537)***	1.738 (.277)***	2.814 (.378)***	2.034 (.336)***	1.089 (.774)
Hispanic	1.142 (.521)*	.792 (.328)*	1.221 (.349)***	1.129 (.324)***	-.919 (.713)
Married	-.044 (.209)	.159 (.142)	-.229 (.143)	.107 (.139)	.006 (.255)
Education	-.147 (.087)	-.107 (.065)	-.135 (.074)	-.216 (.066)***	-.193 (.129)
Unemployed	.091 (.344)	.310 (.258)	.058 (.275)	-.180 (.276)	.563 (.552)
Cell phone	.191 (.234)	-.170 (.172)	.018 (.164)	.251 (.169)	.154 (.310)
Household poverty	.067 (.087)	-.047 (.056)	.071 (.061)	.295 (.059)***	.092 (.108)
Neighborhood poverty	-.216 (.207)	.011 (.106)	-.329 (.092)***	-.148 (.112)	-.488 (.255)
High blood pressure	2.385 (.218)***	2.616 (.159)***	2.239 (.160)***	2.277 (.158)***	2.878 (.288)***
General health status	.486 (.093)***	.531 (.068)***	.609 (.069)***	.657 (.069)***	.675 (.123)***
Exercise	-.588 (.200)**	-.939 (.149)***	-.657 (.169)***	-.816 (.153)***	-.674 (.278)**
Daily sodas	-.009 (.078)	.118 (.059)*	.225 (.069)***	-.006 (.075)	-.040 (.119)
Heavy drinker	-.088 (.481)	-.585 (.346)	-.323 (.239)	-.817 (.356)*	.621 (.589)
Smoker	-1.012 (.247)***	-.222 (.181)	-.580 (.190)**	-.492 (.194)**	-.854 (.309)**
Insured	.634 (.277)*	.331 (.202)	.160 (.238)	.165 (.210)	.679 (.481)
Depression	.771 (.262)**	.772 (.198)***	1.041 (.167)***	1.103 (.211)***	.607 (.362)
Psychological distress	.004 (.369)	-.160 (.292)	-.328 (.330)	-.287 (.324)	-.525 (.592)
Trans fat ban x male	.466 (.444)	-.054 (.294)	.396 (.311)	.004 (.305)	-.175 (.541)
Trans fat ban x black	-.366 (.610)	.263 (.326)	.135 (.414)	-.339 (.390)	-.481 (.904)
Trans fat ban x Hispanic	-.011 (.579)	.528 (.383)	.428 (.370)	-.428 (.373)	1.491 (.810)
Constant	26.592	25.065	24.448	25.107	26.511
R^2	.074	.111	.176	.097	.129
Valid N	4561	7644	6332	6627	2051

NOTES:
$^*p \leq .05$; $^{**}p \leq .01$; $^{***}p \leq .001$ (two-tailed tests).

Conclusion

In December of 2006, the NYC DHMH imposed an artificial trans fat ban in the hope that the elimination of artificial trans fat in restaurant food would improve the health of New Yorkers. However, despite the legal requirement that the artificial trans fat ban enhance the health of New Yorkers (Kruk, 2010; Spivey, 2007), empirical research on the effectiveness of the ban has focused exclusively on whether the imposition of the ban lessened the amount of artificial trans fat and saturated fat contained in the food served in fast food restaurants. This research finds that the artificial trans fat ban did curtail the amount of artificial trans fat and saturated fat served in fast food restaurants. However, there is no empirical verification to date as to whether this observed reduction in the amount of artificial trans fat contained in fast food actually enhanced the health of New Yorkers to any substantial degree. Just because the amount of artificial trans fat was attenuated in fast food following the establishment of artificial trans fat ban does not necessarily signify that the ban improved the health of New Yorkers to any substantial degree since any health benefit derived from a reduction of dietary fat in a person’s diet may simply be counterbalanced by an amplification in the consumption of carbohydrates (Gerberding, 2009). The artificial trans fat ban was also so narrowly circumscribed it seems unlikely that it would have any marked impact on a health related outcome such as obesity.

The study conducted here analyzed data drawn from several representative surveys of New Yorkers before and after the imposition of the artificial trans fat ban to determine whether the ban was effective in reducing obesity among NYC residents. We speculated that if the artificial trans fat ban was efficacious in attenuating obesity, there should be a noteworthy decrease in the obesity of individuals surveyed following the implementation of the ban. However, while it was postulated that New Yorkers would be "healthier and thinner" following the implementation of the ban (Lancet, 2006:2106), our analyses showed little change in the BMI of NYC residents following the enactment of the ban. We also found little empirical evidence that an individual's gender, race and or ethnicity moderated the effect of the ban on obesity. The BMI of males did not decrease markedly following the implementation of the ban. Additionally, although blacks and Hispanics generally consume high amounts of artificial trans fat, neither demographic group showed any substantive decrease in their level of obesity after the ban.

Certain caveats should be contemplated when evaluating the import of our results. First, the findings reported here must be replicated before they can be accepted without question. The more frequently such research is undertaken, the greater confidence we can place in the generalizability of our findings. Second, because the ban was implemented throughout NYC, we lacked a control group of untreated New Yorkers for comparison. Although the increase in the prevalence of obesity was slightly higher in New York City (2.3%) than that experienced nationally (2.1%) from 2005 to 2010, it is still difficult to completely refute the possibility that implementation of the ban blunted the growth in obesity among New Yorkers without a randomized controlled study. It is also conceivable that our inability to discern evidence supporting the effectiveness of the artificial trans fat ban in reducing obesity may be attributable to the survey data being aggregated to the borough level. While we believe that borough is an appropriate unit for testing the impact of the ban since the ban applied to all the boroughs and this aggregation is large enough to allow for a sufficient range of variation in the BMI scores in the population, one can probably make a reasonable argument that a more homogenous geographical unit of analysis such as census tract might be needed to evince a substantive artificial trans fat ban effect because obesity (Ludwig et al., 2011) and fast food restaurants (Block et al., 2004) tend to be concentrated in certain neighborhoods. Future research might wish to consider this possibility. Fourth, our findings should be tempered by the fact that because we use two measures of obesity based on the BMI, we cannot definitely say what the effect of the ban might be for other outcome measures of obesity such as the shoulder-to-waist ratio. Although the BMI is used commonly to measure obesity, it is problematic in certain respects (Rothman, 2008). Our study is limited to the BMI because this is the only measure of obesity available in the dataset we analyze. Further insight into the effectiveness of legally mandated artificial trans fat bans on obesity might wish to use richer datasets that include other measures of obesity. Finally, the underlying causal mechanisms responsible for the null effect of the artificial trans fat ban on obesity needs to be addressed in future research. The analysis of detailed information on people's dining habits before and after the ban may be able to furnish additional insight into why the artificial trans fat did not decrease obesity among New Yorkers to any noteworthy degree.

The effect of artificial trans fat bans on the health of the public is an important question that is raised frequently, but with scant empirical evidence on which to base definitive answers. The purpose of this study was to help shed additional light on this issue. Although our findings suggest that the implementation of NYC's artificial trans fat ban did little to attenuate obesity among New Yorkers, policymakers might wish to consider further empirical evaluations of these bans on obesity and on other health related outcomes to more fully determine whether they are effective in improving public health.

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