AN EXAMINATION OF COMMUNITY AND CONSUMER TOBACCO AND FOOD
RETAIL ENVIRONMENTS

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ABSTRACT

Heather D'Angelo: An Examination of Community and Consumer Tobacco and Food Retail
Environments
(Under the direction of Kurt M. Ribisl)

Community and consumer tobacco and food environments may contribute to

neighborhoods that either support or limit health promoting choices. Tobacco use and dietary

intake behaviors consolidate early in life and track over time; yet tobacco and food environments

are often studied independently. The three studies in this dissertation examine the intersection of

tobacco and food environments at the community and consumer levels. Studies One and Two

examine the availability of tobacco outlets and fast food restaurants surrounding public schools

(n=18,379) in a national sample of 97 counties within 40 states. Study One used spatial point

pattern analysis to examine whether tobacco outlets and fast food restaurants cluster around

schools. Significant clustering of tobacco outlets occurred as close as 200 m from all schools.

Significant clustering of fast food restaurants occurred as close as 200 m from schools in cities

and suburbs, and within 600 m of schools in rural areas. Study Two used generalized linear

mixed models to examine whether tobacco outlet and fast food restaurant availability within an

800 m radial buffer of schools was associated with student socioeconomic status and

race/ethnicity. The odds of having both a tobacco outlet and fast food restaurant near a school

increased by 5% for every 10% increase in the percentage of Hispanic students (IRR 1.05, 95%

CI 1.03, 1.07) and by 3% for every 10% increase in low income students (IRR 1.03, 95% CI

1.01, 1.05). Study Three examined the consumer tobacco and food environment within rural, small food stores and used the Diffusion of Innovation (DOI) to investigate retailer (n=55) perceptions of the availability, display and promotion of tobacco products and healthy foods. Retailers with greater perceived *relative advantage* were more willing to sell and display more healthy foods and beverages, but DOI constructs were not associated with willingness to reduce tobacco products and marketing. The three studies in this dissertation have implications for using land use planning, zoning and licensing ordinances to improve the retail tobacco and food environments at both the community and consumer level.

To J and K, I love you to the moon and back.

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CHAPTER 1. INTRODUCTION

Problem Statement

Obesity and tobacco use are risk factors for cardiovascular disease and many forms of cancer, and disparities in both exist by socioeconomic status, race/ethnicity, and geography.[1, 2] Rates of obesity are higher among non-Hispanic Black and Hispanic youth compared with non-Hispanic White youth,[3] and rates of current smoking are higher among those living at or below the poverty level than among those living above the poverty level.[4] In terms of geography, obesity rates are higher, and the prevalence of current smoking is greater among adults living in rural compared with urban counties, particularly in the rural Southern United States (U.S.).[5, 6]

In 2007-2008, 33% of children and 41% of adolescents consumed fast food in the prior 24-hours,[7] and Black and Hispanic children are more likely to consume fast food and sugar sweetened beverages compared with White children.[8] Dietary habits and obesity developed in childhood or adolescence may track into adulthood,[9, 10] and unhealthy behaviors, such as smoking and poor dietary intake, appear to covary,[7] consolidate early[11] and track together over time.[9, 12] In a meta-analysis of 51 nutritional studies, compared with non-smokers, smokers had poorer diets, including higher total energy intake and lower intakes of fiber, vitamin C, iron, calcium, and beta carotene.[13] Adolescents who smoke tend to have poorer diets[9] and consume more fast food[11] compared with non-smokers. Therefore, intervening early to prevent the adoption of unhealthy behaviors is critical. A growing body of research examining the influence of the built environment on youth health behaviors and outcomes has found associations between the availability of retail outlets and dietary intake, obesity and tobacco use.

In separate lines of research, the availability of retail tobacco and food outlets have been associated with obesity[14] and smoking[15], and may contribute to a neighborhood that either supports or limits health promoting choices. Tobacco and food environments are often studied independently, yet they occur together, not in isolation, within neighborhoods. In nutrition environment research, Glanz et al.[16] distinguish between the *community environment*, the type and location of food outlets and restaurants, and the *consumer environment*, the availability, price, promotion, and placement of foods within food outlets and restaurants. Community and consumer distinctions have also been applied to retail tobacco environments.[17] At the community level, the availability of tobacco outlets has been associated with youth smoking initiation,[18] and the availability of fast food restaurants has been associated with higher youth Body Mass Index (BMI).[19] At the consumer level, exposure to tobacco marketing at the point-of-sale (POS) has been associated with youth smoking initiation and undermines quit attempts among adults,[20] while healthy food availability within retail food stores has been associated with consuming more healthy foods.[21, 22]

Examining tobacco and food retail environments together provides an opportunity to examine how environmental factors may influence both dietary intake and tobacco use. The studies in this dissertation examine the intersection of tobacco and food retail environments at the community and consumer levels to assess dimensions of the built environment that may be related to health disparities observed by race/ethnicity, income, or geography.

Studies One and Two examine fast food restaurants (FFR) and tobacco outlets (TO) surrounding schools in 97 counties spanning 40 states, and representing 25.7% of the U.S. population. Fast food restaurants and tobacco outlets were examined because they have both been implicated in adolescent health behaviors and outcomes, and both have the potential to be

regulated by licensing or zoning ordinances.[23] Study One uses spatial analysis to examine whether FFR and TO cluster around schools in a national sample of counties selected as part of a larger study, Advancing Science and Policy in the Retail Environment (ASPiRE, Grant Number: U01 CA154281). Study Two examines whether FFR and TO availability near schools is associated with school demographic characteristics, including student socioeconomic status and race/ethnicity.

Study Three investigates the consumer tobacco and food retail environment in small food stores in rural North Carolina through a cross-sectional retailer questionnaire and in-store observation. Small food stores, such as convenience stores, are an important venue for both improving healthy food availability and reducing access to tobacco products, particularly among youth. Convenience stores also present a more readily changed environment compared with a fast food restaurant that often have fixed menus and are operated as chains or franchises without local ownership. Using the Diffusions of Innovations (DOI) framework, retailers' perceived attributes of implementing strategies to increase the availability, display, and promotion of healthy foods and reduce the availability, display and promotion of tobacco products were assessed, and linked to the actual products, displays and promotions within stores. The research questions for each study are:

Study One: Do fast food and tobacco outlets cluster around public schools in a sample of 97 counties in the contiguous U.S.?

Study Two: What is the association between school socio-demographic characteristics and fast food restaurant and tobacco outlet availability near public schools in a sample of 97 counties in the contiguous U.S.?

Study Three: Are the perceived attributes of implementing a healthy store strategy associated with retailer willingness to a) increase the availability, display, and promotion of *healthy foods and beverages* and b) reduce the availability, display, and promotion of *tobacco products* and in turn, is retailer willingness to implement a healthy store strategy associated with actual implementation, or the observed in-store availability, promotion and display of a) *healthy foods and beverages* and b) *tobacco products.*

Significance of the Proposed Research

Studies One and Two

The proposed studies will contribute to a broader understanding of the community retail environment surrounding public schools in the U.S. by examining access to both fast food and tobacco outlets. Given the disproportionate rates of obesity, cardiovascular disease, and some cancers observed among racial and ethnic minority populations,[24, 25] understanding access to unhealthy foods and tobacco products and marketing can help to understand "upstream" determinants of population health.[26] These studies will contribute to a greater understanding of the distribution of fast food restaurants and tobacco outlets by utilizing a national dataset to explore whether there is spatial clustering of outlets around schools. No studies to our knowledge have examined the spatial clustering of fast food and tobacco outlets near schools. Of the studies that have assessed fast food restaurants near schools, only two have been on a national scale[27, 28] and neither of these examined spatial clustering. No studies examining the availability of tobacco outlets near schools have been on a national scale and only one study (in New York City) assessed whether there was a spatial association between tobacco outlets and schools.[29] Further, there are no national studies of socioeconomic or racial/ethnic disparities in tobacco outlet availability near schools.

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There is growing interest in policies and programs that address multiple health behaviors that contribute to the burden of chronic disease.[30] Examining the availability of fast food and tobacco outlets near schools is important to inform policies that could improve children's health. Adolescence is a critical period of development when health behaviors adopted may be sustained over time.[12] Studies have found that adolescents frequently shop at tobacco outlets such as convenience stores[31, 32] and eat at fast food restaurants,[33] which has been associated with youth smoking initiation and consuming more calories, fat, sodium, and sugar-sweetened beverages, respectively.[34, 35] Through zoning or licensing restrictions, communities could limit the number of fast food or tobacco outlets, or create buffer zones around schools and other youth focused areas (e.g. playgrounds) where no fast food or tobacco outlets could zoning[23]. Making health promoting changes at the policy level through land use policies would allow for sustained environmental change that could improve the health behaviors of children and track into adulthood to improve the health of future generations of children and families.

Study Three

Study Three builds on previous studies by using the Diffusion of Innovations as a framework to examine retailers' perceptions regarding the sale and promotion of healthy foods and tobacco products in the context of the perceived attributes of an innovation. In this case, the innovation is the implementation of strategies to increase the availability, display and promotion of healthier foods and decrease the availability, display, and promotion of tobacco products. Previous studies examining retailer perceptions of selling healthier foods have primarily been conducted in urban and suburban locations in the Northeast and Mid-Atlantic regions; whereas, our study includes retailers in a rural location in the South. No studies to our knowledge have assessed small food retailer perspectives on decreasing dependence on tobacco products.

Healthy stores interventions and programs have mostly taken place in urban food deserts in cities including Baltimore, Philadelphia, New York, and Minneapolis.[36, 37] Yet, many people in *rural* areas also may not have easy access to large supermarkets;[38, 39] therefore small food stores play an important role in providing staple foods between supermarket trips. This study will add to our understanding of the unique challenges that rural food retailers may face in order to stock healthy foods in their stores. This can inform future retailer interventions and the development of local licensing ordinances to not only improve healthy food access, but also minimize exposure to tobacco products and marketing at the point-of-sale. Previous research has shown that many retailers do not stock healthy food because they believe that their customers will not buy it.[40] Yet, customers cannot buy what is not available, making it difficult to demonstrate customer demand. A goal of this study is to learn more about small food retailers as part of a broader effort to ultimately break this cycle. Further, we will examine the determinants of selling and promoting tobacco products, and identify potential leverage points to encourage retailers to limit tobacco products and marketing within their stores.

CHAPTER 2. LITERATURE REVIEW

Obesity and Tobacco Use Among Youth

Obesity and tobacco use are risk factors for cardiovascular disease and many forms of cancer, and disparities in both of these risk factors exist by socioeconomic status and race/ethnicity.[1, 2] Rates of obesity are highest among non-Hispanic Black ("Black") and Hispanic youth compared with non-Hispanic White ("White") youth.[3] In 2007-2008, over a third of children and 40% of adolescents consumed fast food in the previous day.[34] Black and Hispanic youth are also more likely to consume fast food and sugar sweetened beverages compared with White youth,[8] and consuming fast food has been associated with increased intake of total energy, fat, sodium, and sugar-sweetened beverages among youth.[34, 35]

Rates of current tobacco use are highest among White high school students; however, in 2012 current tobacco use among middle school students was higher for Hispanic students (10.5%) compared with White students (5.1%), and cigar use was highest among Black high school students compared with both White and Hispanic students.[41] Rates of smoking initiation are highest among lower income youth of all race/ethnicities.[42, 43] Given that about 90% of adult smokers initiate smoking by age 18,[44] early intervention among vulnerable populations is critical. Similarly, dietary habits and obesity developed in adolescence may track into adulthood,[9, 10] and unhealthy behaviors, such as smoking and poor dietary intake, appear to covary,[7] consolidate early[11] and track together over time.[9, 12]

Adolescent Health Behavior Adoption and Consolidation

Adolescence is a critical period of development when youth tend to take more risks and make poor decisions.[45] There is evidence that adolescents may consolidate multiple health risk behaviors. Students in the U.S. who use alcohol and drugs are more likely to use tobacco products.[46, 47] Among a sample of 145 high school students in St. Paul/Minneapolis, smoking cigarettes was positively associated with soda consumption, eating high fat foods and patronizing fast food restaurants.[48] A larger study of middle and high school students (n=4756) in the same city found that adolescents who smoked consumed fast food more frequently, and consumed more soda and fewer servings of fruits and vegetables per day compared with non-smokers.[11] In Virginia, a study of middle and high school students (n=10,635) found that smokers consumed vegetables and milk/dairy products less frequently compared with non-smokers.[49]

Behaviors developed in adolescence may also track into adulthood. A study of adolescents (6th through 12th grade) followed over 7 years found that not only did students consolidate smoking, physical inactivity, and poor food choice behaviors early on,[9] but also that these behaviors tracked over the 7 year period.[12] That is, over time adolescents who smoke are less likely to quit smoking, those who have low levels of physical activity are less likely to become more physically active, and those with poor diets are less likely to consume more healthy foods. Given that in adolescence, there is clustering of multiple unhealthy behaviors, specifically tobacco use and poor diet, examining the potential influence of the location of fast food restaurants and tobacco outlets near schools will help to understand multiple environmental determinants of behavior adoption. The next section describes associations between adolescent health and fast food and tobacco outlet availability near schools, and although they were assessed

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independently, they point towards a mechanism by which adolescents might adopt *multiple* unhealthy behaviors.

Community Food and Tobacco Environments

Associations with Youth Health Outcomes

Health disparities observed among racial/ethnic minority and low income populations have driven research into assessing inequalities in neighborhood access to health promoting resources as possible explanations.[50] The availability supermarkets, convenience stores, parks and playgrounds, has been associated with obesity[14], smoking[15] and physical activity,[51] respectively. While features of the community environment are often studied independently, they occur together, not in isolation, within neighborhoods. Smiley et al[52] found that the densities of supermarkets/produce stores, retail areas, and recreational facilities were correlated with each other, and that African American neighborhoods tended to have multiple low resource densities.[52] This review will identify studies that have examined the availability of fast food and tobacco outlets in association with youth health outcomes and make the case that examining both food and tobacco outlets together is necessary to gain a more robust understanding of the overall environmental influences on health.

Living near fast food restaurants has been associated with higher BMI,[53] consuming more fast food[54, 55] and fewer healthy foods[53, 55, 56] among adolescents. In a study of neighborhood food environments and adolescent diet and health, living near fast food restaurants, convenience stores and grocery stores was associated with increased sugar sweetened beverage consumption, while living near a convenience store was also associated with higher BMI.[57] A three-year longitudinal study found that a convenience store within 0.25 miles of a girl's home was associated with a 3.38 greater odds of obesity or overweight, while produce/farmer's markets within 1 mile

reduced the risk of overweight or obesity by nearly 80%.[58] However, another study found that BMI among New York City high school students was inversely associated with the availability of fast food restaurants (and, as a placebo test, banks) in the census tract where students homes were located, after controlling for individual and neighborhood level characteristics.[59] The discrepant finding of this study may be due to the unique retail mix in New York City neighborhoods and the use of a census tract to define the neighborhood. The next section describes studies that have examined fast food and tobacco outlet availability in *school* neighborhoods in association with youth health behaviors and outcomes.

Alviola et al. examined FFR availability near schools and found that the presence of a FFR within 1 mile of a school was associated with a 1.23% increase in BMI among students, after accounting for school proximity to a highway interstate.[60] Using a sample of over 3 million ninth grade students, Currie found that a FFR within 0.1 miles of a school was associated with an increased obesity incidence of 5.2%.[61] Davis and Carpenter found that among a sample of over 500,000 middle and high school students, having a FFR near their schools was associated with consuming fewer fruits and vegetables, more soda, and increased the odds of being overweight or obese by 6 and 7%, respectively.[62] Powell et al. found that greater convenience store availability in school neighborhoods (by zip code) was associated with significantly higher BMI and overweight in a repeated cross-sectional study of over 70,000 adolescents.[19] Convenience store proximity to schools has also been associated with higher school obesity rates,[63] and kids shopping at convenience stores near schools purchase high amounts of energy dense, low nutrient foods.[31] Finally, two studies have found null results when examining the association between adolescent diet[64] and weight[65] with FFR near schools.

TO availability within school neighborhoods has been associated with adolescents ever smoking,[66, 67] smoking susceptibility,[68] school smoking prevalence,[69, 70] and students purchasing their own cigarettes.[70] Over 75% of adolescents in the U.S. have reported exposure to tobacco marketing in retail stores.[71] Convenience stores are frequented by children on the way to and from school, particularly in low income urban areas.[31] A study of convenience stores surrounding schools in Minneapolis found that 87% of stores had exterior tobacco advertising and stores carried few healthy foods.[72] Exposure to tobacco outlets and in turn, tobacco marketing at the point-of-sale has been associated with youth smoking in both cross sectional and longitudinal studies. Over 60% of a sample of middle school students in California (n=2125) visited tobacco outlets once a week or more frequently, which was associated with a 50% greater odds of ever smoking.[32] A longitudinal study in California found that students who shopped at stores selling tobacco products two or more times a week had 2.58 times the odds of smoking initiation compared to students who shopped less than once a week. [73] In contrast, one study found no association between TO availability and adolescent smoking outcomes after controlling for multiple individual risk factors, including peer smoking status.[74]

The availability of FFR and TO near adolescents' homes and schools is an important contextual factor to consider when examining correlates with adolescent dietary intake and smoking. Although there are some mixed results, the evidence suggests that a higher availability of FFR near schools influence adolescent dietary intake and BMI, and a higher availability of TO near schools is associated with smoking initiation. The next section examines differences in the availability of FFR and TO near schools by neighborhood or student socio-demographic characteristics.

Fast Food Restaurant and Tobacco Outlets Availability Near Schools

Several studies describe FFR availability surrounding schools. Of these, six were located in the U.S., two in Canada and one in New Zealand. Three used spatial analysis methods to examine whether FFR cluster near schools located in urban areas. [75-77] Using spatial analysis allows for the determination of whether the likelihood is greater for an outlet to be clustered within a certain distance surrounding a school than would be expected if outlet location was unrelated to school location. The majority of studies used 400 and 800 m buffers surrounding schools to account for 5 and 10 minute walking distances. Studies also varied on whether they used road network or straight line (Euclidean) buffers, depending on the data available.

Among the studies using spatial analysis, all found that FFR were significantly clustered around schools. In Chicago, Austin and colleagues found 3 to 4 times as many FFR located within 1.5 km of schools than would be expected if FFR location were not related to school location.[76] FFR were found to cluster near schools in high and moderate commercialization zones and near schools in high income (median household income of block group >\$ 43,700) but not lower income neighborhoods.[76] In New York City, more FFR were clustered around public elementary and high schools with a higher percentage of black students and around schools in block groups with a higher percentage of black residents.[75] However, public high schools in higher income neighborhoods had greater FFR clustering compared to lower income neighborhoods.[75] In New Zealand, schools located in the most socioeconomically deprived neighborhoods had 3 times the number of FFR within 400 m of the school.[77]

Studies that did not use spatial analysis to account for clustering near schools have used ANOVA to examine differences in FFR density and median household income, logistic regression to model the outcome of at least one FFR vs. no FFR located within a buffer

surrounding schools, or negative binomial regression to model the outcome of the count of FFR within school buffers. Two studies examined FFR near all U.S. public middle and high schools.[27, 28] Zenk and Powell[27] found that schools in the lowest income neighborhoods had more FFR and convenience stores nearby, but schools in neighborhoods with a higher proportion of Black residents had fewer FFR and convenience stores nearby, controlling for school size, urbanicity and population density. Sturm[28] examined the presence of FFR, convenience stores, snack stores and liquor stores surrounding schools in the U.S. and found that schools with a higher percentage of Hispanic students and schools with more low income students were more likely to have a FFR within 400m. There was no association between FFR presence near a school and the proportion of Black students.[28] In Montreal, the odds of a FFR being located within 750 m of a low income compared to a high income school was over 30 times greater (OR 30.9, 95% CI 19.6, 48.9), after controlling for commercial density.[78] Another study of public schools in New York City broadened the definition of "unhealthy food sources" to include chain and local FFR, pizzerias, convenience stores, and bodegas near schools.[79] Schools with higher proportions of low-income and Hispanic students had the greatest exposure to all unhealthy food sources. After controlling for population density, subway stops, and proportion of commercially zoned area, the association remained only for bodegas.

Although many of the FFR access studies reviewed also included an analysis of access to store types that sell both food and tobacco products (e.g. convenience, bodegas, grocery stores), few have directly examined tobacco outlet density in school neighborhoods in association with neighborhood characteristics. A study simulating a retailer density reduction policy found that 22% of tobacco outlets in Missouri and 51% in New York were located within 1000 ft. of schools.[80] The effect was more pronounced in urban areas, particularly in New York City where

nearly 80% of retailers were within 1000 ft. of schools.[80] Another study using spatial analysis found significant clustering of TO near schools in New York City, and TO availability was positively associated with population density, commercial zoning, and the percentage of residents receiving public health insurance coverage.[29] However, there was no significant association of TO availability with neighborhood racial/ethnic composition. In Ontario, Canada, about 65% of tobacco outlets were located within 500 m of a schools, with more outlets near schools in lower income neighborhoods.[81] In California, schools with a higher density of tobacco retailers in the school neighborhood had higher proportions of Hispanic students and students receiving free or reduced price lunch.[15]

The available studies examining FFR and TO near schools have found significant clustering around schools in the urban areas studied. The literature on neighborhood disparities in FFR and TO located within walking distance of schools is not conclusive, but points towards higher FFR and TO availability near lower income schools and schools with higher proportion of Hispanic and/or Black/African American students, although this finding is not consistent across studies. By comparison, few studies have examined tobacco outlets near schools in association with school demographic characteristics.

Consumer Food and Tobacco Environments

Healthy Food Availability in the U.S.

In the U.S., 23.5 million people live in a food desert, a low-income census tract where a substantial number or share of residents has low access to a supermarket or large grocery store.[82] Although there have been some mixed findings, low-income and minority neighborhoods tend to have lower access to supermarkets compared to white and higher income neighborhoods.[83, 84] Morland et al found that there were more than four times as many supermarkets in white

compared to black neighborhoods in four U.S. states.[85] A national study found fewer supermarkets and more convenience stores in low income neighborhoods, regardless of neighborhood ethnicity, and overall, predominantly Black and predominantly Hispanic neighborhoods had fewer supermarkets compared to White neighborhoods.[86]

There are also differences in healthy food availability by geography. In urban areas, predominantly Black high poverty areas had fewer supermarkets and convenience stores but more grocery stores while Hispanic high poverty areas had fewer supermarkets, but more convenience and grocery stores, compared to White, low poverty neighborhoods. In rural areas, both predominantly Black and Hispanic high poverty areas had more convenience and grocery stores compared to White low poverty areas, however Hispanic high poverty areas had fewer supermarkets.[86] Sharkey et al. examined food access disparities in rural colonias in Hidalgo County, Texas and found high access to convenience stores, and, in highly deprived areas, lower access to supermarkets, supercenters, and grocery stores.[87] However, in another study of six rural Texas counties, higher neighborhood deprivation was associated with *increased* supermarket access.[88] In the rural Mississippi Delta, low-income residents have to travel more than 30 miles to reach a large supermarket, and therefore rely on smaller food stores with a more limited selection of foods.[89]

In addition to disparities in the types of *stores* available (e.g. supermarkets), there are also neighborhood disparities in the types of *foods* (e.g. fresh produce) available.[90, 91] These disparities in access have been associated with poorer dietary intake and increased obesity risk,[22, 92, 93] both important cardiovascular disease and cancer risk factors. In a study set in six rural counties, convenience stores were the most accessible store type, and also represented half of all food stores or restaurants serving fast food (e.g. hamburgers, fried chicken).[94] Others have found

that fresh produce is not readily available in rural convenience stores.[95] In a rural South Carolina county, 74% of all food stores were convenience stores, however only between 4% and 29% of convenience stores sold healthier options such as low-fat/nonfat milk, apples, high-fiber bread and eggs; moreover, healthy items in convenience stores tended to cost more compared to supermarkets.[39]

In addition to offering few healthy foods, convenience stores also tend to sell and prominently display and promote tobacco products. In 2002, 85% of convenience stores and 92% of gas station/convenience stores in the U.S. sold tobacco products.[96] In a national study of retail tobacco marketing, convenience stores (without gas stations) averaged 28 tobacco marketing materials per store, and 73% displayed tobacco product promotions.[97] Smaller studies have found similar results. In downtown Albany, New York, 84% of food stores sold tobacco products and 66% displayed tobacco ads,[98] and 97% of a sample of convenience stores around urban schools in Minnesota displayed tobacco ads.[72] In three communities within Nashville, Tennessee, 90% of convenience/small grocery stores sold tobacco products while only 30% sold any fruit and 17% sold any vegetables.[99] However, convenience stores in the U.S. generate nearly twice as much sales from food compared with tobacco products,[100] and declines in cigarette consumption[101] may contribute to tobacco products becoming a less profitable product category.

In summary, lower income, minority and rural neighborhoods tend to have more convenience stores and fewer supermarkets, although there are regional differences in these findings. Convenience stores may represent a commonly used food source in rural areas lacking a large chain supermarket. Further, convenience stores have also been found to sell few healthy food items, while most sell, display, and promote tobacco products.

Retailer and Customer Perspectives on Healthy Food Availability

Despite well documented disparities in healthy food access, little research has been done to understand the determinants of healthy food availability within rural small food stores. Small food stores are typically independently owned and the retailer has full control over the product mix, store layout, and marketing and advertising within the store. Retailers of small food stores may not stock healthier foods and beverages because they do not perceive customer demand for healthy foods.[40, 102, 103] Yet evidence from both cross-sectional and intervention studies suggest that if healthy foods were available in small food stores, customers would purchase them. In cross-sectional studies, living in a neighborhood with more shelf-space devoted to fresh vegetables was associated with consuming more servings of fresh vegetables[104] and shopping at a small food store with more fruits and vegetables available was associated with significantly increased odds of purchasing both fruits (12%) and vegetables (15%).[105]

Small food store interventions have resulted in significant increases in both sales and purchasing frequency of promoted foods.[37] A systematic review of small food store intervention trials shows promising results, with all 16 interventions resulting in increased availability of healthy foods, increased sales of healthy foods in all interventions that tracked sales data (n=5), and increased purchasing frequency of promoted foods in nine out of the ten interventions that measured it.[37] Although a majority of stores were corner stores where tobacco products are heavily marketed, only one store owner in the Good Neighbors Program in San Francisco voluntarily removed tobacco advertising, and no other interventions mentioned tobacco as a focus.

Most small food retailer research in the U.S. has been done in urban areas. Gittelsohn et al. interviewed 19 corner store retailers in Baltimore and found that customer demand and

profitability influenced their decision to stock healthy foods.[103] Andreyeva et al. interviewed 68 non-supermarket food retailers in five of the most populous towns in Connecticut and found that 83% were interested in selling healthier items in their stores.[40] Retailers perceived that customer demand for healthy items was lower than for unhealthy items, and the primary barrier to stocking healthy foods was perceived customer dislike of the item. However, more than half of retailers surveyed stated that they sold healthy foods in their stores, and believed that their customers would have healthier diets if they stocked healthier foods in the stores. Although retailers perceived low customer demand for healthy foods, residents expressed their desire to be able to purchase healthy foods in their neighborhood corner stores.

Ayala et al.[106] and Gittelsohn et al.[107] used a mixed method approach to interview small food retailers in eight major U.S. cities after changes in the WIC food package (e.g. fruits, vegetables, whole grain bread were added to package). Retailers stated that stocking decisions were most highly influenced by customer requests and profitability of the food item, followed by refrigerator/freezer availability. Qualitative interviews revealed that retailers stock foods primarily on the basis of customer demand, and weight regular customers' preferences highly.[107] Perceived retailer benefits of stocking the new WIC package food items included increases in sales, customers, and improved store atmosphere. Retailers also stated that customers liked the convenience and availability of healthy foods. Challenges or barriers included keeping up with the supply and stocking of perishable foods.

Jilcott-Pitts et al. interviewed corner store retailers and customers in rural food deserts and urban non-food deserts in Eastern North Carolina as part of the formative research for a healthy stores intervention.[108] Through qualitative interviews, retailers stated they would stock healthy foods but perceived low customer demand for healthy items. Retailers perceived that

products that sold best were alcohol and cigarettes. Among food items, snack products (e.g. chips, candy) sold best. Other barriers to stocking more healthful foods included space, refrigeration, and shelf life. Rural customers shopped more frequently at corner stores compared to urban customers, and more often stated that they do not eat more fruits and vegetables because the stores they shop at do not stock them. Most customers were willing to purchase fresh fruits (92%) and vegetables (79%) at the corner store.

Overall, in both urban and rural settings, several key themes emerge: 1) retailers do not perceive there is adequate customer demand for healthy foods; 2) customers claim they would purchase foods if it were available at the corner/convenience store; 3) common barriers to stocking healthy foods are demand, profitability, space and refrigeration.

CHAPTER 3. THEORETICAL FRAMEWORK AND CONCEPTUAL MODELS

This chapter describes the theories and frameworks that have informed each dissertation study. Studies One and Two were informed by several frameworks that posit that there are underlying historical, social and economic determinants that contribute health outcomes and are inherently linked to place. Study Three was informed by the Diffusion of Innovations, a theoretical framework for identifying the determinants of the decision to implement an innovation.

Health Inequalities and Place Frameworks

Bernard and colleagues present a framework linking health disparities by place to inequalities in the "distribution of resources"[109] within and between neighborhoods. Neighborhood resources can be divided into physical and social domains. The built environment falls within the physical domain, and resources can be positive, such as parks, or negative, such as liquor stores, graffiti, and abandoned vehicles. Bernard and colleagues propose that there are rules that govern how neighborhood environments influence health. Within the physical domain, proximity to resources is the predominant rule; that is, living near positive or negative resources affects health. Yet it is not only access or proximity to resources that influences health, but the interplay between the physical and social domains that determine the effect the environment will have on health.

The rules governing the social environment within a neighborhood shape both the type and quality of resources available to residents, and how residents are able to access resources

within their neighborhoods. The shaping of the neighborhood physical environment is based on the economic context of the area, part of the social domain. Historical and political factors, including retail redlining and racial residential segregation, drive the economic context of an area, which in turn determines the types of businesses and services that locate within particular neighborhoods.[110, 111] For example, large chain supermarkets in the U.S. with less expensive food prices[112] are more likely to be located in higher income, non-minority neighborhoods.[84] However, in other countries, with different historical, political, and economic contexts, the opposite has been found.[113, 114]

Similar to the Bernard framework, the Schulz and Northridge framework is based on the hypothesis that there are fundamental causes of health inequities stemming from historical, social, political and economic factors at the societal, or macro, level that then translate into inequalities in the distribution of wealth and in educational, employment and political opportunities.[111, 115, 116] It is both the macro-social factors and the resulting inequality of resource distribution that influence zoning and land use laws, and residents' proximity to neighborhood resources, such as retail stores and public parks. In turn, proximity to resources, whether health promoting (or detracting), influences health behaviors and health outcomes. Rossen and Pollack adapt the Schulz and Northridge framework by adding zoning and land use as part of the community's political context.[117] They suggest that zoning be used as a tool to address health disparities, for example, by distributing health promoting resources more equitably across neighborhoods, or limiting exposure to tobacco outlets near schools or playgrounds.

As proposed by the previous frameworks, health inequalities may manifest through disparities in neighborhood income and access to health promoting resources. Kwate proposes that neighborhood inequalities in fast food outlet density are a product of racial residential

segregation.[118] Racial residential segregation has been associated with inequalities in income, educational and employment opportunities, and housing quality,[119] all critical factors for maintaining a healthy lifestyle.

According to Kwate, racial residential segregation influences fast food density through four pathways. First, it creates neighborhoods with concentrated minority populations and concentrated poverty, and fast food chains target minority and low-income customers through low prices and targeted marketing campaigns.[118, 120, 121] The same can be said for the tobacco industry. According to industry documents, minority and low-income neighborhoods have historically been targeted for menthol marketing,[122, 123] and cigarette pack prices are cheaper in lower income, minority neighborhoods.[124, 125] Next, residential segregation shapes the economic context of a neighborhood, and allows fast food restaurants to draw from a pool of low-wage workers. Third, residential segregation influences physical infrastructure through zoning regulations that determine the siting of fast food restaurants and, finally, social processes determine whether the community has the political clout to keep out businesses that may negatively impact residents' health. Higher income neighborhoods or towns may have the economic and political strength to reject new fast food restaurants development, while lower income neighborhoods may be eager for the increased employment opportunities. For example, the town of Concord, MA, a wealthy Boston suburb, bans all fast food restaurants,[126] and a study examining fast food land use planning proposals between 2001 and 2013 found that among the 77 communities that proposed a ban or restriction on fast food restaurants, the 77% were predominantly White and 66% had average household incomes greater than the U.S. average.[127]

The same political, economic, and social contexts that influence the location of fast food outlets also influence the location of tobacco outlets. Both types of outlets rely on a low-wage

work force,[128] and may represent undesirable types of businesses in higher income communities. The tobacco and fast food industries both target low income, minority, and youth populations with promotions and advertising.[129-132] Older children and teens attending middle and high schools may also be more likely to be targeted by both the fast food and tobacco outlets, particularly convenience stores, due to their greater autonomy and purchasing power.[133]

The overall conceptual framework for Studies One and Two (Figure 3.1) draws on the previously described frameworks by envisioning that there are multiple levels of influence on youth health outcomes. Historical, political, and economic factors shape the distribution of wealth, employment and educational opportunities, and determine housing opportunities that factor into racial residential segregation. The social and political context both shapes and is shaped by the characteristics of residents, and can determine whether, where and what types of retail outlets are built, through zoning laws and/or local restrictions or regulations. Similarly, the quality and location of schools is shaped by the social and political context of an area. The consumer retail environment is shaped by the types of outlets available, which determines the availability, placement, price and promotion of healthy (e.g. fruits and vegetables) or unhealthy (e.g. cigarettes, fast food) products. The consumer environment also includes any targeted marketing or promotions to youth, lower income, or racial/ethnic minority populations, which may take the form of exterior promotions and advertising, price promotions, or products with youth appeal. [131, 134-136] In turn, the consumer environment provides environmental cues and creates social norms around tobacco use and fast food consumption that influence youth dietary intake and smoking.
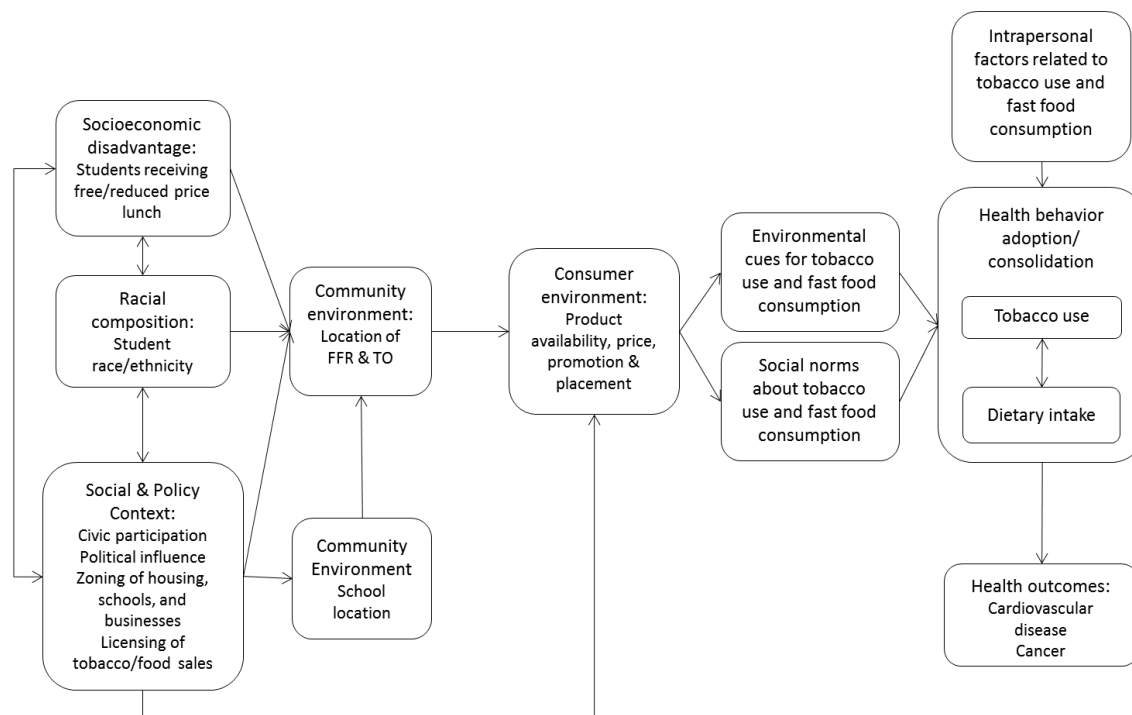
Figure 3.1. Conceptual model for Studies One and Two: Examining the influence of school neighborhood characteristics on adolescent health.

Hypotheses for Studies One and Two

The following hypotheses will be tested:

H1: Fast food restaurants and tobacco outlets will cluster around public schools in a sample of 97 counties in the contiguous U.S.

H2: There will be more fast food restaurants and more tobacco outlets near schools with higher proportions of students receiving free or reduced price lunch, Hispanic students and non-Hispanic Black students.

H2a: There will be more fast food restaurants and more tobacco outlets near high schools and middle schools compared with primary schools.

Conceptual Model for Study Three

Most healthy stores interventions have used Social Cognitive Theory and the Social Ecological Framework to inform intervention development, primarily because they focus on explaining and changing *consumer* behavior by changing the store environment.[37] This study focused on *retailer* behavior using the Diffusion of Innovations (DOI)[137] to explain a retailer's implementation of strategies to increase healthy food availability and reduce the display and marketing of tobacco products (i.e. the innovation) (Figure 3.2).

According to Rogers, there is an innovation-decision process that explains the adoption of innovations.[137] The first stage is *knowledge* of the innovation, and is influenced by decision-maker (retailer) and organizational (store) characteristics. The organizational characteristics explored in this study include WIC and SNAP authorization status, as these programs might make it easier for retailers to stock healthier foods, and previous research has shown differences in both healthy food availability[138] and in point-of-sale tobacco marketing[98, 139] by WIC/SNAP authorization status. *Knowledge* is followed by *persuasion*, when the retailer forms a favorable or unfavorable attitude towards the innovation. The *persuasion* stage is characterized by the perceived attributes of the innovation (i.e. *relative advantage*, *compatibility, complexity, observability,* and *trialability,* described below). The next stage is the *decision* to either adopt or reject the innovation, and is operationalized in this study as retailer *willingness* to adopt a healthy store strategy. Finally, the *implementation* of the innovation is when the retailer puts their decision into action and is operationalized as the availability, promotion, and display of healthy foods and tobacco products in the store.

Study Three focuses on the persuasion, decision and implementation stages of the innovation-decision process. In the persuasion stage, there are five characteristics of an

innovation (perceived attributes) that influence whether they will adopt it. The first is *relative advantage*, and is operationalized as whether retailers perceive that adopting a strategy to increase healthy food availability or reduce tobacco products and marketing is an improvement over what they currently stock, display and promote in their stores. Attributes of *relative advantage* that are relevant in this context are primarily economic advantages such as sales, profitability, demand, and gaining a competitive edge over other stores. *Compatibility* refers to how well the innovation is perceived as fitting in with the retailer's current business practices, the business image, the physical layout of the store, and the available products from suppliers in the retailer's network. *Complexity* refers to how difficult the retailer perceives the innovation to be, and will be assessed relative to training staff, maintaining products, and the extra work or planning required to adopt the innovation. *Trialability* is the ability of the retailer to easily try out the innovation and is operationalized as whether retailers can change the store product mix or layout easily, and easily switch back to the original product mix or display configuration. *Observability* is whether the results of the innovation are visible to customers.

Combined, the perceived attributes influence the decision stage, operationalized as retailer willingness[140] to adopt specific strategies to transition to a healthy store by increasing healthy food availability, display, and promotion and reducing tobacco product availability, display, and promotion. Measuring willingness rather than intention may result in more meaningful responses given that retailers may not have ever considered some strategies (e.g. discontinuing the sale of tobacco products). Willingness to adopt a strategy was assessed as part of a "suppose" situation[141] where the retailer would receive some assistance through a program or intervention to help with implementation. Willingness in turn influences the actual

implementation of the innovation, operationalized as the observed in-store healthy food and

tobacco product availability, display, and promotion.
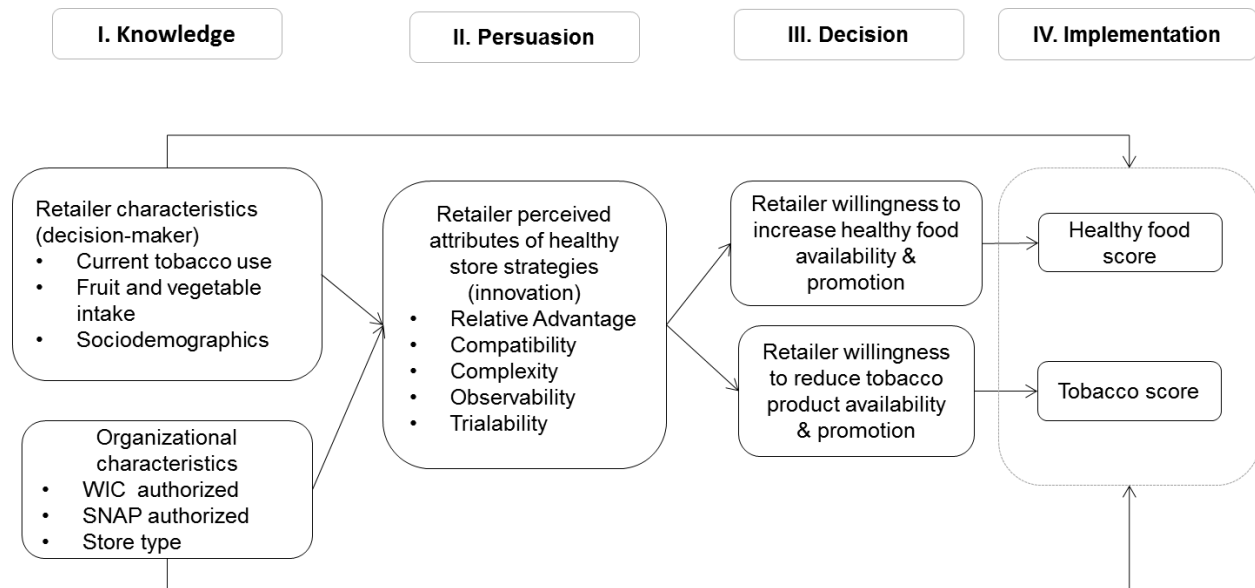
Figure 3.2. Conceptual model for Study Three: Using the diffusion of innovations framework for predicting retailer healthy store strategy adoption.

Hypotheses for Study Three

The following hypotheses will be tested:

H1: Retailers who perceive *greater* relative advantage, compatibility, observability, trialability,

and *lower* complexity for stocking healthy foods/limiting tobacco products, will have *greater*

willingness to implement a strategy to increase the availability, display and promotion of

healthy foods and beverages ("healthy food strategy") and reduce the availability, display and

promotion of tobacco products ("tobacco product strategy"), and in turn,

H2a: Retailer willingness to implement a healthy food strategy will be positively associated with

healthy food strategy implementation score, or the in-store availability display and promotion of

healthy foods and beverages

H2b: Retailer willingness to implement a tobacco product strategy will be negatively associated with tobacco product strategy implementation score, or the in-store availability, display, and promotion of tobacco products.

H3: Retailers of stores that accept a) WIC and b) SNAP will have greater willingness to adopt a healthy food strategy/tobacco product strategy.

CHAPTER 4. STUDY ONE: SPATIAL CLUSTERING OF TOBACCO OUTLETS AND FAST FOOD RESTAURANTS AROUND PUBLIC SCHOOLS

Introduction

Examining the retail tobacco and food environment surrounding schools provides an opportunity to assess built environmental factors that might influence both dietary intake and tobacco use among youth. In 2012, 6.7% of middle school and 23.3% of high school students currently used any tobacco products[41] and in 2007-2008, 33% of children and 41% of adolescents consumed fast food in the prior 24-hours.[7] Evidence suggests that these behaviors co-occur, and track over time among youth.[12] Adolescents who smoke tend to have poorer diets[9] and consume more fast food[11] compared to non-smokers. Consuming fast food has been associated with poor diet quality, including increased intake of total energy, fat, sodium, and sugar-sweetened beverages among both children and adolescents.[34]

School proximity to retail tobacco and food outlets has been implicated in influencing both smoking initiation and dietary intake among youth. In the U.S., 22% of tobacco outlets in Missouri, 51% in New York State, and 80% in New York City fell within 1000 ft.(305 m) buffers around schools.[80] Tobacco outlet density within school neighborhoods has been associated with adolescents ever smoking,[66, 67] smoking susceptibility,[68] school smoking prevalence,[69, 70] and students purchasing their own cigarettes.[70] A national study found 37% of U.S. public schools have at least one fast food restaurant within a ½ mile radius.[27] Greater fast food restaurant availability near schools has been associated with lower consumption of fruits and vegetables, greater consumption of soda,[62] higher body mass index (BMI)[60] and obesity

incidence,[61] and increased odds of obesity[62] among youth. However, others have reported null findings between fast food restaurant proximity to schools and adolescent diet [64] and weight.[65]

School proximity to retail tobacco and food outlets is a problem, because it provides both easier access to products and exposure to ads and marketing on the storefront and at the point-of-sale. Both tobacco and fast food companies target youth with advertising[129, 130, 142] and offer special products that have youth appeal, like kid's meals with toys[134] or flavored little cigars.[143] Over 75% of adolescents in the U.S. have reported exposure to tobacco marketing in retail stores,[71] and a longitudinal study of non-smoking youth at baseline found that students who shopped at stores selling tobacco products two or more times a week had 2.58 times greater odds of smoking initiation compared to students who shopped less than twice a month.[73] Children and teens are exposed to between 2.4 and 4.1 fast food ads per day on television,.[144] and exposure to food advertising increases preference for advertised food items.[145] The clustering of fast food and retail tobacco outlets around schools could therefore provide environmental cues and shape social norms around consuming fast food and using tobacco products.

Examining the spatial clustering of outlets relative to schools provides information beyond outlet availability or proximity because it determines whether outlet location is spatially dependent on school location. Decisions on where to site retail outlets and restaurants are based in part on proximity to a consumer base.[146] Given high rates of consumption of fast food among children and adolescents[34, 147] and the desire of tobacco companies to recruit smokers at a young age,[148] both the fast food and tobacco industries have an incentive to sell their products closer to schools. Using spatial point pattern analysis can identify whether and where outlets are clustered around schools.

The bivariate K function tests whether the spatial patterning of outlets relative to schools is no different than what would be expected if the outlets were distributed randomly, or if there is spatial dependence (clustering) between outlets and schools.[149] The bivariate K function has been used to determine clustering of fast food restaurants and food outlets near schools[75-77, 150] and the clustering of fast food restaurants near supermarkets.[151] U.S. studies using a measure of spatial clustering found that fast food restaurants clustered within 500 m of public schools in New York City,[75] and in Chicago there were up to 7 times more fast food restaurants within 1.5 km of schools than would be expected if restaurant location was unrelated to school location.[76] No studies have measured the spatial clustering of tobacco outlets relative to schools using a bivariate K function, or used a national sample of U.S. counties to measure the spatial clustering of either type of outlet relative to schools. The following research question was addressed: Are there more (a) fast food restaurants and (b) tobacco outlets around public schools in a sample of 97 U.S. counties than would be expected if fast food restaurant/tobacco outlet location was not associated with school location?

Methods

Schools and Study Area

As part of a larger study aimed at creating a national sampling frame of tobacco outlets, a random sample of counties within the contiguous U.S. was selected using a probability proportionate to size (PPS) method[152] proportionate to county population size with minimal replacement. The resulting 97 counties within 40 states represent 25.7% of the U.S. population(Figure 4.1).[153] Because counties were selected proportionate to population size, and not selected with equal probability, larger, more populous counties were more likely to be selected.

31
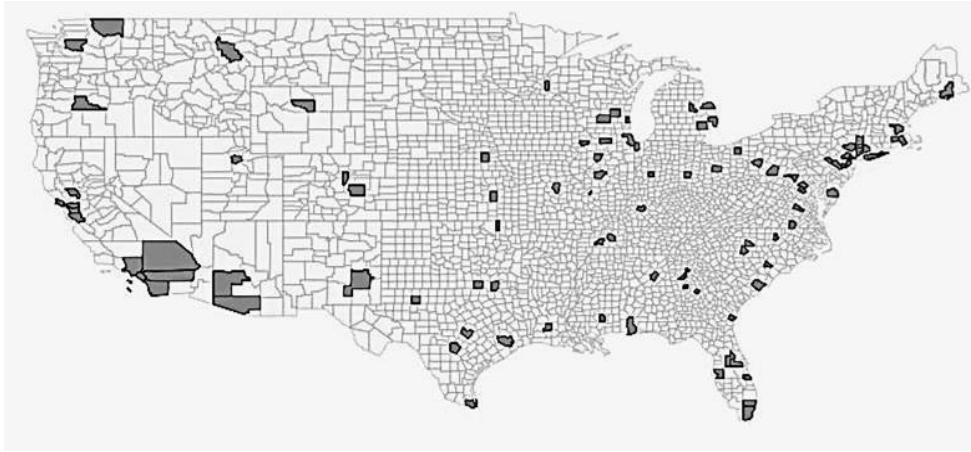
Figure 4.1. U.S. counties (N= 97) randomly selected to create the study area. Shaded counties are those that were selected.

School geographic coordinates, address, school level and urban centric locale were obtained for 2010-2011 from the National Center for Education Statistics (NCES) Elementary/Secondary Information System (ELSi).[154] School urban centric locale is based on the school's physical address (or mailing address if physical address was unavailable) and is a measure of a school's location relative to areas an urban core, classified as located in cities, suburbs, towns, or rural areas (*see Appendix 4.3*). Because of the small number of schools in towns (n=453), we combined schools in suburbs and towns.

There were 18,457 public primary, middle and high schools in the study area; 71 duplicate schools were excluded (i.e. identical on school name, address, and student enrollment). Seven schools were excluded because they were online only, hospitals, residential treatment centers, or juvenile detention facilities leaving 18,379 schools. Private schools were not included in order to examine environments around public, freely accessible schools for U.S. children.

Fast Food Restaurants and Tobacco Outlets

Business name, address, latitude, and longitude were obtained from commercial business lists for both outlet types. We purchased data from Dun & Bradstreet (D&B) using SIC codes for fast food and pizza chain restaurants (58120307, fast-food restaurant, chain; 58120601, pizzeria, chain), consistent with similar studies.[155] Food outlet validation studies have found commercial sources to have at least moderate sensitivity.[156] Over 40 kinds of establishments sell tobacco products in the U.S..[96, 100] We narrowed our search to establishment types likely to sell tobacco products[157] using NAICS codes and searched both D&B and ReferenceUSA (445110,supermarkets and other grocery (except convenience) stores; 445120, convenience stores; 453991,tobacco stores; 447110; gasoline stations with convenience stores; 452910, warehouse clubs and supercenters; 451212, news dealers and newsstands; 445310, beer, wine, and liquor stores; 446110, pharmacies and drug stores;452112, discount department stores; 447190, other gasoline stations). Outlets without a valid street address were excluded, as were chains known to not sell tobacco were excluded (e.g. Target, Trader Joe's).Among pharmacies, we retained the top 50 chains and retained Wal-Mart as the only likely tobacco retailer in the discount department store category. The final list included 16,909 chain fast food and chain pizza restaurants ("fast food restaurant") and 89,245 tobacco outlets.

Analyses

QGIS 2.2.0 was used to create point shapefiles for schools and outlets using the NAD 83 Conus Albers projection. A polygon layer was created for the counties in the study area using Tiger Line shapefiles of county boundaries from the U.S. Census, 2010. Shapefiles for points and polygons were imported into R (version 3.1.1) using the *spatstat* package.[158] The polygon shapefile for the counties in the study area constituted the window in which the points were

located and provided edges to the study area. Descriptive statistics on the distance between schools to the nearest fast food and tobacco outlet were calculated using R, and differences in distances analyzed using t-tests.

The bivariate K function was used to determine whether and where spatial clustering of fast food restaurants and tobacco outlets ("outlets") occurs around schools. A vector of distances (r) at which to estimate the K function was constructed between 0 and 2 kilometers (km) in 10 meter (m) increments in order to capture a range of travel distances around schools. Because outlets were not distributed equally across the study area, and the location of outlets and schools may be affected by local zoning regulations, an inhomogeneous bivariate K function accounted for localized variations in the density of both schools and fast food restaurants and tobacco outlets across the study area, similar to previous work.[75] An edge correction was applied using Ripley's isotropic correction[159] because outlets located outside the study area (county boundaries) would not be counted, even if they were within a distance r of the school. This could lead to biased estimates of the bivariate K-function, which is dependent on values of r.[160] The formula for the inhomogeneous bivariate K-function including the edge correction gives:

$$\hat{K}_{ij}(r) = (\hat{\lambda}_{ix}\, \hat{\lambda}_{jy}\, A)^{-1} \sum_x \sum_y w(i_x, j_y)\, I\,(d_{ix, jy} < r)$$

where x is school location and y is fast food or tobacco outlet ("outlet") location. The bivariate K function is the ratio of the total number outlets, j, located within a distance r of a randomly chosen school, i, and normalized by the local densities of schools and outlets ($\hat{\lambda}_{ix}, \hat{\lambda}_{jy}$) in the study area (*A*). *I* is an indicator function that equals one if an outlet is located within a given distance r of a school, 0 if otherwise; therefore any outlets located beyond distance r would not be counted. The edge correction is applied as a weight, $w(i_k, j_l)$, that accounts for the boundaries

of study area by adjusting for the portion of each school centered circle of radius *r* that is included in the study area.

Because of the large size of the dataset, schools were subset by the NCES designated school urban centric locale ("locale") into city, suburb/town, or rural. Using the *spatstat* package, we generated observed and expected (theoretical) bivariate K functions for each distance, *r*. The expected bivariate K function is based on the null hypothesis of complete spatial randomness (CSR) of outlets relative to schools. Running multiple simulations creates an envelope with lower and upper critical boundaries, and clustering occurs when the observed bivariate K function exceeds the upper critical boundary at a particular distance. Ratios of observed to expected bivariate K functions were calculated to examine the magnitude of clustering at 400 and 800 m from schools, common walking distances for children.[161] Figures showing the observed and expected K functions with upper and lower critical boundaries within 2 km and the difference between observed and expected K functions within 800 m were created separately for fast food and tobacco outlets within each locale.

Results

Tobacco outlets were located closer to schools than fast food restaurants, on average (Table 4.1) and differences were statistically significant in all locales (p=.000). In cities, the average distance from a school to the nearest tobacco outlet was 0.45 km (SD 0.40), about a 5 minute walk, and in suburbs/towns and rural areas, distances were greater (mean 0.62 km, SD 0.58, mean 1.78 km, SD 3.14, respectively)(Table 4.1). The average distance from a school to the nearest fast food restaurant was 0.88 km in cities (SD 0.59), 1.39 km in suburbs/towns (SD 2.02) and 6.85 km in rural areas (SD 10.4) (Table 4.1).

Table 4.1. Distance between Public Schools (n=18,379) and Fast Food Restaurants and Tobacco Outlets, by Urban Locale, 2011

| | Distance from school to nearest outlet (km) | | | | | | | |
| | Tobacco outlet | | | | Fast food restaurant | | | |
School urban locale	Mean	SD	Median	Range	Mean	SD	Median	Range
City (n=7,501)	0.45[*]	0.40	0.35	0-5.0	0.88	0.59	0.77	0.01-6.11
Suburb/ Town (n=8770)	0.62[*]	0.58	0.48	0-12.2	1.39	2.02	0.98	0.01-65.1
Rural (n=2,108)	1.78[*]	3.14	1.02	0-78.1	6.85	10.4	3.29	0.03-102.1

[*]Significantly different from the mean distance between school and nearest fast food restaurant, p=.000

Both tobacco outlets and fast food restaurants were significantly clustered around schools although the distances at which clustering occurred varied by school locale (Figure 4.2). To show differences in the magnitude clustering by distance from school on a smaller scale, the difference in observed to expected bivariate K functions within 800 m of schools is presented in Figure 4.3. Clustering of tobacco outlets begins at about 200 m from all schools and increases with increasing distance from schools. Similarly, clustering of fast food restaurants begins at approximately 200 m from city and suburban schools, but begins at around 600 m from rural schools.

City schools showed the greatest magnitude of clustering for both tobacco and fast food restaurants (Figure 4.3). The ratio of observed to expected K function within 800 m of schools (approximately ¼ mile) reveals that there are over 14 times more tobacco outlets around schools in cities, 8 times more in suburbs, and 3.5 times more in rural areas than would be expected if tobacco outlet location were not associated with school location (Table 4.2). Similar patterns

were observed for fast food where the ratio was 11.6 times more around schools in cities, 8.5 times more in suburbs, and 1.9 times more in rural areas than would be expected if fast food restaurant location was unrelated to school location.
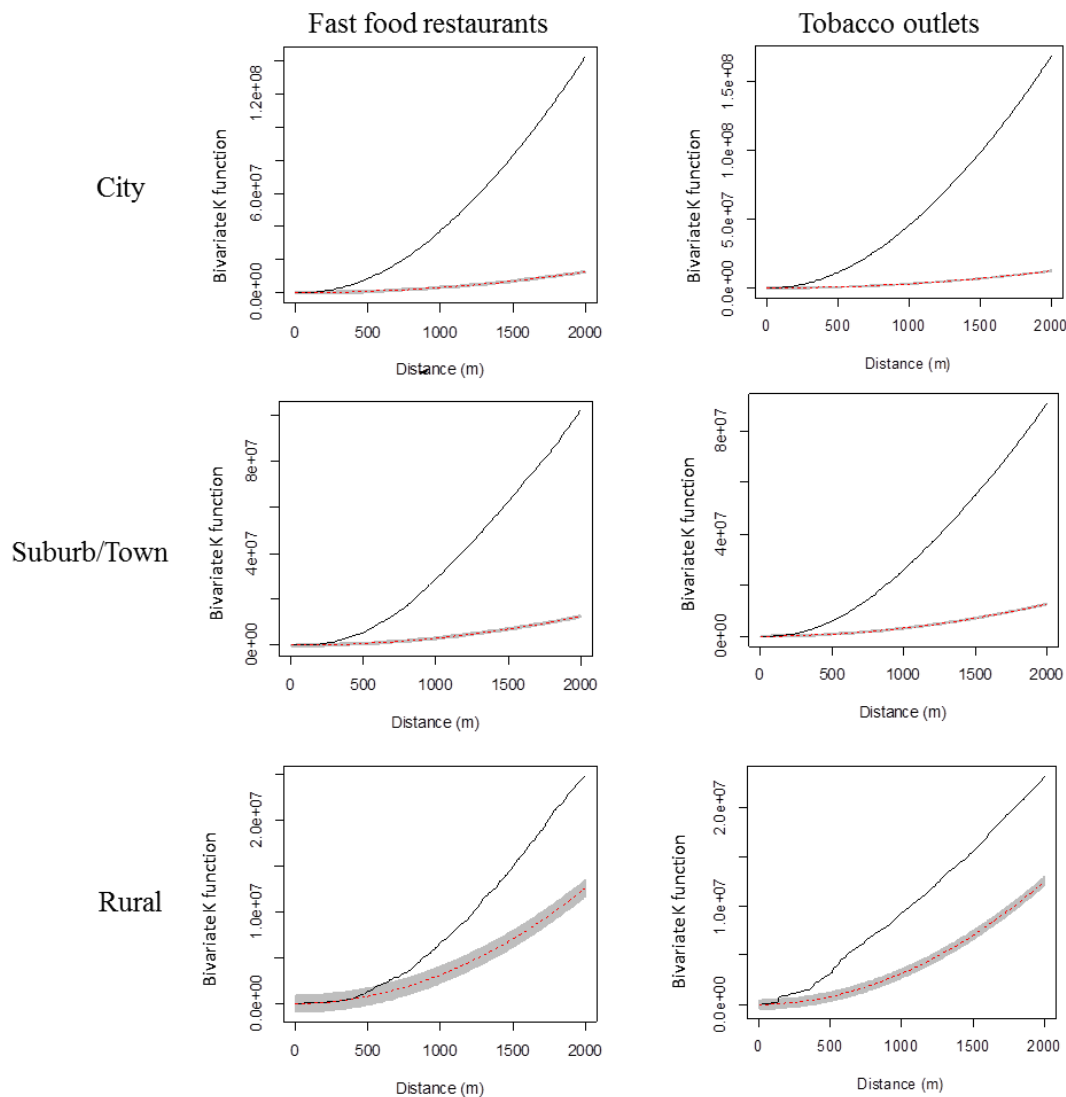
Figure 4.2 Spatial clustering of chain fast food restaurants and tobacco outlets near schools by school urban centric locale in 97 U.S. Counties, 2011. Solid line: observed bivariate K function; dashed line: expected bivariate K function with shaded upper and lower critical boundaries. Spatial clustering occurs when the observed K function exceeds the expected.

Figure 4.2. Spatial clustering of chain fast food restaurants and tobacco outlets near schools by urban centric locale in 97 U.S. counties, 2011.
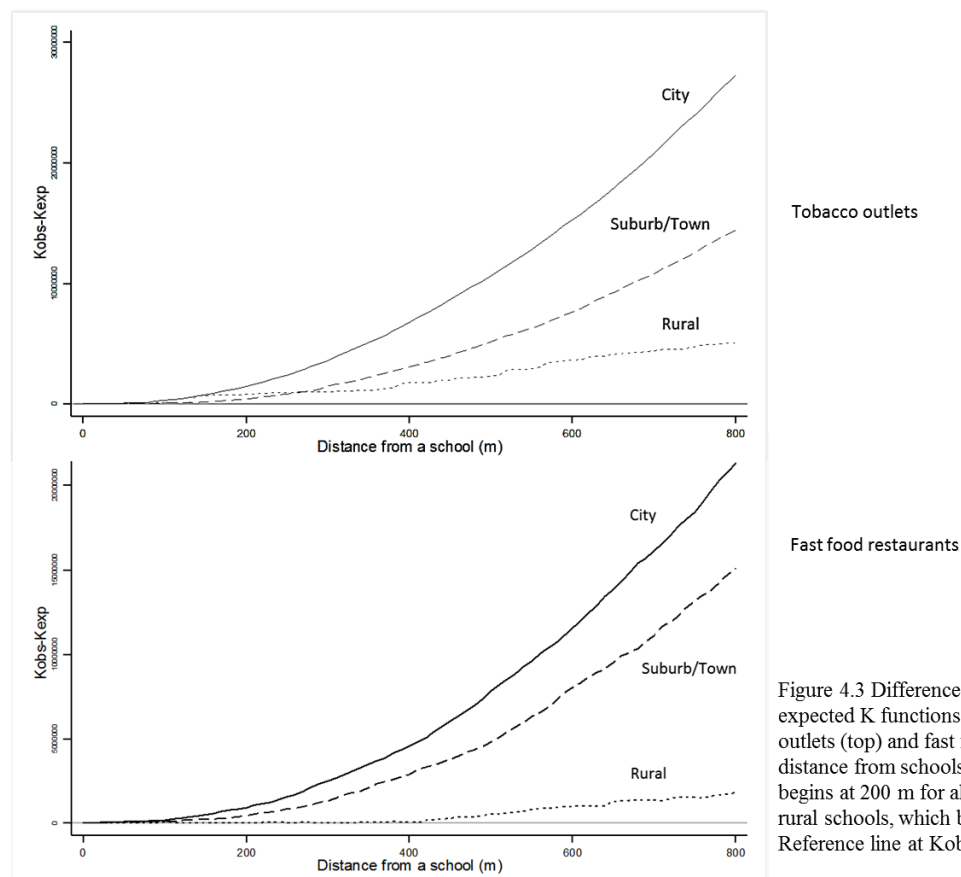
Figure 4.3 Difference in observed and expected K functions (Kobs-Kexp) for tobacco outlets (top) and fast food restaurants by distance from schools Significant clustering begins at 200 m for all but fast food around rural schools, which begins around 600 m. Reference line at Kobs-Kexp=0.

Figure 4.3. Difference in observed and expected K functions (Kobs-Kexp) for tobacco outlets and fast food restaurants by distance from schools.

Table 4.2. Ratio of Observed to Expected K Function for Outlets Relative to Schools, 2011

School urban locale	Tobacco outlet		Fast food restaurant	
	400 m	800 m	400 m	800 m
City (n=7,501)	14.5	14.6	10.1	11.6
Suburb/Town (n=8770)	7.1	8.2	6.8	8.5
Rural (n=2,108)	4.5	3.5	1.1[a]	1.9
[a]No significant clustering at this distance				

Discussion

Both tobacco outlets and fast food restaurants were significantly clustered around schools in diverse geographic areas in this sample of U.S. counties. There were more of both outlet types than expected around all schools at distances as close as 600 m, or under a 10 minute walk; and in cities and suburbs, clustering occurred as close as 200 m from schools. We found a greater degree of clustering of tobacco outlets compared with fast food, and that tobacco outlets are located closer to schools, on average. The sheer number of tobacco outlets compared with fast food restaurants may account for these differences: there were over 5 tobacco outlets for every fast food restaurant in the study area, likely because there are multiple types of retail outlets that sell tobacco, whereas fast food was more narrowly defined. Some tobacco outlets are also places where kids can access unhealthy foods and beverages (e.g. convenience stores, pharmacies), and it is likely that about half of the tobacco outlets in our sample were convenience or gas/convenience stores.[96] These findings suggest that children and adolescents in the U.S. are exposed to a greater number of both tobacco outlets and fast food restaurants in school neighborhoods than what would be expected if outlet location was not associated with school location.

Tobacco outlets were located closer on average to schools compared with fast food restaurants, for each locale. In cities, the average distance to the nearest tobacco outlet was less than 500 m, just over a 5 minute walk, and to the nearest fast food restaurant was about 900 m, or just over a 10 minute walk. In rural areas, the average distance to the nearest tobacco outlet was 1.78 km or a little over one mile away. In New York City, Frick et al.[29] found even shorter average distances between schools to the nearest tobacco outlet (0.16 km) and in Chicago, Austin et al. found the average distance from a school to the nearest fast food restaurant was 0.60 km.[76]

Our study area covered a more diverse geographic area which may account for differences. Frick et al. also found that proximity and density were associated, with a shorter distance between a school and a tobacco outlet being associated with greater tobacco outlet density within school neighborhoods,[29] similar to our findings of a greater magnitude of clustering in cities and suburbs where the distance between a school and the nearest tobacco outlet or fast food restaurant was shorter.

Previous studies using spatial analyses to examine fast food restaurants around schools have found similar results. In both Chicago and New York City, researchers used the bivariate K function and found that fast food restaurants clustered around schools, although the magnitude of clustering in both those locations was lower than found around city schools in this study.[75, 76] In New Zealand, both fast food and convenience stores clustered around schools, with a greater ratio of observed to expected K function near schools located in areas with greater population density.[77] In contrast, national chain fast food restaurants in Scotland did not cluster around schools within distances up to 1.5 km, although there was evidence of spatial clustering of other food outlet types.[150] Although no studies have examined tobacco outlet clustering near schools using a bivariate K function, there was significant spatial autocorrelation of tobacco outlets in neighborhoods around schools in New York City.[29] In other words, tobacco outlets clustered relative to each other in school neighborhoods, but clustering relative to schools was not measured.

Compared to previous studies, we found a greater magnitude of clustering around schools located in cities. The large size and diverse geography of our study area is likely the cause of the disparity between our study and studies of single cities. The observed bivariate K function is a ratio in itself, and the denominator is calculated based on the observed outlet density within a

predefined study area. The inhomogeneous K function we used accounted for the varying density of outlets across the study area, but the inclusion of cities of different sizes likely yielded an overall lower average outlet density for schools in cities compared with outlet density within a single large city. Large cities may have a greater overall concentration of outlets, yielding smaller observed K functions, and lower ratios of observed to expected K functions than observed in a more diverse study area.

Strengths and Limitations

This is the first study using a large sample of U.S. counties to examine the spatial clustering of both tobacco outlets and fast food restaurants near public schools. We have shown that both tobacco outlets and fast food restaurants are clustered relative to schools within easy walking distances for children in diverse geographic locations. We cannot establish causation with youth tobacco use or dietary intake. However, identifying whether and within what distance tobacco outlets and fast food restaurants cluster around schools can inform zoning and licensing policies that can impact the built environment in school neighborhoods.

Our narrow inclusion criteria (i.e. only chain fast food/pizza restaurants) and extensive list cleaning to exclude chains known not to sell tobacco are likely to have improved the ability of our lists to accurately capture fast food restaurants and tobacco outlets near schools. However, our list may include stores that do not actually sell tobacco products, or may have under-or over-counted the number of actual outlets in the study area. In addition, we chose to focus on chain fast food and pizza restaurants but many other food outlets, including some categorized as tobacco outlets, such as convenience stores or bodegas, are likely to increase youth access to and intake of unhealthy foods.

Our study area included 97 counties with small, medium, and large cities, along with suburbs and rural areas, and this geographically diverse study area allowed us to compare the relative magnitude of clustering around schools in different locales while using an inhomogeneous bivariate K function allowed us to account for the varying outlet density observed around schools across the study area. We did not account for commercial land use or population density beyond stratifying by school locale. However, clustering of fast food near schools was similar in New York City with and without accounting for commercially zoned land.[75] Further, even if population density or commercial land use accounted for clustering, students attending schools in densely populated areas would still be exposed to the same outlets on their way to and from school each day. In addition, we did not examine if clustering differed by type of school (elementary, middle and high school) and further research may examine potential differences in access to tobacco and fast food by type of school.

Implications for Practice and Research

Examining whether tobacco outlets and fast food restaurants cluster around schools could inform licensing and zoning ordinances that impact the location of retail tobacco outlets and fast food restaurants. Zoning and licensing ordinances can help localities create healthier neighborhoods around schools by restricting the types of businesses or the types of products sold near schools.[23, 162, 163] Santa Clara County in California and the City of New Orleans have implemented bans on tobacco outlets near schools.[164] Chicago banned the sale of flavored tobacco products within 500 feet (152 m) of schools,[165] while Detroit banned the location of fast food outlets within 500 feet of schools.[166] Given that significant clustering of both tobacco outlets and fast food occurs up to and beyond 800 m (2625 ft.) of schools, restricting the location

or sale of specific products within 500 ft. or even 1000 ft. of schools are likely to be conservative policies.

Conclusion

Both tobacco outlets and fast food restaurants significantly clustered within walking distance of public schools in this sample of U.S. counties, with children attending schools in cities having the greatest excess to both types of outlets. The location of outlets relative to schools may influence youth dietary intake and smoking initiation by increasing exposure to exterior and point-of-sale advertising, marketing and promotions, and making access to unhealthy foods, beverages and tobacco products easier.

CHAPTER 5. STUDY TWO: IS THE AVAILABILITY OF FAST FOOD RESTAURANTS
AND TOBACCO OUTLETS NEAR SCHOOLS ASSOCIATED WITH SCHOOL
SOCIODEMOGRAPHIC CHARACTERISTICS?

Introduction

Obesity and tobacco use are risk factors for cardiovascular disease and many forms of

cancer, and disparities in both of these risk factors exist by socioeconomic status and

race/ethnicity.[1, 2] Rates of obesity are highest among non-Hispanic Black ("Black") and Hispanic

youth compared with non-Hispanic White ("White") youth.[3] Black and Hispanic youth are also

more likely to consume fast food and sugar sweetened beverages compared with White youth,[8]

and consuming fast food has been associated with increased intake of total energy, fat, sodium,

and sugar-sweetened beverages among both children and adolescents.[34, 35]

Rates of current tobacco use are highest among White high school students; however, in

2012 current tobacco use among middle school students was higher for Hispanic students

(10.5%) compared with White students (5.1%), and cigar use was highest among Black high

school students compared with both White and Hispanic students. Rates of smoking initiation are

highest among lower income youth of all race/ethnicities.[42, 43] Given that about 90% of adult

smokers initiate smoking before age 18,[44] early intervention among vulnerable populations is

critical. Unhealthy behaviors, such as smoking and poor dietary intake, appear to co-vary,[9]

consolidate early[11] and track together over time.[9, 11, 12]

Evidence suggests that fast food restaurant (FFR) availability near schools is associated

with higher body mass index (BMI),[60, 62] and retail tobacco outlet (TO) availability near schools

is associated with youth smoking initiation.[66, 67] Children are exposed to retail outlets in school neighborhoods when they walk, drive to and from school, or leave campus during lunch. Students permitted to leave school during lunch are more likely to consume fast food compared with students on closed campuses.[167] A longitudinal study of middle school students who had never smoked at baseline found that students visiting tobacco outlets at least twice a week had over twice the odds of initiating smoking after 12 months compared with students who visited stores less than twice a month.[73]

Studies have found that FFR and TO may be disproportionately located near schools in lower income or racial/ethnic minority neighborhoods,[15, 27] or near schools with higher proportions of low income or racial/ethnic minority students.[15, 28, 75] One national study found more FFR near schools in lower income compared to higher income neighborhoods, but fewer in predominantly Black compared to predominantly White neighborhoods.[27] While there are no national studies of TO near schools, a national study of census tracts in the U.S. found TO density was higher in census tracts with a higher proportion of Black and Hispanic residents.[168]

Compared to higher income neighborhoods, FFR in lower income neighborhoods are more likely to offer free prizes with purchase[169] and kids' meals.[134, 169] Similarly, stores selling tobacco products in lower income and racial/ethnic minority neighborhoods have more tobacco marketing,[170, 171] lower cigarette prices,[125] and higher availability of products with youth appeal, like menthol cigarettes,[124] and little cigars and cigarillos.[135] Little work has examined the association between fast food advertising at restaurants on youth outcomes, but greater receptivity to television fast food advertising is associated with increased odds for obesity,[172] and higher BMI,[173] while exposure to point-of-sale tobacco marketing has been associated with youth smoking initiation, prevalence, susceptibility, and pro-smoking attitudes.[174, 175]

There has been no research to date that concomitantly examines both the availability of FFR and TO near schools and examines the extent to which availability differs by race/ethnicity and socioeconomic status of the students in the school. Increased availability of both FFR and TO near schools is a problem for youth not only because of easier access to unhealthy products, but also because of increased exposure to point-of-sale marketing for those products given that both fast food and tobacco companies target low income, minority, and youth populations with promotions and advertising.[123, 129, 130, 132, 143]

We examined the availability of FFR and TO near public schools in a national sample of U.S. counties in association with student race, ethnicity and socioeconomic status. We hypothesized that schools with higher proportions of Black, Hispanic, and students receiving free/reduced price lunch would have: (1) more FFR, (2) more TO, and (3) greater odds of having *both* a FFR and a TO near schools as compared to schools that were less diverse and had fewer students eligible for free/reduced lunch. Because student age influences their accessibility to stores and purchasing power, we also hypothesized that high and middle schools would have more FFR, more TO and be more likely to have both nearby, compared to primary schools.

Methods

Study Area and Schools

As part of a larger study, Advancing Science and Policy in the Retail Environment (ASPiRE), a random sample of counties within the contiguous U.S. was selected proportionate to county population size using a probability proportionate to size (PPS) method152 with minimal replacement. The resulting 97 unique counties within 40 states comprises 25.7% of the U.S. population.153 Because counties were selected proportionate to population size, and not selected with equal probability, larger, more populous counties were more likely to be selected. This

resulted in a sample with census tracts containing higher proportions of Hispanic and Black residents, compared to the national average. (Appendix 5.1)

Using data from the National Center for Education Statistics (NCES) Elementary/ Secondary Information System (ELSi)[154] we identified 18,457 public primary, middle and high schools within the 97 study counties. School name, address, latitude and longitude, grade level, and student demographic characteristics, including the proportion of students in the school that qualified for free or reduced priced lunch and the racial and ethnic distribution of students within each school, were obtained for 2010-2011. We excluded 71 duplicate schools (i.e. identical on school name, address, and student enrollment) and seven schools that were online only, hospitals, residential treatment centers, or juvenile detention facilities, leaving 18,379 schools. Private schools were not included in the sample; however charter schools were included if they were classified as a public school by NCES.

Fast Food Restaurants and Tobacco Outlets

We purchased food outlet data from Dun & Bradstreet (D&B) using SIC codes for "fast-food restaurant, chain" and "pizzeria, chain", consistent with similar studies.[155, 176] Food outlet validation studies have found commercial sources to have at least moderate sensitivity.[156] We limited the fast food list to only D&B because we were not able to obtain a list from a second commercial source (ReferenceUSA) using the same SIC codes, however the tobacco outlet list was created from lists obtained from both D&B and ReferenceUSA. Because there is no national retail tobacco outlet licensing system, to identify tobacco outlets we used a list of probable tobacco outlets generated for the ASPiRE study, which selected establishment types likely to sell tobacco products.[157] All chains known to not sell tobacco were excluded (e.g. Target, Trader Joe's) to improve list specificity. Among pharmacies, we retained the top 50 pharmacy chains

(Appendix 4.2), and retained only Wal-Mart in the discount department store category because other stores in this category did not sell tobacco products (e.g. TJ Maxx, JC Penny).

We used QGIS 2.2.0 to map the points for schools, FFR and TO using the NAD 83 Conus Albers projection. Euclidean radial buffers 800 m from each school centroid were created, a commonly used distance to account for a 10 minute walk.[161, 177] The number of FFR and TO within each school buffer area was calculated using the field count function. Because our study area included non-contiguous counties, some schools had buffers extending beyond the study area (n=323) into a county where we did not have the location of FFR or TO. A sensitivity analysis excluding these schools resulted in similar findings, (Appendix 5.5) therefore we present the results with all 18,379 schools. Point layers were joined with census tracts (Tiger Line files, U.S. Census, 2010) and tract level data on population and land area was used to calculate population density.

Measures

Dependent variables

Three dependent variables were created within 800 m radial school buffers ("near schools"): 1) the number of FFR; 2) the number of TO; 3) a binary outcome indicating whether a school has both a FFR *and* a TO versus only one or neither a FFR nor a TO.

Independent variables

Using the school level ELSi data, we characterized the proportion of students receiving free or reduced price lunch ("low income") and the proportion of Black and Hispanic students. School grade level (primary, middle, high) and total students were used as covariates. To control for urbanicity, we included tract population density, or population per square mile at the census tract level, similar to another national study.[27] School urban centric locale was included as a

second measure of urbanicity, and measures a school's location relative to populous areas using four major categories: city, suburb, town and rural. (Details on all measures presented in Appendix 5.2).

Analysis

Descriptive statistics were calculated for the schools and the study area. The average number of FFR and TO (unadjusted) was examined by quartile of student demographic characteristics using ANOVA analyses with Bonferroni pairwise comparisons. Generalized linear mixed models with a random effect at the county level were used to: 1) account for clustering of schools within counties resulting from the sampling design, and 2) account for non-normally distributed count data. We estimated the association between the count of FFR and TO near schools and student characteristics using a multilevel negative binomial regression model. Goodness of fit tests (Chi-squared) showed that a negative binomial model was a better fit for the data compared with a Poisson model because of over-dispersion of the count data. A generalized linear mixed model with a binary distribution was used to predict the odds of schools having both types of outlets versus one or none, in association with school characteristics. Missing data on the percentage of students receiving free/reduced price lunch (n=4,955), percentage of Black (n=3) and percentage of Hispanic students (n=3) was imputed using the Markov chain Monte Carlo (MCMC) method of multiple imputation in SAS 9.3. The imputed data set was created using PROC MI, and modeled using PROC GLIMMIX and PROC MIANALYZE. Models were also run on complete cases, and results were similar (Appendix 5.6), therefore we present the results with the imputed data

Results

Descriptive Statistics

Table 5.1 shows the characteristics of the schools and study area.

Table 5.1. Characteristics of Schools and Study Area in 97 Counties in the Contiguous United States, 2011 (n=18,379)

	% of schools or mean (SD)	
School characteristics		
Schools with at least one outlet within 800 m		
Fast food restaurant	40.3	
Tobacco outlet	77.3	
Both	38.2	
Number of outlets within 800 m		
Fast food restaurant	0.9	(1.6)
Tobacco outlet	6.4	(12.7)
Student composition		
Non-Hispanic Black, %	16.5	(24.5)
Hispanic, %	36.7	(31.2)
Non-Hispanic White, %	35.8	(31.5)
Other[a], %	4.26	(5.27)
Receiving free or reduced price lunch, %	47.8	(31.2)
School level		
Primary	63.9	
Middle	17.1	
High	19.1	
Student body size	669.6	(528.1)
Urban centric locale of school		
Suburb	45.3	
City	40.8	
Rural	11.5	
Town	2.5	
Neighborhood characteristics (census tract)		
Population per square mile (100s)[b]	66.5	(117.7)

[a] Asian, American Indian/Alaska Native, Hawaiian/Pacific Islander; categories do not add up to 100% because reporting did not capture categories of multiple race/ethnicities; [b] 2010 U.S. Census; [c] American Community Survey, 2011

Within 800 m, 40.3% of schools had at least one fast food restaurant, while 77.3% had at least

one TO. Examining outlet types together, 38.2% of schools had both a FFR and a TO within 800

m. Schools had an average of 0.9 FFR (range 0-29) and 6.4 TO (range 0-269) within 800 m.

(Additional descriptive statistics are found in Appendix 5.3.) Schools in the study area were

comprised of, on average, 16.3% Black students, 34.6% Hispanic students and 35.8% non-

Hispanic White students (Table 5.1). Nearly half of students received free or reduced price lunch

(47.8%). Most schools were primary (63.9%), and over 45% of schools were located in suburbs,

40% in cities and the remainder in towns or rural areas (Table 5.1).

Bivariate Analyses

The average number of FFR and TO near schools increased with each increasing quartile

of Hispanic students, Black students, and students receiving free/reduced price lunch. The

inverse was true for quartiles of White students (Figure 5.1). For example, schools within the

highest quartile of White students had an average of 0.44 FFR within 800 m, compared with an

average of 1.3, 1.0 and 1.1 FFR near schools with the highest quartile of Hispanic, Black, and

students receiving free/reduced price lunch, respectively. Similar patterns were observed for TO,

with an average of 2.78 TO near schools with the highest quartile of White students, compared

with 9.2, 9.6 and 10.9 for schools with the highest quartile of Hispanic, Black, and students

receiving free/reduced price lunch, respectively. The difference in the average number of FFR

and TO between the lowest and highest quartiles within each student demographic category was

statistically significant (p<0.05). Similarly, the percentage of schools that had both a FFR and a

TO within 800 m increased with each increasing quartile of Hispanic, Black and students

receiving free/reduced price, but *decreased* with increasing quartile of White students. Nearly

53% of schools with the highest Hispanic student population, 41 % of schools with the highest

Black student population, and 46% of schools with the highest percentage of students receiving free or reduced price lunch, had both a FFR and TO within 800 m, compared to 38% of schools overall and only 21% of schools with the highest White student population (Figure 5.1).
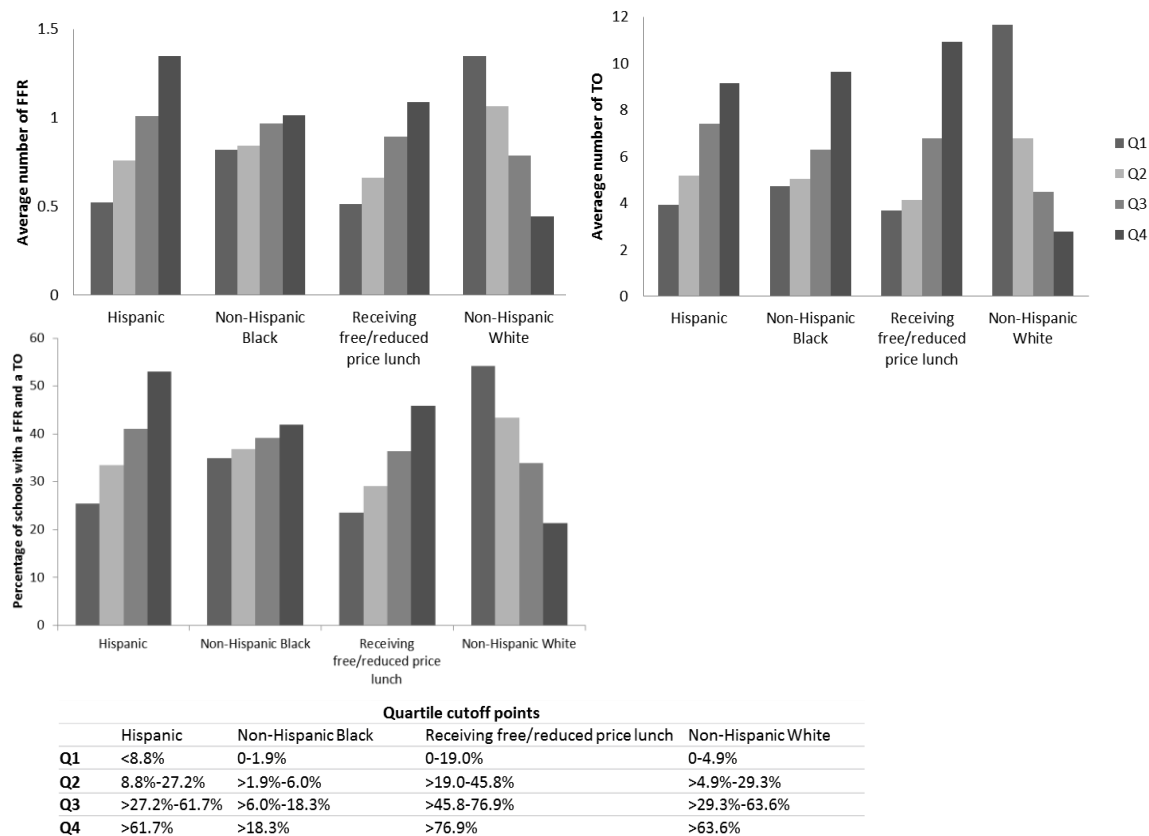
Figure 5.1. Average number of fast food restaurants (FFR, top left) and tobacco outlets (TO, top right), and percentage of schools with both a FFR and TO (bottom) within 800 m of schools by quartile of student demographics. Cutoffs for quartiles are shown in legend.

Regression Analyses

Table 5.2 presents models for each dependent variable, adjusted for school enrollment, school level, school urban locale and neighborhood population density. The number of FFR within 800 m of a school increased by 5% for every 10% increase in the percentage of Hispanic students, and by 3% for every 10% increase in the percentage of students receiving free/reduced

price lunch (Table 5.2). The percentage of Black students was not significantly associated with the number of FFR within 800, but was associated with TO availability. The number of TO increased by 4% for every 10% increase in the percentage of Black students and students receiving free/reduced price lunch. Similar to FFR, for every 10% increase in the percentage of Hispanic students, the number of TO increased by 7%.

The odds of a school having *both* a FFR and a TO within 800 m increased by 5% for every 10% increase in the percentage of Hispanic students in a school, and by 3% for every 10% increase in students receiving free/reduced price lunch. There was a slight positive, but non-significant association between the percentage of Black students and the odds of having both outlet types near schools (Table 5.2).

We also found a strong association between school level and the availability of FFR and TO. Compared to primary schools, high schools had 42% more FFR, 25% more TO, and high schools had nearly 1.5 times the odds of having both a FFR and a TO within 800 m. Middle schools had 7% more FFR within 800 m of schools compared with primary schools, but there was no difference in the number of TO or the odds of having both a FFR and a TO within 800 m of middle compared with primary schools.

Sensitivity Analyses

After excluding schools with buffers extending beyond the study area (1.76% of schools) descriptive statistics were identical and the results of the regression analyses were similar to those including all schools (Appendix 5.5). Significance and direction of the associations did not change after excluding schools on the edges of the study area. Similarly, analyses with schools that had complete data on student demographics (n=13,421) yielded similar results compared with the imputed data (Appendix 5.6).

Table 5.2. Incidence Rate Ratios, Odds Ratios and 95% CI for the Availability of Fast Food Restaurants, Tobacco Outlets and Both Within 800 m Radius of Public Schools in 97 Counties in the Contiguous the U.S. (N=18,379)

	Count of FFR		Count of TO		School has at least one FFR & TO	
	IRR (95% CI)	p-value	IRR (95% CI)	p-value	OR (95% CI)	p-value
Student composition						
White and other students (ref)						
Hispanic students, %	1.05 (1.04, 1.06)	<.0001	1.07 (1.06, 1.08)	<.0001	1.05 (1.03, 1.07)	<.0001
Black students, %	1.01 (0.99, 1.02)	0.3263	1.04 (1.03, 1.05)	<.0001	1.01 (0.99, 1.03)	0.5014
Student receives free/ reduced price lunch, %						
Yes (No, ref)	1.03 (1.02, 1.04)	<.0001	1.04 (1.03, 1.04)	<.0001	1.03 (1.01, 1.05)	0.0009
School level						
Primary school (ref)	1		1		1	
Middle school	1.07 (1.01, 1.15)	0.0297	1.04 (1.00, 1.08)	0.0841	1.08 (0.99, 1.19)	0.0927
High school	1.42 (1.33, 1.51)	<.0001	1.25 (1.20, 1.30)	<.0001	1.47 (1.33, 1.61)	<.0001
Total students	1.0 (1.0, 1.0)	0.5706	1.0 (1.0, 1.0)	<.0001	1.0 (1.1, 1.0)	0.061
Population per sq. mile (100s)	1.02 (1.01, 1.02)	<.0001	1.03 (1.02, 1.03)	<.0001	1.07 (1.06, 1.08)	<.0001
Urban Centric Locale						
City (ref)	1		1		1	
Suburb	0.84 (0.79, 0.88)	<.0001	0.68 (0.65, 0.70)	<.0001	0.79 (0.73, 0.86)	<.0001
Town	0.68 (0.56, 0.82)	0.0003	0.71 (0.63, 0.80)	<.0001	0.66 (0.51, 0.84)	0.001
Rural	0.17 (0.15, 0.20)	<.0001	0.23 (0.21, 0.25)	<.0001	0.15 (0.13, 0.19)	<.0001

Continuous variables presented in deciles (10% or 10 unit increase interpretation); CI Confidence Interval; FFR, fast food restaurant; TO, tobacco outlet. Models include all variables shown.

Discussion

We examined the availability of FFR and TO near schools in a national sample of U.S. counties in association with student demographic characteristics. Within a 10 minute walk (800 m), over 40% of all schools had at least one FFR, over 77% had at least one TO, and nearly 40% had both. In bivariate analyses, both the average number of FFR and TO and the percentage of schools with both outlet types within 800 m increased as the concentration of Hispanic, Black and low income students in a school increased. For example, over half of schools with the highest percentage of Hispanic students had both a FFR and TO within 800 m, compared with only 21% of schools with highest percentage of White students.

The number of FFR and TO near schools was also associated with student race/ethnicity and socioeconomic status in models controlling for school and neighborhood characteristics. Schools with a higher percentage of Hispanic and Black students, and a higher percentage of students receiving free/reduced price lunch had greater numbers of TO within 800 m of the school. Schools with more Hispanic and low income students had more FFR nearby, and also had a greater odds of having *both* a FFR and a TO within walking distance. Finally, high schools had nearly 1.5 times greater odds of having both outlet types within 800 m compared with primary schools.

Our first hypothesis examined whether student racial/ethnic and socioeconomic composition was associated with the number of FFR near schools, and was supported for Hispanic and low income students but not Black students. Our results are similar to a national study in the U.S. that found more limited service restaurants (restaurants without table service, including, but not limited to FFR) around schools with a higher proportion of Hispanic students and low income students, but no association between restaurant availability and non-Hispanic

Black students.[28] Similarly, another national study found more FFR near schools in low income compared to high income neighborhoods, but fewer FFR near schools in predominantly Black compared to White neighborhoods.[27] Both national studies also controlled for school urban locale. There was no association between the number of chain FFR and student race/ethnicity or socioeconomic status in New York City after controlling for built environment measures, such as commercially zoned land and subway stations.[79] Therefore, while our hypothesis was not fully supported, the literature points to similar findings.

For TO, our hypothesis was fully supported. We found a higher number of TO near schools with greater proportions of Black, Hispanic and students receiving free/reduced price lunch. Similarly, a national study found TO density was higher in neighborhoods with more Black and Hispanic residents.[168] Among studies that have explicitly measured TO near schools, our findings are similar. High schools in California in neighborhoods with at least five TO within a half mile had higher proportions of Hispanic and low income students.[15] In New York City, schools in neighborhoods with a higher proportion of low income residents had greater TO density within both a quarter and half mile radius around schools.[29] Unlike our study, TO density near schools was inversely associated with the proportion of Black residents in Chicago[18], and not associated with the proportion of Black students in California.[15]

Our third hypothesis was partially supported. We found that schools with higher proportions of Hispanic students and low income students, but not Black students, had a greater odds of having both a FFR and a TO nearby. The growth of the Hispanic population in the U.S. combined with increasing acculturation have lead food marketing and advertising companies to segment and target younger, Hispanic audiences.[178, 179] As stated previously, the association between the number of FFR and TO near schools and the proportion of Black students has been

mixed. There are a few possible explanations for the significant positive association found with the proportion of Black students and the number of TO near schools compared with FFR. The tobacco industry has historically targeted low income, Black neighborhoods and youth with marketing and promotions,[123] and spends considerably more money at the point-of-sale, compared with the fast food industry, which is able to advertise on television.[129, 180] This spending often includes cash incentives to retailers to carry and promote a particular tobacco brand,[181] and may influence both the type and locations of businesses in school neighborhoods by providing financial incentives for retailers to locate near schools in certain neighborhoods. Chain FFR represent a corporate brand and may be subject to different types of constraints when finding a location, compared with TO that are predominantly convenience or gas/convenience stores that may or may not be corporate owned or managed.

Inconsistencies in findings between studies may also be due to differences in the types of outlets included and sources of lists. Our study used only chain fast food and pizza restaurants in order to capture the major restaurants found in nearly every state, and that are often heavily advertised and marketed towards youth. Sources of TO lists vary considerably between studies. Previous studies in smaller geographic areas have used tobacco licensing lists or single sources of business lists, while we used a systematic process to clean and merge two business lists, and excluded chains known not to sell tobacco products to improve list specificity. Another study field validating two business lists found that this method correctly identified nearly 90% of all TO in a three county study area[157]. Studies also are not consistent in how TO availability is measured, and use different school buffer areas (network versus Euclidean buffers, for example) and different neighborhood definitions (census tract versus school buffer area), which can contribute to variability in findings.

Finally, we found that there were more FFR around both high schools and middle schools compared with primary schools. A study in New York City found significantly more chain fast food and pizza near high schools compared with elementary schools.[79] The fast food industry overtly targets both children and adolescents[142] but older children are more autonomous and are more likely to be permitted to walk to a restaurant during or after school and to have some disposable income as compared to younger children. In addition, there were more TO near high schools (although not middle schools), and high schools were more likely to have both a FFR and TO nearby compared with primary schools. Stores that sell tobacco may target older teens who have higher purchasing power to buy a broader range of products[182] and some may actually be of legal age to purchase tobacco. However, sales to minors are also more likely to occur among older compared with younger teens,[183] therefore the finding of greater tobacco outlet availability around high schools is troubling. The increased rate of FFR, TO and both around high schools suggests that retailers may be well aware of and ready to take advantage of the autonomy and purchasing power of older youth.

Strengths and Limitations

This is the first study to our knowledge to examine both FFR and TO availability near public schools in association with student race, ethnicity and socioeconomic status. We used a national sample of counties selected proportionate to population size. Therefore the geographic profile of the schools in the sample were more suburban and urban, resulting in higher proportions of Hispanic and Black students compared with the national average and may not be generalizable to all U.S. schools. Our narrow inclusion criteria (i.e. only chain fast food and pizza restaurants) and extensive list cleaning to exclude chains known not to sell tobacco are likely to have improved the ability of our lists to accurately capture FFR and TO availability near

schools. However, our list may include stores that do not actually sell tobacco products, or may have under-or over-counted the number of actual TO or FFR in the study area. In addition, by not counting convenience stores as a potential source of unhealthy foods, we underestimate how convenience stores near schools might be differentially impacting the food choices of school age youth.

There was missing data for 4,955 schools on the percentage of students receiving free or reduced lunch; therefore we used the Markov chain Monte Carlo (MCMC) method of multiple imputations in SAS 9.3 to impute the missing data. We also ran models including only schools with complete data, and the results were nearly identical (Appendix 5.4). We used generalized linear mixed models to account for the sampling design and clustering of schools within counties. Clustering violates the assumption of independence required for OLS regression. Other studies of outlet availability near schools have not used multilevel or mixed models to account for this type of clustering, although some have used spatial analyses.[29, 184] We did not account for spatial autocorrelation in the dependent variables using a spatial regression model; however, the use of the generalized linear mixed model with a random effect at the county level accounts for the correlation between schools in the dependent variable. Further, adding a spatial component to models using count data has been found to only marginally improve model fit beyond a standard Poisson or negative binomial regression model.[185] Because it is an ecological study measuring associations between features of school neighborhoods and student characteristics, we cannot establish causation with individual dietary intake or tobacco use. However, identifying differences in the food and tobacco retail environments around schools can inform licensing and zoning policies to create sustainable, environmental changes that could have an impact at the population level.[186]

Conclusion

Low income and racial/ethnic minority students are disproportionately exposed to both FFR and TO near schools in this sample of U.S. counties. Licensing and/or zoning policies could restrict the location of fast food and tobacco retail outlets in school neighborhoods, and might influence both dietary intake and smoking initiation among vulnerable youth populations.[23, 80, 117] Research examining the contribution of the built environment to youth health behaviors would benefit from multilevel studies that examine the relative contribution of home and school neighborhoods, and parental and peer factors. Health promoting changes at the policy level could impact access and would allow for sustained environmental change that could change social norms and improve the health of future generations of children and families.

CHAPTER 6. STUDY THREE: USING THE DIFFUSION OF INNOVATIONS TO EXAMINE RURAL SMALL FOOD STORE RETAILERS' PERCPETIONS OF IMPLEMENTING HEALTHY STORE STRATEGIES

Introduction

Obesity rates are higher, and the prevalence of current smoking is greater among adults living in rural compared with urban counties, particularly in the rural Southern United States (U.S.).[5, 6] Neighborhood food access and point-of-sale tobacco marketing have been investigated as underlying factors contributing to disparities in obesity[14] and smoking.[174, 187] Residents of rural areas often do not have easy access to large supermarkets[38, 39, 188, 189] while convenience stores are often readily available.[87] Further, healthy foods and beverages may not be common in convenience stores,[39] while energy dense foods, sugar-sweetened beverages[190] and tobacco products are typically abundant.[96, 97] Given that rural convenience stores may play an important role in providing staple foods between supermarket trips,[89] understanding the determinants of stocking healthier products could help inform programs or interventions designed to increase healthy food access in small food stores.

Small food stores, such as convenience or corner stores, are a promising intervention venue to increase healthy food access in areas underserved by large supermarkets.[36] However, most efforts in the U.S. have been conducted in urban areas such as Baltimore [191] and Philadelphia,[192] while fewer have targeted small food stores in rural areas.[37, 193] A common theme across small food store research is that owners/managers may not stock healthier foods and beverages because they do not perceive customer demand for healthy food.[40, 102, 103] In Eastern North Carolina, corner store retailers perceived low demand for healthy foods, while

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alcohol, cigarettes and snack products (e.g. chips, candy) were believed to sell best.[108] However, most customers interviewed were willing to purchase fresh fruits (92%) and vegetables (79%) at the corner store if they were available.[108]

Given that there may be a disconnect between retailer perceptions of customer demand and customer purchasing behavior, understanding retailers' perspectives on selling and promoting more healthy products, and fewer unhealthy products, could help inform future interventions and programs. In a paper authored by the research teams from four healthy corner stores interventions in the U.S., the authors cite that formative research, building relationships with retailers, and considering retailers' perspectives when designing an intervention are all important components of a successful program.[36] This study fills a gap in the literature by assessing retailers' perspectives on selling both healthy foods and tobacco products in small food stores in rural areas.

Conceptual Framework

Most healthy stores interventions have used Social Cognitive Theory and the Social Ecological Framework to inform intervention development, primarily because they focus on explaining and changing *consumer* behavior by changing the store environment.[37] This study focused on *retailer* behavior using the Diffusion of Innovations framework (DOI)[137] (Figure 3.2).

Definition of the Innovation

The overall innovation assessed was the implementation of "healthy store strategies", or the types of strategies that retailers adopt when participating in a healthy store intervention or program. There were two aspects of the innovation assessed in this study: 1) the implementation of strategies to increase the availability, display and promotion of healthier foods and beverages, and 2) the implementation of strategies to decrease the availability, display, and promotion of

tobacco products. The strategies were chosen based on previous interventions and programs that work with retailers to increase the availability of healthier foods and beverages in small food stores. Healthy food strategies include, for example, stocking fresh fruits and vegetables and displaying healthy foods near the cash register/check-out area, while tobacco strategies include removing interior or exterior tobacco product ads/signs and moving tobacco product displays away from the cash register. We chose to examine the innovation in terms of both healthy foods and tobacco products because 1) tobacco products and marketing are ubiquitous in the majority of small food stores/convenience stores[170], 2) exposure to tobacco products and marketing has been associated with tobacco use among adults and youth[20], and 3) some healthy stores programs that provide financial or technical support to stores have required that retailers limit tobacco product displays or marketing.

Innovation-Decision Process

Knowledge

According to Rogers, there is an innovation-decision process that explains the adoption of innovations.[137] The first stage is *knowledge* of the innovation, and is influenced by previous practice, decision-maker (retailer) characteristics, such as education, gender, age, and organizational (store) characteristics, such as participation in food assistance programs, or store type. *Knowledge* consists of awareness of the innovation's existence, how to use or implement the innovation, and an understanding of the principles of how the innovation works.[137] Typically, people with earlier (versus late) knowledge of an innovation have more education, higher social status, and more exposure to mass media and interpersonal channels of communication. Knowledge is also influenced by previous practice. Knowledge of an innovation, however, is not sufficient for predicting innovation adoption. Many people know about innovations, but have not

adopted them because they do not deem the innovation as being relevant or useful. Therefore, the knowledge stage is followed by *persuasion*, when the retailer forms a favorable or unfavorable attitude towards the innovation.

Persuasion

The *persuasion* stage is characterized by the perceived attributes of the innovation, *relative advantage*, *compatibility, complexity, observability,* and *trialability.* The first is *relative advantage*, and is operationalized as whether retailers perceive that adopting a strategy to increase healthy food availability or reduce tobacco products and marketing is an improvement over what they currently stock, display and promote in their stores. Attributes of *relative advantage* that are relevant in this context are primarily economic advantages such as sales, profitability, demand, and gaining a competitive edge over other stores. *Compatibility* refers to how well the innovation is perceived as fitting in with the retailer's current business practices, the business image, the physical layout of the store, and the available products from suppliers in the retailer's network. *Complexity* refers to how difficult the retailer perceives the innovation to be, and will be assessed relative to training staff, maintaining products, and the extra work or planning required to adopt the innovation. *Trialability* is the ability of the retailer to easily try out the innovation and is operationalized as whether retailers can change the store product mix or layout easily, and easily switch back to the original product mix or display configuration. *Observability* is whether the results of the innovation are visible to customers.

Decision and Implementation

The next stage is the *decision* to either adopt or reject the innovation, and is operationalized in this study as retailer *willingness* to adopt a healthy store strategy. Finally, the *implementation* of the innovation is when the retailer puts their decision into action and is

operationalized as the availability, promotion, and display of healthy foods and tobacco products in the store. Both willingness and implementation of the innovation are described further in the Measures section.

The purpose of this study was to:

1) Examine which DOI perceived attributes are associated with retailer willingness to implement a healthy store strategy to a) increase the availability, display, and promotion of *healthy foods and beverages* and b) reduce the availability, display, and promotion of *tobacco products* and in turn,

2) Examine whether retailer willingness to implement a healthy store strategy is associated with implementation, or the observed in-store availability, promotion and display of a) *healthy foods and beverages* and b) *tobacco products.*

Methods

Study Setting and Participant Recruitment

We recruited a convenience sample of small food store retailers in Lenoir, Wayne and Wilson Counties in Eastern North Carolina (NC). All three counties are rural, have a lower than state average median household income, greater than 20% of residents living in poverty, and have multiple areas within the county designated as food deserts, or low income tracts with low access to large supermarkets.[82, 194] We obtained a list of potentially eligible stores and addresses for each county using ReferenceUSA, a commercial database. Stores were eligible if they were a non-chain grocery, convenience store or convenience store with gas station, were independently owned or managed, and had 3 or fewer primary cash registers.

Five trained research assistants (RAs) received a list of store names and addresses and visited the stores in person to assess store eligibility. After store eligibility was ascertained, the RA attempted to recruit retailers. RAs visited stores primarily during non-peak hours (approximately between 9AM and 6PM) to maximize the chances of retailers being available. If the retailer was unavailable, RAs reattempted stores up to three times and/or returned at times specified by the retailer. When the retailer was available, the RA completed the eligibility screening. Participant eligibility criteria included: 1) owner/manager of a small food store in Lenoir, Wayne or Wilson Counties, NC; 2) in charge of stocking food and tobacco products; 3) fluent in English; and 4) age 18 or older. Participants received a $25 gift card for their participation. Informed consent was verbally obtained, and the procedures approved by the University of North Carolina at Chapel Hill Institutional Review Board (IRB Study # 14-0645).

Eligible participants were asked to conduct the interview in a quiet part of the store. The data collection instrument included a retailer questionnaire and a store observation form. The store observation took place after the interview and included items on product availability, placement, price promotions and signs/ads for specific foods, beverages and tobacco products. RAs used iPads$^©$ with 3G internet access to record responses to the questionnaire and complete store observation forms via the online survey interface Qualtrics. If internet access was unavailable, RAs used a paper version of the survey instrument and later entered survey responses online. Data collection took place in July 2014. The data collection instrument and informed consent form are shown in Appendix 6.1.

Measures

Table 6.1 describes all constructs, measures and sample items.

Table 6.1 Constructs and Measures for Study Three

Construct	Measures/Sample Item
Perceived attributes of the innovation	Likert scale 1 to 5, strongly disagree to strongly agree
Relative Advantage: Degree to which an innovation is perceived a better than the idea it supersedes	Stocking more healthy foods would increase my overall sales.
Compatibility: Degree to which an innovation is perceived as being consistent with existing values, past experiences and needs	Adding more healthy foods to what my store offers would fit in well with how I run my business
Observability: Degree to which the results of an innovation are visible to others	My customers will notice if I promoted healthy foods.
Complexity: Degree to which an innovation is perceived as difficult to understand and use	It would be difficult to train my staff to stock and maintain healthy foods, like fresh produce.
Trialability: Degree to which an innovation may be experimented with on a limited basis	If I add more healthy foods to my store and they don't sell, I can easily go back to my original product mix
Willingness to adopt a strategy	Likert scale 1 to 5 unwilling to very willing
Retailer characteristics	
Current tobacco use	Do you smoke cigarettes every day, some days or not at all?
Fruit and vegetable intake	How many cups of fruits vegetables do you eat in a day?
Socio-demographics	Age, gender (male/female), education level
Organizational characteristics	
Store type	Gas station present (yes/no)
WIC authorized	Yes/no
SNAP authorized	Yes/no

Retailer characteristics

Previous practice may be a predictor of innovation adoption;[137] therefore we measured two retailer behaviors that may be associated with implementation of healthy food or tobacco product strategies: fruit and vegetable intake and current smoking status. Fruit and vegetable intake was measured by self-reported servings of fruits and vegetables consumed per day, and

was categorized as high (3 or more servings per day) vs. low (< 3 servings per day).[195] Retailers who reported smoking every day or some days were considered smokers[195] and people who smoked "not at all" were non-smokers. Retailer age (years), gender (male/female) and education level were also measured. Education level was collapsed into two categories, some college or more vs. high school or less.

Organizational characteristics

Organizational characteristics have been associated with the adoption of workplace smoking policies,[27] healthy food availability in small food stores,[28] and in grocery store managers' decision to stop selling tobacco products.[29] In addition, previous research has documented differences in both healthy food and tobacco product availability and marketing by store type[91, 97] and food assistance program participation.[139, 196] All stores were independently managed and small in size, therefore the presence of a gas station (yes/no) was observed to define store type. Participation in a state or federal food assistance program was measured by separate questions asking whether the store was authorized to accept WIC (yes/no) and SNAP benefits (yes/no).

Perceived attributes of the innovation

The retailer questionnaire included items measuring each of the perceived attributes of the innovation. Items assessing perceived attributes of stocking and promoting healthy foods were informed by previous food retailer research, [40, 106, 197] whereas, measures on the perceived attributes of reducing tobacco product availability and marketing were created anew because of a lack of studies in this area. *Relative advantage, compatibility, complexity, observability,* and *trialability* were measured separately for strategies related to 1) healthy foods, and 2) tobacco

products. Retailers were oriented to the types of products categorized as healthy foods and

tobacco products in a question prompt with the following statement,

> *"When I say healthy foods I mean things like fresh fruits and vegetables, whole wheat breads and cereals, and low fat dairy products. When I say tobacco products, I mean all types including cigarettes, cigars, smokeless tobacco and e-cigarettes. How much do you agree with the following statements?"*

All items were measured on a five-point Likert-type scale with options ranging from strongly

disagree to strongly agree. Items were coded so that higher values indicated stronger agreement.

Willingness to implement a strategy

Willingness to implement a specific healthy store strategy was assessed for eight healthy

food strategies and four strategies related to tobacco products. Willingness was assessed under

the following situation:

> *"There are local programs in our state that help small stores like yours become a "healthy store" that sells healthier foods. Stores receive advice on how to sell healthier foods, and some help with marketing and community outreach, and in return, the store owner agrees to make some changes. If you were to receive some assistance through a program like this, tell me how willing you would be to make the following changes. If you already do these things, tell me how willing you are to keep on doing them."*

Willingness to implement each strategy was measured on a 5 point scale from not at all willing

to very willing. Two scales were created from the items: 1) willingness to implement a healthy

food strategy, and 2) willingness to reduce tobacco products and marketing.

Healthy store strategy implementation

We operationalized healthy store strategy implementation as the stocking, promotion and

display of 1) healthy foods and beverages and 2) tobacco products, as assessed by a standardized

store observation form completed by research assistants. The healthy food category included

fresh (whole and pre-cut) and frozen fruits and vegetables, whole wheat bread, low-calorie

beverages (bottled water, diet soda), and low-fat/fat free milk. Tobacco products included

cigarettes, cigars/cigarillos, smokeless tobacco and e-cigarettes. For a descriptive comparison, we also examined the presence of unhealthy food products and marketing The unhealthy food category included candy, white bread, sugar-sweetened beverages (e.g. soda, sweetened juices and teas), and whole milk. Data collectors observed both the store exterior and interior. For each food/beverage, the interior observation examined product availability (adapted from the NEMS-S instrument[198], product placement (i.e. displayed on endcaps and near a primary checkout register), the presence of price promotions (e.g. buy one get one free), and ads. If an ad contained both a healthy and unhealthy product (e.g. soda and diet soda), it was counted once in each category. For each tobacco product, the interior observation examined product availability, product placement (i.e. presence of a power wall, displayed near a primary checkout register, self-service), the presence of price promotions, and ads. The exterior observation examined the presence of price promotions and ads on the building exterior and property for both food/beverages and tobacco products. Separate scores were created for healthy foods and tobacco products. A greater score indicated greater product availability and more displays, promotions or ads for the products within each category (see Appendix 6.2).

Analyses

Descriptive statistics were calculated to summarize retailer and organizational characteristics and the results of the store observation. Cronbach's alpha was calculated for each of the perceived attribute measures assessed by at least three items; Pearson correlation coefficients and p-values were obtained for those with two items. Appendix 6.3 shows the values of Cronbach's and Pearson correlation coefficients for each attribute. The *trialability* items for both healthy foods and tobacco products exhibited little variability and were excluded from analyses. For healthy foods, scales were used for each perceived attribute except *trialability*. For

tobacco products, a scale was used only for *complexity*; for all other perceived attributes related to tobacco products, individual items were included in the regression model.

Regression analyses were conducted separately with each willingness scale (healthy food and tobacco) as the dependent variables and the perceived attributes as independent variables. Multiple linear regression was used to model retailer willingness to implement a healthy food strategy. Because there was little variability in the responses to the four items assessing retailer willingness to reduce tobacco products and marketing (scale median 1.25, 48% responded "unwilling" for all four strategies), and the variable was not normally distributed, a linear regression model was not appropriate for the analysis. Therefore, we collapsed the tobacco willingness scale into a dichotomous variable: *willing* (willingness scale>=2; 28.9% of respondents) and *unwilling* (willingness scale<2, reference group) and used logistic regression to examine whether the perceived attributes were associated with the odds of a retailer being willing to reduce tobacco products or marketing.

Next, two multiple linear regression models examined the association of retailer willingness with healthy store strategy implementation. Models were created separately for healthy food strategy score, and tobacco products and marketing score as the dependent variables. Healthy food scores were not normally distributed and were natural log transformed. Retailer and organizational characteristics were used as control variables. The sample size was not large enough to formally conduct a mediation analysis to examine whether willingness mediated the association between the perceived attributes and related healthy store strategy implementation scores. Therefore, where appropriate, we examined whether the perceived DOI attributes were associated with healthy store strategy implementation scores, in models with and without retailer willingness.

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Results

Retailer and Organizational Characteristics

Figure 6.1 displays participant recruitment. Of the 108 stores visited, 91 stores were located and screened for eligibility, of these, 18 stores were excluded because they had more than 3 registers and one retailer was excluded due to language. This left 72 eligible retailers; 17 declined participation and 55 completed interviews (55/72 =76% response rate). Store observations were completed in 54 stores because the RA felt unsafe at one store after completing the interview.
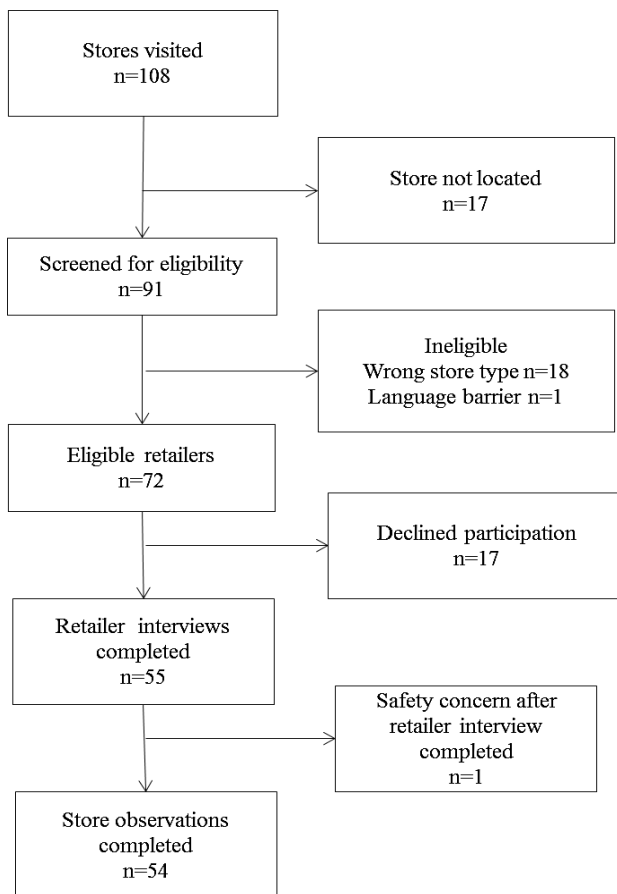

Figure 6.1. Store and retailer recruitment

Most retailers were male and over half completed some college or more (Table 6.2). Stores were either convenience with gas stations (63.6%) or convenience/small grocery stores (34.5%).

About half of stores accepted SNAP benefits and 7.3% accepted WIC. All stores sold low-calorie

beverages, sugar-sweetened beverages and candy. Only 27.8% sold whole wheat bread and

42.6% sold skim or low-fat milk. Fresh fruits were sold at 30.2% of stores, but only 9.4% sold

fresh vegetables. In contrast, most stores sold white bread (83.3%) and whole milk (81.5%). All

stores sold cigarettes, and the vast majority sold smokeless tobacco and cigars/cigarillos, while

72.2% sold e-cigarettes (Table 6.2).

Table 6.2. Retailer and Store Characteristics, Eastern North Carolina, 2014; n=55 retailers; n=54 store observations

	n (%) or median (range)	
Retailer characteristics		
Male	40	72.7
Age, years	38.5	19 -77
Education		
High school or less	25	46.3
Some college	10	18.5
College graduate	19	35.2
Organizational characteristics		
Convenience with gas station	35	63.6
Convenience/small grocery	19	34.5
SNAP authorized	29	52.7
WIC authorized	4	7.3
Food/beverages sold		
Sugar-sweetened beverages (e.g., cola, fruit drinks, sweetened tea)	54	100.0
Low-calorie beverages (water, diet soft drinks)	54	100.0
Candy	54	100.0
White bread	45	83.3
Whole wheat bread	15	27.8
Whole milk	44	81.5
Skim milk or low fat milk (1% or 2 %)	23	42.6
Fresh fruits	16	30.2
Fresh vegetables	5	9.4
Tobacco products sold		
Cigarettes	54	100.0
Smokeless tobacco	52	96.3
Cigars or cigarillos	51	94.4
E-cigarettes	39	72.2

Retailer Willingness to Implement Healthy Store Strategies

Among the healthy food strategies assessed, retailers were most willing to stock

skim/low-fat milk, display healthy snacks near the register, and stock whole wheat bread (Table

6.3).

Table 6.3. Retailer Willingness[a] to Implement Healthy Store Strategies, Eastern North Carolina,
U.S., 2014

Healthy food strategies	N	Mean	SD	Median	% willing
Stock skim, 1% or 2% milk.	53	3.6	0.19	4	73.6
Display healthy snacks such as fruit at or next to the checkout counter	53	3.5	0.19	4	69.8
Stock whole wheat bread, like Nature's Promise 100% Wheat Bread	53	3.4	0.21	4	66.0
Stock at least 3 choices of fresh fruits and 3 choices of fresh vegetables, not including potatoes, onions, lemons, or limes.	53	3.1	0.20	4	50.9
Create a healthy checkout aisle that displays only healthy foods and beverages.	53	3.0	0.19	4	49.1
Stock prepared fresh fruits or vegetables, like pre-cut apple slices or carrot sticks.	53	2.6	0.21	2	39.6
Stock any frozen fruits or vegetables.	53	2.4	0.22	1	35.9
Move soda, chips or candy displays away from the register	53	2.4	0.20	2	34.0
Tobacco product strategies					
Remove ads/signs for tobacco products outside the store	51	1.9	0.18	1	15.7
Remove ads/signs for tobacco products inside the store.	52	1.7	0.16	1	15.4
Move tobacco product displays away from the register.	52	1.4	0.13	1	5.8
Not sell any type of tobacco product	52	1.1	0.07	1	1.9
[a]Higher score indicates greater willingness(range 1to 5). Percent willing are those answering 4 or 5.					

About half of retailers were willing to stock at least three fresh fruits and three fresh vegetables

and create a healthy checkout aisle that displayed only healthy foods and beverages. Fewer were

willing to stock pre-prepared or frozen fruits and vegetables, and only 34% were willing to move

unhealthy food and beverage displays away from the register. In contrast, nearly all retailers were *unwilling* to reduce the availability of tobacco products or marketing. Only about 15% were willing to remove tobacco ads/signs from the store, and even fewer were willing to move tobacco products away from the register (5.8%) or stop selling tobacco products altogether (1.9%).

Association of Diffusion of Innovation Perceived Attributes with Retailer Willingness

Table 6.4 presents the results of the linear regression model examining the association of retailer perceived attributes of healthy food strategies with willingness to implement healthy food strategies. WIC authorization was the only organizational characteristic retained that significantly improved the model. After controlling for retailer education level, gender, age, and WIC authorization, retailers who perceived greater *relative advantage* of implementing healthy food strategies had greater willingness to implement a healthy food strategy (B= 0.41, p=.016, Table 6.4). In other words, retailers who perceived more advantages of selling healthier foods in terms of increased sales, foot traffic and gaining a competitive edge over other stores had greater willingness to implement a healthy food strategy. Retailers who perceived lower *complexity* for implementing healthy food strategies, and greater *observability* of implementing strategies also had greater willingness, although the results were of borderline significance (p=.076, p=.08, respectively). *Compatibility* with current business practices was not a significant predictor of willingness to implement a healthy food strategy (Table 6.4). None of the perceived attributes of reducing tobacco products and marketing were associated with the odds of a retailer being willing to reduce tobacco products or marketing (Appendix 6.4).

Table 6.4. Correlates of Retailer Willingness to Implement a Healthy Food Strategy[a] , Eastern North Carolina, 2014, n=52

Variable	B	SE	P value
Perceived attributes of healthy food strategies[b]			
Relative advantage	0.41	0.16	0.016[*]
Complexity[c]	0.25	0.14	0.076[+]
Compatibility	0.21	0.17	0.237
Observability	0.35	0.19	0.080[+]
Retailer characteristics			
Education level: Some college or more vs. High school or less	0.08	0.22	0.724
Female vs. male	-0.56	0.27	0.047[*]
Age, years, centered	0.01	0.01	0.158
Organizational characteristic			
WIC accepted vs. not accepted (ref)	0.58	0.40	0.160
Constant	-1.10	0.98	0.266
R-sq	0.36		

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001; [a] Willingness scale based on responses to 8 items measured on a 5 point Likert scale, from 1= not at all willing to 5= very willing. [b] Scales developed from items measured on a 5 point Likert scale, from 1= strongly disagree to 5= strongly agree; [c] Higher values represent lower complexity

Healthy Store Strategy Implementation

Product availability is summarized in Table 6.2, while Figure 6.2 shows differences in displays, signs, and promotions for healthy foods, unhealthy foods and tobacco products. A higher percentage of stores had displays near the register, signs/ads, and promotions for unhealthy foods and tobacco products compared with healthy foods, both inside and outside of the store (Figure 6.2). At least one unhealthy food or beverage and tobacco product was displayed near the register in almost all stores (92.6%, 88.9%, respectively), while healthy foods were displayed near the register in only a little more than a third of stores (Figure 6.2). Signs/ads for tobacco products were present inside all stores, and on the exterior of 85.2% of stores. Signs/ads for unhealthy foods were displayed inside about half of stores (53.7%) and outside

61.1% of stores, while signs/ads for healthy foods were displayed inside 35.2% of stores and outside only 14.8% of stores. Similarly, only 31.5% of stores had interior price promotions for healthy foods while 53.7% had promotions for unhealthy foods and 72.2% had interior promotions for tobacco products.
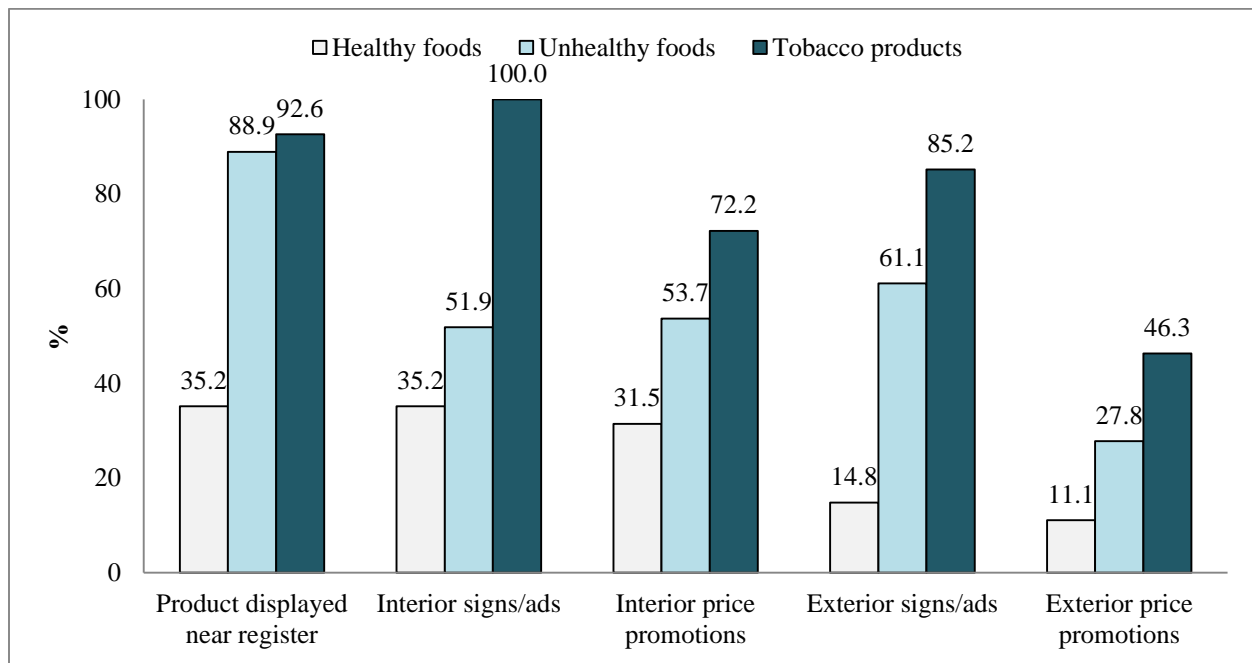

Figure 6.2. Percentage of stores (n=54) with displays, ads and price promotions for healthy foods, less healthy foods and tobacco products. **Healthy foods**: low calorie beverages, whole wheat bread, low fat milk, fruits, vegetables; **unhealthy foods**: sugar sweetened beverages, candy, whole milk, white bread; **tobacco products**: cigarettes, smokeless, cigars/cigarillos, e-cigarettes

Healthy food products and marketing score

The median healthy food score was 3.5 and ranged from 1 to 23 (possible score 0-42). Table 6.5 presents the results of three multivariate models examining associations between perceived attributes, willingness and healthy food score. Model 1 assesses the association of perceived attributes with healthy food score, while Model 2 examines the association of retailer willingness to implement a healthy food strategy with healthy food score. Model 3 examines

associations between perceived attributes and healthy food score after accounting for retailer willingness. All models include retailer and organizational characteristics.

Model 1 found that greater perceived *relative advantage of stocking* and promoting healthy foods was associated with higher healthy food scores (B=0.57, p=.001, Table 6.5). *Relative advantage* was the only DOI attribute significantly associated with healthy food score. Model 2 included retailer willingness without perceived attributes, and found that greater willingness to implement a healthy food strategy was positively associated with healthy food score (B=0.35, p=.006). In Model 3, the coefficient for *relative advantage* was attenuated when willingness was added to the model, but remained significant (B=0.49, p=.006), while willingness became attenuated and non-significant (B=0.11, p=.424, Table 6.5).

Retailer and organizational characteristics were also significant predictors of healthy food score. For example, in Model 3, smokers compared with non-smokers (B=0.73, p=0.024) retailers with some college education or more (vs. high school or less) (B=0.79, p=0.004), and older retailers (B=0.02, p=0.013) had significantly higher healthy food scores. Stores with gas stations had higher healthy food scores compared with stores without gas (B=0.92, p=0.001) Accepting WIC benefits was the strongest predictor of a higher healthy food score (B=1.74, p=0.000); however, accepting SNAP benefits was not significantly associated with healthy food score.

Table 6.5. Correlates of Store Healthy Food Products and Marketing Score[a], Eastern NC, 2014

Variable	Model 1			Model 2			Model 3		
	B	SE	p-value	B	SE	p-value	B	SE	p-value
Willingness to implement a healthy food strategy	-	-	-	0.35	0.12	0.006*	0.11	0.14	0.424
Perceived attributes of healthy food strategies[b]									
Relative advantage	0.57	0.15	0.001**	-	-	-	0.49	0.17	0.006**
Complexity[c]	0.03	0.13	0.841	-	-	-	0.01	0.13	0.941
Compatibility	0.11	0.16	0.478	-	-	-	0.08	0.16	0.605
Observability	0.20	0.19	0.304	-	-	-	0.13	0.20	0.509
Retailer characteristics									
Fruit & vegetable intake: High vs. low[d] (ref)	-0.07	0.25	0.766	-0.08	0.25	0.757	-0.10	0.25	0.688
Smoker vs. non-smoker (ref)	0.63	0.3	0.040*	0.69	0.32	0.035*	0.73	0.31	0.024*
Education: Some college or more vs. High school or less (ref)	0.73	0.25	0.005**	0.64	0.27	0.022*	0.79	0.25	0.004**
Female vs. male (ref)	-0.61	0.27	0.027*	-0.16	0.27	0.569	-0.5	0.28	0.087+
Age, years, centered	0.02	0.01	0.007**	0.01	0.01	0.112	0.02	0.01	0.013*
Organizational characteristics									
Store with gas station vs. no gas station	0.91	0.26	0.001**	0.95	0.27	0.001**	0.92	0.26	0.001**
WIC authorized (yes vs. no)	1.8	0.39	0.000***	1.42	0.43	0.002**	1.74	0.41	0.000***
SNAP authorized (yes vs. no)	0.35	0.22	0.128	0.46	0.24	0.056+	0.35	0.22	0.127
N	49			49			49		
R-sq	0.49			0.61			0.62		

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001; [a]Score is log transformed, **healthy foods**: low calorie beverages, whole wheat bread, low fat milk, fruits, vegetables; [b]Scales developed from items measured on a 5 point Likert scale, from 1= strongly disagree to 5= strongly agree; [c]Higher values represent lower complexity; [d]High= 3 or more servings/day, low=< 3 servings/day

Tobacco products and marketing score

The median tobacco products and marketing score was 18 and ranged from 6 to 27 out of a possible score of 43. Because none of the DOI attributes were significantly associated with retailer willingness to reduce tobacco products and marketing, we did not examine models with DOI attributes predicting tobacco products and marketing score. Table 6.6 examines retailer willingness in association with tobacco products and marketing score.

Table 6.6. Correlates of Tobacco Products and Marketing Score[a] in Small Food Stores, Eastern North Carolina, 2014

Variable	B	SE	p-value
Willing to reduce tobacco products and marketing vs. unwilling	-1.02	1.40	0.47
Retailer characteristics			
Smoker vs. non-smoker (ref)	1.26	1.81	0.49
Education: Some college or more vs. High school or less (ref)	0.01	1.56	0.99
Female vs. male (ref)	-2.77	1.57	0.09[+]
Age, years, centered	-0.09	0.05	0.08[+]
Organizational characteristics			
Store with gas station vs. no gas station (ref)	4.92	1.66	0.005[**]
WIC accepted vs. not accepted (ref)	-6.10	2.67	0.03[*]
SNAP accepted vs. not accepted (ref)	3.39	1.40	0.02[*]
Constant	13.33	2.15	0.000[***]
N	51		
R-sq	0.44		

[+] $p<0.10$, * $p<0.05$, ** $p<0.01$, *** $p<0.001$; [a]**Tobacco products:** cigarettes, smokeless tobacco, cigars/cigarillos, e-cigarettes

Retailer willingness to reduce tobacco products and marketing was not significantly associated with tobacco products and marketing score; however, some retailer and organizational characteristics were (Table 6.6). Female compared with male, and older retailers had lower tobacco scores, although results were only near significance (B=-2.77, p=0.09 and B=-0.09, 0.08, respectively). Stores with gas stations had significantly higher tobacco scores compared to stores

without gas stations (B=4.92, p=0.005). Stores that accepted WIC had significantly lower

tobacco scores compared to stores that did not accept WIC (B=-6.10, p=0.03, while stores that

accepted SNAP had higher tobacco scores compared with those that did not accept SNAP (B=-

3.39, p=0.02).

Discussion

We used the Diffusion of Innovations framework to examine which perceived attributes

of healthy stores programs were associated with retailer willingness to implement, and actual

implementation of, healthy store strategies among retailers of small food stores in rural North

Carolina. Although we found relatively low availability of healthy foods in small rural food

stores, retailers reported that they were willing to implement strategies to increase healthy food

availability and promotion. The strategies that retailers were most willing to implement included

increasing the availability of skim/low fat milk, whole wheat bread, and fresh fruits and

vegetables, and displaying healthy foods near the checkout. In contrast, the vast majority of

retailers in our sample sold and promoted all four tobacco products examined and were

overwhelmingly *unwilling* to implement any strategies to reduce tobacco products and

marketing.

Relative advantage was the only DOI perceived attribute significantly associated with

both retailer willingness to implement a healthy food strategy and the actual healthy food

products and marketing within the store. This is consistent with DOI research that has found

relative advantage to be the strongest predictor of an innovation's rate of adoption, particularly

when considering the economic benefits of an innovation.[137] The items that assessed the relative

advantage of selling healthier foods were related to increased sales, increased foot traffic and

gaining a competitive edge over other stores. Previous research with retailers has found that

perceived customer demand and profitability are often a barrier to stocking healthy foods.[40] Our findings are consistent, in that retailers who perceive greater advantages of selling healthier foods have greater willingness to sell and promote healthy foods and may already stock and promote healthier food items. Retailers who perceived lower *complexity* and higher *observability* of healthy food strategies also had higher willingness to implement strategies; however these attributes were not significantly associated with healthy food products and marketing score.

We did not find an association between the perceived DOI attributes and retailer willingness to reduce tobacco products and marketing, nor did we find any significant associations between willingness and tobacco products and marketing score. While some supermarkets and pharmacies, most recently CVS Caremark, have voluntarily stopped selling tobacco products citing ethics and benefits to customer health,[199-201] voluntarily reducing dependence on tobacco products in small food stores may be influenced by factors external to retailer perceptions. Convenience stores generate about $300,000 annually from tobacco products,[96] and the tobacco industry uses contracts to incentivize the sale and promotion of tobacco products.[29, 30] Smaller stores may rely on industry incentives to generate greater profit margins on tobacco products. Some studies have found tobacco products are important for small food retailers to generate foot traffic, and retailers report that they need the contracts and related incentive programs to keep prices competitive with neighboring stores.[202]

An interesting finding was that store participation in food assistance programs (WIC and SNAP) was associated with both healthy food and tobacco product availability and marketing. However, there were differences by food assistance program. Stores that accepted WIC (compared to those that did not) had significantly higher healthy food scores, and significantly lower tobacco products and marketing scores. Stores that accepted SNAP were no were different

from stores that did not in their healthy food scores, but SNAP stores had higher tobacco product scores. Although both programs provide food assistance for low income populations, eligibility criteria and the types of foods required to be stocked by participating stores differ. Only pregnant women or families with children under age five are eligible for WIC, while SNAP eligibility is based solely on family income level. WIC stores are required to stock fresh fruits and vegetables, whole wheat bread, 100% juice, low fat milk and other specific healthier food items. Only pregnant women or families with children under age five are eligible for WIC, whereas SNAP eligibility is based only on family income level. WIC stores are required to stock fresh fruits and vegetables, whole wheat bread, 100% juice, low fat milk and other specific healthier food items. SNAP requires stocking of staple food items, but not necessarily specific healthier items. Previous research has found more tobacco marketing and promotions in stores located in lower income neighborhoods[97] where more small food stores that accept SNAP may be located. Further, a study of tobacco retail outlets in Philadelphia found that SNAP and WIC stores were more likely to display exterior and interior tobacco marketing compared with other types of tobacco outlets.[139]

Implications for Research and Practice

Our results show promise for working with retailers in rural settings to increase healthy food availability in small food stores. It may be worthwhile to focus efforts on influencing perceived *relative advantage* by demonstrating initial customer demand for specific healthy foods. This could be accomplished by using methods to facilitate the stocking and promotion of healthy foods through free or reduced cost products, price promotions, free shelving, displays and signage, and in store cooking demonstrations[37, 193] to generate customer demand and increase sales of healthier items. We found that retailers were most willing to stock and display whole,

fresh produce rather than pre-cut or frozen, and were less willing to move unhealthy food items away from the register. Providing retailer training and equipment to store fresh, pre-cut or frozen produce could serve to lower perceived complexity of implementing strategies, and have been offered in previous intervention studies with some success.[36, 203] However, considerable resources must be allocated to each store to implement interventions with multiple incentives, and it may only be possible to implement an intervention with multiple components in a small number of stores.[204]

Given that WIC authorization was the strongest predictor of healthy food products and marketing score, another option is to implement a policy that requires a minimum standard of healthy foods in small food stores. When the WIC guidelines were changed to include fresh produce, retailers of small food stores accepting WIC reported that both demand and sales of fresh produce increased.[107, 205] Another promising strategy is to develop licensing ordinances that can be enacted locally and require stores to stock fresh produce and other healthy staple items as a condition of stores maintaining a business license. Localities, in turn, may provide technical assistance and help with initial marketing and display of the new food items.[204] Minneapolis, Minnesota has already passed a staple foods ordinance of this kind, and participating stores doubled the amount of fresh produce stocked in only one year.[36]

In contrast with healthy food strategies, we found low levels of retailer willingness to reduce dependence on tobacco products. Because of the clout that the tobacco companies exert over retailers[206] and the revenue derived from tobacco products, policies that restrict tobacco product availability, promotion and display at the point-of-sale may be more effective than voluntary approaches that attempt to persuade retailers. In fact, tobacco retailer licensing ordinances are the inspiration behind healthy food licensing ordinances.[204] Implementing tobacco

retailer licensing systems not only allows officials to monitor compliance with state and local laws, but also allows localities to implement further restrictions, including restricting the sale of candy and fruit flavored tobacco products or banning tobacco retailers within 1,000 feet of schools.[207] An ideal policy strategy may be to incorporate tobacco product restrictions into a healthy foods ordinance so that stores receiving incentives or technical assistance to improve healthy food availability must also abide by restrictions on the sale, promotion and display of tobacco products and marketing at the point-of-sale.

Strengths and Limitations

This is the first study to use the DOI framework to examine retailer perceptions of implementing healthy store strategies, and it is among the first to explore perceptions among retailers of small food stores in a rural setting. Further, this is the first study to assess perceptions related to the sale and promotion of healthy foods and tobacco products. Although the sample size was smaller than hoped, we obtained a similar number of participants compared with previous retailer studies.[40, 106] Small food store retailers are extremely busy and difficult to recruit for on-site interviews; therefore, we tried to maximize recruitment by visiting stores up to three times and at times specified by the retailer.

While most of the items assessing DOI perceived attributes of healthy food strategies resulted in reliable scales, some items did not perform well enough to include or collapse into scales. Improved items may be needed to assess *trialability* in this context, as are items assessing the attributes associated with reducing tobacco products and marketing. Due to the cross-sectional nature of our study, we are unable to assess whether perceptions of DOI attributes and retailer willingness temporally precede the actual stocking and promotion of healthy foods within stores. It may be that stocking and promoting healthy foods leads retailers to perceive greater

relative advantage and to be more willing sell and promote healthier foods. Still, it is important to learn which attributes are associated with the implementation of healthy store strategies in order to design appropriate interventions.

Conclusion

Small, rural food store retailers are willing to implement strategies to increase the availability, promotion and display of healthy foods and beverages, but not willing to reduce the availability, promotion and display of tobacco products and marketing. Practitioners implementing healthy store programs should prioritize demonstrating the relative advantages of stocking and promoting healthier foods. This may include providing or incentivizing healthy food items, technical assistance and support, and displays and marketing materials. Local healthy foods ordinances that require stores to stock a minimum amount of healthy foods could be combined with restrictions on tobacco sales and marketing, given that it may be difficult to influence retailers to voluntarily reduce dependence on tobacco products and marketing.

CHAPTER 7. CONCLUSION & SYNTHESIS

Summary of Dissertation Activities

The goal of this dissertation was to examine the intersection of retail food and tobacco environments at both the community (Studies One and Two) and consumer (Study Three) levels. Examining the community environment (the number, type, and location of outlets) and the consumer environment (the availability, price, promotion, and placement of products within outlets) for both food and tobacco provides an opportunity to examine the environmental factors that may influence both dietary intake and tobacco use. Further, both the locations of food and tobacco retail outlets, and the products sold within those outlets, have been implicated in health outcomes, and both have the potential to be regulated through licensing or zoning ordinances.

A conceptual model adapted from previous work was developed to describe the influence of place on health, and the mechanisms that drive the inequitable distribution of resources and shape the places where we live. The conceptual model was influenced by the framework created by Bernard et al. that links health disparities to inequalities in the distribution of negative or positive resources[109] within and between neighborhoods. In this framework, proximity to resources is the predominant rule; that is, living near positive or negative resources (e.g. parks vs. liquor stores) affects health. We can expand upon this to say that resource proximity to schools may also contribute to health given the amount of time youth spend at school and traveling to and from school.

Similar to the Bernard framework, the Schulz and Northridge framework is based on the hypothesis that health disparities stem from historical, social, political and economic factors that translate into inequalities in the distribution of wealth and in educational, employment and political opportunities within neighborhoods.[111, 115, 116] Rossen and Pollack adapt the Schulz and Northridge framework by adding zoning and land use as part of the community's social and political context.[117] The resulting inequality in socioeconomic disadvantage and racial/ethnic composition of a neighborhood influence licensing, zoning and land use laws that determine the types of retail outlets available, the location of retail outlets, and the location of schools within neighborhoods.[110, 111]

In summary, historical, political, and economic factors shape the distribution of wealth, employment and educational opportunities, and determine housing opportunities that factor into the creation of neighborhoods characterized by socioeconomic disadvantage and/or racial residential segregation. Similarly, the location of retail outlets and schools are shaped by the same political, economic, and social contexts that drive the racial/ethnic and socioeconomic composition of a neighborhood. The socioeconomic and racial/ethnic composition of a neighborhood matter because higher income, predominantly white neighborhoods may have more political influence and civic participation, compared with lower income, racial/ethnic minority neighborhoods. More political influence and participation equals more power over the types of outlets allowed to be sited in communities, or near schools. Higher income neighborhoods or towns may have the economic and political clout to reject new fast food restaurant development or limit the sale of tobacco products, while lower income neighborhoods may be eager for the increased employment opportunities and economic development brought to the community by new businesses.

The community food and tobacco environment also determines the consumer environment, because the types of stores available drive the availability and promotion of healthy (e.g. fruits and vegetables) or unhealthy (e.g. cigarettes, fast food) products. For example, convenience stores typically sell and display marketing for tobacco products, and fast food restaurants sell primarily high calorie, low nutrient foods. On the other hand, chain supermarkets are likely to sell healthier food options. On top of this, both the tobacco and fast food industries target low income, minority, and youth populations with promotions and advertising,[129-132] creating neighborhoods that may be saturated with sources of unhealthy foods and tobacco products targeted directly to the community's more vulnerable populations. Therefore, this dissertation presented three studies that add to a growing body of literature that examines the influence of place on health by analyzing aspects of the community and consumer environments that have implications for policies to influence the availability and promotion of foods and tobacco products around schools and within small food stores.

Studies One and Two examined the community food and tobacco environments, operationalized as the availability of fast food restaurants and retail tobacco outlets, around public schools in a national sample of 97 U.S. counties. The availability of fast food restaurants captured an aspect of the community food environment that is a source of energy dense, low nutrient foods and beverages distinct from retail stores that sell both food *and* tobacco products (e.g. supermarkets, convenience stores). Further, the fast food industry has been found to target youth, lower income and minority populations with promotions and marketing, similar to the tobacco industry. The location of both fast food restaurants and tobacco outlets relative to schools may influence youth dietary intake and smoking initiation by increasing exposure to

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point-of-sale advertising, marketing and promotions, and facilitating access to unhealthy foods, beverages and tobacco products.

Study One used spatial analysis to examine whether the location of fast food restaurants and tobacco outlets was related to the location of public schools, or if outlet location was independent of school location. This research question was designed to establish whether children of all ages attending public schools may be exposed to more outlets near their schools than would be expected if outlet location was not associated with school location. If outlet location *is* associated with school location, it raises the question of whether fast food and tobacco retail outlets are intentionally locating near a steady source of potential young customers. Study Two examined the availability of fast food restaurants and tobacco outlets near public schools in the same sample of U.S. counties in association with student socioeconomic status, race/ethnicity and school level. This study allowed for the examination of whether fast food and tobacco outlet availability was greater near schools with higher proportions of lower income and racial/ethnic minority students, and whether schools with higher proportions of lower income and racial/ethnic minority students were more likely to have both a fast food restaurant and tobacco outlet nearby. We also examined whether there were differences in outlet availability by school level, to assess availability for older children and adolescents compared with younger children.

Study Three focused on the consumer environment within small food stores in rural North Carolina using a cross-sectional retailer questionnaire and an in-store observation. It used the Diffusions of Innovations framework to assess retailer (owner/manager) perspectives of the sale and promotion of healthy foods and tobacco products, and linked these perspectives to the actual product availability and marketing within stores. This study sought to examine the determinants of implementing healthy store strategies (e.g. selling low fat milk, removing

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signs/ads for tobacco products) and to identify which strategies retailers were most willing to implement.

Synthesis of Significant Findings

Study One examined whether the location of fast food restaurants and tobacco outlets was related to the location of public schools, or if outlet location was independent of school location. There were more fast food restaurants and tobacco outlets near schools than would be expected if outlet location was unrelated to school location, but distances at which significant clustering occurred varied by school location and outlet type. Significant clustering of tobacco outlets occurred as close as 200 m from schools in all locales. Significant clustering of fast food restaurants occurred as close as 200 m from schools in cities and suburbs, and within 600 m of schools in rural areas. These represent relatively short distances for both children and adolescents to walk during lunch or after school. Even if children do not intend to purchase fast food, or attempt to purchase tobacco products, the presence of the outlet combined with any exterior marketing or promotions provides an environmental cue for doing so, and contributes to social norms that promote consumption of fast food and use of tobacco products.

After establishing that both fast food restaurants and tobacco outlets clustered near schools, Study Two examined the presence of each type of outlet, both individually and together, near schools in association with student demographic characteristics. Within a 10 minute walk (800 m), over 40% of all schools had at least one fast food restaurant, over 77% at least one tobacco outlet, and nearly 40% had both. Over half of schools within the highest quartile of Hispanic students (where greater than 61.3% of the school population is Hispanic) had both a fast food restaurant and tobacco outlet within 800 m, while only 21% of schools with highest percentage of White students (greater than 63.6% of the school population is White) had both

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nearby. In multilevel models controlling for urban locale, population density, student enrollment, and school level, schools with a higher percentage of Hispanic and Black students, and a higher percentage of students receiving free/reduced price lunch had greater numbers of tobacco outlets within 800 m of the school. Schools with more Hispanic and low income students had more fast food restaurants nearby as well as of having *both* a fast food restaurant and a tobacco outlet within walking distance. A national study found similar results, with more FFR near schools in lower income compared to higher income neighborhoods, but fewer in predominantly Black compared to predominantly White neighborhoods.[27] While there are no national studies of TO near schools, a national study of census tracts in the U.S. found tobacco outlet density was higher in census tracts with a higher proportion of Black and Hispanic residents.[168] Study Two also found that high schools were more likely to have *both* a fast food restaurant and a tobacco outlet nearby compared to primary schools. Therefore, low income, Hispanic, and older students (with more autonomy and purchasing power) are disproportionately exposed to both fast food restaurants and tobacco outlets near their schools in this sample of U.S. counties.

Taking Studies One and Two together, in this sample of 97 U.S. counties, both tobacco outlets and fast food restaurants clustered around public schools and were more available near schools with higher proportions of Hispanic and low income students. As stated previously, there are historical, social and economic factors that have shaped the racial/ethnic and socioeconomic composition of neighborhoods, including retail redlining and residential segregation.[110, 208] These factors have facilitated the targeted marketing of minority and low income communities by both the fast food industry and by businesses that sell tobacco products, especially convenience stores. Fast food restaurants, convenience stores and other retail establishments that sell tobacco products rely on market research when deciding where to locate new outlets. Market research

aimed at determining whether a particular location will or will not be conducive to the success of a new business typically includes the demographic profile of the area, including age, race/ethnicity, and income, and information on neighboring businesses, schools and other places that might generate foot traffic and provide a steady stream of customers.

Marketing strategies include segmentation of consumer audiences by demographic characteristics including race/ethnicity and age, consumer spending habits, and geographic location or neighborhood.[209] Marketing strategies also include how and where to market to certain audiences, including children and teens. The Mintel marketing firm reported in 2012 that 59% of Black and 50% of Hispanic teens spend money weekly on foods and beverages compared with 46% of non-Hispanic White teens.[133] Compared with White and Hispanic teens, a higher percentage of Black teens spend money on candy and snacks, while more Hispanic teens spend money on beverages and eating out.[178] Another Mintel report offers this advice to restaurants about the types of channels to use when marketing to multicultural households with children, including neighborhoods and schools with more racial/ethnic minority students:

> "Marketing efforts to attract multicultural families to a manufacturer's products may include targeted marketing campaigns to geographic areas or schools with higher prevalence of Hispanic, Asian, or black students, creating marketing material, whether it is written, video, or spoken, in the audience's native language, or increasing presence in multicultural family-friendly festivals."[210]

In summary, social, economic and political factors have contributed to the shaping of neighborhoods that differ in the locations and availability of fast food restaurants and tobacco outlets. Corporate marketing practices to segment and target particular racial, ethnic and age groups may capitalize on the geographic locations of their target audiences, either in neighborhoods or near schools with higher proportions of low income or racial/ethnic minority residents or students.

The results of Studies One and Two provide evidence that the location of fast food restaurants and tobacco outlets is spatially related to school location, with greater availability near schools with older, more diverse and lower income students compared with schools with younger, less diverse and higher income students. Because Studies One and Two are cross sectional, we do not have data on whether fast food restaurants or tobacco outlets opened near schools as a result of school demographic characteristics. However, given that both the fast food and tobacco industries have been shown to target youth, lower income, and racial/ethnic minority populations, the positioning of these outlets near schools is cause for concern.

Turning to the consumer food and tobacco environments, Study Three used the Diffusion of Innovations framework to examine which perceived attributes of healthy stores programs were associated with retailer willingness to implement, and actual implementation of, healthy store strategies among retailers of small food stores in rural North Carolina. We found relatively low availability of healthy foods in small rural food stores. Only 30% of stores sold any fresh fruits and 9% sold any fresh vegetables, while all stores sold sugar-sweetened beverages, candy and cigarettes. However, retailers reported that they were willing to implement strategies to increase healthy food availability and promotion in their stores, if they were to receive advice on how to sell healthier foods, and some help with marketing and community outreach. Retailers were most willing to increase the availability of skim/low fat milk, whole wheat bread, and fresh fruits and vegetables, and display healthy snacks near the checkout. Retailers with greater perceived *relative advantage* of implementing healthy food strategies had greater willingness to implement a healthy food strategy and also sold, displayed and promoted a greater amount of healthy foods and beverages. In contrast, the retailers in our sample were overwhelmingly *unwilling* to implement any strategies to reduce tobacco products and marketing, and none of the perceived

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DOI attributes were associated with either willingness to reduce tobacco products and marketing or with the actual availability, display and promotion of tobacco products in the store.

The results of Study Three indicate that demonstrating the relative advantages of stocking, displaying and promoting healthier foods in stores may increase the likelihood of healthy *food* strategy implementation, but other factors may influence retailer decisions to reduce dependence on tobacco products. Previous research has found that small food stores rely on tobacco industry contracts to increase their profits on tobacco products, stay competitive with neighboring stores, and generate foot traffic.[211, 212] While previous interventions and programs that work directly with retailers to increase healthy food availability have been promising, the vast majority of healthy store programs have not included tobacco products and marketing as a focus.[37] However, that may be changing, as there is growing interest in uniting efforts at the point-of-sale among nutrition, tobacco and alcohol advocates.[213] An important consideration is that voluntarily reducing dependence on tobacco, even with some assistance, may not be feasible because the economic advantages of *not* selling tobacco products are not obvious for many small food store retailers, while there are many economic advantages to participating in a tobacco company contract program.

Strengths and Limitations

Studies One and Two were cross sectional, ecological studies, therefore we cannot establish causation with individual behaviors or health outcomes. Both studies utilized a national sample of U.S. counties proportionate to population size. Our study area included 97 counties in 40 states covering a diverse geographic area, therefore the geographic profile of the schools in the sample were more suburban and urban, and may not be generalizable to all U.S. schools. For the food environment surrounding schools, the studies focused on fast food restaurants, but many

other outlets, including mobile food vendors and some store types included as tobacco outlets, promote and sell unhealthy foods to youth. However, our narrow inclusion criteria (i.e. only chain fast food/pizza restaurants) and extensive list cleaning to exclude chains known *not* to sell tobacco are likely to have improved the ability of our lists to accurately capture fast food restaurants and tobacco outlets near schools. The list of tobacco outlets, however, may include stores that do not actually sell tobacco products, or may have under-or over-counted the number of actual outlets in the study area and it was not feasible to verify the tobacco retail outlets in our sample. We were not able to account for commercial land use across the study area, however, we did stratify by the school urban locale in Study One, and controlled for both urban locale and population density in Study Two. An important consideration is that even if commercial land use accounted for clustering, students attending schools in densely populated areas would still be exposed to the same outlets near their schools each day.

Study Two was the first study to our knowledge to examine both fast food restaurants and tobacco outlets near public schools in association with student race, ethnicity and socioeconomic status. There was missing data for 4,955 schools on the percentage of students receiving free or reduced lunch; therefore we used the Markov chain Monte Carlo (MCMC) method of multiple imputations in SAS 9.3 to impute the missing data. We also ran models including only schools with complete data, and the results were nearly identical. Study Two also used generalized linear mixed models to account for the sampling design and clustering of schools within counties that violates the assumption of independence required for OLS regression. We did not account for spatial autocorrelation in the dependent variables using a spatial regression model; however, the use of the generalized linear mixed model with a random effect at the county level accounts for the correlation between schools in the dependent variable. Further, adding a spatial component to

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models using count data has been found to only marginally improve model fit beyond a standard Poisson or negative binomial regression model.[185]

Study Three was the first study to our knowledge to use the Diffusions of Innovations framework to examine retailer perceptions of implementing healthy store strategies, and it is among the first to explore perceptions among retailers of small food stores in a rural setting. Although the sample size was smaller than hoped, we obtained a similar number of participants compared with previous retailer studies.[40, 106] Our sample size allowed us to detect a significant effect size of approximately 0.35 in linear regression models. Small food store retailers are difficult to recruit for on-site interviews; therefore, we tried to maximize recruitment by visiting stores up to three times and at times specified by the retailer.

While most of our items assessing the perceived attributes of healthy *food* strategies resulted in reliable scales, some items, particularly those assessing perceptions regarding reducing tobacco products and marketing, did not perform well enough to include or collapse into scales. We also used a convenience sample of retailers, and therefore the retailers in our sample may not be representative of rural small food store retailers. Due to the cross-sectional nature of our study, we are unable to assess whether perceived attributes of the innovation and retailer willingness temporally precede the actual stocking and promotion of healthy foods within stores. It may be that stocking and promoting healthy foods leads retailers to perceive greater relative advantage and to be more willing to sell and promote healthier foods. Still, it is important to learn which attributes are associated with the implementation of healthy store strategies in order to design appropriate interventions. Future research could conduct longitudinal studies to assess whether there are changes in retailers' perceptions of implementing healthy strategies before and after a retailer intervention.

Implications for Research, Practice and Policy

All three studies in this dissertation have implications for research, practice and policy. Studies One and Two showed that fast food restaurants and tobacco outlets cluster as close as 200 m to 600 m of schools in our sample of U.S. counties, and that high schools and schools with a higher proportion of low income and Hispanic students were more likely to have both a fast food restaurant and a tobacco outlet within 800 m. Model zoning ordinances have been developed to help localities create healthy food zones around schools. The ordinances can be adapted to fit community needs, but could prohibit new fast food restaurants from locating near schools or other places frequented by youth, such as parks and playgrounds.[162] For example, the city of Detroit banned the location of fast food outlets within 500 feet of schools.[166] Similar types of ordinances apply to tobacco retailers. Requiring licensing in order to sell tobacco products is one strategy to control the location and density of tobacco outlets. The City of New Orleans has implemented a ban on tobacco sales near schools[164] and Chicago banned the sale of flavored tobacco products within 500 feet (152 m) of schools.[165]

The majority of localities in the U.S. that restrict the location of fast food restaurants have been higher income, predominantly White communities that cite preserving the culture or aesthetic of their towns as a reason to restrict less desirable businesses.[127] Given our finding that schools with higher proportions of lower income and Hispanic students were more likely to have both a fast food and tobacco outlet nearby, research into the determinants of lower income localities adopting ordinances to restrict businesses that sell and market unhealthy products to children is needed.

Research examining the impact of policies that change the built environment would benefit from multilevel, longitudinal studies that examine the relative contribution of

neighborhood, parental, and peer factors on youth health outcomes. Children could also be

followed over time as they progress through primary, middle and high schools, and the

contribution of the community food and tobacco environments to the consolidation of youth

dietary intake and tobacco use behaviors could be assessed at each stage in association with

changes in the availability of outlets when moving to a different school. Exploring collaborations

with those in the field of injury prevention could strengthen arguments for closed campus

policies for middle and high school students at lunch time.[214] Similarly, collaborating with active

living advocates to include an emphasis on healthy retail around schools, particularly in

programs such as Safe Routes to Schools,[215] could also strengthen proposals for zoning

restrictions to limit fast food restaurant and tobacco retail outlet density around schools.

The third study explored the consumer food and tobacco environment within rural North

Carolina convenience stores. While the retailers in our sample were willing to implement

strategies to increase the availability, promotion and display of healthy foods and beverages, they

were not willing to reduce the availability, promotion and display of tobacco products and

marketing. Among this sample of retailers in rural North Carolina, voluntarily reducing

dependence on tobacco products is not a viable option. For this reason, incentives provided

through an intervention or healthy store program, or local ordinances that require stores to stock

a minimum amount of healthy foods, could be linked with restrictions on tobacco sales and

marketing, such as requiring businesses to purchase a license to sell tobacco products. WIC

participation was a strong predictor of higher healthy food availability, display and promotion

scores, and stores that accepted WIC also had significantly lower tobacco products and

marketing scores. Yet stores that participated in SNAP had higher amounts of tobacco products

and marketing scores compared to non-SNAP stores. Given that retailers are unwilling to

voluntarily reduce tobacco products and marketing, tying restrictions on tobacco products to WIC and SNAP eligibility is a policy option that could reduce the availability, display, and promotion of tobacco products in small food stores that serve low income populations.

In conclusion, land use planning and zoning regulations can be used at both the community and consumer levels to influence both the retail food and tobacco environments. Community land use and local licensing ordinances are meant to be tools to change communities over time, and the impact on health outcomes may not be immediate. But it is important to remember that using policies and zoning to influence the types of products sold near schools would create a sustained environmental change at the community level, which could change social norms and improve the health of future generations of children and families.

APPENDIX 4.1. LIST OF COUNTIES: STUDIES ONE AND TWO

County	State
Baldwin	Alabama
St Clair	Alabama
Maricopa	Arizona
Pima	Arizona
Alameda	California
Contra Costa	California
Los Angeles	California
Marin	California
Orange	California
Riverside	California
San Bernardino	California
San Diego	California
Santa Clara	California
Yolo	California
El Paso	Colorado
Jefferson	Colorado
Fairfield	Connecticut
Sussex	Delaware
Broward	Florida
Hillsborough	Florida
Indian River	Florida
Lake	Florida
Miami Dade	Florida
Orange	Florida
Bibb	Georgia
Fulton	Georgia
Glynn	Georgia
Pike	Georgia
Cook	Illinois
Lee	Illinois
Peoria	Illinois
Sangamon	Illinois
Hendricks	Indiana
Lake	Indiana
Scott	Iowa
Lyon	Kansas
Daviess	Kentucky
Allen	Louisiana
Hancock	Maine
Montgomery	Maryland
Washington	Maryland
Bristol	Massachusetts
Middlesex	Massachusetts

Bay	Michigan
Huron	Michigan
Oakland	Michigan
St Clair	Michigan
Washington	Minnesota
Lamar	Mississippi
Boone	Missouri
St Louis City	Missouri
Lewis Clark	Montana
Lancaster	Nebraska
Essex	New Jersey
Mercer	New Jersey
Middlesex	New Jersey
Morris	New Jersey
Chaves	New Mexico
Dutchess	New York
New York	New York
Orange	New York
Suffolk	New York
Westchester	New York
Durham	North Carolina
Mecklenburg	North Carolina
Rowan	North Carolina
Licking	Ohio
Montgomery	Ohio
Portage	Ohio
Washington	Oklahoma
Deschutes	Oregon
Allegheny	Pennsylvania
Bucks	Pennsylvania
Lehigh	Pennsylvania
Somerset	Pennsylvania
Providence	Rhode Island
Berkeley	South Carolina
Dillon	South Carolina
Gibson	Tennessee
Lauderdale	Tennessee
Bexar	Texas
Cameron	Texas
Denton	Texas
Harris	Texas
Hunt	Texas
Mitchell	Texas
Travis	Texas
Salt Lake	Utah
Brunswick	Virginia

Fairfax	Virginia
Hanover	Virginia
King	Washington
Okanogan	Washington
Dane	Wisconsin
Dodge	Wisconsin
Milwaukee	Wisconsin
Washakie	Wyoming

APPENDIX 4.2. OUTLET INCLUSION CRITERIA

SIC and NAICS codes used to identify fast food restaurants and tobacco retail outlets		
Fast food/pizza restaurants[a]		
SIC Code	58120307	Fast-food restaurant, chain
	58120601	Pizzeria, chain
Probable tobacco retail outlets[b]		
	445110	Supermarkets and other grocery (except convenience) stores
	445120	Convenience stores
	453991	Tobacco stores
	447110	Gasoline stations with convenience stores
NAICS code	452910	Warehouse clubs and supercenters
	451212	News dealers and newsstands
	445310	Beer, wine, and liquor stores
	446110	Pharmacies and drug stores
	452112	Discount department stores
	447190	Other gasoline stations

[a] SIC codes include all types of chain fast food restaurants (e.g. hamburger, chicken, subs/sandwiches, pizza) but did not include donut or coffee shops. [b] Excluded chains known not to sell tobacco (e.g. Target, Whole Foods)

Top 50 pharmacies in us included in pharmacy category
http://www.drugstorenews.com/sites/drugstorenews.com/files/annualreport_april2010.pdf)

1 Walgreens
2 CVS Caremark
3 Rite Aid
4 Walmart
5 Good Neighbor Pharmacy
6 Leader, Dublin
7 Kroger, Cincinnati
8 Health Mart
9 Safeway
10 American Associated Pharmacies
11 Target
12 Kmart
13 Ahold,
14 Supervalu
15 Publix
16 Medicine Shoppe International
17 Costco
18 Sam's Club

19 H-E-B
20 Giant Eagle
21 Hy-Vee
22 Albertsons
23 Winn-Dixie
24 Fred's
25 Shopko
26 A&P
27 ShopRite
28 Kinney Drugs
29 Meijer
30 BioScrip
31 USA Drug
32 Kerr Drug
33 Hannaford
34 Raley's
35 Brookshire Grocery
36 Thrifty White Pharmacy
37 Sav-Mor, Novi
38 Care Pharmacy
39 Save Mart
40 Discount Drug Mart
41 Weis Markets
42 Schnucks
43 Bartell Drugs
44 Marc Glassman
45 Navarro Discount Pharmacies
46 Fruth Pharmacy
47 Brookshire Bros.
48 Lewis Drug
49 Pharmaca Integrative Pharmacy
50 Drugstore.com (not applicable to study sample)

Chains excluded because they are known to not sell tobacco products (2011)			
NAICS code	Industry	Exclusions	
445310	Beer, wine, and liquor stores	ABC Stores	
445110	Supermarkets and other grocery (except convenience) stores	Aldi Trader Joe's Whole Foods	
452112	(Discount) department stores	JC Penney Macy's Sears Marshall's TJ Maxx Target	Kmart Big Lots Dollar General Dollar Tree Family Dollar

APPENDIX 4.3. DEFINTION OF SCHOOL URBAN CENTRIC LOCALE

Text excerpted directly from: http://nces.ed.gov/ccd/rural_locales.asp

What are locale codes?
"Locale codes" are derived from a classification system originally developed by NCES in the 1980's to describe a school's location ranging from "large city" to "rural." The codes are based on the physical location represented by an address that is matched against a geographic database maintained by the Census Bureau. This database is the Topographically Integrated and Geographically Encoded Referencing system, or TIGER.

How accurate are urban-centric locale codes?
Geocoding technology has made it possible to know the exact latitude and longitude of about 91 percent of schools, and somewhat less precise locations for the remaining 9 percent. The TIGER database used in assigning locale codes updates information for about one-third of communities every year through the American Community Survey. These developments make today's locale codes far more accurate than was possible in the past.

How are locale codes assigned to school districts?
A school district's locale code is not assigned on the basis of the central office address. It is derived from the locale codes of the schools in the district. If 50 percent or more of the public school students attend schools with the same locale code, that locale code is assigned to the district. For example, if 60 percent of students were enrolled in schools with a "rural - distant" locale code, and 40 percent were enrolled in schools with a "town - small" locale code, the district would be assigned a "rural – distant" locale code. If no single locale code accounts for 50 percent of the students, then the major category (city, suburb, town, or rural) with the greatest percent of students determines the locale; the locale code assigned is the smallest or most remote subcategory for that category.

New Urban-Centric Locale Codes

11 - City, Large:

Territory inside an urbanized area and inside a principal city with population of 250,000 or more.

12 - City, Midsize:

Territory inside an urbanized area and inside a principal city with population less than 250,000 and greater than or equal to 100,000.

13 - City, Small:

Territory inside an urbanized area and inside a principal city with population less than 100,000.

21 - Suburb, Large:

Territory outside a principal city and inside an urbanized area with population of 250,000 or more.

22 - Suburb, Midsize:

Territory outside a principal city and inside an urbanized area with population less than 250,000 and greater than or equal to 100,000.

23 - Suburb, Small:

Territory outside a principal city and inside an urbanized area with population less than 100,000.

31 - Town, Fringe:

Territory inside an urban cluster that is less than or equal to 10 miles from an urbanized area.

32 - Town, Distant:

Territory inside an urban cluster that is more than 10 miles and less than or equal to 35 miles from an urbanized area.

33 - Town, Remote:

Territory inside an urban cluster that is more than 35 miles from an urbanized area.

41 - Rural, Fringe:

Census-defined rural territory that is less than or equal to 5 miles from an urbanized area, as well as rural territory that is less than or equal to 2.5 miles from an urban cluster.

42 - Rural, Distant:

Census-defined rural territory that is more than 5 miles but less than or equal to 25 miles from an urbanized area, as well as rural territory that is more than 2.5 miles but less than or equal to 10 miles from an urban cluster.

43 - Rural, Remote:

Census-defined rural territory that is more than 25 miles from an urbanized area and is also more than 10 miles from an urban cluster.

APPENDIX 5.1. DEMOGRAPHIC CHARACTERISTICS OF STUDY AREA

	U.S. Census Data, 2010, Mean			Schools in 97 County ASPIRE study area, Mean (SD)				
Race/ Ethnicity	All U.S.	U.S. ages 5 to 19	Census Tracts, 97 Counties	All schools	City	Suburb	Town	Rural
% Black	13.2	15.3	13.6	16.5 (24.5)	22.8 (29.5)	13.3 (20.3)	8.56 (14.0)	8.84 (14.9)
% Hispanic	17.1	20.7	27.6	36.7 (31.2)	45.2(32.6)	32.7 (29.2)	22.5 (23.8)	25.0 (26.8)
% White	62.6	57.1	64.2	35.8 (31.5)	21.0 (24.1)	42.3 (31.4)	62.9 (26.5)	57.3 (31.4)

Table 5.2.1. Constructs and Measures

Construct	Measure	Source
Dependent Variables		
Fast food restaurant (FFR) availability	Number of FFR within 400 m (0.25 mi) & 800 m (0.5 mi) Euclidean school buffers	Dun & Bradstreet, Inc.
Tobacco outlet (TO) availability	Number of TO within 400 m & 800 m Euclidean school buffers	Dun & Bradstreet, Inc. ReferenceUSA
Availability of both outlets	At least one FFR and TO within each buffer area vs. <1 of either	
Independent Variables		
Student socioeconomic status	Students receiving free or reduced price lunch, %	NCES, 2010-2011
Student racial/ethnic composition	Non-Hispanic Black students, % Hispanic students, %	
Covariates		
School level	School Level code is calculated from the school's corresponding low and high grade span values. Primary (low grade = PK-3; high grade = PK-8) Middle (low grade = 4-7; high grade = 4-9) High (low grade = 7-12; high grade = 12 only)	NCES, 2010-2011
Total students	Number of students enrolled	NCES, 2010-2011
Urban-centric Locale[a]	Urban centric locale code is based on the school's physical address and is a measure of a school's location relative to populous areas. Four major categories were used: 1) City (large, midsize, small), 2) Suburb (large, midsize, small) 3) Town (fringe, distant, remote), 4) Rural (fringe, distant, remote)	NCES, 2010-2011; (NCES assigned, based on 2000 Census geography)
Population Density	Number of people per square mile within the census tract where the school is located.	U.S. Census Bureau, 2010

[a] See Appendix C for description of each urban locale category. FFR, Fast food restaurant; TO, Tobacco outlet; NCES, National Center for Education

APPENDIX 5.3. ADDITIONAL DESCRIPTIVE STATISTICS STUDIES ONE AND TWO

Table 5.3.1 Percentage of public schools with at least one fast food restaurant, one tobacco retail outlet, and both within walking distance, in 97 counties in the contiguous United States, 2011 (n=18,379)

	Within 400 m of schools			Within 800 m of schools		
	% of schools with at least one outlet			% of schools with at least one outlet		
	Fast food	Tobacco	Both	Fast food	Tobacco	Both
Primary	11.9	43.1	10.0	39.6	77.6	37.5
Middle	12.2	41.5	10.8	37.7	74.8	35.7
High	18.4	46.5	16.0	45.0	78.7	42.9
All schools	13.2	43.5	11.3	40.3	77.3	38.2

Table 5.3.2 Number of fast food restaurants and tobacco retail outlets near public schools in 97 counties in the contiguous United States, 2011

	Primary Schools	Middle Schools	High Schools	All Schools	
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Range
Within 400 m					
Fast Food	0.2 (0.6)	0.2 (0.6)	0.3 (0.9)*	0.2 (0.6)	0-9
Tobacco	1.6 (3.9)	1.5 (3.9)	2.0 (5.2)*	1.6 (4.2)	0-79
Within 800 m					
Fast Food	0.9 (1.5)	0.8 (1.5)	1.2 (2.0)*	0.9 (1.6)	0-29
Tobacco	6.2 (11.1)	5.8 (12.1)	7.7 (17.3)*	6.4 (12.7)	0-269

[a] Schools with an urban centric locale designated as a small, medium or large city, NCES;*ANOVA pairwise comparison, high schools significantly different from primary and middle schools, $p < .05$

Table 5.3.3 Additional Characteristics of schools and study area in 97 counties in the contiguous United States, 2011 (n=18,379)

	% of schools or mean (SD)	
School characteristics		
Schools with at least one outlet, 400 m		
Fast food restaurant	13.2	
Tobacco outlet	43.5	
Both	11.3	
Schools with at least one outlet, 800 m		
Fast food restaurant	40.3	
Tobacco outlet	77.3	
Both	38.2	
Number of outlets, 400 m		
Fast food restaurant	0.2	(0.6)
Tobacco outlet	1.6	(3.9)
Number of outlets, 800 m		
Fast food restaurant	0.9	(1.6)
Tobacco outlet	6.4	(12.7)

APPENDIX 5.4. MODELS USING 400 M BUFFERS AROUND SCHOOLS

Table 5.4.1. Incidence rate ratios and 95% CI for the count of fast food restaurants and tobacco outlets within 400 m radius of public schools in 97 counties in the contiguous the U.S. (N=18,379)

| | Within 400 m of schools | | | |
| | Count of fast food restaurants | | Count of tobacco outlets | |
	IRR (95% CI)	p-value	IRR (95% CI)	p-value
Student composition				
Hispanic (%)	1.08 (1.05, 1.10)	<.0001	1.08 (1.06, 1.09)	<.0001
Black (%)	1.04 (1.01, 1.06)	0.01	1.04 (1.02, 1.05)	<.0001
Low income (%)	1.03 (1.01, 1.06)	0.01	1.05 (1.03, 1.05)	<.0001
School level				
Primary school (ref)	1		1	
Middle school	1.14 (1.01 ,1.30)	0.0349	1.05 (0.98, 1,12)	0.16
High school	2.21 (1.96, 2.49)	<.0001	1.42 (1.33, 1.51)	<.0001
Total students	1.00 (1.00, 1.00)	0.0098	1.00 (1.00, 1.00)	<.0001
Population per sq. mile (100s)	1.02 (1.01, 1.02)	<.0001	1.03 (1.02, 1.03)	<.0001
Urban centric locale				
City(Ref)	1		1	
Suburb	0.88 (0.79, 0.97)	0.0132	0.64 (0.60, 0.68)	<.0001
Town	0.75 (0.53, 1.05	0.096	0.79 (0.65, 0.96)	0.02
Rural	0.18 (0.13, 0.24)	<.0001	0.23 (0.20, 0.26)	<.0001

Continuous variables presented in deciles (10% or 10 unit increase interpretation)

Table 5.4.2. Odds of a school having both a fast food restaurant and a tobacco outlet within walking distance, in 97 counties in the contiguous U.S. , N=18,379

	400 m		800 m	
	OR (95% CI)	p-value	OR	p-value
Student composition				
Hispanic (%)	1.08 (1.06, 1.11)	<.0001	1.05 (1.03, 1.07)	<.0001
Black (%)	1.02 (0.99, 1.05)	0.1524	1.01 (0.99, 1.03)	0.5014
Low income (%)	1.03 (1.00, 1.05)	0.0585	1.03 (1.01, 1.05)	0.0009
School level				
Primary school (ref)	1		1	
Middle school	1.23 (1.07, 1.41)	0.0031	1.08 (0.99, 1.19)	0.0927
High school	1.96 (1.74, 2.22)	<.0001	1.47 (1.33, 1.61)	<.0001
Total students	1.0 (1.0, 1.0)	0.0013	1.0 (1.1, 1.0)	0.061
Population per square mile (100s)	1.02 (1.02, 1.03)	<.0001	1.07 (1.06, 1.08)	<.0001
Urban Centric Locale				
City(Ref)	1		1	
Suburb	0.73 (0.65, 0.82)	<.0001	0.79 (0.73, 0.86)	<.0001
Town	0.57 (0.36, 0.88)	0.0123	0.66 (0.51, 0.84)	0.001
Rural	0.13 (0.09, 0.20)	<.0001	0.15 (0.13, 0.19)	<.0001

Continuous variables presented in deciles (10% or 10 unit increase interpretation)

APPENDIX 5.5. SENSITIVITY ANALYSES

Table 5.5.1 Incidence rate ratios and 95% CI for the count of fast food restaurants and tobacco outlets within 400 m radius of public schools in 97 counties in the contiguous the U.S. (N=18,280) excluding schools with buffers beyond the study area

| | Within 400 m of schools | | | |
| | Count of fast food restaurants | | Count of tobacco outlets | |
	IRR (95% CI)	p-value	IRR (95% CI)	p-value
Student composition				
Hispanic students (%)	1.08 (1.05, 1.10)	<.0001	1.07 (1.06, 1.09)	<.0001
Black students (%)	1.03 (1.01, 1.06)	0.0163	1.03 (1.02, 1.05)	<.0001
Free/reduced price lunch (%)	1.03 (1.01, 1.06)	0.0185	1.04 (1.03, 1.06)	<.0001
School level				
Primary school (ref)	1		1	
Middle school	1.15 (1.01 ,1.30)	0.03	1.05 (0.98, 1,12)	0.1484
High school	2.20 (1.95, 2.49)	<.0001	1.42 (1.33, 1.52)	<.0001
Total students	1.00 (1.00, 1.00)	0.0083	1.00 (1.00, 1.00)	<.0001
Population per sq mile (100s)	1.02 (1.01, 1.02)	<.0001	1.03 (1.02, 1.03)	<.0001
Urban Centric Locale				
City(Ref)	1		1	
Suburb	0.87 (0.79, 0.97)	0.0119	0.64 (0.60, 0.68)	<.0001
Town	0.73 (0.5, 1.05)	0.0733	0.79 (0.65, 0.96)	0.0175
Rural	0.18 (0.14, 0.24)	<.0001	0.23 (0.20, 0.26)	<.0001

Continuous variables presented in deciles (10% or 10 unit increase interpretation)

Table 5.5.2. Incidence rate ratios and 95% CI for the count of fast food restaurants and tobacco outlets within 800 m radius of public schools in 97 counties in the contiguous the U.S. (N=18,056)) excluding schools with buffers beyond the study area

| | Within 800 m of schools | | | |
| | Count of fast food restaurants | | Count of tobacco outlets | |
	IRR (95% CI)	p-value	IRR (95% CI)	p-value
Student composition				
Hispanic students (%)	1.05 (1.04, 1.06)	<.0001	1.07 (1.06, 1.08)	<.0001
Black students (%)	1.01 (0.99, 1.02)	0.3754	1.04 (1.03, 1.05)	<.0001
Free/reduced price lunch (%)	1.03 (1.02, 1.04)	<.0001	1.03 (1.03, 1.04)	<.0001
School level				
Primary school (ref)	1		1	
Middle school	1.07 (1.01, 1.14)	0.0476	1.03 (0.99, 1.08)	0.1073
High school	1.41 (1.32, 1.50)	<.0001	1.24 (1.19, 1.30)	<.0001
Total students	1.0 (1.0, 1.0)	0.5623	1.0 (1.0, 1.0)	<.0001
Population per sq mile (100s)	1.02 (1.01, 1.02)	<.0001	1.03 (1.02, 1.03)	<.0001
Urban Centric Locale				
City(Ref)			1	
Suburb	0.87 (0.82, 0.92)	<.0001	0.67 (0.65, 0.70)	<.0001
Town	0.70 (0.58, 0.84)	0.0001	0.71 (0.63, 0.80)	<.0001
Rural	0.18 (0.16, 0.21)	<.0001	0.23 (0.21, 0.25)	<.0001

Continuous variables presented in deciles (10% or 10 unit increase interpretation)

Table 5.5.3. Odds of a school having at least one fast food restaurant and one tobacco outlet within walking distance, in 97 counties in the contiguous U.S.) excluding schools with buffers beyond the study area

	400 m		800 m	
	OR (95% CI)	p-value	OR	p-value
Student composition				
Hispanic students (%)	1.09 (1.06, 1.12)	<.0001	1.05 (1.03, 1.07)	<.0001
Black students (%)	1.02 (0.99, 1.06)	0.1721	1.01 (0.99, 1.03)	0.5627
Free/reduced price lunch (%)	1.02 (0.99, 1.05)	0.1148	1.03 (1.01, 1.05)	0.0012
School level				
Primary school (ref)	1		1	
Middle school	1.23 (1.07, 1.41)	0.003	1.07 (0.98, 1.18)	0.1354
High school	1.96 (1.74, 2.22)	<.0001	1.45 (1.32, 1.59)	<.0001
Total students	1.0 (1.0, 1.0)	0.0011	1.0 (1.0, 1.0)	0.0717
Population per square mile (100s)	1.02 (1.02, 1.03)	<.0001	1.07 (1.06, 1.08)	<.0001
Urban Centric Locale				
City(Ref)	1		1	
Suburb	0.73 (0.65, 0.82)	<.0001	0.79 (0.73, 0.86)	<.0001
Town	0.57 (0.36, 0.88)	0.0122	0.63 (0.49, 0.81)	0.0004
Rural	0.14 (0.09, 0.20)	<.0001	0.15 (0.13, 0.19)	<.0001

Continuous variables presented in deciles (10% or 10 unit increase interpretation)

APPENDIX 5.6. SCHOOLS WITH COMPLETE DEMOGRAPHIC DATA

Table 5.6.1 Incidence rate ratios and 95% CI for the count of fast food restaurants and tobacco outlets within 800 m radius of public schools in 97 counties in the contiguous the U.S. with complete data (N=13,421)

	Count of fast food restaurants		Count of tobacco outlets	
	IRR (95% CI)	p-value	IRR (95% CI)	p-value
Student composition				
Hispanic students (%)	1.06 (1.04, 1.08)	0.000	1.06 (1.05, 1.07)	<.0001
Black students (%)	1.00 (0.99, 1.03)	0.226	1.05 (1.04, 1.06)	<.0001
Free/reduced price lunch (%)	1.03 (1.01, 1.04)	0.000	1.03 (1.02, 1.04)	<.0001
School level				
Primary school (ref)	1		1	
Middle school	1.10 (1.13, 1.19)	0.023	1.03 (0.98, 1.07)	0.215
High school	1.51 (1.39, 1.63)	0.000	1.15 (1.10, 1.21)	0.000
Total students	1.0 (1.0, 1.0)	0.073	1.0 (1.0, 1.0)	0.003
Population per sq mile (100s)	1.02 (1.01, 1.02)	0.000	1.0 (1.0, 1.0)	0.000
Urban Centric Locale				
City(Ref)	1		1	
Suburb	0.83 (0.77, 0.89)	0.000	0.79 (0.75, 0.84)	0.000
Town	0.72 (0.59, 0.89)	0.000	0.70 (0.60, 0.82)	0.000
Rural	0.18 (0.16, 0.21)	<.0001	0.24 (0.21, 0.26)	0.000

Continuous variables presented in deciles (10% or 10 unit increase interpretation)

Table 5.6.2 Odds of a school having at least one fast food restaurant and one tobacco outlet within walking distance, in 97 counties in the contiguous U.S. among schools with complete data (N=13,421)

	800 m	
	OR	p-value
Student composition		
Hispanic students (%)	1.06 (1.04, 1.08)	0.000
Black students (%)	1.00 (0.99, 1.03)	0.619
Free/reduced price lunch (%)	1.02 (1.00, 1.04)	0.017
School level		
Primary school (ref)	1	
Middle school	1.13 (1.01, 1.25)	0.033
High school	1.51 (1.35, 1.70)	0.000
Total students	1.0 (1.0, 1.0)	0.001
Population per square mile (100s)	1.00 (1.00, 1.00)	0.000
Urban Centric Locale		
City(Ref)	1	
Suburb	0.76 (0.69, 0.85)	0.000
Town	0.69 (0.52, 0.91)	0.009
Rural	0.17 (0.14, 0.21)	0.000

Continuous variables presented in deciles (10% or 10 unit increase interpretation)

APPENDIX 5.7. ADDITIONAL ANALYSES FOR STUDY TWO

The following are ancillary analyses examining alternate measures of population density in Study Two. Alternate measures were explored in order to more closely approximate the population density within each school buffer area. Working with the GIS librarian at UNC, three distinct population density measures were calculated for the schools in Durham County (see table below). Using an aggregate measure of the population density within the census block groups that intersected each school buffer resulted in an average population density 0.01% higher than population density at the tract level. Given the minor difference in population density using tract or aggregated block groups, and the fact that data at the census block data are not available on a national level, population density at the tract level was retained for analyses in Study Two.

Comparison of population density using three different measures for schools in Durham County (n=44)	Average population per sq. mile
1. Census tract where school centroid falls (current measure)	2056.0
2. Census Block Groups (CBG)that intersect with the 800 m school buffer (sum of population of all intersecting CBG's/ sum of land area of all intersecting CBGs)	2085.1
3.Census Blocks that intersect with the 800 m school buffer (sum of population of all intersecting blocks/ sum of land area of all intersecting blocks)	2233.0
Difference between tract and block group (Methods 1 and 2)	0.01%
Difference between tract and block (Methods 1 and 3)	0.09%

Next, I examined an alternate dependent variable for Study Two. The following shows the results of an analysis using a multinomial, multilevel regression model with 4 categories for the outcome instead of the binary outcome presented in Study Two (i.e., school has both a FFR and TO with 800 m vs. only one type or none):

Combined outcome within 800 m (for multinomial model)	N	Percent
No outlets	3,784	20.59
==Fast food only==	==383==	==2.08==
Tobacco outlet only	7,189	39.12
Both	7,023	38.21
Total	18,379	100.0

Very few schools had only a FFR (and no TO) within 800 m. Below is a comparison of the multinomial outcome (using only complete cases, n=13,421) to the dichotomous outcome from the Study Two original results (imputed, n=18,379).Both models control for school level, total students, population density, urban locale. Odds ratios (OR) are presented for a 10% increase in the independent variable

	Logistic: Both vs. none or one (Study Two data)			Multinomial: Both, Tobacco only, FF only vs. none					
				Both		Tobacco only		Fast food only	
Student composition	OR	p-value		OR	p-value	OR	p-value	OR	p-value
Hispanic students (%)	1.05	<.0001		1.15	<0.001	1.13	<0.001	1.01	0.905
Black students (%)	1.01	0.5014		1.05	0.242	1.08	0.003	0.996	0.904
Free/reduced price lunch (%)	1.03	0.0009		1.07	0.016	1.08	<0.001	==1.041==	==0.092==

Results are similar between the "both" categories for both models, however the odds are 10% greater for Hispanic students using the multinomial model. The low number of schools with FFR only is likely causing that category to be underpowered as an OR of 1.04 was found for the percentage of students receiving free/reduced price lunch, but it did not reach significance. There are no apparent advantages of a multinomial compared with a binary outcome.

APPENDIX 6.1. INFORMED CONSENT AND DATA COLLECTION INSTRUMENT

B. Screening for eligibility (Complete for all stores approached)

Site ID: |_ _ |_ _|, Store ID: |_ _ |_ _|_ _|

Hello, my name is <**name**>, and I work at UNC Chapel Hill under the supervision of Kurt

Ribisl. We are working on a project to better understand how retailers decide what types of

products to sell in stores like yours here in North Carolina. Can I ask you a few questions to see

who would be the best person to talk to in your store?

What is your job title? (Circle only one; if more than one, circle the topmost one)

Owner 1

Manager   2

Assistant Manager   3

(if 1, 2 , or 3, CONTINUE to question 2)

Other (Specify)_____   4

(If 4 then CONTINUE to Q 1A)

   1a. Do you make decisions about which products to sell and where to place them in the
store?
      |__|Yes or |__|No
   (If no, STOP, THANK, not eligible

   2. Are you at least 18 years of age or older? |__|Yes or |__|No
   (If no, STOP, THANK, not eligible)

Great, it looks like we can proceed with the interview if you are willing. We are conducting one-

time interviews of about 15 minutes with about 100 owners or managers of stores like yours. The

interview is confidential: we will not record your name or any other personal information. ***Only project staff will have access to your store name and answers.***

 We will be asking about the products you sell, and your thoughts about what you sell and display in your store, and a few basic demographic questions.

We will also look at the different products you sell and how they are displayed in your store.

Your participation is voluntary and you can decline to answer any question; there are no right or wrong answers.

There is a small chance that some of the questions may make you feel uncomfortable, if so you can choose not to answer those questions.

If you agree to participate, you will receive a $25 gift certificate as a token of our appreciation. Is this something you would be willing to help us with?

Do I have your permission to begin asking you questions?
(If no) Thank you for your time, have a great day.

(If yes), Great, and if you have any questions or concerns about the study, or are dissatisfied at any time with any aspect of this study, you may contact Heather D'Angelo at 413-214-2687. You may also contact the Institutional Review Board at 919-966-3113 if you have any questions or concerns about your rights as a research participant. Be sure to reference IRB Study # 14-0645.

SHOW OWNER/MANAGER STUDY INFORMATION SHEET AND POINT OUT IRB AND STUDY CONTACT INFORMATION AT THE BOTTOM

FOR LENOIR COUNTY ONLY: And, at the end of the interview, if you are interested, you can take an information sheet about a retailer program coming to your area later this year.

Great, let's get started.

Q1 INTERVIEWER

○ MB (1)

○ CH (2)

○ HD (3)

Q2 DATE: MMDD

Q3 START TIME IN 24 HOUR FORMAT: HHMM

Q4 COUNTY

○ Lenoir (1)

○ Wayne (2)

○ Wilson (3)

Q5 STORE ID NUMBER

Q6 ATTEMPT

○ 1st (1)

○ 2nd (2)

○ 3rd (3)

Q7 STORE TYPE

❍ Convenience only (1)

❍ Convenience store with gas station (2)

❍ Small grocery (3)

❍ Other, please specify (4) _____

Q8 STREET ADDRESS

Q9 CONSENT Hello, my name is <NAME>, and I work at UNC Chapel Hill under the

supervision of Dr. Kurt Ribisl. We are working on a project to better understand how retailers

decide what types of products to sell in stores like yours here in North Carolina. Can I ask you a

few questions to see who would be the best person to talk to in your store? Great, are you the

[READ RESPONSES]

❍ Owner, GO TO Q11 (1)

❍ Manager or Assistant Manager, GO TO Q11 (2)

❍ Clerk/cashier or other, GO TO Q10 (3)

❍ DECLINED TO BE SCREENED, GO TO Q35 (4)

Q10 Do you make decisions about which products to sell and where to place them in the store?

❍ Yes, GO TO Q11 (1)

❍ No, THANK, NOT ELIGIBLE, GO TO Q35 (2)

○ DECLINED, GO TO Q35 (3)

Q11 Are you at least 18 years of age or older?

○ Yes, GO TO Q12 (1)

○ No, THANK, NOT ELIGIBLE (2)

○ DECLINED, GO TO Q35 (3)

Q12 Great, it looks like we can proceed, let me tell you more about the project. We are conducting one-time interviews of about 15 minutes with about 100 owners or managers of stores like yours. The interview is confidential: we will not record your name or any other personal information.   Only project staff will have access to your store name and answers.   We will be asking about the products you sell, and your thoughts about what you sell and display in your store, and a few basic demographic questions. We will also look at the different products you sell and how they are displayed in your store. Your participation is voluntary and you can decline to answer any question; there are no right or wrong answers. There is a small chance that some of the questions may make you feel uncomfortable, if so you can choose not to answer those questions.   If you agree to participate, you will receive a $25 gift certificate as a token of our appreciation. Is this something you would be willing to help us with?   Do I have your permission to begin asking you questions?

○ Yes (1)

○ No, THANK, GO TO Q35 (2)

Q13 Great, and if you have any questions or concerns, here is the study information sheet with contact numbers. [GIVE PROJECT INFO SHEET] FOR LENOIR COUNTY ONLY: And, at

the end of the interview, if you are interested, you can take an information sheet about a retailer

program coming to your area later this year. FOR EVERYONE:PRODUCTS & SUPPLIERS

We are interested in learning about suppliers that you use to stock certain products. I'll go one

product at a time, and if you have the same answer to several products, please let me know. The

choices are [READ CHOICES] How do you supply [PRODUCT] to your store?

	Self-supply from supermarket or warehouse club (1)	Through a distributor who delivers multiple products or brands (2)	Through a distributor or manufacturer of specific brands (e.g. Coke, Philip Morris) (3)	Another source (4)	NA (-88)	DK/DECLINED (-99)
1. Low calorie beverages, like water and diet soft drinks (1)	❑	❑	❑	❑	❑	❑
2. Sugary beverages such as soft drinks, energy drinks, and sports drinks (2)	❑	❑	❑	❑	❑	❑
3. Skim, 1% or 2% milk (3)	❑	❑	❑	❑	❑	❑
4. Whole wheat bread, like Nature's Promise 100% Whole Wheat Bread (4)	❑	❑	❑	❑	❑	❑

5. Fresh fruits (5)	❑	❑	❑	❑	❑	❑
6. Frozen fruits (6)	❑	❑	❑	❑	❑	❑
7. Frozen vegetables (7)	❑	❑	❑	❑	❑	❑
8. Fresh vegetables (8)	❑	❑	❑	❑	❑	❑
9. Candy (9)	❑	❑	❑	❑	❑	❑
10. Tobacco products (10)	❑	❑	❑	❑	❑	❑

Q14 Now I'm going to ask about healthy foods and tobacco products. When I say healthy foods I mean things like fresh fruits and vegetables, whole wheat breads and cereals, and low fat dairy products. When I say tobacco products, I mean all types including cigarettes, cigars, smokeless tobacco and e-cigarettes. How much do you agree with the following statements? You can choose from [READ CHOICES]

	Strongly Agree (1)	Agree (2)	Neutral (3)	Disagree (4)	Strongly Disagree (5)	NA (7)	DK/DECLINED (-99)
Stocking more healthy foods would increase my overall sales. (1)	○	○	○	○	○	○	○
Stocking more healthy foods would increase foot traffic. (2)	○	○	○	○	○	○	○
Stocking more healthy foods gives my store a competitive edge over other stores in my area. (3)	○	○	○	○	○	○	○

Stocking fewer tobacco products and more of another product would decrease my overall sales. (4)	❍	❍	❍	❍	❍	❍	❍
Given that fewer people are smoking, stocking fewer tobacco products would give my store a competitive edge over other stores in my area. (5)	❍	❍	❍	❍	❍	❍	❍
Adding more healthy foods to what my store offers is not that different from the types of products I currently stock. (6)	❍	❍	❍	❍	❍	❍	❍
My business has the right equipment and/or enough space to stock more healthy foods. (7)	❍	❍	❍	❍	❍	❍	❍
There are distributors in my area that could supply my store with healthy foods. (8)	❍	❍	❍	❍	❍	❍	❍
Healthy foods would not work in my store because they spoil or expire	❍	❍	❍	❍	❍	❍	❍

quickly. (9)							
Adding more healthy foods to what my store offers would fit in well with how I run my business (10)	❍	❍	❍	❍	❍	❍	❍
Selling tobacco products fits in well with how I run my business (11)	❍	❍	❍	❍	❍	❍	❍
If I stocked fewer tobacco products it would violate the terms of a contract I have with a tobacco company. (12)	❍	❍	❍	❍	❍	❍	❍
Selling tobacco products does not fit in with my business's image. (13)	❍	❍	❍	❍	❍	❍	❍
My customers will notice if I change the types of foods that I stock. (14)	❍	❍	❍	❍	❍	❍	❍
My customers will notice if I promoted healthy foods. (15)	❍	❍	❍	❍	❍	❍	❍
My customers will notice if I sold fewer tobacco products. (16)	❍	❍	❍	❍	❍	❍	❍
My customers will notice if I took down	❍	❍	❍	❍	❍	❍	❍

tobacco signs and displays. (17)							
It would take a lot of extra work to increase the amount of healthy foods that I stock in my store. (18)	❍	❍	❍	❍	❍	❍	❍
It would be difficult to train my staff to stock and maintain healthy foods, like fresh produce. (19)	❍	❍	❍	❍	❍	❍	❍
It would be complicated to stock fewer tobacco products. (20)	❍	❍	❍	❍	❍	❍	❍
It would take a lot of extra work or planning to sell fewer tobacco products in my store. (21)	❍	❍	❍	❍	❍	❍	❍
If I add more healthy foods to my store and they don't sell, I can easily go back to my original product mix. (22)	❍	❍	❍	❍	❍	❍	❍
If I displayed healthy foods near the register and it didn't work out, I can easily go back to the old layout. (23)	❍	❍	❍	❍	❍	❍	❍

If I stocked fewer tobacco products and it didn't work out, I can easily go back to my original product mix. (24)	○	○	○	○	○	○	○
If I moved tobacco product displays away from the register, and it didn't work out, I can easily put them back. (25)	○	○	○	○	○	○	○
Other managers and owners of stores like mine stock healthier foods. (26)	○	○	○	○	○	○	○
Other managers/owners of stores like mine sell tobacco products and display tobacco ads. (27)	○	○	○	○	○	○	○

Q15 The following statements refer to how well products sell in your store. You can choose from strongly disagree to strongly agree.   How strongly do you agree with the following statements?

	Strongly Agree (1)	Agree (2)	Neutral (3)	Disagree (4)	Strongly Disagree (5)	NA (-88)	DK/DECLINED (-99)
Healthy foods sell well in my store.	○	○	○	○	○	○	○

(1) If I offered more healthy foods, my customers would buy them. (2)	○	○	○	○	○	○	○
Tobacco products sell well in my store. (3)	○	○	○	○	○	○	○
If I offered [more varieties of] tobacco products, my customers would buy them (4)	○	○	○	○	○	○	○

Q16 This next question is about profit. How much profit do you make from selling

[PRODUCT]?

	Very little (1)	Below Average (2)	Average (3)	Above Average (4)	Very high (5)	NA (-88)	DK/DECLINED (-99)
1. Low calorie beverages, like water and diet	○	○	○	○	○	○	○

soft drinks (1)							
2. Sugary beverages such as soft drinks, energy drinks, and sports drinks (2)	❍	❍	❍	❍	❍	❍	❍
3. Skim, 1% or 2% milk (3)	❍	❍	❍	❍	❍	❍	❍
4. Whole wheat bread, like Nature's Promise 100% Whole Wheat Bread (4)	❍	❍	❍	❍	❍	❍	❍
5. Fresh fruits (5)	❍	❍	❍	❍	❍	❍	❍
6. Fresh vegetables (6)	❍	❍	❍	❍	❍	❍	❍
7. Candy (7)	❍	❍	❍	❍	❍	❍	❍
8. Tobacco products (8)	❍	❍	❍	❍	❍	❍	❍

Q17 There are local programs in our state that help small stores like yours become a "healthy store" that sells healthier foods. Stores receive advice on how to sell healthier foods, and some help with marketing and community outreach, and in return, the store owner agrees to make some changes. If you were to receive some assistance through a program like this, tell me how

willing you would be to make the following changes. If you already do these things, tell me how

willing you are to keep on doing them. You can choose from [READ CHOICES]

	Not at all willing (1)	Somewhat willing (2)	Neutral (3)	Willing (4)	Very Willing (5)	DK/DECLINED (-99)
1. Stock at least 3 choices of fresh fruits and 3 choices of fresh vegetables, not including potatoes, onions, lemons, or limes. (1)	○	○	○	○	○	○
2. Stock any frozen fruits or vegetables. (2)	○	○	○	○	○	○
3. Stock prepared fresh fruits or vegetables, like pre-cut apple slices or carrot sticks. (3)	○	○	○	○	○	○
4. Stock whole wheat bread, like Nature's Promise 100% Wheat	○	○	○	○	○	○

Bread (4)						
5. Stock skim, 1% or 2% milk. (5)	○	○	○	○	○	○
6. Display healthy snacks such as fruit at or next to the checkout counter (6)	○	○	○	○	○	○
7. Move soda, chips or candy displays away from the register (7)	○	○	○	○	○	○
8. Move tobacco product displays away from the register. (8)	○	○	○	○	○	○
9. Remove ads/signs for tobacco products outside the store (9)	○	○	○	○	○	○
10. Remove ads/signs for tobacco products inside the store. (10)	○	○	○	○	○	○
11. Not	○	○	○	○	○	○

sell any type of tobacco product (11)						
12. Create a healthy checkout aisle that displays only healthy foods and beverages. (12)	❍	❍	❍	❍	❍	❍

STORE & RETAILER INFORMATION

Q18 Does your store accept WIC?

❍ Yes (1)

❍ No (0)

❍ DK/DECLINED (-99)

Q19 Does your store accept SNAP/EBT or Food Stamps?

❍ Yes, GO TO Q20 (1)

❍ No, GO TO Q21 (0)

❍ DK/DECLINED (-99)

Q20 As far as you know, can customers purchase cold, prepared foods with SNAP benefits?

❍ Yes (1)

○ No (0)

○ NA (-88)

○ DK/DECLINED (-99)

Q21 Which of these best describe your store?

○ Independently owned and managed (1)

○ Chain or corporate managed (0)

○ Other (4) _____

○ DK/DECLINED (-99)

Q22 Do you smoke cigarettes...

○ Every day (2)

○ Some days, or (1)

○ Not at all (0)

○ DECLINED (-99)

Q23 Approximately how many cups of fruits and vegetables do you eat in a typical day?

○ 0 (1)

○ 1-2 (2)

○ 3-4 (3)

○ 5 or more (4)

○ DECLINED (-99)

Q24 Over the past 30 days, how often did you drink soft drinks, soda, or pop? Do not include

diet or sugar free soft drinks, soda or pop.

○ Never (1)

○ Less than Once a Month (2)

○ Once a Month (3)

○ 2-3 Times a Month (4)

○ Once a Week (5)

○ 2-3 Times a Week (6)

○ Daily (7)

○ DECLINED (-99)

Q25

Q26 Looking at the picture, do you think that if stores had graphic warning labels on cigarette

packs and ads that it would make your customers [SHOW PICTURE ABOVE READ

STATEMENTS]

	A lot more likely (1)	A little more likely (2)	No difference (3)	A little less likely (4)	A lot less likely (5)	NA (7)	DK/DECLINED (6)
More likely to buy cigarettes, less likely to buy cigarettes, or would it make no difference to them? (1)	O	O	O	O	O	O	O

More likely to visit the store, less likely to visit the store, or would it make no difference? (2)	○	○	○	○	○	○	○

Q27 Which one or more of the following would you say is your race? CHOOSE ALL THAT

APPLY

❑ White (8)

❑ Black or African American (9)

❑ Asian (10)

❑ Native Hawaiian or Other Pacific Islander (11)

❑ American Indian or Alaska Native (12)

❑ Other (specify): (13) _____

❑ DECLINED (-99)

Q28 Are you Hispanic or Latino?

○ Yes (1)

○ No (0)

Q29 What is your age? ENTER 99 FOR DECLINED

Q30 What is the highest level of education that have you completed?

❍ Less than high school (0)

❍ High school graduate or GED (1)

❍ Some college (2)

❍ College graduate or more (3)

❍ DECLINED (-99)

Q31 CODE GENDER

❍ Male (0)

❍ Female (1)

Q32 Those are all of the questions I have. Do you have any questions for me? Thank you very much for your time and help. I have a small token of our appreciation.

❍ Incentive given (1)

Q33 FOR LENOIR COUNTY ONLY Would you like some information about a healthy stores project coming to this area?

❍ Yes, GIVE INFO SHEET (1)

❍ No (2)

❍ NA, NOT LENOIR COUNTY (3)

Q34 INTERVIEW END TIME IN 24 HOUR FORMAT HHMM

Q35 STORE TRACKING

○ Could not locate/out of business (1)

○ Ineligible: wrong store type (2)

○ Ineligible: language (3)

○ Ineligible: age (4)

○ Will reattempt (5)

○ Unable to meet with owner manager, final attempt (6)

○ Declined to participate (7)

○ Completed interview (8)

○ Other (9) _____

Q36 COMMENTS

Q37 STORE AUDIT: INTERIOR

	NUMBER OF (1)
AISLES (1) CASH REGISTERS (2)	

Q38 INTERIOR: FOOD & BEVERAGE PRODUCTS SOLD, PLACEMENT, PROMOTIONS, ADS

	Sold here?		Displayed at/near register?			Displayed on end cap?				Any price promotions?			Any signs/ads?		
	Yes (1)	No (0)	Yes (1)	No (0)	NA (-88)	Front (1)	Rear (2)	No (0)	NA (-88)	Yes (1)	No (0)	NA (-88)	Yes (1)	No (0)	NA (-88)
Sugary beverages (regular soft drinks, energy drinks, sports drinks) (1)	❍	❍	❍	❍	❍	❑	❑	❑	❑	❍	❍	❍	❍	❍	❍
Low-calorie beverages (water, diet soft drinks) (2)	❍	❍	❍	❍	❍	❑	❑	❑	❑	❍	❍	❍	❍	❍	❍
Candy (3)	❍	❍	❍	❍	❍	❑	❑	❑	❑	❍	❍	❍	❍	❍	❍
Whole wheat bread (4)	❍	❍	❍	❍	❍	❑	❑	❑	❑	❍	❍	❍	❍	❍	❍
White bread (5)	❍	❍	❍	❍	❍	❑	❑	❑	❑	❍	❍	❍	❍	❍	❍
Skim milk or low fat milk (1% or 2 %) (6)	❍	❍	❍	❍	❍	❑	❑	❑	❑	❍	❍	❍	❍	❍	❍
Whole milk (7)	❍	❍	❍	❍	❍	❑	❑	❑	❑	❍	❍	❍	❍	❍	❍
Fresh fruits (8)	❍	❍	❍	❍	❍	❑	❑	❑	❑	❍	❍	❍	❍	❍	❍
Fresh vegetable	❍	❍	❍	❍	❍	❑	❑	❑	❑	❍	❍	❍	❍	❍	❍

	s (9)													

Q39 For whole fruits & vegetables, count the types of fruits and vegetables available up to 5. Do not count: onions, potatoes or garlic, or lemons or limes. If not sold here choose 0. For pre-cut and frozen, indicate whether they are sold in this store.

	Whole						Pre-cut sold here?		Frozen sold here?	
	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)	Yes (1)	No (2)	Yes (1)	No (2)
Fruits (1)	○	○	○	○	○	○	○	○	○	○
Vegetables (2)	○	○	○	○	○	○	○	○	○	○

Q40 Are any tobacco products sold here?

○ No (4)

○ Yes, and store has a "power wall" (1)

○ Yes, and visible without a power wall (2)

○ Yes, but not visible (3)

○ DK (5)

Q41 INTERIOR: TOBACCO PRODUCTS SOLD, PLACEMENT, PROMOTIONS, ADS

	Sold here?		Displayed at/near register?				Any price promotions?					Any signs/ads?		
	Yes (1)	No (0)	Yes, and self-service (1)	Yes, enclosed (0)	No (-88)	NA (4)	None (1)	Special price (0)	Multi-buy (BOGO) (-88)	Cross-product (4)	NA (5)	Yes (1)	No (0)	NA (-88)
Cigarettes (1)	❍	❍	❑	❑	❑	❑	❑	❑	❑	❑	❑	❍	❍	❍
Smokeless tobacco (2)	❍	❍	❑	❑	❑	❑	❑	❑	❑	❑	❑	❍	❍	❍
Cigars/cigarillos (4)	❍	❍	❑	❑	❑	❑	❑	❑	❑	❑	❑	❍	❍	❍
E-cigarettes (5)	❍	❍	❑	❑	❑	❑	❑	❑	❑	❑	❑	❍	❍	❍

Q42 Interior audit comments

Q43 EXTERIOR: FOOD & BEVERAGE PROMOTIONS, ADS

	Any price promotions?			Any signs/ads?		
	Yes (1)	No (0)	NA (-88)	Yes (1)	No (0)	NA (-88)
Sugary beverages (regular soft drinks, energy drinks, sports drinks) (1)	❍	❍	❍	❍	❍	❍
Low-calorie beverages (water, diet soft drinks) (2)	❍	❍	❍	❍	❍	❍
Candy (3)	❍	❍	❍	❍	❍	❍

	None (0)	Special price (1)	Multi-buy (BOGO) (2)	Cross-product (3)	NA (-88)	Yes (1)	No (0)	NA (-88)
Whole wheat bread (4)	○	○	○	○	○	○		
White bread (5)	○	○	○	○	○	○		
Skim milk or low fat milk (1% or 2 %) (6)	○	○	○	○	○	○		
Whole milk (7)	○	○	○	○	○	○		
Fresh fruits (8)	○	○	○	○	○	○		
Fresh vegetables (9)	○	○	○	○	○	○		

Q44 EXTERIOR: TOBACCO PROMOTIONS, ADS

	Any price promotions?					Any signs/ads?		
	None (0)	Special price (1)	Multi-buy (BOGO) (2)	Cross-product (3)	NA (-88)	Yes (1)	No (0)	NA (-88)
Cigarettes (1)	❑	❑	❑	❑	❑	○	○	○
Smokeless tobacco (2)	❑	❑	❑	❑	❑	○	○	○
Cigars/cigarillos (3)	❑	❑	❑	❑	❑	○	○	○
E-cigarettes (4)	❑	❑	❑	❑	❑	○	○	○

Q45 Exterior audit comments

Q46 AUDIT STATUS

	Complete (1)	Partially complete (2)	Incomplete/declined (3)
Interior audit (1)	○	○	○
Exterior audit (2)	○	○	○

Q47 OTHER COMMENTS/FIELD NOTES

Table 6.2.1 Healthy food strategy scoring

	Scoring		
Products	Stocking	Placement & Promotions	Combined Score
Healthy foods			
Fruits	Fresh: 0 to 5 for varieties available Frozen, any available: 1 Precut, any available : 1	Exterior: Price promotion: 1 Sign/ad: 1 Interior: Displayed on front endcap: 1 Displayed on rear endcap: 1 Displayed near register: 1 Price promotion: 1 Sign/ad: 1	0-14
Vegetables	Fresh: 0 to 5 for varieties available Frozen, any available: 1 Precut, any available : 1	Exterior: Price promotion: 1 Sign/ad: 1 Interior: Displayed on front endcap: 1 Displayed on rear endcap: 1 Displayed near register: 1 Price promotion: 1 Sign/ad: 1	0-14
Whole wheat bread	Any available: 1	Exterior: Price promotion: 1 Sign/ad: 1 Interior: Displayed on front endcap: 1 Displayed on rear endcap: 1 Displayed near register: 1 Price promotion: 1 Sign/ad: 1	0-8
Low-fat milk	Skim or low-fat milk available:1	Exterior: Price promotion: 1 Sign/ad: 1 Interior: Displayed on front endcap: 1 Displayed on rear endcap: 1 Displayed near register: 1 Price promotion: 1 Sign/ad: 1	0-8

Low calorie beverages	Bottled water or diet soda, "zero" drinks available: 1	Exterior: Price promotion: 1 Sign/ad: 1 Interior: Displayed on front endcap: 1 Displayed on rear endcap: 1 Displayed near register: 1 Price promotion: 1 Sign/ad: 1	0-8
Range Healthy Food Score Possible Higher is more *healthy* foods and promotions	0 to 17	0 to 25	0 to 42

Table 6.2.2 Tobacco product strategy scoring			
	Scoring		
Products	Stocking	Placement & Promotions	Combined
Cigarettes	Any available: 1	Exterior: Price promotion, special price 1 Price promotion, multi-buy 1 Price promotion, cross-product: 1 Sign/ad: 1 Interior: Displayed near register, self-service: (not applicable, illegal) Displayed near register, enclosed: 1 Price promotion, special price 1 Price promotion, multi-buy 1 Price promotion, cross-product: 1 Sign/ad: 1	0-10

Cigars, cigarillos	Any available: 1	Exterior: Price promotion, special price 1 Price promotion, multi-buy 1 Price promotion, cross-product: 1 Sign/ad: 1 Interior: Displayed near register, self-service: 1 Displayed near register, enclosed: 1 Price promotion, special price 1 Price promotion, multi-buy 1 Price promotion, cross-product: 1 Sign/ad: 1	0-11
Smokeless tobacco (chew, snus)	Any available: 1	Exterior: Price promotion, special price 1 Price promotion, multi-buy 1 Price promotion, cross-product: 1 Sign/ad: 1 Interior: Displayed near register, self-service: 1 Displayed near register, enclosed: 1 Price promotion, special price 1 Price promotion, multi-buy 1 Price promotion, cross-product: 1 Sign/ad: 1	0-11

E-cigarettes	Any available: 1	Exterior: Price promotion, special price 1 Price promotion, multi-buy 1 Price promotion, cross-product: 1 Sign/ad: 1 Interior: Displayed near register, self-service:1 Displayed near register, enclosed: 1 Price promotion, special price 1 Price promotion, multi-buy 1 Price promotion, cross-product: 1 Sign/ad: 1	0-11
Range Tobacco Score Possible	0 to 4	0 to 39	0 to 43

Variable	Question	Construct	N	Mean	SD	Median	Min	Max	Agree/ strongly agree (%)	Included in scale?
	Table 6.3.1 DOI Constructs assessed for healthy foods-1=Strongly disagree to 5=Strongly agree (* Indicates reverse coded for scale analyses, not reverse coded in this table); HF=assessed for healthy food									
Q14_1	Stocking more healthy foods would increase my overall sales.	Relative Advantage HF 1	52	2.92	0.97	3	2	5	34.62	Yes
Q14_2	Stocking more healthy foods would increase foot traffic.	Relative Advantage HF 2	53	2.98	0.93	3	2	4	41.51	Yes
Q14_3	Stocking more healthy foods gives my store a competitive edge over other stores in my area.	Relative Advantage HF 3	53	3.02	1.01	3	1	5	45.29	Yes
Q14_6	Adding more healthy foods to what my store offers is not that different from the types of products I currently stock.	Compatibility HF 1	52	2.98	1.09	2.5	1	5	44.23	No
Q14_7	-My business has the right equipment and/or enough space to stock more healthy foods.	Compatibility HF 2	55	3.47	1.02	4	2	5	67.27	Yes
Q14_8	-There are distributors in my area that could supply my store with healthy foods.	Compatibility HF 3	50	3.74	0.8	4	1	5	86	No
Q14_9*	-Healthy foods would not work in my store because they spoil or expire quickly.	Compatibility HF 4	54	3.26	1.15	2	1	5	61.11	Yes

Q14_10	-Adding more healthy foods to what my store offers would fit in well with how I run my business	Compatibility HF 5	54	3.44	0.86	4	2	5	61.11	Yes
Q14_14	-My customers will notice if I change the types of foods that I stock.	Observability HF 1	54	3.76	0.93	4	2	5	79.62	Yes
Q14_15	-My customers will notice if I promoted healthy foods.	Observability HF 2	55	4.02	0.41	4	2	5	96.36	Yes
Q14_16 *	-It would take a lot of extra work to increase the amount of healthy foods that I stock in my store.	Complexity HF 1	55	2.73	1.08	4	1	5	30.91	Yes
Q14_17 *	-It would be difficult to train my staff to stock and maintain healthy foods, like fresh produce.	Complexity HF 2	53	2.26	0.9	4	2	5	15.09	Yes
Q14_20	-If I add more healthy foods to my store and they don't sell, I can easily go back to my original product mix.	Trialability HF 1	54	3.87	0.62	4	1	5	87.04	No
Q14_21	-If I displayed healthy foods near the register and it didn't work out, I can easily go back to the old layout.	Trialability HF 2	54	3.91	0.45	4	2	5	92.59	No

Table 6.3.2 DOI Constructs assessed for tobacco product strategies (*Indicates reverse coded for scale analyses, not reverse coded in this table)

Variable	Question	Construct	N	Mean	SD	Min	Max	Agree / strongly agree (%)
Q14_4*	Stocking fewer tobacco products and more of another product would decrease my overall sales.	Relative Advantage T 1	52	3.6	0.98	1	5	73.08
Q14_5	Given that fewer people are smoking, stocking fewer tobacco products would give my store a competitive edge over other stores in my area.	Relative Advantage T 2	55	1.87	0.77	1	4	5.45
Q14_11*	-Selling tobacco products fits in well with how I run my business	Compatibility T 1	52	3.94	0.5	1	4	88.46
Q14_12*	-If I stocked fewer tobacco products it would violate the terms of a contract I have with a tobacco company.	Compatibility T 2	52	3.48	1.09	1	5	69.23
Q14_13	-Selling tobacco products does not fit in with my business's image.	Compatibility T 3	52	2.23	0.78	1	4	11.54
Q14_14.0	-My customers will notice if I sold fewer tobacco products.	Observability T 1	53	4.11	0.67	2	5	94.34
Q14_15.0	-My customers will notice if I took down tobacco signs and displays.	Observability T 2	52	3.77	0.76	2	5	76.93
Q14_18*	-It would be complicated to stock fewer tobacco products.	Complexity T 1	53	2.98	1.12	1	5	43.4
Q14_19*	-It would take a lot of extra work or planning to sell fewer tobacco products in my store.	Complexity T 2	52	2.83	1.08	1	5	34.62
Q14_22	-If I stocked fewer tobacco products and it didn't work out, I can easily go back to my original product mix.	Trialability T1	53	3.79	0.74	1	5	88.68
Q14_23	-If I moved tobacco product displays away from the register, and it didn't work out, I can easily put them back.	Trialability T2	52	3.79	0.78	1	5	88.47

Table 6.3.3 Scale creation for DOI constructs related to healthy food strategies				
Construct	Items included in scale	Alpha	Correlation coefficient (p value) for 2 item scales	Decision
Relative advantage	Q14_1, Q14_2, Q14_3	0.7079	na	Use scale
Compatibility v2	Q14_7, Q14_9, Q14_10	0.6406	na	Use scale
Observability	Q14_14, Q14_15	0.4104	0.26 (0.059)	Use scale
Complexity	Q14_16,Q14_17 (both reverse)	0.5851	0.41 (.002)	Use scale
Trialability	Q14_20,Q14_ 21	Na	na	low variability: exclude from model
Willingness	Q17_1 to Q17_8, Q17_12 (all healthy food strategy items)	0.75	na	Use scale

Table 6.3.4 Scale creation for DOI constructs related to tobacco strategies				
Constructs	Items included in scale	Alpha	Correlation coefficient (p value) for 2 item scales	Decision
Relative advantage	Q14_4 (reverse), Q14_5	0.1499	-0.08 (.56)	Use items
Compatibility	q11 (reverse) q12 q13	0.2430	na	Use items
Observability	q14_14_0 q14_15_0	0.2314	.13 (.36)	Use items
Complexity	q14_18, q14_19	0.7066	0.55 (0.000)	Use scale
Trialability	q14_22, q14_23	Na	na	low variability: exclude from model
Willingness	q17_8 q17_9 q17_10 q17_11 (all tobacco items)	0.72	na	Use scale

Table 6.4.1 Correlates of retailer willingness to implement a strategy to reduce tobacco products and marketing[a] , Eastern North Carolina, 2014, n=47.

Variable	OR	95% CI	
Perceived attributes of selling/promoting fewer tobacco products[b]			
Relative advantage items			
Stocking fewer tobacco products and more of another product would decrease my overall sales[c]	1.58	0.58	4.29
Given that fewer people are smoking, stocking fewer tobacco products would give my store a competitive edge over other stores in my area.	0.94	0.36	2.47
Complexity[d]	1.10	0.39	3.11
Compatibility items			
Selling tobacco products fits in well with how I run my business[c]	1.61	0.36	7.27
Selling tobacco products does not fit in with my business's image.	1.32	0.60	2.89
If I stocked fewer tobacco products it would violate the terms of a contract I have with a tobacco company.[c]	2.46	0.85	7.09
Observability items			
My customers will notice if I sold fewer tobacco products.	0.33	0.10	1.12
My customers will notice if I took down tobacco signs and displays.	1.52	0.44	5.19
Retailer characteristics			
Education level: Some college or more vs. High school or less	0.56	0.12	2.58
Female vs. male	1.48	0.22	9.95
Age, years, centered	1.00	0.95	1.06
Pseudo R-sq	0.15		

* $p<0.05$; [a] Outcome is a score of 2 or greater (somewhat willing or more) vs. < 2 on a willingness scale based on the average of 4 items scored on a Likert scale from 1(not at all willing) to 5 (very willing). [b]Items measured on a 5 point Likert scale, from 1= strongly disagree to 5= strongly agree; [c]Item is reverse coded so that a higher value is more disagreement with statement. [d] Scale, higher values represent lower complexity

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