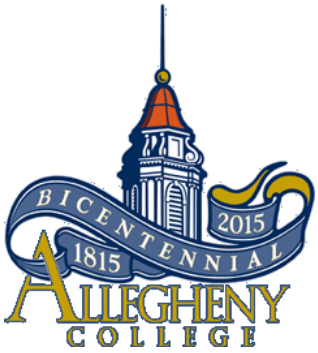
Identifying barriers to healthy eating in northwest Pennsylvania, a study of the food environment using NEMS



Senior Comprehensive Project

in partial fulfillment of

Bachelor of Science Degree

Global Health Studies

May 2016

Alyssa J. Brindle

Identifying barriers to healthy eating in northwest Pennsylvania, a study of the food environment using NEMS

May 2016

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Alyssa Brindle

This work represents my own work unless otherwise cited.

This senior comprehensive project has met the minimum requirements

of the Global Health Studies

major for a Bachelors of Sciences degree

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ABSTRACT

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Graduation Date:	*May 2016*
Title:	*Identifying barriers to healthy eating in northwest Pennsylvania: A study of the food environment using NEMS*
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The food environment is believed to play a crucial role in an individual's access to healthy, affordable foods. Research suggests that access to adequate portions of high quality, affordable food is critical for optimal health. Thus, an inadequate food environment could exert an impact on a suite of chronic diseases in a region. This study obtained baseline data on price, quality, and availability of healthy food in the northwestern Pennsylvania city of Meadville, by evaluating food outlets in the region with the Nutrition Environment Measures Survey for Stores and Convenience Stores (NEMS-S, CS). It examined and compared healthy foods versus less healthy foods across stores. Comparing data from Meadville to national baseline NEMS study data suggest that to families living in poverty, Meadville could be considered a food desert in terms of healthy and affordable foods due to their scarcity and limited availability at affordable prices. Seasonality, however, did not impact the prices of food or quality. Additionally, availability of foods other than fresh produce varied only slightly with season. The lack of available healthy, affordable options in convenience stores is most notable in the present findings. Studies show that intervention efforts to improve the food environment can positively impact families' eating habits and behaviors. Conclusions from this research can be used to design targeted interventions in the food environment to improve food security for low-income families in the Meadville region.

"The wise man should consider that health is the greatest of human blessings. Let food be your medicine." - Hippocrates

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I want to thank my parents for their unwavering support, flawless advice, and providing me with invaluable opportunities that have and will continue to set me up to achieve success and happiness in my life. My entire family continues to be my rock.

Finally, I want to thank my ACXC and ACTF family. Competing in three seasons of a sport year-round while completing a project of this magnitude was a challenge in itself in terms of time, energy, and capacity. It presented massive challenges that I was able to overcome with grace due to the support of my teammates and coaches. Balancing these things has taught me more than I can account for and I am humbled by and grateful for these experiences.

Chapter 1: Motivation and background

This project grew out of a recognition and interest in the shifting paradigm of thinking surrounding the obesity epidemic and increase in chronic disease rates in the U.S. Serving as a Health Coach in the Meadville community, along with having other observational experiences with community members, fostered my concern of healthy food access and how it was effecting the health of individuals. I took note that circumstantial factors (i.e. access, income, etc.) were inhibiting individuals from following physician recommendations and general guidelines to manage their chronic diseases. This seemed to be a fundamental problem and something that was out of the control of the patient or the physician. Thus, I wanted to set out and see if the environment was the underlying problem. More specifically, I wanted to see if the food environment was conducive to living a healthy lifestyle. Did the current food environment offer healthy options at an affordable prices that were accessible to all levels of citizens in the town? After researching best practices to measure the food environment, the Nutrition Environment Measures Survey (NEMS) proved to be the most sound and accepted tool. Using this tool allowed me to collect vital data that has an impact all parts of the Meadville community and can be used in efforts towards chronic disease prevention. It is my hope that this project is telling about the current state of the food environment and food access in Meadville, and adds to the conversation surrounding ways to get every individual access to healthy, affordable food.

Science and the environment

The environment in which a person lives has a profound impact on the physical and mental health of that individual. A person pulls all factors that enable survival from his or her environment on a daily basis and relies on the environment heavily for resources and sustenance. Nutrition and food are crucial components to survival and through research, more is becoming known about what the human body needs to optimize its life. Therefore, before completing a project within a food environment, a high level of understanding needs to be had about what food contributes positively to chronic disease prevention and which foods, on the contrary, tend to foster chronic disease within a population. What food is available and accessible is a determinant of the quality of life and health. Psychological factors surrounding how a person interacts with the environment in which he or she lives also come into play. It is impossible to generalize how someone will act in a set environment, but it is recognized to some degree that the environment can play a role in determining behavior. Individual habits and behavior need not be neglected, though this project focuses on the environment and how to optimize it to influence the best behaviors.

Ethics and social responsibility

This project has important ethical implications. A community is ideally a place that should foster the well-being of all of its citizens. Food access is a crucial part of this because food is a basic life necessity, and at that, healthy food is necessary to sustain a certain quality of life and health. The issue of food access brings about important questions and concerns such as where the line is drawn in terms of what a community should ethically be providing for its citizens. Do people have a right to healthy food, or simply a right to food? For retailers, is offering healthy food at higher prices than unhealthy food unethical? Embedded in these issues is the underlying question of responsibility. Should it be the government's job to ensure that everyone has adequately affordable, healthy food? Is it a social responsibility that should be taken on by key stakeholders at a community level and promoted by its own citizens? Is it the responsibility of large companies or retailers of food to make sure their products are sold in a way that meets the needs of every individual of the community? There are no clear

answers to these questions, but with research on the environment and what is currently comprising food environments, they are starting to be answered.

Policy and economics

Policies that govern how and where people get what food they do are crucial to the sustainability of a community. The information from this project has the potential to impact any type of policy that dictates food access in the Meadville community because it assesses what is available, affordable, and accessible. There is a wide variety of policies one multiple different levels that impact what people eat. Starting from the federal level, there are national food assistance programs that trickle down to towns and communities. There are also policies that affect retail and economics that impact how food is sold and how it is reaching the population. Financial status, on both and individual level and a community level, is a main driver in determining food access, and is therefore a main consideration in policy-making. Using the information from this project could help assess the effectiveness of existing policies and determine where changes or new ones might be needed. Minor policy suggestions are made at the end of the project.

Cultures and society

Food is something that varies widely across not only the planet, but between communities. Things like customs, tastes, preferences, and norms all affect what people eat and are influenced by things like religion, ethnicity, culture, and societal values. It is of utmost importance that values of this sort are understood when trying to understand a food environment and subsequently developing policies or interventions concerning food access. The culture and societal values that exist in a community are large determinants to whether the food environment is meeting the needs of its inhabitants. It also plays a role in shaping the food environment and determining what the most important factors of it are. It is for these reasons that this study has important implications. Studies of this nature are essential for understanding a community at the most ground-level possible, which in turn leads to the most effective interventions and programs to optimize healthy food access. It is clear to see that the implications of this project are widespread across a multitude of facets that makeup a community.

Motivation

According to the USDA, about 30 million Americans live in neighborhoods without easy access to nutritious food that is affordable. Most of these people are living in low-income neighborhoods over one mile from a grocery store. (Ver Ploeg et al, 2012) Evidence shows rural residents are at elevated risk for chronic diseases and a lack of access to healthy foods. (Ahern et al, 2011) With new national efforts to persuade people to take preventative action with their health by eating a well-balanced diet, it is important to consider that these efforts assume that everyone has ready access to the healthy, recommended foods. However, this is often not the case, thus it is important that efforts are made by retailers and communities to provide as healthy and affordable options as possible. A community's food environment is a key determinant of the health and wellness of its members, but it is vast. A first step in improving access is to understand what current options are available, and if they are healthy, affordable, and accessible. Retail food outlets vary in what they provide based on factors like geographical placement and transportation, climate and seasonality, and markets. This study's aim was to accurately assess the healthy food options in the Meadville community year-round. The significance lies in the quantitative nature of the data and the standardization that it provides, allowing comparison of food categories across stores. Being aware of the characteristics of the food environment and how they change is important for a range of professionals like health care providers who are advising patients on what to eat, as well as social workers, dietitians, financial planners and other social service entities. It is the hope that this study can start to contribute to explanations of health disparities and inequalities within the community and provide a baseline for researching the food environment in its entirety.

Study Area Background and Demographics

Meadville, Pennsylvania is often classified as a rural city in the Northwestern part of the state in Crawford County. It is rural in its proximity to the nearest urbanized areas being about 45 minutes south of Erie, PA and 90 minutes north of Pittsburgh, PA by car (Figure 1). However, it is not a standard rural town as one might think of traditionally. Instead of being comprised of mostly farmland, the center of town is quite dense with businesses and shops packed around a main street with dense housing interspersed and surrounding this centralized area. It is a sort of urban plot immediately surrounded by rural areas. Once a more booming industrial area made up of logging, iron production, and large industry employers like the Talon Corporation and Channellock Tools, Meadville and the surrounding region took a substantial economic hit in the 1980's. Major declines in heavy industry occurred, but today Meadville is powered by smaller industry like its tool and die machining, banking, education, and social services. (City of Meadville, n.d.) With a population of around 13,000 people, just over 26% are living in poverty compared to 14.9% in Crawford County. (US Census, City Data)

Food security is a concern in this region. 25.8% of the Meadville population received food stamp/SNAP benefits on the past twelve months. (ACS, US Census) Additionally, Crawford County has an adult obesity rate currently at 32%, greater than both the state and national averages, and has been increasing steadily since 2009, based on running averages as measured by the RWJF County Health Rankings. Children in Crawford County face these challenges as well: 20% of children in kindergarten through 12th grade in the Crawford Central School District are obese and nearly 40% obese or overweight. (PA Department of Education) Nearly 51% of children in Crawford Central School District are eligible for the free and reduced lunch program for their meals during a week, with the highest risk school serving as many as 84% of children through this program. (Annie E. Casey Foundation) To be eligible for the free and reduced lunch program, a household must have an income at or below 130 percent of the poverty level for free meals or between 130 percent and 185 percent of the poverty level

for reduced-price meals. (FRAC) Families in Meadville face varying challenges with finances, transportation, and education. A number of those challenges affect their ability to gain nutritious foods on a regular basis to nourish themselves and their children. It is possible that the makeup of the food environment could have linkages to contributors to these staggering rates.

Figure 1: Map showing Meadville, Pennsylvania in proximity to major cities (Meadville, Pennsylvania, n.d.).



Important opportunities in food access exist in this region and strides are already being made. Meadville houses the oldest continuously-run market structure in the state of Pennsylvania, the Meadville Market House, which acts as a hub for many local farmers and growers to sell their produce. In addition to the modest list of efforts shown in *Figure 1a*, other collaborations exist like soup kitchens and food donation programs. A range of efforts are being made to expose community members to healthier foods and increase access. Collaborations between community members and community food meetings are making these efforts possible.

The climate of the region is known to be that of long winter months, with an average annual precipitation of about 44 inches, higher than that of the average rate in the U.S. (U.S. Climate Data) Yearly temperatures can range from 90 degrees to below zero at times and snowfall is upwards of 106 inches. Seasonality is an influencing factor in growing seasons and puts a deficit on local farmers making direct sales.

Figure 1a: Chart displaying some of the main existing food access efforts in Meadville, PA. (FARM, Waggett, n.d.)

Project/Initiative	Description
Center for Family Services (CFS)	Offers helpful resources regarding education on budgeting and also runs and operates several regional food pantries.
Weekend Nutrition for Students Project, Inc. (WiNS) backpack program	An initiative at First and Second District Elementary giving students bags with food to go home with for the weekend. Students receive a breakfast, lunch, and snack for each day not in school.
Community Wellness Initiative (CWI)	A grant to address community health issues related to access to affordable, healthy food and exercise. Efforts have been made to do this by planting, growing, and harvesting fruit and vegetables in a community garden located at the Meadville Area Recreation Complex (MARC) and refurbishing trails at the MARC to encourage walking and running outdoors.
Creating Landscapes for Families	Families work together to plan, plant, grow, harvest and prepare vegetables in a community garden. The adults prepare a meal that everyone shares. There are also activities accompanying the meals.
Women, Infants, and Children (WIC) program	Provides nutritious foods, nutrition education, and breastfeeding support to pregnant, breastfeeding and recently delivered women, infants, and children who meet eligibility requirements- all at no cost to participants. Program runs up to the child's 5th birthday.
Community Garden Collaboration	Several community gardens, such as the Ackerman family community garden, where families, community groups, religious organizations, businesses, and individuals together grow a harvest while building an empowered community. At some gardens, the public can walk up and help themselves.
Project O.N.E.	Ongoing initiative to develop a relationship between the local farmers of the region and the Meadville community. Its aim is to provide public access to healthful foods for residents through learning about the availability and benefits of locally grown foods and good nutrition. It includes "Back to Basics" cooking classes and a community-supported agriculture program, as well as the Second Saturday Community Market. (Meadville Market House)

The Food Environment

Researchers are hard-pressed to define the food environment briefly because it encompasses so much. The USDA talks about the food environment in terms of three "food environment factors": food choices, health and well-being, and community characteristics. "Food choices" integrates access to affordable, healthy food including number and proximity to stores, expenditures, prices, taxes, and participation in nutrition assistance programs. The "health and well-being" factor considers indicators of a community being able to foster healthy diets like food security, ability to be active, rates of obesity or diabetes, etc. Lastly, the "characteristics of a community" are influential because things like income, poverty, demographics, transportation, and fitness centers can all come into play in the food environment. Clearly, a variety of personal factors can influence what food a person encounters one a daily basis as

well, but the food environment can be looked at through the lens of more structurally based and policy-dependent parts like the retail food sector.

Crawford County scored a 7.8 out of 10 on Robert Wood Johnson Foundation's Food Environment Index, which takes into account both food insecurity and food access. Food environments include a massing of aspects and have been historically overlooked in research because not until recently have there been tools developed to accurately measure and compare them in a standardized way. It is often necessary to scale down the food environment in order to study it. In this particular study's case the focus was the retail sector looking at only grocery and convenience stores. Specific to this project, a food environment includes what foods are available at the store, prices, placement, advertising, and accessibility. (Glanz et al, 2007) It is important to note that larger store sizes are often associated with offering more favorable prices for healthier items, but are not as common as smaller convenience stores. (Krukowski et al, 2010)

Chapter 2: Study design and results

Introduction

Low-income and rural areas are particular interests of study because of the significant challenges they present for their residents in obtaining fresh, healthy foods. Residents of rural areas are at higher risk for obesity, chronic diseases, hypertension, and heart disease than urban residents, and are less likely to obtain preventative health care. (Ahern et al, 2011) Diet quality could be an explanatory factor for these rates. Sharkey and Horel (2009) found that greater population density was associated with greater access to fruits and vegetables. Additionally, less access to larger stores, public transportation, and other financial means were found to hinder healthy food access in these types of regions. The need for more place-based research is growing as evidence has indicated a link between individual behaviors and the environment, specifically the food environment when talking about obesity. The price and availability of foods dictates the climate of the food environment, diet quality, and thus exerts an influence on obesity. (Swinburn et al, 1999) Studies have found that in low-income areas, changes in store environments and what is available in them can have a substantial impact on the purchasing of foods, and thus health-related outcomes. (Jetter & Cassady, 2006) Improving upon access in food environments could serve as an effective primary prevention strategy when addressing the health of a community population.

It is known that proximity and density of grocery stores is associated with lower prevalence of obesity and diabetes. (Cummins & Mcintyre, 2006 and Ahern et al, 2011) Measurements of retail food environment and its links to diet have been largely observational up until this point, making it hard to determine instances of causality. A growing body of research is starting to steer towards measuring food environments quantitatively for comparison across food outlets. Assessing food outlets in this way allows for areas of improvement in a food environment to be identified. From this, targeted approaches and interventions to meet the nutritional needs of a community can be employed.

Rural areas are also largely affected by environmental factors and seasonality which can present significant barriers for fresh-produce and transportation. The purpose of this study was to assess the retail food environment to quantify its impact on the population and to identify possible present determinants to healthy eating. This was done by measuring the price, quality, and availability of healthy versus unhealthy food options in 25 food outlets. The aim was to provide a basis of data from which targeted and effective interventions can be developed and to see where each food outlet is lacking or what overall trends exist in the Meadville food outlets that possibly contribute to unhealthy eating.

Methods

Summary
This study used the Nutrition Environment Measures Survey (NEMS) to assess price, quality, and availability of healthy foods at 25 foot outlets in Meadville, PA. Two rounds of data collection took place to account for seasonality, in the months of June to July, and November to December, respectively. Data were collected on 11 different basic food categories, standardized for comparison. Total NEMS-S composite health scores were obtained for each outlet and significant differences were seen between grocery stores and convenience stores, but not between seasons.

Sample

This study included a total of 25 food outlets, consisting of 6 grocery stores and 19 convenience stores (Figure 2). Letters were sent to the larger food outlets and made available during data collection if necessary to make store managers aware of and explain the procedure.

Figure 2:

Food Outlet Type	Number (%)
Grocery Store	6 (24)
Convenience Store	19 (76)
Gas Station	6 (24)
Dollar Store	4 (16)
Farmer's Market	2 (8)
Drug Store	3 (12)
Other	4 (16)
Total:	**25**

GIS data were used to identify the food outlets that would be included in the study (Figure 3). Regional data included stores where people who live in the Meadville city limits most frequently shop for food. Food outlets were classified into grocery or convenience, and then further into dollar stores, drug stores, gas stations, farmer's markets, and other. Classification was based on size, characteristics, and number of categories of food offered. Stores were omitted if they did not meet these qualifications of contributing considerably to the Meadville food environment.

Figure 3:

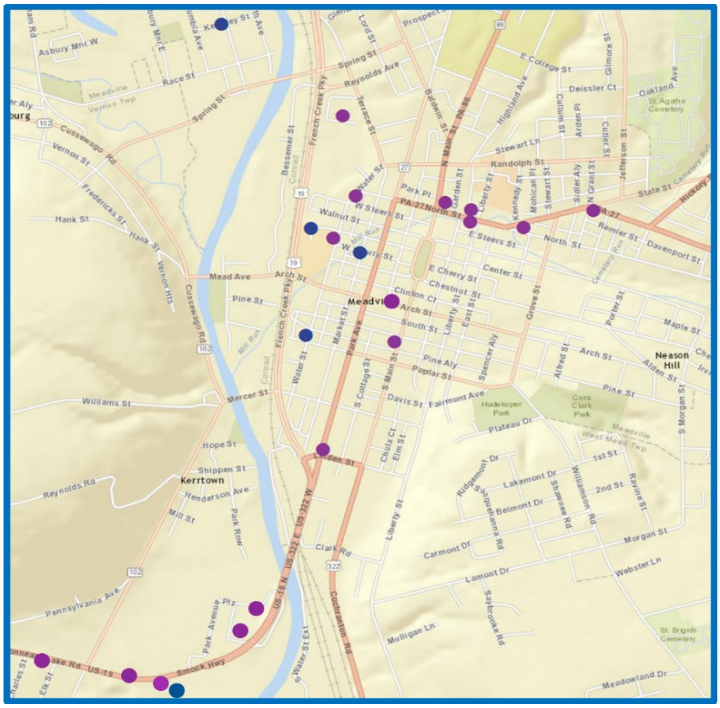


Figure 3 shows a GIS map of the data collection area. Note that 4 stores, 2 grocery and 2 convenience, are not pictured because they are further west than the map shows.

Measurement tool

The Nutrition Environment Measures Survey for Stores (NEMS-S) was used to collect the data in this study. It is an observational measure for retail food outlets that allows for reliable and valid food measures that are comparable across any outlets that are audited in a community. It addresses type and location, accessibility and availability of healthful choices, pricing, promotion, and other pertinent aspects of understanding a nutrition environment. (Glanz, et al 2007) The tool was validated through test-retest and interrater reliability assessments to ensure quality. In this study, the 11 food categories that were analyzed were milk, fruit, vegetables, ground beef, hot dogs, frozen dinners, baked goods, beverages, bread, baked chips, and cereal. There categories were obtained from U.S. consumption frequency patterns by the NEMS creators. Data on eggs, frozen and canned vegetables and fruit, rice, pasta, and beans were also collected for the purpose of this study, but are not reflected in the composite NEMS scores.

Study Procedure

Two pilot tests were carried out during initial NEMS training, one grocery and one convenience store, to determine any items to be added or removed and to ensure consistency and quality and customization to this region. After identifying each food outlet to be used in the study, the list was enumerated giving each outlet a classified identification number for confidentiality purposes. The only information identifiable from the numbers was whether it was a grocery store or convenience store.

Data collection began in the month of June, leading into July, after letters were disseminated. The second round of data collection began at the end of November, leading into December. All data for grocery stores were collected between 9 a.m. and 4 p.m. and for convenience stores before 4:30 p.m. and after 6 p.m. to ensure items were as well stocked as possible. The same protocol for price, quality, and availability was followed as closely as possible for each store visit. With regards to price, data were collected on the standard price without a store-specific savings card and not the store promotional price. It was not assumed that each community member possessed one of the cards and sale and price promotions vary constantly. Each visit lasted from thirty minutes to two hours. After each visit, data were double checked for any missing or mismarked items. Data were then entered into the spreadsheets.

Data Analysis

Data for each outlet were then scored using the NEMS scoring sheet, which provided a third consistency check. A total NEMS score was obtained for each outlet that was audited, on a scale of -9 to 54, as well as categorical scores for price (-9 to 18), quality (0 to 6), and availability (0 to 30), which combine to make the total score. The total NEMS scores that were measured for each food outlet can be considered “health” scores because they show a general overview of how the availability, quality, and price of healthy options combine to impact customers’ health. A higher score indicates a “healthier” store, or a greater opportunity for a shopper to purchase healthy food items there. Descriptive statistics, frequencies, and store type and season comparisons were calculated using chi square and t-tests in SAS University edition (SAS Institute, Cary, NC).

Results

Table 1 shows all types of stores combined to compare by seasonality and no significant differences were observed. Average Availability, Price, Quality, and Total scores across all stores remained nearly the same across seasons with a very slight decrease in the winter in Availability, Quality, and Total. There was a very slight increase during winter in Price, but not enough for notable differences (i.e. all changes <1).

Table 2 summarizes the composite scores for healthy nutrition environments by store type and season. In general, the scores for Availability and Quality were spread across the possible range. Availability scores ranged from 1 to 27 and Quality scores ranged from 0 to 6. The scores for Price, however, only spanned part of the possible range with the lowest being -1 and the highest being 8. In both the summer and the winter, the differences between grocery and convenience stores in Availability, Quality, and Total are significant. As expected, grocery store scores were higher than convenience stores. The Price scores differed in the same direction, but minimally by only 1 to 3 points, meaning grocery store prices were only slightly lower than convenience store prices.

Table 1: Composite NEMS scores for all food outlets by season.

	Mean (+/- SD)	
	Summer (n=25)	**Winter (n=25)**
Availability (0 to 30)	12.28 (7.16)	11.76 (7.54)
Price (-9 to 18)	1.92 (2.23)	1.96 (2.07)
Quality (0 to 6)	2.44 (2.65)	2.32 (2.56)
Total (-9 to 54)	16.64 (10.52)	16.04 (10.29)

*Higher scores indicate greater availability, better quality, and lower prices for “healthful” options compared to “regular” choices.

Table 2: Composite NEMS scores for food outlets by season and store type.

	Mean (+/- SD)			
	Summer		**Winter**	
	Grocery stores (n=6)	**Convenience stores (n=19)**	**Grocery stores (n=6)**	**Convenience stores (n=19)**
Availability (0 to 30)	24(2.66)	9(3.33)	24(4.37)	8(3.17)
Price (-9 to 18)	4(2.42)	1(1.92)	3(2.42)	2(1.97)
Quality (0 to 6)	6 (0.4)	1(2.06)	6(0.84)	1(2.03)
Total (-9 to 54)	33(4.56)	11(4.93)	32(5.65)	11(5.02)

*Higher scores indicate greater availability, better quality, and lower prices for “healthful” options compared to “regular” choices.

Total NEMS Composite Scores

Looking at individual stores showed specific changes. With the grocery stores (Figure 4), it was found that 4 out of the 6 stores had NEMS scores that dropped from the summer to winter months, one store stayed constant, and one store’s score went up in the winter. Overall, the scores of the stores went

down during the winter months, indicating less readily available, quality, healthy options. This was to be expected as the weather during the winter months inhibits growing of fresh fruits and vegetables, interferes with transportation, etc. The convenience stores scores showed a different pattern (Figure 5). Only 6 of the scores decreased during the winter months, while 5 stayed the same and 8 actually went up. A possible explanation of this could be the time period in which the data were collected. Since the winter data were collected after the summer data, efforts or initiatives of convenience stores could have changed, enhancing the offerings of healthier options to better match the recent public emphasis on health and wellness. It is also important to note that two of the convenience stores are local farmers' markets, one that closes for the winter months and one that does not supply produce in the winter but remains open for other items. It is included here as the data were collected before it closed for the season.

Figure 4:

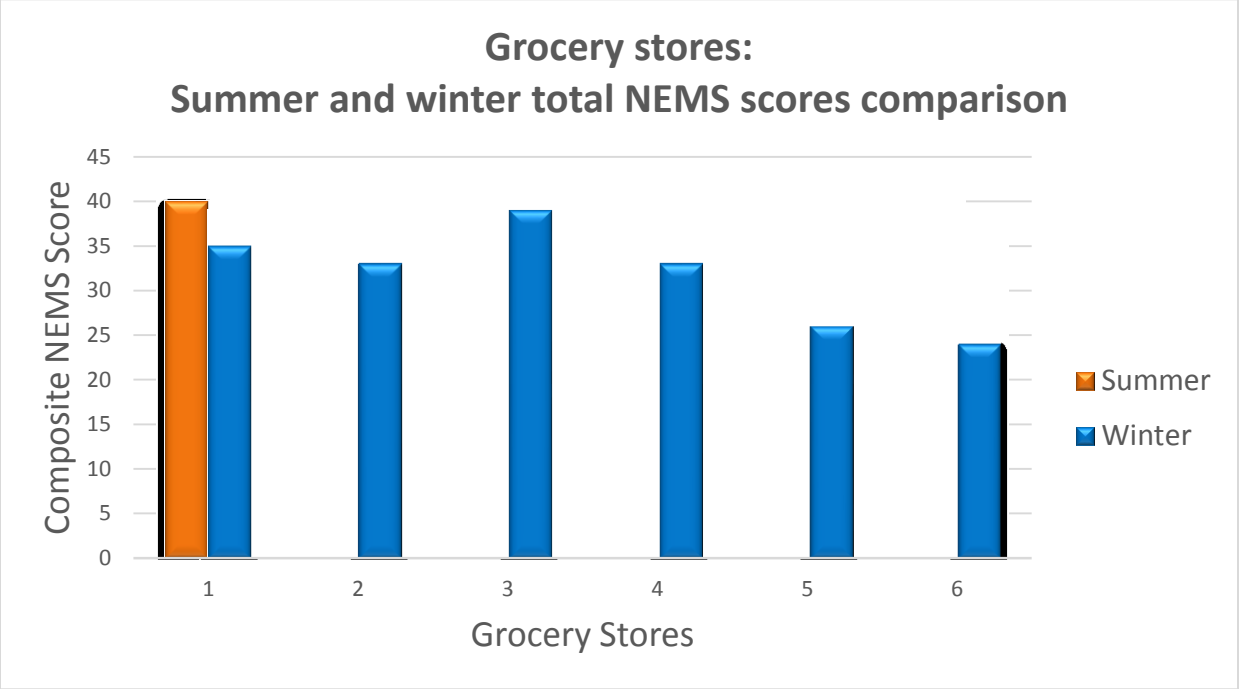


Figure 4 shows the comparison between each total NEMS score for each grocery store in the summer vs. the winter. The total NEMS score is on a scale of -9 to 54 points and includes price, quality, and availability measures. A higher score indicates more healthy options available.

Figure 5:

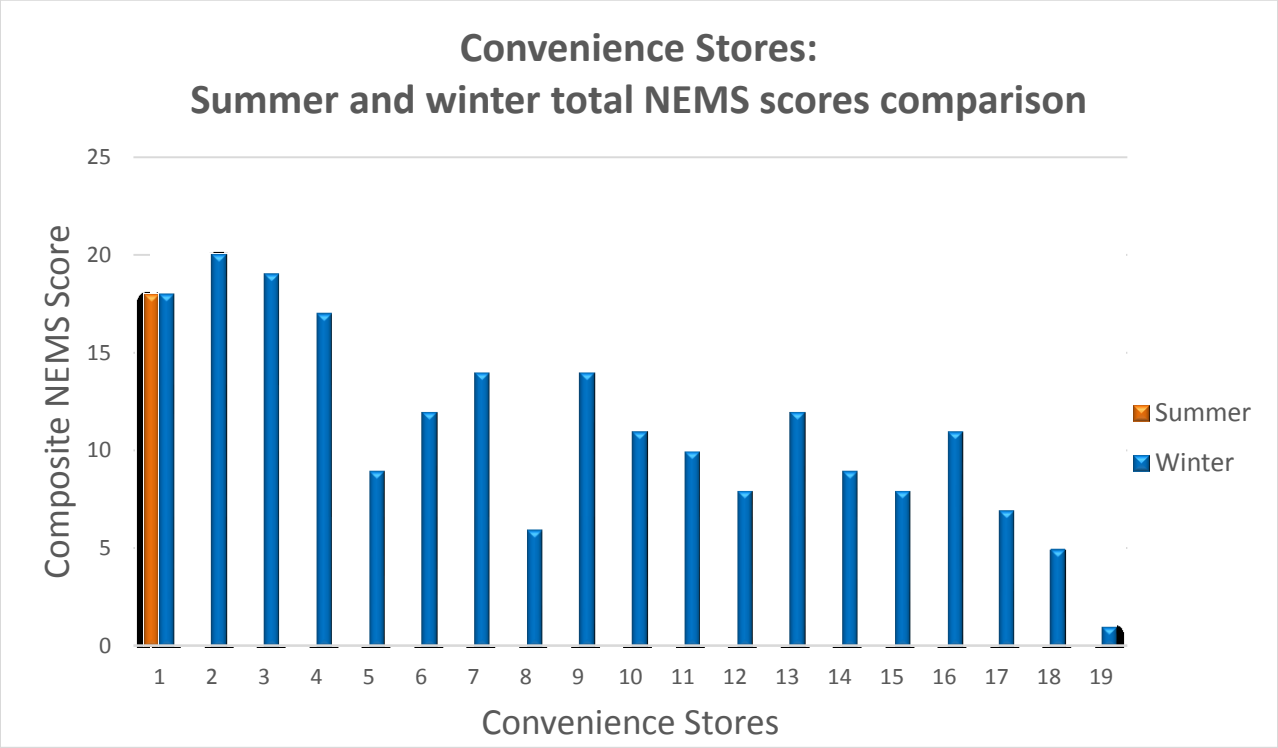


Figure 5 shows the comparison between each total NEMS score for each convenience store in the summer vs. the winter. The total NEMS score is on a scale of -9 to 54 points and includes price, quality, and availability measures. A higher score indicates more healthy options available.

Fresh Produce Availability

In grocery stores, the number of varieties that each store carried decreased during the winter months, as expected (Figure 6). In the summer, half of grocery stores offered 10 or more varieties of fruit while in the winter none of them offered 10 or more as all stores only carried 5 to 9 varieties. Similarly, 5 grocery stores carried 10 or more vegetables during the summer months while only 2 did during the winter months. In convenience stores, fruit availability just barely increased during the summer with one farmer's market carrying 10 or more varieties of fruit (Figure 7). Most stores stayed constant with the vast majority either offering no fruit or 1 to 5 varieties. The same pattern is seen in the vegetables, with one more store offering no vegetables in either season. Again, it is important to note that these results reflect the early winter season before the farmer's market closed, therefore, during most of the winter the figure would show even more of a disparity with there being 15 stores that carry zero fruits or vegetables instead of 14, and only 1 and 0 stores carrying 5-9 varieties of fruits and vegetables, respectively.

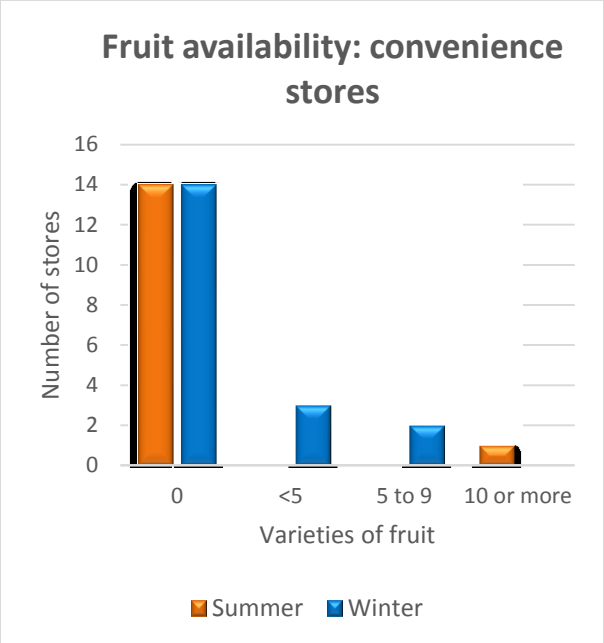
Figure 6:





Figure 6 shows fruit and vegetable availability in grocery stores in the summer compared to the winter.

Figure 7:



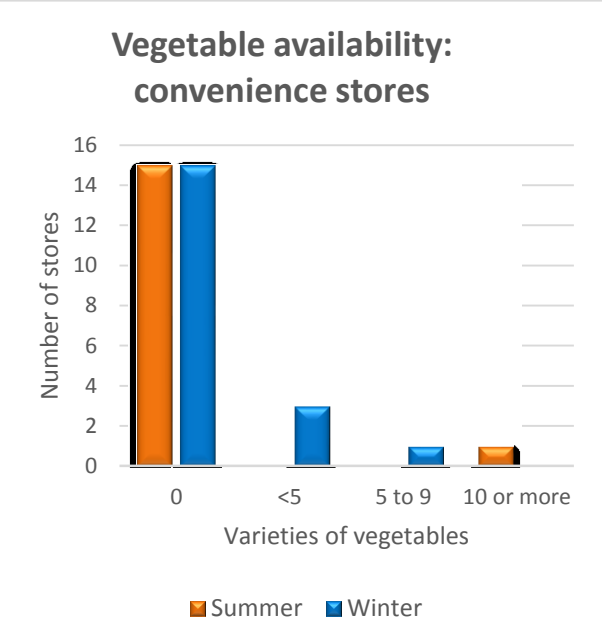


Figure 7 shows fruit and vegetable availability in convenience stores in the summer compared to the winter. *From about mid-December to April, graphs would reflect a farmer's market seasonal closing, taking away a store from the 5-9 varieties and adding it to the 0 column, for both fruit and vegetable.

Table 3 compares non-fresh produce items and their availability to each season. Interestingly, no significant differences were seen in the availability in these items except for canned fruit.

Table 3: Association of seasonality with store availability characteristics.

Food category		Season n (%) Summer 25 (50.0)	Season n (%) Winter 25 (50.0)	p-value	Odds Ratio OR (95% CI)
Low fat Milk					
	Yes	21 (48.8)	22 (51.2)		0.72 (0.14, 3.59)
	No	4 (57.1)	3 (42.9)	0.683	1.0
Lean meat					
	Yes	5 (45.4)	6 (54.6)		0.79 (0.21, 3.03)
	No	20 (51.3)	19 (48.7)	0.732	1.0
Fat free hot dogs					
	Yes	8 (53.3)	7 (46.7)		1.21 (0.36, 4.07)
	No	17 (48.6)	18 (51.4)	0.76	1.0
Reduced fat frozen dinners					
	Yes	9 (52.9)	8 (47.1)		1.20 (0.37, 3.86)
	No	16 (48.5)	17 (51.5)	0.77	1.0
100% fruit juice					
	Yes	21 (48.8)	22 (51.2)		0.72 (0.14, 3.59)
	No	4 (57.1)	3 (42.9)	0.68	1.0
Whole wheat bread					
	Yes	16 (57.1)	12 (42.9)		1.93 (0.62, 5.98)
	No	9 (40.9)	13 (59.1)	0.25	1.0
Baked chips					
	Yes	14 (60.9)	9 (39.1)		2.26 (0.73, 7.05)
	No	11 (40.7)	16 (59.3)	0.16	1.0
Healthy cereal					
	Yes	19 (51.3)	18 (48.7)		1.23 (0.35, 4.37)
	No	6 (46.1)	7 (53.9)	0.75	1.0
Canned fruit					
	Yes	8 (33.3)	16 (66.7)		0.26 (0.08, 0.85)
	No	17 (65.4)	9 (34.6)	0.02	1.0

Discussion

Patterns seen in the Meadville region were similar to those seen in the NEMS pilot study data that are often used as a national comparison. It similarly shows a very large difference between grocery stores and convenience stores in food availability. (Glanz et al, 2007) Larger disparities in prices existed in healthier items between grocery and convenience stores. For example, fruit was priced significantly

higher at convenience stores than grocery stores. The overall trends indicated little difference between seasonality, aside from the two farmer's markets that lack produce in the winter months, but rather an overall lack of availability of healthy options in convenience stores across seasons.

When considering the environment effects on food purchasing, and thus health outcomes, Larson et al. (2009) found ample evidence of higher obesity rates among those who have greater access to convenience stores rather than grocery stores. Nutrition or food environments are thought to contribute significantly to the present obesity epidemic. It is known that being overweight or obese increases a person's risk for a number of adverse health conditions such as metabolic syndrome, Type 2 diabetes, stroke, and hypertension as well as other conditions. (Must et al, 1999) Less common knowledge, however, is that obesity is markedly higher among residents in rural areas in America, even while controlling for demographic, diet, and physical activity variables. (Befort et al, 2005-2008) Approximately 35 percent of children 10–17 years of age living in small rural areas were overweight or obese, compared to 30.9 percent living in urban areas. (Child Health USA 2010) A number of factors play into rural rates being higher, much having to do with lower incomes and access to close, affordable, fresh foods. A major barrier reported by low income families in rural Minnesota was that there were limited types or choices of quality healthy foods that were affordable. (Hendrickson, et al, 2006) Transportation acts as another barrier and in one state-wide study in Maine, it was found that families that traveled over twenty miles to shop were shopping at stores with higher NEMS scores than those who were not. (Hartley et al, 2011) It is the hope that this study can provide a more solidified context in which community members, stakeholders, retailers, and any other interest groups make decisions on how to provide healthy, affordable, accessible food to the Meadville community.

Limitations

Using a tool to measure the food environment presents inevitable limitations because no single tool can encompass every existing food group or category. It is possible that "healthy" options that stores may have carried were neglected because they did not fit into a specific NEMS category or type that was standardized. For instance, chicken or fish were not included in the survey. Additionally, in grocery stores it neglected fresh made foods such as the deli counter or salad bar. While these are generally more expensive options, they might be worth including as they may provide healthier options. Similarly, in gas stations there is often a made-to-order option through a touch-screen that houses some healthy options that are comparable in price to ones on the shelves but again, the NEMS does not consider these.

Other factors to consider are the time periods when items are stocked on a shelf. Although measures were taken to collect data at times of high item volume, it is possible that stores have different schedules and an item that is regularly on the shelves may not have been at the time of data collection. Reversely, an item that is usually less available could have been stocked. Between the summer and the winter, the same stores were not visited at the exact same time, but this should only account for slight variability, if any. As noted earlier, special store savings cards were also not considered. The price patterns would have undoubtedly looked different but promotions and sales only last for certain periods of time and are constantly changing. This study also left out an accessible food outlet, The Market House, a farmer's market in the center of Meadville due to the high variability in what food it offers.

Future Recommendations

There is ample opportunity for initiatives in improving how accessible and affordable healthy foods are to the larger Meadville community, specifically in the convenience store sector. Notable present healthy food promotion exists in one grocery store which advertises weekly “dietitian picks” which indicates which foods on the shelves are “heart healthy” or “gluten free” for instance. There are no convenience stores that had any type of health promotion or healthy food advertisements displayed which leaves large room for improvement.

Next steps must be taken to overlay the current data with proximity between stores and in relation to neighborhoods, as well as transportation data. Income data will also be useful in determining which food the most at-risk populations have ready access to. While the data is available, it was not analyzed in this study. Additionally, real-time data would be an essential additional piece to include with this data. This can take the form of knowledge/behavior surveys finding out where people shop, what their reasons are, and seeing how it lines up with what is available. It could also take the form of health screenings to overlay current reported dietary intake, chronic disease rates and health conditions per neighborhood and determine any associations with what food is available and close to them. One study found that among people reporting poor health status, the prevalence of fruit and vegetable affordability and access challenges was four times that of people reporting excellent health status (20 percent vs. 5 percent). There was also a substantial gap in reported fruit and vegetable affordability and accessibility problems between those who reported having feelings of stress the previous day (12.2 percent) and those who did not have such feelings of stress (5.6 percent). (FRAC) Survey data would be similarly valuable in this region and may show disparities.

Chapter 3: Theoretical foundations, implications, and importance

Individuals with chronic diseases that are partially dietary related, such as obesity, metabolic syndrome, and diabetes, are often met with individual behavioral change interventions and encouragement to practice self-control. There is often a dietitian or physician that offers a stringent food plan and recommendations on what to eat and what to avoid. This approach has its theoretical foundations rooted in the Health Belief Model. According to this model, the perceived threat to health, or of disease, and the perceived benefits of taking action must outweigh the perceived barriers to action. (Boston University, 2016) It is clear that this model is flawed in this case because in an individual's case, often the perceived barriers are too great to take necessary action for their health. This could be due to a number of things such as low-income, lack of time due to long work hours, or lack of transportation. Therefore, there is an inevitable disconnect between advice from a health professional and what actions are actually possible for the patient. What the patient is capable of within his or her current situation or environment cannot always align with the recommendations to be healthier. Changes in the built environment can bridge this gap. Specifically in the food environment, positive changes in price and availability of healthy foods can lessen those perceived barriers not only on an individual level, but on a population level, thus contributing to better health outcomes and adherence to healthy diets.

Ecological studies and the ecological method of viewing behavior changing provides a helpful contrast as it allows behaviors to be seen in the context of a person's environment and situation, rather than alone. (Ahern et al, 2011) Disparities in dietary intake, obesity or chronic disease rates can exist between neighborhoods that have varying access to things in the built environment, stores, or restaurants, for example. What is available and what makes up a person's environment can shape their behaviors. Therefore, changes in the environment can potentially change behaviors and habits. This is important to consider when approaching behavioral change in health because an individual-level approach may prove to be less effective than an environmental approach.

Food Deserts

The original definition of a "food desert," as defined by the USDA, states that a significant number of residents in an area have to live far away from a supermarket, which is considered over one mile in urban areas and over 10 miles in rural areas. (ERS, USDA) While this definition provided sound data, it has been expanded and morphed to encompass other factors that influence food access such as neighborhood or individual characteristics like transportation options or income. There are other effective ways to measure access rather than distance from a supermarket, such as concentration of stores for example. Also looking at neighborhood characteristics, demographics, and stores characteristics is necessary to fully recognize an area as a food desert. Using census tracts, the USDA and ERS have newly defined areas where it measures how many people are over a half mile from a grocery store, who lack vehicle access, are low income, and live in high group quarters. Under the original food desert definition, small subsections or neighborhoods in Meadville were considered food deserts, as well as most of Vernon Township which is the town west adjacent to Meadville. The layer showing where a significant portion of the population lack vehicle access includes a larger region than the food desert measure. It is important to consider rural people traveling to Meadville for food outside city limits. Perhaps these types of characteristics, along with the characteristics of surrounding stores should be the makeup of a new food desert classification. It is possible that those living in an area that is not technically considered a food desert live close to a supercenter or store, but are not able to afford

the fresh produce there because they are low income. The retail food environment would not be serving the health needs of the population in this case. This region could be a considered a food desert under these classifications, perhaps.

Healthy Community Environments

Having more reliable and valid measurements of the food environment can to lead to positive impacts on communities and improvements to individual dietary behavior. (Mckinnon et al, 2009) Tools like the NEMS help measure and get a firm grasp on where a food environment really lacks and where improvements and interventions can be made. Every community and region is unique and has different determinants to healthy eating. It is important to measure and target the specific determinants in an area to have an effect on reducing obesity and creating a healthier living environment. One study rated both physical activity environments and nutrition environments on quality and favorability and assessed the weight and obesity of adults and children in the respective neighborhoods. The results found that in the less favorable environments, there was higher prevalence of obesity. This showed that obesogenic neighborhoods can be identified and targeted for interventions and improvements. It also shows that the environment does affect each behavior and what type of lifestyle it enables a person to live. (Saelens et al, 2012) Another study identified that many "built environments" around the country promote a sedentary lifestyle and unhealthy eating. (Sallis & Glanz, 2006) Factors in the physical environment like lack of trails, sidewalks, and the like- and far distances or busy, dangerous areas- can discourage walking. In addition, promotion of fast foods and convenience stores promotes a lack of accessibility of fresh fruits and vegetables. More families are starting to have to rely more on convenient food than cooking due to a lack of time, transportation, or means and equipment.

The environment a person lives in on a daily basis and what is available to him or her has a significant impact on the choices he or she makes. These different factors that impact the food environment and people's food choices were demonstrated in a study that dealt with the concern of people relying on stores that are closest in proximity to them but have more limited healthy food choices. The study found that, when possible, people will choose the supermarket that is larger with more diverse food options; however, that is not always a possibility due to proximity issues, income, transportation, or other factors. (Cannuscio et al, 2013) Illustrating some of those barriers, a study found that fresh fruit and vegetable affordability and access challenges were greater for households with lower incomes. Those with annual household income less than $24,000 reported problems 2½ times as frequently as those with incomes between $60,000 and $89,999 (13.8 percent vs. 5.7 percent). (FRAC, 2011)

Low income families face setbacks that higher income families do not such as a lack of access to transportation, having to choose between paying bills and purchasing groceries, and odd job hours that put an emphasis on the need for convenience. Specifically, the link between low-income families and obesity has been widely noted. We see a higher percentage of obesity in low income populations compared to higher income populations. (Strauss et al, 1999) In addition, children who are born and raised in a low income family are at a higher risk for obesity than children who are raised with higher income. In the US, 14.94 percent of children ages 2-4 from lower income families were obese. (Dalenius, et al. Pediatric Nutrition Surveillance System, 2010) This percentage is rising and is significant because it shows that being obese is not necessarily under the control of the individual anymore.

Food Insecurity

Studies show that food insecurity and poverty are both associated with lower fruit and vegetable consumption and lower quality diets. (Drewnowski, 2004) Food insecurity rate in Pennsylvania is 14.2% as of 2013, with the child food insecurity rate being 20.4% (Feeding America). The Crawford County child poverty rate is 32.2% in 2010. (ERS) Classification as a food insecure household means that at some point or points during a year, one or more household members did not have access to an adequate food supply, often because they lacked money or other resources used to obtain that food. Having an inadequate food supply refers to the fact that it lacks the quality necessary for a balanced diet. Less commonly, it can also refer to having inadequate amounts, in even less food secure households. 1 in 6 people and 1 in 5 children in the U.S. have experienced food insecurity (Feeding America).

The Supplemental Nutrition Assistance Program (SNAP), or food stamps, and Women Infants and Children (WIC) program are both federal programs that exist to ease the burden of food security. To be eligible for food stamps, an individual's gross income must be at or below 130% of the poverty level, and the WIC program applies to those between 100% and 185% of the poverty guidelines, but only lasts until the child's first birthday. (USDA) While federal nutrition assistance programs like SNAP and WIC aid many food insecure people, there are still those who fall through the cracks. Nationally, 26% of food insecure people are ineligible for food assistance programs because they are above 185% of the poverty line. (Feeding America) In this study, the food outlets that accept WIC are 5 of the grocery stores. Being more widespread, SNAP is accepted at 22 of the 25 total outlets surveyed.

Food insecurity can be measured directly by evaluating the environments in which residents gain access to food (school, grocery and convenience stores, restaurants, etc.). The food environment provides a critical insight into food choices that families must make. In order to be able to provide the most effective approaches to address food insecurity in this region, it is essential to understand in depth how the food environment functions and impacts families.

Food insecurity can lead to families make poor food choices – often calorie dense and nutrient poor choices that fill bellies but do not provide a healthy foundation for children's development. Moreover, in addition to providing a risk factor for obesity and related diseases such as diabetes, food insecurity can also lead to nutritional deficiencies that place children at risk for illnesses, weakened immune status, and increased susceptibility to environmental exposures. Obesity disproportionately challenges people of low socio-economic classes and is closely correlated with poverty level. Nearly 30% of families with children live beneath the federal poverty level (US Census 2010), yet these levels underestimate the total number of families with children who have struggled to cover the cost of food during at least one month in the past year. The long-term costs associated with high health care challenges due to obesity-related diseases such as diabetes, heart disease, and chronic joint and back pain, fall back on communities.

Chapter 4: Additional food environment elements and policy

Evidence upholds that the food environment influences dietary behavior significantly enough to be considered in any obesity-related policy. The environment that a person in exposed to on a daily basis is what shapes the knowledge, attitude, and behaviors in regards to eating and people are exposed to a number of these environments each day. (Mckinnon et al, 2009) What foods are available and what opportunities and capabilities a person has are at the core of food purchases and consumption. What drives a person to eat what he or she eats can be influenced by an enormous number of factors. It is impossible to take into account every factor in a given instance, we often consider things like geographic location in the world, cultural background, religion, tradition, All of these parts makeup a person's purchasing power. The purchasing of food is a multi-faceted occurrence that is not the same for any two people. Understanding and exploring the food environment is essential before creating interventions or policies to impact obesity and eliminating environmental determinants to healthy diets.

Marketing and branding is a policy-heavy side to the food environment. In this study, store brand items were sometimes compared to national brand or name brand items. In all cases, the store brand was either the same price or lower than the name brand item. Therefore, it would seem like a simple fix to just advise those who are strapped for finances to just purchase the store brand item instead of the name brand item to save money. There are a multitude of factors that play into a person's decision of which brand of an item to purchase. Though often subconscious, each decision about a product is made up of perceptions and influencers that the food environment bombards people with on a daily basis. Marketing plays a massive role in decision making, as well as personal preference, perception of quality, price, and associations that one may attach to products. If a person was able to make a completely objective, untainted choice on a product to purchase, economic markets would have a generally different look to them. All of the factors that affect the consumer decision-making process are especially apparent in the food market. Purchasing food items is something that every citizen must do so the marketing of food brands is inescapable in the U.S. It is the norm to be bombarded with opinions, brands, labels, and facts on a daily basis about what one should purchase to eat. Companies have taken hold of the vulnerability of food consumers to market their product effectively and get ahead in the unending race to the home cupboard. This makes marketing and branding an important piece of the retail food environment sector.

Policies that effect this part of the retail food sector are important to consider as they can influence the health outcomes of adults, and especially children. There are a number of things that effect store brand sale performance in comparison to national brands. Store brand items are indeed a significant part of food retail as they currently comprise 1 out of every 5 items sold in U.S. supermarkets. (Collins-Dodd & Lindley, 2003) Larger name brand food manufacturers often have food lobbyists that influence government and policy in a way so they walk the fine line between telling people to eat healthy without discouraging them from buying their product. (Nestle, 2003) In the U.S., store brand items are often looked at as lower quality than name brand items. They are also almost always priced lower than name brand items. Interestingly enough, this is not the case in the European food market or other countries, necessarily, and often quite the opposite. (Dhar & Hoch, 1997)

Even though the general case in the U.S. is as such, the success of the sales of store brand food items still varies across regions, grocery stores, and categories of food. Stores differ in the number of brands they carry of certain items. Depending on the grocery store, there are usually certain store brand products that it tries to promote or specializes in producing more than others. In those cases, they may carry a lesser concentration of name brand items so there is not as much competition for their store

brand item. This varies across stores and obviously hinges on demand from customers. Purchasing also varies across food categories in the sense that a person may be more easily persuaded to purchase a store brand olive oil, for example, but cannot be deterred from purchasing name brand cereal. (Dhar & Hoch, 1997) Certain food categories are dominated by name brands, whereas others have some room for competition from local stores.

While there are entire economic and political sides to this phenomena, fleshing out the psychological side of why people choose the brands they do is a challenge for researchers. There is a range of consumers that goes from the highly price conscious to those who are less strapped by price and pay for the quality, or at least believe they do. A large portion of how food tastes or how one experiences a food item has to do with the emotional part of the brain, studies have shown. A good example is the classic case of Coca-Cola in the 1980's when the company changed the chemical composition of their drink. Even though the "new" Coke was preferred by the majority of people in a blind taste test, there was backlash from consumers because they had an emotional attachment to the "old" Coke and were not complacent with changing the product. (Paasovaara et al, 2012) Another study found that people who were given Coke and Pepsi blindly exhibited the same brain response through fMRI, but knowing the brand made a dramatic difference and heavily influenced how participants' brains responded based on which they had a stronger preference for. (McClure et al, 2004) Clearly, most people make purchases based on a past experience they had with the food. (Wyma et al, 2012) The food could remind them of something, or they may have had an experience while eating the food, or maybe they associate the food with good feelings or emotions. Whatever the case, attachment to food plays a huge role in why people choose to buy recognizable food brands over generic or store brand foods.

Children are perhaps the most susceptible to branding and the implications it can have. One study found that children who were given the same exact meal in a McDonald's packaging versus a generic packaging rated the one in the McDonald's packing as tasting better. (Robinson et al, 2007) This shows how powerful branding can be on the satisfaction with an item. Just seeing a name or a logo can prime a person's mind to believe they are about to taste something tasty. Brands can clearly boost the food taste experience and brand name association can affect how people perceive the taste of foods.

When deciding in the grocery store, most of the time people forgo the rational comparisons of multiple item choices in one food category. That would take time and deciphering of labels. When deciding between two items that are extremely similar, people often make the quick decision of what is most recognizable or what they have had success with in the past. The situation a person is in also plays a big role in how they might purchase brand items. On one hand, store brand items might be the better option for people who are budget sensitive and trying to save more money. On the other hand, one study found that people who were middle-aged and more educated were more prone to buying store brand items. (Lybeck et al, 2006) Perhaps they are less vulnerable to the tricks of branding. It is a case by case basis. While most people like to believe they are getting their bang for their buck, there might be a much smaller margin of difference between name brand products and store brand products than what is perceived in the general public.

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ALLEGHENY COLLEGE
MEADVILLE, PENNSYLVANIA

Dear Manager:

Our project group at Allegheny College is visiting restaurants in the Meadville area to measure the foods that people in this neighborhood have available to them. Members of our project team are visiting restaurants to look at certain things such as the menu and signage.

We are **not** inspectors or evaluators, nor are we connected with your competitors. We follow strict rules to protect any information we collect. We will assign an identification (ID) number to your restaurant, and only the project staff will see your individual information. Information about your restaurant will be combined with others before it is shared outside, and the name of your restaurant will not be used.

Thank you for allowing us to spend a few minutes in your restaurant, recording this information. We may wish to schedule a time to ask you additional questions. Your participation is voluntary, and you may inform us at any time if you do not wish to participate. If you have questions or concerns, please contact me at (973)349-2300.

Best regards,

Alyssa Brindle
Project Coordinator
Student at Allegheny College

Dr. Caryl Waggett
Supervisor
Allegheny College

NEMS Scoring Sheet for Stores

Store:

Item	Availability of Healthier Item	Avail Total Points	Price	Price Total Points	Quality	Quality Total Points
Milk	YES low-fat/skim = 2 pts Proportion (lowest-fat to whole) ≥ 50% = 1 pt		Lower for lowest-fat = 2 pts Same for both = 1 pt Higher for low-fat = -1 pt			
Fruits	0 varieties = 0 pts < 5 varieties = 1 pt 5-9 varieties = 2 pts 10 varieties = 3 pts				25-49% acceptable = 1 pt 50-74% acceptable = 2 pts 75%+ acceptable = 3 pts	
Vegetables	0 varieties = 0 pts < 5 varieties = 1 pt 5-9 varieties = 2 pts 10 varieties = 3 pts				25-49% acceptable = 1 pt 50-74% acceptable = 2 pts 75%+ acceptable = 3 pts	
Ground Beef	YES lean meat = 2 pts 2-3 varieties ≤ 10% fat = 1 pt > 3 varieties ≤ 10% fat = 2 pts		Lower for lean meat = 2 pts Higher for lean meat = -1 pt			
Hot dogs	YES fat-free = 2 pts Light, not fat-free = 1pt		Lower for fat-free or light = 2 pts Higher for fat-free or light = -1 pt			
Frozen dinners	YES all 3 reduced-fat types = 3 pts YES 1 or 2 reduced-fat types = 2 pts		*Lower for reduced-fat = 2 pts Higher for reduced-fat = -1 pt			
Baked goods	YES low-fat items = 2 pts		Lower for low-fat (per piece) = 2 pts Higher for low-fat (per piece) = -1 pt			
Beverages	YES diet soda = 1 pt YES 100% juice = 1 pt		Lower for diet soda = 2 pts Higher for 100% juice = -1 pt			
Bread	YES whole grain bread = 2 pts >2 varieties whole wheat bread = 1 pt		Lower for whole wheat = 2 pts Higher for whole wheat = -1 pt			
Baked chips	YES baked chips = 2 pts > 2 varieties baked chips = 1 pt		**Lower for baked chips = 2 pts Higher for baked chips = -1 pt			
Cereal	YES healthier cereal = 2 pts		**Lower for healthier cereal = 2 pts Higher for healthier cereal=-1 pt			
	Availability Subtotal=		**Price Subtotal=**		**Quality Subtotal=**	
				Total NEMS Store Score =		

Ranges- Availability Subtotal: 0 to 30 Price Subtotal: -9 to 18 Quality Subtotal: 0 to 6
TOTAL NEMS SCORE RANGE: -9 to 54

* Based on majority of frozen food items
**Per box or bag, not price per ounce