Grocery Store Display Design Limits In-Store Food Accessibility For Wheelchair Users

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Approximately 61 million American adults, 1 in 4, live with some type of disability (CDC 2019). The Americans with Disabilities Act (ADA), implemented in July of 1990 and phased in by 1992, was intended to prohibit discrimination against people with disabilities in several areas including employment, transportation, and public accommodations (US Department of Labor 2010). The ADA also aims to provide more opportunities for disabled customers to have the same purchasing power for goods and services (ADA 1991).

The ability to access food is essential to life and health (Huang, Rosenburg, Simonovich, Belza 2012). Food access is defined as "having sufficient resources to obtain appropriate foods for a nutritious diet" and is one dimension of food security defined as "including both physical and economic access to food that meets people's dietary needs as well as their food preferences" (Huang, Rosenburg, Simonovich, Belza 2012). In regards to design, research has shown that shoppers using wheelchairs had challenges in accessing goods and services in supermarkets as a result of the design in the exterior and interior spaces (Mafatlane et al 2015). In this thesis, I examine food access at the scale of interior store access.

In terms of disability, "food access" is much more challenging throughout the shopping experience from when a seated person leaves their residence, navigates the store, checks out at the store, and returns home with their goods. The importance of accessing healthy foods is arguably more important for those with disabilities because they have an increased likelihood of being food insecure (Coleman and Nord 2013) and they are at higher risk of health complications if they do not nourish their body properly (CDC 2019). This thesis proposes a new definition of food accessibility that expands on the current, and includes the requirement of having limited barriers along with appropriate resources to obtain healthy food. My new definition of food accessibility reads as, "having sufficient resources combined with limited exterior and interior physical barriers to obtain foods for a nutritious diet".

This thesis analyzes the reach patterns of wheelchair users to determine how accessible grocery store products are to customers shopping from a seated position. Data was collected from a Boulder Whole Foods Market. The research methods consisted of a pre-survey, survey, and survey data analysis. The pre-survey assessed store product display and layout for differential accessibility between wheelchair users and able-bodied people. The survey assessed which items were in reach, out of reach, and in a grey area (grey meaning items may be reachable depending on the item and user height). The third phase developed a random sample of grocery store items from the Thrifty Food Plan Market Basket to determine accessibility to products needed for a healthy diet (USDA 2021). This data was summarized in the survey data analysis phase. Findings from my randomized grocery sample show that 62.5% of the organic option was in reach and 66.7% of the conventional option was in reach. This is equivalent to 37.5% of organic products and 33.3% of conventional products being out of reach from a seated position. There were also findings made outside of the randomized sample grocery list that prove wheelchair users are at a disadvantage when shopping for the same products as able-bodied individuals.

The results prove that wheelchair users, due to a limited range of reachability, are at a disadvantage (compared to non-disabled shoppers) when it comes to accessing necessary grocery store products. Interior reachability should be taken into account when considering food accessibility among wheelchair users. New design solutions would improve the accessibility of healthy food for wheelchair users.

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Approximately 61 million American adults, 1 in 4, live with some type of disability (CDC 2019). 13.7% of the population with a disability have serious difficulty walking or climbing stairs (CDC 2019). 6.8% of people with a disability have difficulty doing errands alone (CDC 2019). 5.9% are deaf or hard of hearing, and 4.6% of the population is blind or has serious difficulty seeing (CDC 2019). The Americans with Disabilities Act, implemented in July of 1990 and phased in by 1992, was intended to prohibit discrimination against people with disabilities in several areas including employment, transportation, and public accommodations (US Department of Labor 2010).

The ability to access food is essential to life and health (Huang, Rosenburg, Simonovich, Belza 2012). This thesis follows a similar question to the themes explored in Naomi Schwartz's research: "...to what extent has disability gone (un)considered in food access research?" (Schwartz, Buliung, Wilson, 2019). Food access is defined as "having sufficient resources to obtain appropriate foods for a nutritious diet" and is one dimension of food security (defined as "including both physical and economic access to food that meets people's dietary needs as well as their food preferences") (Huang, Rosenburg, Simonovich, Belza 2012). Food access is defined as "a complex process requiring a location to access food, adequate financial and transportation resources, and the cognitive ability to plan and carry out accessing food" (Huang, Rosenburg, Simonovich, Belza 2012). This thesis questions the current definition of food access and proposes a new definition to be "having sufficient resources combined with limited exterior and interior physical barriers to obtain foods for a nutritious diet". My definition of food accessibility includes all parts of the shopping experience from when a person leaves their residence to when they return home with their grocery items. The term food accessibility should involve all parts of the shopping experience, including physically being able to pick items off of the shelf when inside the grocery store.

The issues that affect wheelchair users' ability to access the goods and services they want and need within a community are complex (McClain 2000). In regards to design, research has shown that shoppers using wheelchairs had challenges in accessing goods and services in supermarkets as a result of the design of the exterior and interior spaces (Mafatlane, Fidzani, and Gobotswang 2015). In the US, the Americans with Disabilities Act is intended to limit discrimination so that those with disabilities would have equal enjoyment of employment opportunities, purchasing goods and services, and participation in state and local government programs and services (ADA 2010). This thesis critiques the current regulations and standards put in place by the 2010 Americans with Disabilities Act and recommends ways in which this legislature should be improved.

Professionals in health and rehabilitation are increasingly concerned about the quality of life, equality of opportunity, community participation, independent living, and economic self-sufficiency of persons with functional impairments (McClain 2000). Accessibility to healthy foods is a necessity to all humans, especially those with underlying health concerns as limited access could lead to further health complications (CDC 2019). Navigating a community designed largely for the able-bodied brings about problematic inconveniences and risks for disabled wheelchair users including

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exclusionary parking, building entrances, and inaccessible restrooms (McClain 2000).

There are complex challenges people who use mobility devices face when moving about a community (Prescott, Miller, Routhier, Mortenson 2020). Barriers arise when the demands of the environment exceed the capabilities and resources of the disabled (Prescott, Miller, Routhier, Mortenson 2020). For instance, certain travel conditions increase the burden on a mobility-impaired individual including steep sidewalks or multiple bus transfers needed to reach a certain destination (Harris, Yang, Sanford 2015; Prescott, Miller, Routhier, Mortenson 2020). This thesis asks: what is the experience like for seated customers when navigating the interior of grocery stores? Modern alternatives to shopping for groceries in-person are grocery delivery and pick-up services but those alternatives have limits as well. One limitation is that the disabled population has a lower percentage of access to internet and electronic devices compared to those without disabilities (Perrin and Atske 2021) which could inhibit reliable grocery shopping online for this demographic.

For those who prefer in-store shopping, there are challenges. Difficulty navigating aisles, hesitation in getting assistance from store employees, and the inability to reach products above a certain threshold may make wheelchair users more vulnerable to the effects of food inaccessibility. Once wheelchair users successfully enter even an ADA-compliant grocery store, their interaction with displays and ability to gather food they want can be more challenging – and even impossible. Disabled customers are not always able to physically reach items they need, which shifts the issue of food access from an economic standpoint to a physical one. In other words, even after multiple obstacles are surmounted, food is still less accessible for disabled customers.¹

¹ This research was inspired by my time working at Whole Foods Market. During my time working in the grocery store industry, I witnessed multiple wheelchair-bound customers without a personal shopping assistant unable to reach products higher up on displays. Disabled customers would not ask for help, but when I offered it, it was gratefully accepted, especially regarding hard-to-reach items.

Given the complexity and scale of this research, a design solution to remedy these issues isn't inherently obvious. Further research should be conducted to determine potential solutions. The good news is, there are potential design solutions. Universal design is defined as "the design of all products and environments to be usable by people of all ages and abilities to the greatest extent possible" (Presier and Ostroff, 2001: Yu, Tullio-Pow, and Akhtar 2015). Universal design solutions in a business as vital as a grocery store are imperative to make food accessible to all demographics, regardless of disability. My best solution is for seated shoppers to bring an assistant to the store to help reach products. Potential design solutions can be subtle additions to what we know as a traditional grocery store. Perhaps placing healthy food options on lower shelving could provide easier access from a seated position. Because grocery store products are lined up face to face horizontally on a shelf, the items that are horizontally displayed at the top of shelving units are completely out of reach to seated shoppers. Instead, displaying items in a column fashion vertically on shelves would allow shoppers of all heights a greater chance to reach items from any height. Perhaps disabled shoppers could move about the store with a call button device and use it when they need assistance reaching a product. Other ideas include marking items like a vending machine so employees can gather out of reach items, or providing shallower shelving for certain aisles.

It's time we think about design solutions for wheelchair reachability as a necessity for grocery store design. Grocery store accessibility has interior design flaws that could be a contributing factor to unequal product access.

2 RESEARCH QUESTION

HOW MIGHT GROCERY STORE DISPLAY DESIGN DISPROPORTIONATELY IMPACT THE ACCESSIBILITY AND SHOPPING PATTERNS OF WHEELCHAIR USERS?

3 LITERATURE REVIEW

1.0 FOOD INSECURITY AND FOOD ACCESSIBILITY

1.1 FOOD INSECURITY DEFINITION AND U.S. POPULATION STATS

The USDA has developed a spectrum of food security ranging from high food security to high food insecurity (USDA Economic Research Service 2021). At one end of the spectrum, there is high food security, where people have "no reported indications of food access problems or limitations" (USDA Economic Research Service 2021). Next on the spectrum is marginal food security, where there are a few reports of "anxiety over food sufficiency or shortage in food in the house" (USDA Economic Research Service 2021). This usually doesn't require a change in diet or food intake. Moving into food insecurity, we have low food security. This demographic "reports of reduced quality, variety, or desirability of diet" and has little indication of reduced food intake. At the other end of the spectrum, we have very low food security. This group "reports of multiple indications of disrupted eating patterns and reduced food intake." This spectrum shows the range of food insecurity and provides the reader with a baseline of understanding of food insecurity in the US (USDA Economic Research Service 2021).

"Factors influencing food access vary across the population depending on culture, socioeconomic status, and importantly, by ability" (Shaw 2006, Shultz 2019). Factors proven to impact an individual and household's level of food security include location, income, employment, and disability. Poor physical access to food has also been considered a risk factor for food insecurity, health, and dietary outcomes (Shultz 2019).

Food insecurity and disability have a direct relationship. There is a correlation between disability and economic hardship (Coleman and Nord 2013). A 2007 study found that half of the food-insecure households in the US have a member with a work-limiting disability (Coleman and Nord 2013, Livermore 2008) that impacts income and can threaten food availability. Adults with disabilities are less likely to be employed than an average able-bodied person (Coleman and Nord 2013). Among ages 15 to 64, 28.6 percent with a severe disability lived in households with income below the Federal poverty level (Coleman and Nord 2013). Compared to the official poverty rate in 2018 at 11.8% for the US Population, there is a clear relationship between disability and poverty (US Census 2018).

Because employment levels are lower and poverty rates are higher among those with disabilities, this demographic is more likely to rely on and participate in food assistance programs such as SNAP. SNAP, known as Supplemental Nutrition Assistance Program and originally known as food stamps, is a "federal benefit designed to help low-income Americans supplement their grocery budgets and purchase healthy food" (U.S. News 2021, Coleman and Nord 2013).

Studies have proven that there is a strong correlation between disability and food insecurity. Alisha Coleman and Jensen Mark Nord analyzed different factors, such as employment and education, of working-age adults with disabilities to identify factors that put households at greater risk of food insecurity. They used the Current Population

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Survey Food Security Supplement (CPS-FSS) and the USDA SNAP and disability assistance programs to determine the benefits that households receive from programs that support the working disabled population (Coleman and Nord 2013). The study found that:

> Food insecurity was more prevalent among households with working-age adults with disabilities: 33.5 percent of households with an adult who was not in labor force-disabled [not working and disabled] were food insecure; 24.8 percent of households with adults with other reported disabilities (adults age 18-64 who had a disability but did not indicate they were out of the labor force due to disability) were food insecure; while 12 percent of households with no adults age 18-64 with disabilities were food insecure. (Coleman and Nord 2013)

The data follows similar trends when looking at very low food security: "Some 17.3 percent of households with a member who was was not in labor force-disabled and 11.8 percent of households with a working-age age member [18-64 years old] with other reported disabilities [adults who have a disability but do not indicate they are out of labor force for disability] were very low food secure" (Coleman and Nord 2013). It is astounding to know that "**37.9 percent of households with very low food security included a working-age adult with a disability"(Coleman and Nord 2013)**. The degree of disability clearly plays a role in the level of food insecurity in a household. The research also found that of "low-income households that participated in SNAP and with an adult who was not in labor force-disabled, 56.1 percent were food insecure."



Figure 1
Prevalence of food insecurity by disability status

Table 1: Prevalence of food insecurity by disability status (Coleman and Nord 2013)

1.2 FOOD ACCESSIBILITY AND THE DISABLED POPULATION

The ability to access food is essential to life and health (Huang, Rosenburg, Simonovich, Belza 2012). Food access is defined as "having sufficient resources to obtain appropriate foods for a nutritious diet" and is one dimension of food security (defined as "including both physical and economic access to food that meets people's dietary needs as well as their food preferences") (Huang, Rosenburg, Simonovich, Belza 2012). Food access is defined as "a complex process requiring a location to access food, adequate financial and transportation resources, and the cognitive ability to plan and carry out accessing food" (Huang, Rosenburg, Simonovich, Belza 2012). This thesis questions the current definition of food access and proposes a new definition to be "having sufficient resources combined with limited exterior and interior physical barriers to obtain foods for a nutritious diet". My definition of food accessibility includes all parts of the shopping experience from when a person leaves their residence to when they return home with their grocery items. The term food accessibility should involve all parts of the shopping experience, including physically being able to pick items off of the shelf when inside the grocery store. Food accessibility can fall under the umbrella of food insecurity as inaccessibility could threaten food security.



Graphic 1 by author: This graphic shows the factors that contribute to food insecurity and highlights the topic "food accessibility." This thesis argues that the interior reachability of food is part of food accessibility, which itself is an aspect of food insecurity



Graphic 2 by author: This graphic shows the elements that impact food accessibility. This thesis examines the circled item "interior reachability" as a contributing factor of food accessibility and questions if this could potentially contribute to the overall theme of food insecurity.

The ability to navigate and move safely and easily through a community varies significantly for those who are physically disabled to those who are not. People with disabilities have the same needs for accessing goods and services as the average able-bodied customer (Mafatlane, Fidzani, and Gobotswang 2015). Their efforts to meet their daily needs are often frustrated by the physical barriers they encounter in the environments they live in (Mafatlane, Fidzani and Gobotswang 2015, Rostron 1997). One of the main reasons for low social and spatial participation from the disabled community is the presence of various architectural barriers in society (Hełdak 2018). Not only is it essential to change the physical environment to improve access to public spaces for

disabled people, but it is also essential to change the social environment including social attitudes and behavior toward disabled people (Butler, Bowlby 1997). For example, an analysis of disability in higher education argues that those with disabilities face multiple obstacles in the physical access of higher education, "even thirty years after federal legislation that prohibited such barriers" (Dunn, 2019). Clarifying the basic removal of architectural barriers for all members of a community leads to practical, economic, and socio-cultural benefits closely linked to the achievement of accessibility and by doing so, creates a healthy city (Pinna, Garau, Maltinti, Coni, 2020).

The daily path area of a disabled individual is impacted greatly by their personal characteristics, mobility device use, transportation, and environmental factors (Prescott, Miller, Routhier, Mortenson 2020). Research has shown that the level at which people participate in the community and move through it on a daily basis is decided in part by their level of disability (Prescott, Miller, Routhier, Mortenson 2020). Certain travel factors such as the number of steps needed to climb to reach one's destination and the number of times that someone transfers buses increase the burden on the individual. The reliance on cars for transportation is high in the U.S. and available transportation is another important factor for food access (Wolfe, Frongillo, Valois 2003; Coveney, O'Dwyer 2009).

The limited geographical distance along with limited mobility for wheelchair users add up to more difficulty gaining access to food. Food deserts, which Schwartz describes as low-income areas with poor geographic accessibility to grocery stores, also disproportionately affect those with disabilities (Schwartz, Buliung, Wilson, 2019). Distance on its own, including the case of food deserts, impacts how disabled individuals interact with public spaces and creates negative impacts on physical health disproportionately more for wheelchair users than the average able-bodied person (Gerber 2020, Braunschweig 2004, Seligman 2012). In a 2007 study measuring accessibility issues outside and within grocery stores completed in a low-income, multiracial urban and suburban Chicago neighborhood, it was concluded that "People with mobility impairments are at a disadvantage in maintaining healthy food choices because of limited access to stores and healthy foods" (Mojtahedi, Boblick, Rimmer, Rowland, Jones, Braunschweig 2007). The USDA notes that even for able-bodied households, "some low-income households may not have access to a full-service grocery store or other sources of healthy and affordable food" which impacts their level of food accessibility (USDA 2015). However, research does show that living in a food desert does not, by itself, contribute to food access difficulties as much as transportation to stores does (Coveney and O'Dwyer 2008).

Accessible designs of supermarkets from urban to suburban settings differ as well. A 2007 study showed that urban areas have more grocery and convenience stores available, but only 46% of the urban stores had an accessible ramp entrance compared to the 88% of suburban stores with an accessible ramp (Mojtahedi 2008). From home, to store, to home, it is clear that the grocery store shopping experience is much more complicated for those who use a wheelchair.

Anderson and Mayer (2020) sum up the inequity of food insecurity with the question: "Is "the market" adequate to distribute food to places of scarcity, or does it need to be mediated by public policy, perhaps based on recognition of the human right to food and nutrition?" In other words, are our systems of food distribution serving all humans, who deserve the right to food and nutrition?

Many factors contribute to food insecurity, such as income, employment, and disability (Shultz 2019). This thesis examines the last link of the chain of food access, which is literal physical access. As previously defined, food-secure households have "no reported indications of food access problems or limitations" (USDA Economic Research Service 2021). The term "food access" is important here. In terms of disability, "food access" is much more challenging and sometimes impossible throughout the shopping experience from when a seated person leaves their residence, checks out at the store, and returns home with their goods.

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1.3 GROCERY STORE BUSINESS TACTICS AND MARKETING RELATIONSHIP TO FOOD ACCESSIBILITY

Retailers including grocery stores can increase profits by increasing sales (Drèze, Hoch, Purk 1994). Manufacturers expend considerable resources to secure valuable shelf real estate as an "improper location or an under-allocation of space might kill a product before it achieves full sales potential" (Drèze, Hoch, Purk 1994). There are four main layouts for retail stores: grid, free form, racetrack, and circulation spine (Nguyen, Le, Martin, Cil, Fookes 2022). The grid layout is popular for most grocery stores (Nguyen, Le, Martin, Cil, Fookes 2022).

In addition to store layout, product design and placement is used to drive shopping behavior. This is accomplished in many ways including through store layout, product packaging, and product placement, and advancements in artificial intelligence technologies have enabled stores to create highly-effective marking tactics that directly influence customer decisions (Nguyen, Le, Martin, Cil, Fookes 2022). Human senses play a role in purchasing patterns, and supermarkets use specific strategies to get customers to buy more goods (Nguyen, Le, Martin, Cil, Fookes 2022).

In 2014, there was an average of 42,214 items carried by supermarkets (Best Marketing Degrees accessed 2022). The middle section is known as the "bulls-eye" zone, as this area generally falls in the line of sight of standing shoppers, which is known to be the most profitable location (Harris 2009). The middle shelf is typically 51 to 53 inches off the floor (Drèze, Hoch, Purk 1994) The average eye height for women in the United States is 59 inches off the floor, and the average men's eye height is 64 inches off the floor as reported in 1994 (Drèze, Hoch, Purk 1994). The bottom shelves are generally where generic brands, bulk items, and store brands are placed in order to not waste prime shelf space (Best Marketing Degrees accessed 2022). Another important tactic that supermarkets use is marketing to children, specifically by using brightly colored packaging, the use of cartoon characters, and strategic shelf placement (Musicus, Tal, Wansink 2015). Research has proven that the positioning of cereals is highly important to cereal companies, and these companies pay slotting fees to "secure profitable shelf space for their products" (Wilkie, Desrochers, Gundlach 2002). It has also been observed that child-targeted foods like cereals are commonly placed at children's eye level, generally on lower shelves than adult cereal, because it is known to be a profitable location (Harris, 2009). It was reported that the middle shelf is the most "coveted location in the supermarket" because products appear at eye level for most adults, as well as children sitting in a shopping cart (Harris, 2009). Data collected measuring 8-year old eye level and younger children sitting in a shopping cart found the best vantage point to market products for children around 48 inches high (Berry and McMullen 2008; Harris 2009). In a study on cereal aisles, 55%-80% of shelf space was dedicated to pre-sweetened cereal (Winson 2004). Studies have concluded that foods high in fat, sugar, and/or sodium are most commonly placed in children's line of sight (Winson 2004). This is significant because the line of sight of a child, around 48 inches, is similar to that of a wheelchair user, ranging from 43 to 51 inches from the floor (Berry and McMullen 2008; Karman Wheelchairs accessed 2022).

Public websites and blogs give a glimpse into what the experience is like for wheelchair users who are shopping, and they give common suggestions and advice. Numotion, the nation's leading provider of Complex Rehab Technology, suggests finding a store that has friendly staff and accessible entrances, asking for employee assistance if one has a limited arm or hand strength, bringing a reacher for items on higher shelves, and using online grocery shopping and home delivery services (Roy 2019). Another wheelchair user advice website notes that "most grocery stores should be basically accessible, but some will be easier to navigate than others," and follows with similar advice to that of Numotion (Invacare 2017).

One might posit that online food order and delivery services such as Instacart or Amazon Prime would ameliorate food insecurity by giving wheelchair users a less physically demanding platform to receive groceries. While some people may prefer to have groceries delivered, this is not a viable option for some of the disabled population. It was reported that only 26% of Americans with disabilities have high-speed internet at home, a smartphone, a desktop or laptop computer, and a tablet compared to 44% of those without disabilities (Perrin and Atske 2021). This would likely make disabled shoppers less able to purchase groceries through an online shopping service.

2.0 WHEELCHAIR USERS INTERIOR AND EXTERIOR BARRIERS AT GROCERY STORES

2.1 FOCUS ON INTERIOR BARRIERS

The majority of literature and study on accessibility did not highlight the interior of the grocery store, although the interior accessibility of grocery stores is lacking in areas such as the accessible height of shelves (Mafatlane, Fidzani and Gobotswang 2015). A qualitative study to identify environmental factors that impact the independence of adults with mobility impairments found that although individual experiences varied, disabled individuals had shared comments on the lack of adequate accessible public facilities (Pusch 2003). Grocery stores are market-driven privately owned businesses, but all businesses must comply with ADA accessible design standards when constructing or altering facilities (ADA 2010). Once wheelchair users are inside the grocery store, they are faced with barriers that inhibit their ability to access all products (Mafatlane, Fidzani, and Gobotswang 2015). Just as food deserts are a threat to their surrounding community by limiting fresh food access, grocery store shelving design is a threat to wheelchair users' equal access to goods.

Wheelchair users are often viewed as dependents, often relying on caregivers

or assistants to help them with daily tasks. This compromises their independence and privacy (Mafatlane, Fidzani, and Gobotswang 2015). The CDC reports that individuals with disabilities are more likely to report poorer overall health, including a higher likelihood of obesity, pressure sores or ulcers, and the presence of overall pain (CDC 2019). The importance of accessing healthy foods is arguably more important for those with disabilities because they are at higher risk of health complications if they do not nourish their body properly. Disabled individuals in particular are at higher risk of health concerns when they have inadequate access to foods with high nutritional value (Seligman 2012). In a 2012 study of the relationship between food insecurity and glycemic control, food-insecure participants were significantly more likely than food-secure individuals to have poor glycemic control (Seligman 2012). The food insecure participants were also more likely to report difficulty affording a diabetic diet, lower diabetes-specific self-efficacy, and higher emotional distress related to diabetes (Seligman 2012). ² The impacts of emotional distress and lack of a healthy diet also lead to a stronger correlation between food insecurity and lack of glycemic control (Seligman 2012).

2.2 CASE STUDY IN BOTSWANA

To complement the many studies done on grocery store and mall exterior accessibility of wheelchair users, Gertrude R. Mafatlane, Lily C. Fidzani, and Kesitegile S.M. Gobotswang created a study on the interior accessibility of wheelchairs in Botswana

² Cost of items is a factor for most when purchasing groceries, and it's no different for wheelchair users. Along with the cost of items, dietary restrictions guide purchasing decisions for all shoppers. Six in ten American adults say they restrict at least one nutritional component from their diet due to dietary restrictions (Manufactoring.com 2014). Access to cultural food items is also important to an individual's physical and mental well-being, as inadequate access can create cultural stress and affect one's identity (Wright, 2021). This ultimately impacts a person's quality of life. Disabled people deserve the right to a satisfactory experience when shopping.

(Mafatlane, Fidzani and Gobotswang 2015). The objectives of the study were to examine the exterior accessibility of supermarkets by wheelchair from the parking lot to the entrance, interior accessibility of supermarkets by wheelchair users reachability of items, the height of counters, aisle width, lighting, and flooring, and finally to recommend effective accessibility strategies to accommodate wheelchair users.

In their study, Mafatlane, Fidzani, and Gobotswang used 30 supermarkets from 20 shopping centers and 10 supermarkets from shopping malls in Gaborone. She interviewed wheelchair-bound participants comprising three males and three females ages 22 to 65 years old. The study assessed the heights and widths of relevant spaces and took pictures that were later analyzed for descriptive statistics. With regard to exterior findings, the study showed that all grocery stores had accessible wide and open entrances. With regard to interior findings, in 66.7 percent of supermarkets, the height

of the counter was high from a seated position, "which makes unloading goods and paying at tills a challenge," along with the space between checkout counters being too narrow (below 880 mm wide).

Observations on the shelving noted that the widths of aisles more than 815 mm wide allowed for easy movement and turns when displays along the aisles were not present. For shelves, all supermarkets had no assisting devices to help pick items from higher shelves, which decreased independence. All supermarkets placed basic commodities at lower levels of the store, where seated shoppers could



Figure 1: Botswana grocery aisle (Department of Family and Consumer Sciences, University of Botswana: Figure 1)

assess the goods. Wheelchair users had to ask for assistance when they needed goods from deep freezers because they could not reach the products on their own. Some participants of the study felt that basic food was accessible from a wheelchair, although the participants varied as to what they defined as "basic food". To some student-aged participants, basic food meant cornflakes and milk, which were located on high shelves.

While the flooring material was suitable for wheelchairs, items from deep freezers were not accessible from a seated position. Mafatlane, Fidzani, and Gobotswang's findings suggest that US grocery stores could also have challenges for wheelchair users. Their recommendations following the study were to implement legislation that includes: a directional map to accessible parking lots, create adequate width of parking spaces near the entrance, widen and remove barriers by entrances, and make shelving and till heights and widths accessible. The other recommendations include that building standards are revised, inaccessible supermarkets are adapted/redesigned, and supermarkets must provide assisting devices to their seated shoppers.

3.0 THE AMERICANS WITH DISABILITIES ACT

3.1 ADA BACKGROUND

The Americans with Disabilities Act (ADA) provides guidelines for grocery store accessibility. In order to better understand the current ADA regulations in grocery stores, it is vital to understand when, how, and why ADA has been implemented and developed over the past 50 years.

3.2 BEFORE ADA

In the aftermath of World War 2 with injured veterans returning from war, the needs of individuals with disabilities came forcibly into the public eye as they never had before. The U.S. became the first country to enact federal accessibility laws, beginning with the Architectural Barriers Act in 1968 and continuing through the landmark Americans with Disabilities Act in 1990, bringing about a wholesale rethinking of our built environment. (Bess 2019)

Before the ADA was made into law, in the 1970s and 1980s, leaders involved in disability rights movements, members of the U.S. Congress, and federal government civil rights agencies agreed that there needed to be additional higher-coverage legislation for persons with disabilities (ACL 2020). This much-needed additional coverage would support businesses with federal funds to make public places less discriminatory toward people with disabilities (ADA 2010).

3.3 ADA: PAST TO PRESENT

After many years of public debate regarding a comprehensive law, the Americans with Disabilities Act was signed into law by President George H.W. Bush on July 26, 1990 (ADA 2010). The main goal of the ADA was to prohibit discrimination for people with disabilities and enhance the opportunities they have in society (ADA 2010). It was intended to level the playing field so that those with disabilities would have the equal enjoyment of employment opportunities, purchasing goods and services, and participation in state and local government programs and services (ADA 2010).

The law states that to be protected under the ADA, one must have a disability which is defined by the ADA as: "a physical or mental impairment that substantially limits one or more major life activities, a person who has a history or record of such an impairment, or a person who is perceived by others as having such an impairment" (ADA 2010). The ADA highlights wheelchair users, visually impaired individuals, and hard-of-hearing people but does not specifically name all the impairments that it protects in its writing (ADA 2010).

The Department of Justice's revised regulations for Titles II and III of the Americans with Disabilities Act of 1990 (ADA 2010) were published in the Federal Register on September 15, 2010 (ADA 2010). The updated regulations "set minimum requirements - both scoping and technical - for newly designed and constructed or altered State and local government facilities, public accommodations, and commercial facilities to be readily accessible to and usable by individuals with disabilities" (ADA 2010).

The 2010 ADA Standards for Accessible Design enforces standards that are applied to new construction, alterations, program accessibility, and barrier removal (ADA 2010). The focus of ADA's Title III is to provide access to public accommodations and services operated by private entities (McClain 2000, DOJ 1991). It has been successful in creating a wholesale rethinking of our built environment (Williamson 2019) and allowed for positive actions that create inclusiveness for disabled members of a community (McClain 2000). It could be argued that this act reduced disability discrimination in both the public and private sectors. It is worth noting that there are ongoing ADA compliance concerns that cause inconvenience to wheelchair users and these "accessibility problems make public goods and services totally out of reach" (McClain 2000). This thesis findings inspire the question: is it in the purview of ADA to provide additional regulations to strengthen grocery store shopping accessibility and lessen the unseen discrimination individuals in wheelchairs face?

4.0 ADA SPECIFICATIONS

The most applicable chapters of ADA regarding the reachability of wheelchair users and ease of movement though the store are chapters three and four. These chapters are summarized below (ADA 2010). Part of my research will include an analysis of whether or not current ADA regulations are sufficient.

Chapter 3 covers the building blocks of the ADA Standards. All sections have been reviewed and applicable sections are summarized below.

308.2 Forward Reach.

308.2.1 Unobstructed. Canned food aisles of a grocery store where wheelchair users must reach forward to obtain an item must be 48" maximum and the lowest forward reach shall be 15" minimum above the finish floor or ground. This may also apply to the freezer and refrigerated sections, display shelves, produce walls, and quick-grab prepped food areas.



Graphic 3: Unobstructed Forward Reach (ADA 2010: Figure 308.2.1)

Section 308.2.2 Obstructed High Reach. Areas in a grocery store this would apply to are prepped hot food sections and produce islands. ADA requires that "clear floor space shall extend beneath the element for a distance not less than the required reach depth over the obstruction. The high forward reach shall be 48 inches maximum where the reach depth is 20 inches (510 mm) maximum. Where the reach depth exceeds 20 inches (510 mm), the high forward reach shall be 44 inches (1120 mm) maximum and the reach depth shall be 25 inches (635 mm) maximum." (ADA 2010).



Graphic 4: Obstructed High Forward Reach (ADA 2010: Figure 308.2.2)

308.3 Side Reach

308.2.1 Unobstructed. Canned food aisles of a grocery store where wheelchair users must reach forward to obtain an item must be 48" maximum and the lowest forward reach shall be 15" minimum above the finish floor or ground. This may also apply to the freezer and refrigerated sections, display shelves, produce walls, and quick-grab prepped food areas.



Graphic 5: Unobstructed Side Reach (ADA 2010: Figure 308.3.1)

Chapter 4 covers accessible routes of the ADA Standards. All sections have been reviewed and applicable sections are summarized below.

Section 403 Walking Surfaces.

Section 403.5.1 Clear Width. Clear width shall be 36" minimum. Section 403.5.2 Clear Width at a Turn. Wheelchair users must be able to make a 180 degree turn around an element, and the width must be 42 inches minimum approaching the turn, 48 inches minimum at the turn, and 42 inches minimum leaving the turn.

4.1 CRITIQUE OF ADA

After my review of the Americans with Disabilities Act, I propose that there are improvements to be made in the legislature. While the ADA is successful in regulating disability-friendly parking lots, entrances, bathrooms, and aisle widths, there is a need for more realistic and equal reachability in grocery store shelving from a seated position. In order for the ADA to achieve its goal of leveling the playing field so that those with disabilities may have equal enjoyment of purchasing goods and services (ADA 2010), the ADA must require accessible shelving that exceeds its current standards. The allotted forward and side reach as seen in graphics 3, 4, and 5, is set at 44 to 48 inches maximum from a seated position, which is grossly underestimating the amount of reach many wheelchair users require to obtain food on grocery store shelves. The ADA should increase the range that a wheelchair user can reach foods that exceed this 44 and 48 inch maximum, and require that there are other options such as shopping assistant devices located in-store to allow for maximum accessibility for wheelchair users when shopping at a grocery store.

5.0 THE THRIFTY FOOD PLAN

5.1 WHAT IS THE THRIFTY FOOD PLAN?

The Thrifty Food Plan 2021 is a comprehensive list of healthy, nutrient-dense foods and beverages along with their recommended daily amounts and associated costs (USDA Food and Nutrition Service 2021). The Thrifty Food Plan is the lowest cost food plan developed by the USDA and is used to determine SNAP benefit amounts, which vary by household size (USDA Food and Nutrition Service 2021). The list is accessible online to the public. The list is not designed for wealthy shoppers, but for people who want to incorporate a healthy diet on a budget. The plan is evaluated every five years and throughout that cycle, the cost of items is "adjusted each month to reflect inflation using the Consumer Price Index" (USDA Food and Nutrition Service 2021). The USDA creates market baskets for 15 different age and gender groups that list the number of pounds per week allotted for subgroups including grains, vegetables, fruits, milk products, meat and beans, and other foods (Hartline-Grafton 2021). It is important for individuals with underlying health concerns or other dietary concerns that use wheelchairs to maintain a healthy diet, and the Thrifty Food Plan is a great baseline for a nutrient-dense diet, and that is why it was chosen as a source for this thesis (USDA Food and Nutrition Service 2021).



Figure 2: USDA Thrifty Food Plan (USDA 2021)

4 METHODOLOGY

1.0 METHODOLOGY INTRODUCTION

The methodology for this thesis consisted of an in-store quantitative analysis of reachability, similar to the case study completed by Mafatlane, Fidzani and Gobotswang analyzing the interior accessibility of wheelchairs in Botswana (Mafatlane, Fidzani and Gobotswang 2015). The study took place at the Pearl Street Whole Foods Market located in Boulder, Colorado. There were three phases in the data collection and analysis: pre-survey, survey, and survey data analysis. Data collected from the survey phase is compared to the data from the Thrifty Food Plan Suggested Market Basket for a family of four (USDA Food and Nutrition Service 2021).

> The Market Baskets of the Thrifty Food Plan 2021 are represented by categories of foods and beverages in the amounts—and associated costs—that make up a healthy diet. Each of the Market Basket Categories includes a variety of commonly consumed food and beverage items ... that can be purchased in nutrient-dense forms to prepare healthy meals and snacks on a limited budget" (Thrifty Food Plan 2020)

CASE STUDY EXPLANATION

Certainly, the research of accessibility should be done in all types of stores such as retail, warehouse, malls, and department stores. This thesis focuses on grocery stores due to the importance and necessity of their function. The USDA categorizes primary and secondary shopping stores in four categories: (1) supercenters, other mass merchandise stores, and club stores; (2) supermarkets, large grocery stores, and commissaries; (3) smaller stores that include convenience stores and pharmacies; and (4) unknown store types (USDA 2015). I analyze a category two store. I acknowledge that there are many ways to analyze the data collected including product cost, health, and accessibility of specialty items such as ethnic foods, gluten-free, dairy-free, vegetarian, and vegan items. This thesis focuses on the baseline amount of healthy food required to be accessible to a household as defined by the USDA Thrifty Food Plan Market Basket (USDA Food and Nutrition Service 2021).

This study selects a particular store accessible to the researcher. Whole Foods Market, located on Pearl Street in Boulder, was selected because of its high standards for food quality and its brand as a healthy store. Boulder, Colorado is an affluent area with a median household income of \$83,019 between 2014-2019, and in 2020, 5.4% of the population under 65 years old have a disability (Census.gov 2022). Whole Foods Market has over 500 retail stores in the US, Canada, and the UK, so the accessibility standards should be high for the number of people that shop there (Whole Foods Market 2022). They have industry-leading meat standards, responsibly farmed seafood, over 230 prohibited ingredients, over 22,000 organic products. (https://tinyurl.com/bddv7hfj link retrieved on 2.18.2022). Whole Foods Market Pearl Street uses a grid layout.

1.1 AVERAGE WHEELCHAIR MEASUREMENTS AND CASE STUDY WHEELCHAIR MEASUREMENTS

The average wheelchair seat height is 19" to 20" from the floor, depth of the seat is 16", the width of the wheelchair from wheel to wheel is 23" to 32", arm height is 29" to 30", and length is 46" to 50" from the back of the wheel to the projection of feet overhang for common wheelchairs (NASD Birdsong and Strickland 1992). As the average side reach overhead is 54", maximum forward reach is 48" above the floor, and low side reach is 9" above the floor, the shopping experience for wheelchair users looks a bit different than that of an able-bodied person (NASD Birdsong and Strickland 1992).

Measurements:

I am 5'6" standing. I did not move through the store in a wheelchair; I sat in an average wheelchair and took measurements shown in graphic 4, including:

My Highest Possible Side Reach: 64"

Comfortable Side Reach: 29" - 54"

Eye-Level Seated: 48"

Arm Reach Straight Out (Shoulder Height): 39"

Leaning Down Reach/Minimum Shelf Height: 10"



Graphic 6 by author

WHEELCHAIR DIMENSIONS



Graphic 7 by author
2.0 OUTLINE OF METHODS

2.1 PHASE ONE: PRE-SURVEY

During this phase, I entered the Whole Foods Market Pearl Street location and did a walkthrough of the store. The goal of this walkthrough was to make simple observations of possible issues I see with the distribution and sale of food products. The main areas of reachability concern that I saw were wall displays, but all displays in the store had reachability concerns. For example, deep reach shelving, wide swing doors, stacked items such as soups and piles of apples, and deep freezers and coolers. Because seated individuals have a harder time reaching products, the initial store survey allowed me to focus on the different store displays that could impact wheelchair users' experience shopping in the store. I analyze foods noted in the Thrifty Food Plan in order to apply the Thrifty Food Plan Market Basket to my survey. I made observations regarding inaccessible foods and products not on the Thrifty Food Plan Market Basket, but that may be critical for particular people; these observations are recorded separately (USDA Food and Nutrition Service 2021).

2.2 PHASE TWO: SURVEY

2.2.1 DESCRIPTION OF RANDOMIZED SAMPLE

I created a randomized sample grocery list from the Thrifty Food Plan Market Basket for a Family of Four. The market basket categories noted in the Thrifty Food Plan are: vegetables, fruits, grains, dairy, protein foods, and miscellaneous. These categories include multiple subcategories and further subcategories (ie category: grain; subcategory: whole-grain staple grains; further subcategory: whole-grain pasta). Analyzing every item on the Thrifty Food Plan list is out of the scope of my study. I analyze the main subcategories (ie: whole-grain staple grains). As long as there is a product that fits into the subcategory, the suggested Thrifty Food Plan diet guidelines would be satisfied and followed. The items chosen to be on the randomized grocery list are taken from the more specific list of recommended grocery items from the Thrifty Food Plan Table A1.1 Thrifty Food Plan Modeling Categories and descriptions of foods. The items on my randomized grocery list are as follows: collard greens, carrots, baked beans, potatoes, onions, apples, cranberry juice blend, whole wheat bread, white bread, mini wheats, frosted corn flakes, low-fat and nonfat milk, whole and 2% milk, american cheese, sausage, chicken breast, eggs, cod filet, unsalted nuts, chicken noodle soup, coffee, vegetable oil, ketchup, and ice cream.

Each photograph shows the randomized grocery list item highlighted in green for in reach, yellow for grey, and red for out of reach. Other food items that may fit in the category but are not chosen for the random sample grocery list will not be highlighted. This is to keep the analysis focused on the items on the randomized sample list.

Table 1. Thrifty Food Plan Market Basket for reference family^a of four, June 2021: aggregate quantities, costs, and cost shares of Market Basket Categories^b in weekly amounts

Market Basket Categories	Quantity® of each Market Basket Category (Ibs)	Cost of each Market Basket Category (\$)d	Cost share of each Market Basket Category (%)*
Vegetables	35.37	46.11	23.91
Dark-green vegetables	3.23	5.88	12.75
Red and orange vegetables	8.28	12.63	27.40
Beans, peas, lentils ^r	6.06	5.42	11.75
Starchy vegetables	10.64	12.71	27.56
Other vegetables	7.16	9.47	20.54
Fruits	26.91	26.90	13.95
Whole fruit	17.76	19.48	72.42
100% fruit juice	9.15	7.42	27.58
Grains	14.13	30.67	15.91
Whole-grain staple grains (e.g., rice, pasta, breads, tortillas)	6.70	16.17	52.73
Whole-grain cereals (e.g., oatmeal, ready-to-eat cereal)®	1.12	3.33	10.87
Refined-grain staple grains (e.g., rice, pasta, breads, tortillas)	5.65	8.91	29.04
Refined-grain other (e.g., cereals, crackers, snacks)	0.66	2.26	7.37
Dairy	41.30	27.94	14.49
Low- and non-fat milk, yogurt, soy alternatives*	25.48	14.95	53.51
Higher fat milk, yogurt, soy alternatives'	15.13	10.27	36.76
Cheese	0.70	2.72	9.73
Protein foods	16.18	47.45	24.61
Meats	2.26	8.96	18.88
Poultry	6.89	17.31	36.49
Eggs	2.12	3.33	7.02
Seafood	2.94	12.80	26.97
Nuts, seeds, soy products	1.97	5.05	10.64

Market Basket Categories	Quantity° of each Market Basket Category (Ibs)	Cost of each Market Basket Category (\$)₫	Cost share of each Market Basket Category (%)°
Miscellaneous	7.05	13.76	7.14
Pre-prepared entrees and side dishes (e.g., soups, frozen entrees, pizza)	1.51	3.71	26.94
Coffee and tea	1.63	2.23	16.17
Table fats and oils	1.71	4.11	29.88
Sauces, condiments, jams, honey, sugars, spices	1.64	2.33	16.90
Other foods and beverages (e.g., soft drinks, fruit drinks, ice cream, pudding, cookies, candy bars)	0.57	1.39	10,10
Total (Vegetables, Fruits, Grains, Dairy, Protein Foods, Miscellaneous)	140.94	192.84	100%

The reference family of four is defined as consisting of four persons: a man and a woman age 20 through 50, a child age 6 through 8, and a child ge 9 through 11.

Morket Basket Categories are foods and bewarges: that are converted and regrouped from the Modeling Categories for the Thirfty Food Plan intr amounts in an purchased form. The Market Basket Categories are based primarily on food groups and subgroups included in the Dietrary Guideines for Americans, 2003-2025.

Quantities are presented as pounds for all Market Basket Categories. For some Market Basket Categories (e.g., low- and non-fat milk, yogurt, and loy alternatives), the amount in pounds can be converted to an approximate amount in fluid ounces by multiplying by 15 34.

*The cost influence is a cost of the Thirty Food Plan, 2021 in June 2027 process. Market Basike Canagory costs may no sum to the total accost due to control USDA updates the cost monthly to account for local price inflation. The Monthly Cost of Food Paport is available at <u>https://cost.nls. usda.gov/cost.usda.food.ellinest.cost.food.esports.monthly-reports.</u>

For the Market Basket Categories vegetables, fruit grane, dany, protein foods, and miscellaneous, the amounts shown represent the percent of the total Market Basket cost. For the subcategories within each of these (e.g., whole fruit and 100% fruit juice that male up the fruits Market Basket Category), the amounts shown represent, the percent of the Market Basket Category cost.

"Nearly all selections within this subcategory are assumed to be canned beans.

* Most selections within this subcategory are assumed to be ready-to-eat cereal and the remainder is cooled breakfast cereals (e.g., oatmeel). * Low- and non-fat milk; yogur, and say alternatives (skim or 1% and 0 g added sugars; <33 g added sugars were permitted for nonfat, unsweetened say beverage). Most selections within this category are assumed to be fluid milk choices that are lower in cost compared to other items within this category.

¹ Higher fat milk, yogurt, and soy alternatives (whole or 2% and/or >0 g added sugars). Most selections within this category are assumed to be whole and 2% fluid milk choices that are lower in cost compared to other items within this category.

Table 2: Thrifty Food Plan Market Basket for a reference family of four (USDA 2021)

2.2.2 DATA COLLECTION FOR STORE SURVEY

I entered the store with a tape measure, my phone camera, a notepad, and a pen. I walked through each section in the store and photographed the displays containing items from my grocery list in the front elevation view. I measured and recorded critical height data: 10", 29", 38", 48", 54" and 64" (as discussed earlier, these represent thresholds of reachability from a seated position). The data collected are shown in graphics in section 3.0. Photographs show areas that were in reach, possibly in reach, and out of reach. Possibly in reach is denoted "grey area." This represents items that could be in reach for some, and could be out of reach for some depending on the product, the method of display (such as stacked products) along with the shoppers physical strength, height, and size.

I analyzed products and their displays in the produce, meat, seafood, dairy, frozen, and dry good sections. I also gathered data for store-specific details and displays such as the filtered water station. The observation, photography, measuring, and recording produced clear, measurable, and recorded evidence. This evidence is analyzed in the survey data analysis phase. Although I included price data in my graphics, it was not interpreted in this study and could be utilized for further research.

2.3 PHASE THREE: SURVEY DATA ANALYSIS

Phase three of the methodology is the analysis of the reachability of the randomized grocery list. Once the data was collected from the survey and I had the display measurements, I created a table that had the random grocery item and data that showed if there was an organic option for the product in reach and if there was a conventional option for the product in reach. Some items that did not have an organic or conventional option have a "-" on the chart. The items that were in the "grey area" are grouped with the "out of reach" items as they aren't definitely reachable.

3.0 DATA COLLECTION GRAPHICS

3.1 CATEGORY: VEGETABLES

3.1.1 DARK-GREEN VEGETABLES



Figure 3.1.1: The item chosen for the Thrifty Food Plan Market Basket randomized sample for dark green vegetables pictured are collard greens.

3.1.2 RED AND ORANGE VEGETABLES



Figure 3.1.2: The item chosen for the Thrifty Food Plan Market Basket randomized sample for red and orange vegetables pictured are carrots.

3.1.3 BEANS, PEAS, AND LENTILS



Figure 3.1.3: The item chosen for the Thrifty Food Plan Market Basket randomized sample for beans, peas, and lentils pictured are baked beans.

3.1.4 STARCHY VEGETABLES



Figure 3.1.4: The item chosen for the Thrifty Food Plan Market Basket randomized sample for starchy vegetables pictured are potatoes.

3.1.5 OTHER VEGETABLES



Figure 3.1.5: The item chosen for the Thrifty Food Plan Market Basket randomized sample for other vegetables pictured are onions.

3.2 CATEGORY: FRUITS 3.2.1 WHOLE FRUIT



Figure 3.2.1: The item chosen for the Thrifty Food Plan Market Basket randomized sample for whole fruit pictured are apples.

3.2.2 100% FRUIT JUICE



Figure 3.2.2 : The item chosen for the Thrifty Food Plan Market Basket randomized sample for 100% fruit juice pictured is the cranberry juice blend.

3.3 CATEGORY: GRAINS 3.3.1 WHOLE-GRAIN STAPLE GRAINS



Figure 3.3.1 : The item chosen for the Thrifty Food Plan Market Basket randomized sample for whole-grain staple grains is whole wheat bread.

3.3.2 WHOLE-GRAIN CEREALS (READY-TO-EAT CEREAL)



Figure 3.3.2 : The item chosen for the Thrifty Food Plan Market Basket randomized sample for whole-grain cereals is mini wheats.



3.3.3 REFINED-GRAIN STAPLE GRAINS

Figure 3.3.3 : The item chosen for the Thrifty Food Plan Market Basket randomized sample for refined-grain staple grains is white bread.

3.3.4 REFINED-GRAIN OTHER



Figure 3.3.4 : The item chosen for the Thrifty Food Plan Market Basket randomized sample for refined-grain staple grains is corn flakes.

3.4 CATEGORY: DAIRY

3.4.1 LOW-FAT AND NONFAT MILK, YOGURT AND SOY





Note: The products in this section are stored behind doors that have a width of 34". This makes it difficult to open from a seated position and grab items close to the door hinges. Seated shoppers are able to reach gallon sizes and a few liter options, but whipped cream is unreachable.

3.4.2 HIGHER FAT MILK, YOGURT + SOY ALTERNATIVES



Figure 3.4.2 : The item chosen for the Thrifty Food Plan Market Basket randomized sample for higher fat milk is whole milk.

3.4.3 CHEESE



Figure 3.4.3 : The item chosen for the Thrifty Food Plan Market Basket randomized sample for cheese is American cheese.

Note: The refrigerated wall area that holds sliced and shredded cheese items uses an acrylic wall in the front to hold items upright. This adds an additional 5" to the base of the shelf that shoppers must reach over.

3.5 CATEGORY: PROTEIN FOODS

3.5.1 MEATS



Figure 3.5.1 : The item chosen for the Thrifty Food Plan Market Basket randomized sample for meats is sausage.



3.5.2 POULTRY

Figure 3.5.2 : The item chosen for the Thrifty Food Plan Market Basket randomized sample for poultry is chicken breast.

3.5.3 EGGS



Figure 3.5.3 : The item chosen for the Thrifty Food Plan Market Basket randomized sample for eggs is any version of a whole egg.

Note: There are regular eggs on the bottom and middle levels and specialty egg items on the top level. The grey area for this shelf is larger because a shopper would not be able to grab from the top stacked carton on the fourth shelf if they are stacked three high, and similarly, wouldn't be able to grab from the fifth shelf if the items were stacked. The eggs would fall and break. The grey level of reachability becomes harder when items are stacked.

3.5.4 SEAFOOD



Figure 3.5.4 : The item chosen for the Thrifty Food Plan Market Basket randomized sample for seafood is cod filets.

3.5.2 NUTS, SEEDS AND SOY PRODUCTS



Figure 3.5.2 : The item chosen for the Thrifty Food Plan Market Basket randomized sample for nuts, seeds and soy products is unsalted nuts.

3.6 CATEGORY: MISCELLANEOUS

3.6.1 PRE-PREPARED ENTREES AND SIDE DISHES



Figure 3.6.1 : The item chosen for the Thrifty Food Plan Market Basket randomized sample for pre-prepared entrees and side dishes is chicken noodle soup.

3.6.2 COFFEE AND TEA



Figure 3.6.2 : The item chosen for the Thrifty Food Plan Market Basket randomized sample for coffee and tea is any type of coffee.

3.6.3 TABLE FATS AND OILS



Figure 3.6.3 : The item chosen for the Thrifty Food Plan Market Basket randomized sample for table fats and oils is vegetable oil.

3.6.4 SAUCES, CONDIMENTS, JAMS, HONEY, SUGARS AND SPICES



Figure 3.6.4 : The item chosen for the Thrifty Food Plan Market Basket randomized sample for sauces, condiments, jams, honey, sugar and spices is ketchup.



3.6.5 OTHER FOODS AND BEVERAGES

Figure 3.6.5 : The item chosen for the Thrifty Food Plan Market Basket randomized sample for other foods and beverages is ice cream.

3.7 ANALYSIS OUTSIDE OF THRIFTY FOOD PLAN RANDOM SAMPLE

3.7.1 REFRIGERATED BERRY DEEP COOLER ISLAND



Figure 3.7.1 : This graphic shows one of the refrigerated deep coolers in the produce section. This one is filled with berries. There is a large amount of grey area with these types of coolers. If products are low in stock, the level of reach increases and makes it much harder to grab items from a seated position. The level of reachability heavily depends on the stocking of items.

BUT OF REACH WATER DISPENSER HANDLE OUT OF REACH WATER CONTAINER/FILLER AREA GREY AREA IN REACH

3.7.2 WATER FILTER STATION

Figure 3.7.2 : This graphic shows the water filter station at Whole Foods Market. The handles to use the water filter station are out of reach from a seated position.

3.7.3 ASIAN SPECIALTY SECTION



Figure 3.7.3 : The items shown are located in the Asian Specialty area.



3.7.4 END CAP DISPLAY

Figure 3.7.4 : Example of end cap reachability. End caps vary.

3.8 RANDOM SAMPLE GROCERY LIST FINDINGS

RANDOM GROCERY ITEM	IS ORGANIC IN REACH?	IS CONVENTIONAL IN REACH?
Collard Greens	GREY AREA	-
Carrots	YES	YES
Baked Beans	NO	NO
Potatoes	YES	YES
Onions	YES	YES
Raw Apple	YES	YES
Cranberry Juice Blend	YES	YES
Whole Wheat Bread	YES	NO
White Bread	YES	NO
Mini Wheats	-	-
Corn Flakes	NO	YES
Low-fat and Nonfat Milk	YES	YES
Whole and 2% Milk	YES	-
American Cheese	YES	YES
Sausage	NO	YES
Chicken Breast	YES	YES
Eggs	YES	YES
Cod Filet	NO	YES
Unsalted Nuts	YES	YES
Chicken Noodle Soup	GREY AREA	YES
Coffee	YES	YES
Vegetable Oil	-	YES
Ketchup	NO	NO
Ice Cream	YES	YES
% OF ITEMS IN REACH	15/24 = 62.5% IN REACH	16/24 = 66.7% IN REACH

5 FINDINGS

5.1 GAPS IN THE LITERATURE

After comparing literature across various topics, it was clear that the current literature lacks specific research in the interior accessibility of grocery stores for seated shoppers and the reachability of products from a seated position. The literature highlighted ways in which wheelchair users and other impaired shoppers may have a harder time purchasing foods they want or need, but it lacked discussion and research of reachability of products.

5.2 NEW DEFINITION FOR FOOD ACCESSIBILITY

I have found definitions for food insecurity and food accessibility, but determined that the definition of food accessibility leaves out nuances of food accessibility including reachability. I propose that the new definition of food accessibility expands on the current, and includes the requirement of having limited barriers along with appropriate resources to obtain healthy food. My new definition of food accessibility reads as, "having sufficient resources combined with limited exterior and interior physical barriers to obtain foods for a nutritious diet."

5.3 CRITIQUE OF THE ADA

My review of the Americans with Disabilities Act had critiques as well, as I found that the allotted side and forward reach outlined in the ADA was not beneficial to me as a seated shopper in my methodology. As a 5'6" standing individual, from a seated position I was able to reach up to 54" and no higher than 64" on a grocery store shelf. The Americans with Disabilities Act is intended to allow the greatest possible accessibility to those with disabilities, and suggesting that the maximum reach of most seated shoppers is 48" from the floor is grossly underestimating the actuality of wheelchair users' reach.

Although the ADA is successful in regulating disability-friendly parking lots, entrances, bathrooms, and aisle widths, there is a need for more realistic and equal reachability in grocery store shelving from a seated position. In order for the ADA to achieve its goal of leveling the playing field so that those with disabilities may have equal enjoyment of purchasing goods and services (ADA 2010), the ADA must require accessible shelving that exceeds its current standards. The ADA should increase the range that a wheelchair user can reach foods to exceed the 44 and 48 inch maximum outlined in chapters three and four. They should also require that there are other options to solve reachability when design solutions are not apparent in grocery stores, such as shopping assistant devices located in-store to allow for maximum accessibility for wheelchair users when shopping at a grocery store.

5.4 SURVEY DATA ANALYSIS FINDINGS

In my pre-survey, I observed that a majority of the grocery store displays had some potential issues. The heights of the refrigerated, frozen, and ambient wall displays throughout the store looked basically the same and the deep freezers and coolers were all roughly the same reach down. The survey phase proved that all wall display heights exceeded 64" tall, and most of these displays were around 89" tall. After taking measurements of the produce displays on my randomized grocery list, it was clear that a portion of every wall display shelf and island deep shelf had some areas that would be unreachable from a seated position.

My survey data analysis findings show that 62.5% of the organic option was in reach and 66.7% of the conventional option was in reach. This is equivalent to 37.5% of organic products and 33.3% of conventional products being out of reach from a seated position. Approximately four in ten organic and three in ten conventional products are out of reach in the above categories. Because the random sample grocery list only observed 24 grocery items from the Thrifty Food Plan Market Basket, it is astonishing that so many of these products were out of reach from a seated position. Not only does this show the unequal accessibility for seated shoppers for the items on the random sample grocery list, but it is only the beginning of what items are out of reach. Further research would benefit from a total, in store analysis of all products in order to gain an understanding

RANDOM SAMPLE GROCERY LIST REACHABILITY RESULTS



Graphic 8 by author

of what percentage of food is inaccessible to a seated shopper.

To extend on the survey data analysis results, there were also contributions and findings for products that were not a part of the Thrifty Food Plan randomized grocery list study. The water filter station is an example of the separation between able-bodied individuals accessibility and wheelchair users accessibility. In figure 3.7.2, the water filter station shows some plastic containers for storing water are in reach from a seated position, but the handles to operate the water filling station were out of reach from a seated position.

In areas throughout the store that use doors to keep frozen and chilled items cold such as milk shown in figure 3.4.2 and ice cream shown in figure 3.6.1, it is more difficult for wheelchair users to gain access to these items as efficiently as able-bodied shoppers. This is similar when stores use island deep freezer and chillers to display foods.

The chilled berry display case, noted in figure 3.7.1, notes that the grey area of reachability depends on the product and level of product stock. When items in these displays are low in stock or picked over, the items fall further back or deeper into the display cases. As distance needed to grab these items increases, level of reachability decreases.

Another area of concern is in culture food sections such as the Asain specialty section in figure 3.7.3 of the ambient grocery store aisles. When looking at figure 3.7.3, items such as untoasted sushi nori and organic wakame are out of reach. Without assistance, a seated shopper would not be able to purchase this item. Cultural foods, along with any other specialty item like gluten free, vegetarian, or vegan items, can impact an individuals quality of life if they are repeatedly not able to reach and therefore

5.5 EXPANSION OF THE LITERATURE

This research supports and builds upon the only known similar research project conducted by Mafatlane, Fidzani, and Gobotswang at grocery stores in Botswana. This study agreed with my findings that there was limited research done on the interior accessibility of grocery stores, hence the need for this study. The work done in Botswana was valuable to this study by providing analysis of the exterior shopping experience from parking to the entrance, the interior accessibility of the store for reachability of items, the height of the counters, aisle widths, lighting, and flooring, and recommendation effective accessibility strategies to accommodate shoppers using a wheelchair (Mafatlane, Fidzani and Gobotswang 2015). This research also gave insight into what a wheelchair user's experience looks like. Their study on reachability of basic foods involved interviews conducted with the participants, falling into the categories exterior accessibility or interior accessibility. The results of the interviews were that the level of satisfaction a participant felt depended on if the products they wanted were in reach. Instead of a qualitative approach like the Botswana study, my work builds on their research in a quantitative analysis. My thesis narrows the focus strictly to reachability from a seated position and analyzes a singular randomized grocery list for this particular case study. The study done by Mafatlane, Fidzani, and Gobotswang made a contribution to the fields of disability, accessibility, and universal design. This thesis extends their work into the interior architecture and display design of grocery stores through a quantitative analysis of reachability.

My research was focused on analyzing one category of structural impairments within the disabled population: wheelchair users. Further research could involve other structural impairments or functional disabilities such as visual or cognitive impairments to test how grocery shopping differs from able-bodied people to those with disabilities other than wheelchair users.

I focused on the Americans with Disabilities Act as the main regulator of store accessibility for disabled shoppers. Continued research may look into other regulations or norms in the grocery industry that regulate disability accessibility, legally mandated or otherwise. It would be beneficial to conduct interviews with grocery stores to see how they implement regulations outside of ADA.

This research uses a singular case study, the Pearl Street Whole Foods Market, to analyze the reachability of products to wheelchair users. There are a wide variety of primary and secondary shopping stores to choose from as noted in the USDA including supercenters, other mass merchandise stores, and club stores; supermarkets, large grocery stores, and commissaries; smaller stores that include convenience stores and pharmacies; and unknown store types (USDA 2015). Further analysis of wheelchair user reachability could use different types of stores to see how reachability differs within these categories.

Additional case study store limitations specific to the in-store analysis are as follows. First, I was unable to measure all items in the store due to limited time and scope constraints, including the inability to record thousands of items in my research. There are over 42,000 items in a grocery store and I was unable to analyze the reachability of every item (Best Marketing Degrees accessed 2022). Future research would benefit from a complete store analysis to see the exact percentage of reachability of the entire store.

Second, I was unable to control the stock on the shelf as this varies day to day, which might have led to some products being harder to reach than others. If certain items were low or out of stock, they may have been harder to reach than those that were fully stocked and reachable from the front of the shelf. As noted in section 5.4, the impact stocking of products has on reachability is evident in all deep coolers and freezers, cooler walls, and ambient display shelving as product reachability decreases as product stock decreases. Similarly, product displays, end caps, specialty displays, and seasonal items are constantly changing throughout the store and make it difficult to analyze.

Third, because I was involved in the methodology, the study results may have differed if another individual was used for the measurements. If someone who was a different height than me was the participant, shelf reachability including in reach, grey area, and out of reach categories may differ. Varying user heights and strengths are a contributing element in the ADA critique and why I have suggested the ADA must increase their allotted forward and side reach.

Fourth, this study used a randomized grocery list consisting of one item per category from the Thrifty Food Plan Market Basket. There are countless grocery lists that could be developed from the Thrifty Food Plan Market Basket which could have differing reachability findings.

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Fifth, another limitation of the study is the analysis of organic and conventional products. Whole Foods Market prides itself on its wide variety of organic products. The organic and conventional data may differ if the study was conducted at a store that was not Whole Foods Market.

Given more time and resources, and to bring more specificity to the study, interviews could be added to the methodology. It would benefit the study to gain qualitative knowledge from wheelchair users' experience shopping in grocery stores. Cost analysis was out of the scope of this study but was included in the graphics in order to be utilized for further research.

The accessibility of food, a basic human need, and right, looks different for all people. Physical proximity and availability of transportation to food distribution locations, adequate financial means to purchase groceries, and the ability to access food are the basic foundations in attaining groceries. Because the disabled populations in the United States are at an increased likelihood to be food insecure and are at a higher risk for health complications if they are not able to nourish their body properly, it is essential to limit the exterior and interior barriers they face to maximize their access to food. For this reason, food accessibility should be defined as "having sufficient resources combined with limited exterior and interior physical barriers to obtain foods for a nutritious diet," in order to properly measure what is accessible and what is not. The term food accessibility should involve all parts of the shopping experience, including physically being able to obtain items on the shelf when inside a grocery store.

The 2010 Americans with Disabilities Act was intended to level the playing field so that those with disabilities would have the equal enjoyment of purchasing goods and services as those who do not have physical impairments. After my review of the ADA, I have concluded that the regulations have flaws and should be adjusted in order for the interior regulation of all businesses to be more accessible. Along with ADA, grocery stores should be held responsible for making products accessible from a wheelchair. Grocery store marketing tactics play a serious role in determining product placement and the location of items in the store. These tactics, such as placing sugary cereal for children in the middle shelf zone, may make it more difficult for wheelchair users to be able to reach healthy options. Perhaps more concrete regulations in grocery store marketing tactics would limit the predominance of unhealthy options in the reachable areas for wheelchair users. Offering a device to seated shoppers that would allow them to call for assistance may be a solution that would benefit wheelchair users' shopping experience without disrupting grocery store product sales.

Because 37.5% of organic products and 33.3% of conventional products from a randomized sample grocery list were unreachable, it is a fair conclusion that grocery store display design and interaction with grocery store shelving can be improved to increase reachability from a seated position. With the data found, there are implications across various fields extending past grocery store display design. Not only is there a call to action for grocery stores, but all businesses that society views as "accessible" but really aren't.

Given the complexity and scale of this research, a design solution to remedy these issues isn't inherently obvious. Further research should be conducted to determine potential solutions. My best solution is for seated shoppers to bring an assistant to the store to help reach products. Potential design solutions can be subtle additions to what we know as a traditional grocery store. Perhaps placing healthy food options on lower shelving could provide easier access from a seated position. Because grocery store products are lined up face to face horizontally on a shelf (graphic 3.6.4 showing reachability of ketchup shows the horizontal fashion that the products are layed out), the items that are horizontally displayed at the top of shelving units are completely out

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of reach to seated shoppers. Instead, displaying items in a column fashion vertically on shelves would allow shoppers of all heights a greater chance to reach items from any height. Perhaps disabled shoppers could move about the store with a call button device and use it when they need assistance reaching a product. Other ideas include marking items like a vending machine so employees can gather out of reach items, or providing shallower shelving for certain aisles.

Further research in the interior reachability of products from a wheelchair will shine light on a difficult issue, and it is the only way to make progress toward equality of access. Future research that would expand on this study would be conducting interviews with wheelchair users to understand the qualitative side of reachability along with conducting interviews with the United States Department of Justice's Civil Rights Division and grocery stores to understand how regulations are created, implemented, and continually complied to. It would be beneficial to complete a total analysis of a grocery store to determine the percent of reachability of all products. This thesis may inspire future research that could focus on new themes such as the cost of products, dietary restrictions, and food preferences and how repeatedly being unable to purchase these items may impact an individual's health or quality of life. I challenge designers of all kinds to create design solutions that correct the discriminatory practices previous designs may have created. As leaders in shaping our built environment, it is necessary to work toward designing solutions that benefit all members of our society.

The unequal ability to reach products in grocery stores is a continuum of marginalization and vulnerability that disabled people face in our society. It is necessary to work towards solutions in accessibility that remedy this discrimination.

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8 BIBLIOGRAPHY

- "1991 ADA Standards for Accessible Design." n.d. Accessed November 7, 2021. https:// www.ada.gov/1991ADAstandards_index.htm.
- "2010 ADA Regulations." n.d. Accessed November 7, 2021. https://www.ada.gov/2010_ regs.htm.
- "2010 ADA Standards for Accessible Design." n.d. Accessed November 7, 2021. https:// www.ada.gov/regs2010/2010ADAStandards/2010ADAstandards.htm.
- "A Retailer's Guide to Compliance with Americans with Disabilities Act." 2019. RE: Brand Standards. April 17, 2019. https://blog.compliantia.com/a-retailers-guide-to-compli ance-with-americans-with-disabilities-act/.
- "ADA Business Connection." n.d. Accessed March 12, 2022. https://www.ada.gov/ business.htm.
- "ADA History In Their Own Words: Part One | ACL Administration for Community Living." n.d. Accessed October 31, 2021. https://acl.gov/ada/origins-of-the-ada. ADMIN. 2020. "Shopping Tips for Wheelchair Users." Freedommobilitycenter.Biz (blog). September 8, 2020. https://freedommobilitycenter.biz/shopping-tips-forwheelchair-users/.
- "Americans with Disabilities Act | U.S. Department of Labor." n.d. Accessed November 8, 2021. https://www.dol.gov/general/topic/disability/ada.
- "Americans with Disabilities Act, Title III Regulations: Nondiscrimination on the Basis of Disability by Public Accommodations and in Commercial ... | Alexander Street, a ProQuest

Company." n.d. Accessed September 22, 2021. https://search-al exanderstreet-com.colorado.idm.oclc.org/view/work/bibliographic_ entity%7Cbibliographic_details%7C3263331#page/14/mode/1/chapter/bibliographic_ entity%7Cdocument%7C3263333.

- "Average Height Wheelchair User." n.d. Karman® Wheelchairs. Accessed March 16, 2022. https:// www.karmanhealthcare.com/average-height-wheelchair-user/.
- Berry, Brent, and Taralyn McMullen. 2008. "Visual Communication to Children in the Supermarket Context: Health Protective or Exploitive?" Agriculture and Human Values 25 (3): 333–48. https://doi.org/10.1007/s10460-007-9110-0.
- Bureau, US Census. n.d. "Income and Poverty in the United States: 2018." Census.Gov. Accessed March 7, 2022. https://www.census.gov/library/publications/2019/demo/p60-266.html.
- Butcher, Kristin. 2021. "The New Thrifty Food Plan Re-Evaluates a 50-plus-Year-Old Design and Low-Income Kids Will Benefit." Brookings (blog). September 1, 2021. https://www. brookings.edu/opinions/the-new-thrifty-food-plan-re-evaluates-a-50-plus-year-old-de sign-and-low-income-kids-will-benefit/.
- Butler, Ruth, and Sophia Bowlby. 1997. "Bodies and Spaces: An Exploration of Disabled People's Experiences of Public Space." Environment and Planning D: Society and Space 15 (4): 411–33. https://doi.org/10.1068/d150411.
- "11 Most Common Aisles of a Grocery Store." Infogrocery (blog). November 17, 2019. https:// infogrocery.com/common-aisles-grocery-store.
- Caspi, Caitlin E., Glorian Sorensen, S. V. Subramanian, and Ichiro Kawachi. 2012. "The Local Food Environment and Diet: A Systematic Review." Health & Place 18 (5): 1172–87. https://doi.org/10.1016/j.healthplace.2012.05.006.
- CDC. 2019. "Disability and Health Related Conditions | CDC." Centers for Disease Control and Prevention. September 9, 2019. https://www.cdc.gov/ncbddd/disabilityandhealth/ relatedconditions.html.
- Cline, Holly Leeann. n.d. "The Evaluation of Universal Design Kitchen Features by People in Wheelchairs." Ph.D., United States -- Virginia: Virginia Polytechnic Institute and State University. Accessed September 25, 2021. http://www.proquest.com/ docview/304967515/abstract/290B68A4AF194165PQ/1.
- Coleman-Jensen, Alisha, and Mark Nord. 2013. "Food Insecurity Among Households with Working-Age Adults with Disabilities." SSRN Electronic Journal. https://doi.org/10.2139/ ssrn.2202869.
- "Company Information." n.d. Whole Foods Market. Accessed February 17, 2022. https://www. wholefoodsmarket.com/company-info.
- Coveney, John, and Lisel A. O'Dwyer. 2009. "Effects of Mobility and Location on Food Access." Health & Place 15 (1): 45–55. https://doi.org/10.1016/j.healthplace.2008.01.010.

- "Department of Justice ADA Title III Regulation 28 CFR Part 36 (1991)." n.d. Accessed March 12, 2022. https://www.ada.gov/reg3a.html#Anchor-36000.
- Drèze, Xavier, Stephen J. Hoch, and Mary E. Purk. 1994. "Shelf Management and Space Elasticity." Journal of Retailing 70 (4): 301–26. https://doi.org/10.1016/0022-4359(94)90002-7.
- Dunn, Patricia A. 2019. "REVIEW: Disability in Higher Education: How Ableism Affects Disclosure, Accommodation, and Inclusion." College English 82 (2): 226-42.
- Eason, Claire. 2020. "Design Thinking: Steps Toward Accessible Architecture." Crit, no. 86 (January): 77–80.
- "Five Essential Tips For Grocery Shopping In A Wheelchair." 2017. Passionate People by Invacare (blog). May 8, 2017. https://www.passionatepeople.invacare.eu.com/five-essen tial-tips-grocery-shopping-wheelchair/.
- Gerber, Elaine. 2020. "Ableism and Its Discontents: Food as a Form of Power, Control, and Resistance among Disabled People Living in U.S. Institutions." Food and Foodways 28 (1): 1–21. https://doi.org/10.1080/07409710.2020.1718273.
- "Grocery Shopping and Best Practices for ADA Compliance -." n.d. Access Advocates (blog). Accessed October 31, 2021. http://accessadvocates.com/grocery-shop ping-and-best-practices-for-accessibility-compliance/.
- Harris, Frances, Hsiang-Yu Yang, and Jon Sanford. 2015. "Physical Environmental Barriers to Community Mobility in Older and Younger Wheelchair Users." Topics in Geriatric Rehabilitation 31 (1): 42–51. https://doi.org/10.1097/TGR.00000000000043.
- Harris, Jennifer L, Marlene B Schwartz, Kelly D Brownell, Vishnudas Sarda, Megan E Weinberg, Sarah Speers, Jackie Thompson, et al. n.d. "Cereal FACTS: Evaluating the Nutrition Quality and Marketing of Children's Cereals," 102.
- Hartline-Grafton, Heather, Senior Advisor, SNAP, Ellen Vollinger, and Legal/Food Stamp Director. n.d. "Thrifty Food Plan 101 (Part 1)." Food Research & Action Center (blog). Accessed December 11, 2021. https://frac.org/blog/thrifty-food-plan-101-part-1.
- Hełdak, Maria, Agnieszka Stacherzak, and Katarzyna Przybyła. 2018. "Demand and Financial Constraints in Eliminating Architectural and Technical Barriers for People with Disabilities in Poland." Journal of Healthcare Engineering 2018 (February): e1297396. https://doi. org/10.1155/2018/1297396.
- Hine, Julian, and Fiona Mitchell. 2001. "Better for Everyone? Travel Experiences and Transport Exclusion." Urban Studies 38 (2): 319–32.
- "Hints From Heloise: No Juice on Aisle 5 (Posted 2013-10-18 20:03:23): A Reader Sounds off on Motorized Wheelchairs in Grocery Stores Losing Juice Halfway through Her Shopping." 2013. The Washington Post (Online). Washington, D.C., United States: WP Company LLC d/b/a The Washington Post. 2013. http://www.proquest.com/docview/1444941373/

citation/EF8553A41E064910PQ/1.

- "Just Fridge." 2020. Just Fridge (blog). August 1, 2020. https://www.justfridge.co.za/6-types-ofsupermarket-fridges-and-their-uses/.
- Kaufman, Carol Felker. 1995. "Shop 'til You Drop: Tales from a Physically Challenged Shopper." The Journal of Consumer Marketing 12 (3): 39. http://dx.doi.org.colorado.idm. oclc.org/10.1108/07363769510090455.
- Khattab, Doaa. 2015. "RETHINKING THE GROCERY STORE: INCLUSIVE WAYFINDING SYSTEM FOR VISUALLY IMPAIRED SHOPPERS IN GROCERY STORES." Journal of Accessibility and Design for All 5 (2): 125–56. https://doi.org/10.17411/jacces.v5i2.104.
- L. Harris, Jennifer, Victoria Webb, Shane J. Sacco, and Jennifer L. Pomeranz. 2020. "Marketing to Children in Supermarkets: An Opportunity for Public Policy to Improve Children's Diets." International Journal of Environmental Research and Public Health 17 (4): 1284. https://doi.org/10.3390/ijerph17041284.
- Landby, Emma. 2019. "Everyday Travel for Families with Children Using Wheelchairs: Parents' Perceptions of Constraints and Adaptation Strategies." Children's Geographies 17 (4): 388–400. https://doi.org/10.1080/14733285.2018.1528342.
- "Long-Term Poverty and Disability Among Working-Age Adults Peiyun She, Gina A. Livermore, 2009." n.d. Accessed October 31, 2021. https://journals-sagepub-com.colorado.idm.oclc. org/doi/abs/10.1177/1044207308314954.
- Mafatlane, Gertrude R., Lily C. Fidzani, and Kesitegile S.M. Gobotswang. 2015. "Wheelchair Users as Consumers: Accessibility of Supermarkets in Gaborone, Botswana." International Journal of Consumer Studies 39 (2): 94–100. https://doi.org/10.1111/ijcs.12155.
- "Majority of US Households Have Someone With Diet Restrictions." 2014. Manufacturing. Net. June 10, 2014. https://www.manufacturing.net/operations/news/13176655/majori ty-of-us-households-have-someone-with-diet-restrictions.
- Matthews, M H, and P Vujakovic. 1995. "Private Worlds and Public Places: Mapping the Environmental Values of Wheelchair Users." Environment and Planning A: Economy and Space 27 (7): 1069–83. https://doi.org/10.1068/a271069.
- Mayer, Tamar, and Molly D. Anderson, eds. 2020. Food Insecurity: A Matter of Justice, Sovereignty, and Survival. London: Routledge. https://doi.org/10.4324/9780429434082.
- McClain, Linda. 2000. "Shopping Center Wheelchair Accessibility: Ongoing Advocacy to Implement the Americans with Disabilities Act of 1990." Public Health Nursing 17 (3): 178–86. https://doi.org/10.1046/j.1525-1446.2000.00178.x.
- Meyer, Bruce D., and Wallace K. C. Mok. 2019. "Disability, Earnings, Income and Consumption." Journal of Public Economics, Trans-Atlantic Public Economics Seminar 2016, 171 (March): 51–69. https://doi.org/10.1016/j.jpubeco.2018.06.011.

- Mojtahedi, Mina C., Patty Boblick, James H. Rimmer, Jennifer L. Rowland, Robin A. Jones, and Carol L. Braunschweig. 2008a. "Environmental Barriers to and Availability of Healthy Foods for People With Mobility Disabilities Living in Urban and Suburban Neighborhoods." Archives of Physical Medicine and Rehabilitation 89 (11): 2174–79. https://doi.org/10.1016/j.apmr.2008.05.011.——. 2008b.
- Musicus, Aviva, Aner Tal, and Brian Wansink. 2015. "Eyes in the Aisles: Why Is Cap'n Crunch Looking Down at My Child?" Environment and Behavior 47 (7): 715–33. https:// doi.org/10.1177/0013916514528793.
- "NASD Simple Home Modifications for the Disabled." n.d. Accessed December 11, 2021. http:// nasdonline.org.
- Nguyen, Kien, Minh Le, Brett Martin, Ibrahim Cil, and Clinton Fookes. 2022. "When AI Meets Store Layout Design: A Review." Artificial Intelligence Review, February. https://doi. org/10.1007/s10462-022-10142-3.
- Ozgormus, Elif, and Alice E. Smith. 2020. "A Data-Driven Approach to Grocery Store Block Layout." Computers & Industrial Engineering 139 (January): 105562. https://doi. org/10.1016/j.cie.2018.12.009.
- Pederson, Chris. 2013. Food Insecurity among Disabled Adult Households. Hauppauge, UNITED STATES: Nova Science Publishers, Incorporated. http://ebookcentral.proquest.com/lib/ucb/detail.action?docID=4759705.
- Perrin, Rew, and Sara Atske. n.d. "Americans with Disabilities Less Likely than Those without to Own Some Digital Devices." Pew Research Center (blog). Accessed October 28, 2021. https://www.pewresearch.org/fact-tank/2021/09/10/americans-with-disabilities-lesslikely-than-those-without-to-own-some-digital-devices/.
- Pinna, Francesco, Chiara Garau, Francesca Maltinti, and Mauro Coni. 2020. "Beyond Architectural Barriers: Building a Bridge Between Disability and Universal Design." In Computational Science and Its Applications – ICCSA 2020, edited by Osvaldo Gervasi, Beniamino Murgante, Sanjay Misra, Chiara Garau, Ivan Blečić, David Taniar, Bernady O. Apduhan, et al., 706–21. Lecture Notes in Computer Science. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-58820-5_51.
- Ploeg, Michele Ver. n.d. "Where Do Americans Usually Shop for Food and How Do They Travel To Get There? Initial Findings From the National Household Food Acquisition and Purchase Survey," 2.
- "Policy Basics: The Supplemental Nutrition Assistance Program (SNAP)." n.d. Center on Budget and Policy Priorities. Accessed December 11, 2021. https://www.cbpp.org/ research/food-assistance/the-supplemental-nutrition-assistance-program-snap.
- Preiser, Wolfgang F. E., and Elaine Ostroff, eds. 2001. Universal Design Handbook. New York: McGraw-Hill.

Prescott, Mike, William C. Miller, François Routhier, and W. Ben Mortenson. 2020.

"Factors Affecting the Activity Spaces of People Who Use Mobility Devices to Get around the Community." Health & Place 64 (July): 102375. https://doi.org/10.1016/j. healthplace.2020.102375.

- "Pro Tips: Grocery Shopping in a Wheelchair." n.d. Numotion. Accessed December 11, 2021a. https://numotion.com/blog/may-2020/pro-tips-grocery-shopping-in-a-wheelchair.
- Pusch, Burton Dane. n.d. "A Qualitative Study to Identify Environmental Factors That Impact the Independence of Adults with Mobility Impairments." Ph.D., United States -- Illinois: Southern Illinois University at Carbondale. Accessed September 22, 2021. http://www. proquest.com/docview/288472191/abstract/3F615A0EF8734FEEPQ/1.
- "Quality Standards." n.d. Whole Foods Market. Accessed January 24, 2022. https://www. wholefoodsmarket.com/quality-standards.
- Rashid, Zulqarnain, Rafael Pous, and Christopher S. Norrie. 2019. "An Independent Shopping Experience for Wheelchair Users through Augmented Reality and RFID." Assistive Technology 31 (1): 9–18. https://doi.org/10.1080/10400435.2017.1329240.
- "Retail Design and the Visually Impaired: A Needs Assessment ScienceDirect." n.d. Accessed March 15, 2022. https://www-sciencedirect-com.colorado.idm.oclc.org/science/article/ pii/S0969698915000284?via%3Dihub.
- Rostron, Jack. 1979. "Housing the Physically Disabled: A Study into the Role of the Private Sector." British Journal of Occupational Therapy 42 (2): 41–42. https://doi. org/10.1177/030802267904200206.
- Roy, Sunit. 2019. "As Big Bazaar Makes over 140 Stores Wheelchair-Friendly..." Afaqs!, March. http://www.proquest.com/docview/2463573569/abstract/D2FA51B5410F4774PQ/1.
- Schwartz, Naomi, Ron Buliung, and Kathi Wilson. 2019. "Disability and Food Access and Insecurity: A Scoping Review of the Literature." Health & Place 57 (May): 107–21. https:// doi.org/10.1016/j.healthplace.2019.03.011.
- Seligman, Hilary K., Elizabeth A. Jacobs, Andrea López, Jeanne Tschann, and Alicia Fernandez. 2012. "Food Insecurity and Glycemic Control Among Low-Income Patients With Type 2 Diabetes." Diabetes Care 35 (2): 233–38. http://dx.doi.org/10.2337/dc11-1627.
- Shaw, Hillary J. 2006. "Food Deserts: Towards the Development of a Classification." Geografiska Annaler: Series B, Human Geography 88 (2): 231–47. https://doi.org/10.1111/j.0435-3684.2006.00217.x.
- She, Peiyun, and Gina A. Livermore. 2009. "Long-Term Poverty and Disability Among Working-Age Adults." Journal of Disability Policy Studies 19 (4): 244–56. https://doi. org/10.1177/1044207308314954.
- "SNAP and the Thrifty Food Plan | Food and Nutrition Service." n.d. Accessed February 22, 2022. https://www.fns.usda.gov/snap/thriftyfoodplan.

- "Stop & Shop Supermarkets To Address ADA Compliance in All Supermarkets." 2018. Department of Justice (DOJ) Documents / FIND. Washington, United States: Federal Information & News Dispatch, LLC. http://www.proquest.com/docview/2120256757/ citation/E3D51E0C66CA40A9PQ/1.
- "The Science of Grocery Shopping: Why You Buy More." n.d. Best Marketing Degrees (blog). Accessed December 11, 2021. https://www.bestmarketingdegrees.org/science-of-grocery-shopping/.
- "Thrifty Food Plan, 2021." 2021, 125.
- "Types of Retail Store Layouts." 2021. Creative Displays Now. November 8, 2021. https://www. creativedisplaysnow.com/types-retail-store-layouts/.
- "U.S. Census Bureau QuickFacts: Boulder County, Colorado." n.d. Accessed February 17, 2022. https://www.census.gov/quickfacts/bouldercountycolorado.
- "USDA ERS Definitions of Food Security." n.d. Accessed October 18, 2021. https://www.ers. usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/defini tions-of-food-security.aspx.
- "USDA ERS Disability Is an Important Risk Factor for Food Insecurity." n.d. Accessed September 14, 2021. https://www.ers.usda.gov/amber-waves/2013/may/disability-is-an-import ant-risk-factor-for-food-insecurity.
- Walker, Renee E., Christopher R. Keane, and Jessica G. Burke. 2010. "Disparities and Access to Healthy Food in the United States: A Review of Food Deserts Literature." Health & Place 16 (5): 876–84. https://doi.org/10.1016/j.healthplace.2010.04.013.
- "What Are Food Stamps and How Do I Access Them? | Family Finance | US News." n.d. Accessed December 11, 2021. https://money.usnews.com/money/personal-finance/family-finance/ articles/what-are-food-stamps-and-how-do-i-access-them.
- "Wheelchair & Mobility Equipment Blog | Numotion." n.d. Accessed December 11, 2021. https:// www.numotion.com/blog/may-2020/pro-tips-grocery-shopping-in-a-wheelchair.
- "Wheelchair Seat Height Determination and Considerations." n.d. Karman® Wheelchairs. Accessed November 27, 2021. https://www.karmanhealthcare.com/wheel chair-seat-height-determination-considerations/.
- Wilkie, William L., Debra M. Desrochers, and Gregory T. Gundlach. 2002. "Marketing Research and Public Policy: The Case of Slotting Fees." Journal of Public Policy & Marketing 21 (2): 275–88. https://doi.org/10.1509/jppm.21.2.275.17591.
- Williamson, Bess. 2019a. Accessible America: A History of Disability and Design. Crip: New Directions in Disability Studies. New York: New York University Press.
- Winson, Anthony. 2004. "Bringing Political Economy into the Debate on the Obesity Epidemic." Agriculture and Human Values 21 (4): 299–312. https://doi.org/10.1007s10460-003-
1206-6.

- Wolfe, Wendy S., Edward A. Frongillo, and Pascale Valois. 2003. "Understanding the Experience of Food Insecurity by Elders Suggests Ways to Improve Its Measurement." The Journal of Nutrition 133 (9): 2762–69. https://doi.org/10.1093/jn/133.9.2762.
- Wright, Kathrine E., Julie E. Lucero, Jenanne K. Ferguson, Michelle L. Granner, Paul G. Devereux, Jennifer L. Pearson, and Eric Crosbie. 2021. "The Impact That Cultural Food Security Has on Identity and Well-Being in the Second-Generation U.S. American Minority College Students." Food Security 13 (3): 701–15. https://doi.org/10.1007/s12571-020-01140-w.
- Yu, Hong, Sandra Tullio-Pow, and Ammar Akhtar. 2015. "Retail Design and the Visually Impaired: A Needs Assessment." Journal of Retailing and Consumer Services 24 (May): 121–29. https://doi.org/10.1016/j.jretconser.2015.03.001.
- Zekas, Rita. 2011. "A Boutique for 'seated' Style Seekers: Designer Launched Line, Then Store, Because Most People in Wheelchairs Abhor Frumpiness." Toronto Star, May 28, 2011, sec. Living.