The Economics of Food Choice Behavior: Why Poverty and Obesity Are Linked

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Abstract

Obesity in the United States does not affect all segments of the population equally. It is more prevalent in deprived neighborhoods and among groups with lower education and incomes. Inequitable access to healthy foods is one mechanism by which socioeconomic factors can influence food choice behaviors, overall diet quality, and bodyweight. Having a supermarket in the immediate neighborhood has been linked to better diets and to lower obesity rates. However, the affordability of healthy foods may have more of an impact on food patterns than does distance to the nearest store. Grains, added sugars, and added fats are inexpensive, good-tasting, and convenient. Their consumption has been linked to lower quality diets, lower diet costs, and lower socioeconomic status. By contrast, the recommended healthier diets not only cost more but were consumed by more affluent groups. New techniques of spatial analysis are a promising approach to mapping obesity rates and linking them with measures of socioeconomic status based on diverse social and economic aspects of the built environment. Low residential property values predicted bodyweights of women better than did either education or incomes. Shopping in low-cost supermarkets was another powerful predictor of bodyweight. Bodyweight gain may be best predicted not by any one nutrient, food or beverage but by low diet cost. Higher obesity rates in poor neighborhoods may be the toxic consequence of economic insecurity. Alleviating poverty may be the best, if not the only, way to stop the obesity epidemic.

Introduction

The obesity epidemic in the United States has been linked to the changing food environment. Studies have linked rising obesity rates with a growing consumption of energy-dense foods, sweetened beverages, and selected dietary ingredients [1, 2]. Much research attention has focused on the consumption of added
sugars and fats and on the role of snacks, beverages, fast foods, large portion sizes, and eating away from home. However, pinpointing which dietary factors are directly responsible for obesity has proved difficult. Food patterns are the result of complex interactions between the person and the social and economic environment [3]. Although individual behavior is clearly involved, diet quality is reliably predicted by education, occupation, incomes and by other, often unobserved, indices of social class.

Obesity rates in the US are not equally distributed across all social strata [4]. Instead, higher rates are observed among some minorities and groups with lower education and incomes [1, 4, 5]. Minorities and the poor are clearly at a disadvantage when it comes to the adoption of healthier eating habits [6]. Local disparities in access to healthy foods may be one problem. Studies on ‘food deserts’ [7] have shown that lower income neighborhoods attracted more fast-food outlets and convenience stores as opposed to full-service supermarkets [8]. By contrast, wealthier areas had access to better restaurants, fresher produce, and more opportunities for physical activity.

Socioeconomic variables, including those in the built environment, have a profound impact on bodyweights and health [9, 10]. Yet, greater distance to the nearest supermarket may not fully explain why obesity rates are much higher in poor neighborhoods [7]. That explanation may involve food affordability and food cost. Simply put, on a per calorie basis, grains, fats and sweets cost less, whereas many healthier and more nutrient-dense foods cost more [1, 11]. In recent analyses of US federal data sets, higher quality diets were associated with higher per calorie diet costs, and were more likely to be consumed by wealthier and better-educated persons [12]. In other studies, the observed influence of socioeconomic status (SES) variables on diet quality, so often attributed to nutrition education, was partly explained by diet cost [13].

Obesity research in the US has steered clear of the complex issues of poverty and social class, preferring to deal with individual-level genetics, metabolism, physiology, or behavior. One concern has been that if obesity becomes a problem of the disadvantaged and the poor, it will no longer command national attention. However, effective obesity prevention and treatment strategies critically depend on knowing the environmental context of the national obesity epidemic. Knowing who is most likely to become obese, where and why, is an essential prerequisite to designing effective strategies for obesity prevention and treatment.

Poverty and Obesity Are Linked

Obesity rates in the US are linked inversely to education and incomes [4]. However, the observed socioeconomic gradient has not been very steep and, other than for white women, not always readily apparent. Some researchers
have emphasized that obesity trajectories were similar for all groups, with obesity rates increasing steadily in both sexes, across all ages and races, and at all incomes and educational levels [4]. By contrast, others have noted divergent trajectories and a growing social gap in obesity rates among children. Whereas obesity rates among children from the highest SES group declined between 2003 and 2007, children from the lowest SES group continued to gain weight [5].

Measuring the social gradient in health and bodyweight presents many challenges. Whether past education and current income measures adequately capture the multiple aspects of SES is unclear. Several researchers believe that these two measures are insufficient to explain the observed influence of social position on long-term bodyweight [14, 15]. Some have tried to supplement the existing measures with new metrics of economic insecurity and with measures of area-based deprivation versus long-term wealth.

Geographic mapping of obesity rates at a sufficiently fine geographic scale offers new insights into the social and economic determinants of health [16]. Existing approaches to mapping obesity rates by state, county, or metropolitan area tend to obscure SES distinctions by neighborhood. Whereas state- and county-level obesity maps issued by the Centers for Disease Control are well known, fewer studies have mapped obesity rates by political districts, health planning areas, zip codes, census tracts or by neighborhoods. Where such data do exist, the link between high-obesity and high-poverty census tracts becomes more apparent.

Figure 1 shows the joint distribution of obesity and 150% poverty by census tract for Seattle King County. Although King County is reputed to be healthy overall, the local disparities in obesity rates by census tract ranged from 5 to over 30%, a 6-fold difference. The map also makes it clear that high poverty and obesity rates shared the same geographic location.

One problem with area-based data is that the links between obesity and the built environment depend on the type of geographic aggregation and may require complex multilevel analysis. Whereas data on poverty and wealth at the census tract level can be readily obtained from the US Census, health and weight data at that level of geographic resolution are exceedingly rare. As a result, we still have an imprecise understanding of the spatial distribution of obesity and its links to poverty and social disadvantage.

New techniques of spatial analysis may help remedy this problem. The geocoding of addresses of health survey respondents allows for more sophisticated spatial analyses of obesity at the individual level [16, 17]. For example, the addresses of participants in the Seattle Obesity Study (SOS) were geocoded to the centroid of the home parcel using the 2008 King County Assessor parcel data. Geocoding followed standard methods in ArcGIS, version 9.3.1. Spatial cluster detection analyses were then used to identify significant obesity clusters in lower income neighborhoods. Relevant neighborhood features included
residential property values, residential density, traffic volume, density of fast food and quick service, intersection density, density of broad-selection food stores and access to parks and trails. SmartMaps, created by the Urban Form Lab, transformed these neighborhood features into spatially continuous values for each study participant, without any need for geographic aggregation.

Fig. 1. Joint geographic distribution of obesity (BMI >30) and 150% poverty rates in Seattle King County by census tract.
In other words, studies of the impact of neighborhood variables on bodyweights and health can now be conducted at the individual level.

Residential property values became the variable of most interest, given that home equity for most Americans represents the bulk of their wealth. Obtained from county tax rolls, property values for study respondents may be a more accurate measure of individual socioeconomic position than provided by either education or income [16]. Based on objective tax data, rather than on self-report, residential property values provide an additional link to neighborhood resources, including access to food sources and local opportunities for physical activity.

Spatial analyses, based on individual-level metrics of the built environment offer a new way to map the geographic distribution of obesity and health behaviors across neighborhoods [17–19]. Such methods also permit a new look at the social, economic and environmental determinants of obesity and self-reported health. In the SOS, consistent inverse associations were obtained between obesity and low residential property values [17]. In analyses based on standard regression models, residential property values were the best predictor of bodyweight of women, adjusting for individual-level education and incomes. In contrast, and consistent with other data, property values had no impact on bodyweights of men.

The disparity in obesity rates among women by property values was more than 3-fold (300%). By contrast, the observed disparities in obesity rates by race/ethnicity, education, or incomes are normally in the order of no more than 20–50%. Property values are a potentially useful and novel metric of wealth for health studies. These new measures point to a strong social gradient in obesity rates across neighborhoods.

Access to Healthy Foods: Proximity or Price?

Having a supermarket in the immediate neighborhood is reported to affect diet quality, bodyweight, and other health outcomes. Studies have noted that people living in low-income or minority communities had limited access to full-service supermarkets and to grocery stores selling healthful foods. Some of those studies were conducted in Detroit, Philadelphia, New Orleans and Los Angeles county, areas often characterized by racial segregation, poor housing and inadequate food supply.

Much of the existing research on obesity and access to healthy foods has relied on two assumptions, both of which may hold for some cities but not others [20]. Lacking data on where people actually shopped for food, researchers were forced to assume that most food shopping was done within the immediate neighborhood. Studies on the food environment and health were then able to correlate the density of supermarkets or fast food restaurants in a given area with
measures of diets and health in the same area. Some studies used the street network distance to calculate the distance between the nearest supermarket and the participant’s home. In many such studies, physical distance between the home and the nearest supermarket was associated with healthier eating, lower body mass index values, and with lower rates of obesity and diabetes. Those studies became the principal research underpinning for many policies related to obesity prevention at the community level. Although the assumption about local food sourcing may have been correct, especially for people lacking transport, none of those studies had any information as to where people actually shopped for food.

There was a further reason why distance to the nearest full-service supermarket was the presumed predictor of diet quality. Here, the underlying assumption was that only supermarkets offered healthful foods, including fresh produce, at affordable prices. Even though supermarket prices can vary across store chains, as do client demographics, few studies looked for differences within the supermarket category by food quality or price.

The SOS was the first to address food shopping destinations and to identify those supermarkets and grocery stores that study participants reported as their primary food sources [20]. First, the locations of all food sources, including supermarkets were geo-coded, as indicated in figure 2. The geocoding of home addresses and food shopping destinations permitted the calculation of network distances between the participants’ homes, the nearest supermarket, and the supermarket that was their primary food source.

First, only 1 in 7 study respondents shopped at the nearest supermarket. Second, the distance from home to the nearest supermarket had no impact on obesity rates. Distance to the supermarket identified as the primary food source was also unrelated to obesity rates. These Seattle-based findings ran counter to the previous research consensus that physical proximity to supermarkets had a major influence on diets and health. That was clearly not the case in Seattle, where most people, admittedly, shopped by car [20, 21].

Characterizing supermarkets by price can help provide additional insights into the economic mechanisms behind the observed disparities in bodyweight. The Seattle supermarkets were assigned to three price categories, high, medium and low, based on the average cost of the market basket of 100 representative foods. The question asked was whether supermarket proximity or price would be more strongly associated with obesity rates, adjusting for individual-level demographics, education and income.

The results were dramatic. Shopping at low-price supermarkets was associated with far higher obesity rates (27%) than shopping at high-price supermarkets (9%), another 3-fold difference. The supermarket effect was significant even after adjusting for the standard individual-level SES variables, education and incomes [20]. The data suggest that supermarket selection, driven by food prices, may be another understudied aspect of SES.
The SOS data run counter to the overwhelming consensus is that physical proximity to supermarkets has a major influence on diet quality and health. In the SOS sample, most people did not shop in the immediate neighborhood, such that mere physical proximity to a store was not an accurate index of exposure. Furthermore, it appeared that the poor and the wealthy shopped farther than absolutely necessary, going up to three miles beyond the nearest store. The interpretation was that lower income groups drove farther in search of food bargains, whereas the wealthy drove to more expensive destination stores more commensurate with their SES.

These Seattle-based data need replicating in cities with different patterns of food shopping. Arguably, communities may be vulnerable to obesity and chronic disease not because the nearest supermarket is more than a mile away, but
because healthy food choice is not always the most affordable choice. Systematic efforts to improve diet quality by improving access to healthful foods will need to take economic inequalities into account.

**The Economics of Food Choice Behavior**

Food choices are made on the basis of taste, cost, convenience, health and variety [22]. Taste refers to the sensory appeal of foods, such as palatability, aroma, and texture. The concepts of taste and energy density are intertwined, since the most energy-dense foods are usually the most palatable and vice versa. Energy density of foods is defined as energy per unit weight or volume (MJ/kg) [23, 24]. Cost refers to the purchase cost per unit of energy (USD/10 MJ) or the purchase cost of a daily diet (USD/day). Convenience refers to the time spent on buying, preparing, and cooking food. Variety refers to the innate drive to secure a varied diet, whereas health refers to concerns with nutrition, chronic disease, and bodyweight.

The low cost and high palatability of energy-dense foods could help explain why higher obesity rates are found among lower income groups [23, 24]. Grains, fats and sweets are good-tasting, satisfying, accessible, and convenient. In general, grains, fats and sweets cost less per calorie than do lean meats, vegetables and fruit (fig. 3). Clinical and laboratory studies suggest that energy-dense foods have a lower satiating power, and may lead to passive overeating and weight gain.

For those reasons, rising obesity rates have been blamed on the food environment. Energy-dense diets, increasing portion sizes and the consumption of
fast foods, snacks and beverages have all been linked at one time or another to obesity risk. Again, physiological mechanisms regulating food intake were generally thought to be at fault. Whereas some studies suggested that humans failed to compensate for calories in liquids, other studies invoked incomplete compensation for solid energy-dense foods.

By contrast, there has been relatively less research emphasis on the obese persons’ economic environment. With the exception of studies on healthy food patterns conducted by the US Department of Agriculture [25], US-based research on diet cost in relation to health outcomes is very limited [11, 12, 26]. Existing studies, some based on econometric modeling, do suggest that constraints on food expenditures may contribute to the obesity epidemic, especially among lower income groups. One hypothesis, grounded in the economics of food choice behavior, is that individual weight gain is best predicted not so much by the consumption of any one food or any one nutrient but by low overall diet cost.

The Cost of Eating Healthy

Diet quality, both in the US and elsewhere, is a function of SES. It is well known that older and wealthier consumers have higher quality, healthier, and more varied diets, with more high-quality meats, seafood, vegetables and fruit [24]. In contrast, lower income households tend to select diets with lower cost meats, inexpensive grains, and more added sugars and fats. The observed influence of SES on diet quality may be explained, in part, by diet cost.

In the SOS, usual dietary intakes of a representative sample of 1,295 adults in King County (WA) were assessed based on a food frequency questionnaire [13]. Energy density (kcal/100 g) was calculated using food composition tables. The monetary value of individual diets was estimated using local retail supermarket prices for 384 foods. A column of prices in USD/100 g edible portion was added to the nutrient composition database. Local prices were attached to 384 FFQ component foods. Prices were obtained for those foods that were most frequently consumed and for the lower cost options, including frozen and canned foods. The underlying assumption in calculating diet costs was that all foods were purchased at retail and then prepared and consumed at home. Analogous assumptions are made by the US Department of Agriculture in calculating the cost of healthful diets, including the Thrifty Food Plan [25].

Mean cost per edible portion of food was calculated, after adjusting for preparation and waste, and was used to estimate the cost of daily diet. Nutrient quality of the diet was based on nutrients of concern as identified by the 2005 Dietary Guidelines: fiber, vitamins A, C and E, calcium, magnesium and potassium. The more costly diets were associated with a higher consumption of fruit and vegetables and with lower consumption of grains, fats and sweets, after adjusting
for energy. Regression analyses showed that intakes of the 7 nutrients and the overall nutrient density of the diet were significantly associated with higher diet costs.

Both diet quality and diet cost were then directly linked to the participants’ SES. Overall diet quality, as measured by nutrient density scores, was significantly higher for the highest education group than for the lowest education group. However, higher quality diets were also more expensive. Estimated diet cost for the highest education group was USD 1.09/day higher than for the lowest group (USD 9.28 vs. USD 8.19, p trend <0.001). Similar cost trends were observed across income strata. These SES-related differences in diet quality were attenuated once diet cost was introduced into the model.

The impact of SES on weights and health is thought to be mediated by diet quality [26]. One interpretation of the observed social gradient has been that higher SES groups have more nutrition knowledge. The present findings shifted the focus from education to the affordability of healthy foods: the observed disparities in diet quality by SES were partly explained by the fact that healthier diets cost more. The higher cost of adopting a healthy diet may pose a barrier to dietary change and may contribute to the observed social disparities in body-weights and health.

Such profound disparities may not be remedied by small shifts in income or by minor manipulation of food prices. A USDA study showed that low-income households spent about USD 1.43 less per person per week on fruit and vegetables, as compared to higher income households. Whereas higher income households did increase fruit and vegetable consumption following an increase in income, lower income households did not. One interpretation is that fruit and vegetables were not a priority and that low-income households chose to spend limited resources on more essential items such as meat, clothing, or rent.

Why Poverty and Obesity Are Causally Linked

A systems approach that incorporates diets, lifestyles and environmental factors is clearly required to deal with the obesity epidemic. To date, obesity prevention and treatment strategies still focus on the individual [27]. Food-seeking behaviors of obese persons continue to be viewed through the prism of physiology and medicine. Excess consumption of added sugars and added fats has been explained using such concepts as satiety deficits and passive overeating. The consumption of sweets and desserts has been explained in terms of an addictive personality, stress, depression, and seeking comfort in high-fat foods. Frequent consumption of palatable sweets and fats has been explained through the mechanisms of ‘cravings’ and neurotransmitter imbalance.

The present hypothesis is that the observed links between poverty and obesity are largely economic. What refined grains, added sugars and added fats have
in common is their low cost. Diets of lower income households provide cheap, concentrated energy from fat, sugar, cereals, potatoes and meat products – but offer little in the way of whole grains, vegetables and fruit. Low-income consumers are more likely to live in areas with limited access to healthier foods and to be users of fast-food as opposed to full-service restaurants. The failure to select healthy diets has been explained in terms of economic conditions that include limited physical access to supermarkets and grocery stores and the time spent commuting to work.

There is accumulating evidence that obesity tends to cluster in poorer neighborhoods. Going beyond education and incomes, the SOS examined the influence of neighborhood type, property values, and supermarket choice on the participants’ bodyweight. Preliminary analyses suggest that SES variables were extremely powerful and were more strongly linked to obesity than were diet-related variables. In other words, the new measures of SES accounted for more variance in obesity rates than did energy density or the macronutrient composition of the diet.

Adopting a healthy diet may pose an economic as well as a behavioral challenge. Some of the current strategies for obesity prevention do not recognize that healthier diets can cost more. Some years ago, the NIH Obesity Education Initiative advised obese patients to look for guavas, persimmons, star fruit, kiwi, and papaya as opposed to bologna and American cheese. Dietary Guidelines 2010 [27] recommended a healthful assortment of foods that included vegetables, fruit, whole grains, low-fat milk products, and fish, lean meat, poultry or beans. The 2010 Guidelines further emphasized foods that were unprocessed, fresh, and contained little sodium and no added sugars and fats. It is a matter of some concern that those obesity prevention strategies are largely based on recommending high-income diets to low-income people.

Studies conducted in Australia, Canada, and the EU contrast with the prevailing US view that healthful diets do not represent any additional expenditure to the consumer. In a French study, diets with a higher content of vitamins and minerals were associated with higher diet costs. In fact, lower energy density and higher nutrient density were each independently associated with higher energy adjusted diet costs. In other modeling studies, based on linear programming, attempting to reduce daily diet costs without taking diet quality into account led to energy-dense diets composed of grains and sweets that were similar to those already consumed by lower income groups. Although spending more does not assure a good diet, reducing diet costs below a certain minimum virtually assures that the resulting diet will be energy rich but nutrient poor.

Based on recent analyses of federal data sets, evidence is emerging that higher quality diets as measured by the Healthy Eating Index (HEI) cost more. Higher HEI scores were associated with higher diet costs, higher incomes, more education, and with lower rates of obesity.
The Economics of Obesity

Economic and food policy interventions at the national and international levels are the most promising approach to obesity prevention. The UK Foresight Report [28] outlined a multisector multilevel strategy that involved all branches of government. However, stemming the obesity epidemic cannot be separated from stemming the tide of poverty. The rising obesity rates may reflect the increasingly unequal distributions of incomes and wealth [29]. Evidence is emerging that obesity in America is a largely economic issue.

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References

Dr. Finegood: I think the take-home message I just got is that if I am poor, I should still try to own a home and shop at Whole Foods so I don’t have the money to eat, is that it?

Dr. Drewnowski: No.

Dr. Finegood: Obviously, I am being a bit facetious.

Dr. Drewnowski: We found that people’s attitudes towards healthy food were the most important predictor of diet quality. If people wanted their diets to be healthy, then they had more nutrient-dense diets, regardless of where they shopped. In other words, it is possible to select nutrient-dense foods even within a low-cost supermarket. We are now doing second-level analyses trying to determine whether or not health-related attitudes determine food choices within the supermarket at all levels of income.
Dr. Finegood: There are a couple of things that are interesting here, such as the 8-fold difference in obesity rates by supermarket. But there is not an 8-fold difference in the cost of food in those supermarkets. The question is: now that you have this detailed ability to look at the spatial relationships, have you tried to look at low-income neighborhoods that are in closer proximity to high-income neighborhoods versus the ones that are not? Even if you do not have money, but live in proximity to a high-income neighborhood, will you be in better shape?

Dr. Drewnowski: We have a grant from the National Institutes of Health to set up a longitudinal cohort for a study of food shopping, obesity, and weight gain. We are doing address-based sampling stratified by ranges of property values. That will allow us to look at residential locations that are of comparable value but far apart, and those that are close together in space but very different in value. In Seattle, people of different SES who live in homes with different property values can live in neighborhoods in close proximity to each other. They may even be using the same neighborhood shops and other resources. We plan to attach GPS tracking devices to 400 people in our longitudinal cohort to flag where people shop and where they eat. We want to find out where in the neighborhood the calories are coming from on a regular basis. We want to know where our subjects get their food, how they schedule their supermarket trips, and whether they eat or shop on the way to or from work or school.

Dr. Bray: Do you have any information about their history of SES? For example, if someone grew up poor, but is now educated and wealthier, will they still have the profile of a poor person?

Dr. Drewnowski: We do not have enough power in our sample to test this hypothesis. We have data on length of residence at the current address, age, and education, so we might be able to figure it out. We found that the leanest people in our sample were women who lived in expensive homes and did not work. We are trying to figure out how SES variables affect food choices.

Dr. Warshaw: You have this sample of Seattle, but how generalizable do you think this is?

Dr. Drewnowski: Seattle is not typical of the US, but neither is Detroit or New Orleans, where a lot of the data on food deserts came from. We are conscious of the potential differences between the cities, because in Seattle people even from low-income households had access to a car, even those living in a food desert. Our subjects mostly shopped in a supermarket once a week; that supermarket was 10 min drive or less. Some people went much farther to big wholesalers, but they went once a month. So, we do have data on the frequency of grocery shopping and distance to the store; we have the demographic profiles of the shoppers, and we know who goes to wholesalers versus high-end grocery stores. There is so much more to know about food shopping and the local context. Even though our data are for Seattle and not the US, our techniques could be applied to other cities in the US. For example, I would expect to find similar distributions of obesity rates in rich versus poor neighborhoods. We are also doing studies of food shopping in Seattle versus Paris.

Dr. Ochoa: Is the individual of a high economic class more obese now than 30 years ago or 60 years ago? We know that there have been changes in different geographic regions of the world in what people eat, how they live, and what they die of.

Dr. Drewnowski: The patterns of obesity and disparity are different as well. It is the lower income groups in the US who are more obese and the higher income groups who...
are less obese. This pattern is reversed in developing countries. For minorities in the US, things become more complicated because in some cases the more affluent minority numbers are more likely to be overweight or obese. There is also the issue of obesity trajectories, and here opinions vary. In the US, obesity data seem to show that all SES groups are getting obese at the same rate, so that all the trajectories are rising in parallel. Data from Europe suggest, to the contrary, that the social disparities are actually increasing. So whom do you believe? In France and in other countries, the poor are becoming obese but the rich are not, or not nearly as fast. So the divergence by SES between the US and the EU is interesting, I am not sure what the final word is. The consensus in the US seems to be that everyone is getting more overweight at the same rate.

Dr. Johnson-Askew: Have you had an opportunity to look at those people in your region that are poorer, or look at those who own their home versus those who do not? The other question is whether you have adjusted for fast food density in your study.

Dr. Drewnowski: We have data on lower income groups. Lower income households live in areas with lower property values, and we can track those by their geographic location. Seattle is not particularly segregated, so that low-income areas cannot be associated with any particular race or ethnicity. We do have geocoded data on the locations and the density of fast foods. We can also distinguish between the fast food restaurants that were closest to our participants’ homes and the ones that they actually went to on a regular basis. The two were not the same. The fast food restaurants that were actually frequented were not even in the immediate neighborhoods. So that is very interesting from the standpoint of public policy. The current strategies to build more supermarkets and take fast foods away are all based on the premise that people shop and eat near where they live. That may not be the case. People make shopping and eating decisions for many reasons. Physical proximity is just one of them.

Dr. Oppert: If I understand correctly, you don’t believe in the food desert concept.

Dr. Drewnowski: No, I don’t believe in food deserts in Seattle. I am prepared to believe that the concept of food deserts is very real in places like New Orleans after Katrina or in Detroit, especially if people have to walk to get the food. It’s just that in Seattle, with our distribution of food sources and our study population, we did not see that. We have submitted a manuscript where we added the transportation component and car ownership to the definition of food deserts – currently thought of as census tracts with low income and distance of more than a mile to the nearest supermarket. We added the mode of transportation: food deserts expand or shrink depending on whether you walk, bike, take the bus, or drive. So, if you walk, there will be places where the nearest supermarket is more than 10 min away. But if you bike, take public transport or go in a car, then pretty much every residential address in Seattle can access a supermarket within 10 min. It may not be the right supermarket but there is a supermarket.

Dr. Oppert: You also showed that some fast food outlets were clustered.

Dr. Drewnowski: Driving influences development.

Dr. Oppert: So, don’t you feel that we are just following what people have done when they have built these food outlets along the major roads?

Dr. Drewnowski: Most of the fast food restaurants were clustered along big arterial roads in a ribbon pattern and did not necessarily target middle schools or low-income areas. Restaurants, including fast foods, tend to locate where the people are, which is something that people in the business world already know about. The location of food
sources depends on traffic patterns and on arterial roads. I should mention that we in
Seattle are very lucky. We do have a number of low-cost ethnic restaurants and some
local food markets, so the food supply is good. From that standpoint, Seattle is not a
typical place, but we think it is representative of the US.

Dr. Rolls: Do you know if food assistance programs have any impact on these
relationships?

Dr. Drewnowski: That’s what we hope to address in the follow-up study. In our first
sample, we didn’t have enough people on food assistance to be able to come to any conclusions.
I can’t answer that question based on existing data from the Seattle Obesity Study.

Dr. Rolls: Do you have food intake data?

Dr. Drewnowski: Yes we do. We have food frequency questionnaire data for
everybody. We have also attached food prices to the food frequency questionnaires so
that we can estimate diet cost.

Dr. Rolls: So, the people who want to eat a healthier diet are choosing healthier foods.
Are they spending more, and if they are spending more where are they getting the
money?

Dr. Drewnowski: Our estimates of diet cost showed that healthier diets did cost more.
People who wanted to eat a healthier diet had higher quality diets, and those diets did
cost more. So, it was just a relative change in spending on food.

Dr. Rolls: So, you don’t know where they would get the money to spend more?

Dr. Drewnowski: These were relative differences across SES strata. Some people did
not mind spending more money to get better foods. In fact, spending more money on
food is not a bad idea, given the high cost of medical care and other consequences of
poor diets. Another thing is that although healthier diets are normally more expensive,
they don’t have to be more expensive. There were people in our sample who were eating
nutrient-dense diets at low cost, and we are trying to find out who they were and what
they were doing right. That is because the relation between nutrient quality and diet cost
is highly variable; whereas some people seem to get good nutrition value for their dollar,
others do not.

Dr. Jakicic: It’s interesting that you know the different grocery chains. We have all
been in these various chains, and we know their different layouts as you go in. Is it the
food selection, is it what they offer, or do you think there are major differences in how
Safeway is laid out compared to Whole Foods? There may be differences in terms of
what is at the end of the aisle, what is at the eye level versus what is on the bottom shelf.
I know that, at least in our place, the brands pay the grocery chain to have their products
in a better location. I wonder: is there a difference in marketing that may help to explain
some of this?

Dr. Drewnowski: Usually supermarkets are laid out in the same way, with processed
foods in the middle and fruits and vegetables and meat and dairy on the perimeter. The
dietary strategy to: ‘shop the perimeter’ is deservedly popular, because that is where
the most nutrient dense foods are. We are actually doing a project with the art school to map
the nutrient density of foods by supermarket aisle. If you want cheap sources of
potassium, which aisle do you go to? Do you go toward the aisle with the canned fish or
toward the vegetables, or the fruits, or the potatoes? We need to know how shoppers use
the supermarket layout once they are inside.

What’s interesting here is that some supermarkets were shopping destinations
whereas other were not. People would drive for miles to go to a specific supermarket,
bypassing many others on the way, so there must have been something special about those stores. I think that every supermarket would like to distinguish itself in some way and become the preferred shopping destination for people coming in from all over the place. We were able to create some interesting shopping polygons to map each supermarket’s service area. We found that adjoining supermarkets could serve customers of very different SES.

**Dr. Barclay:** I am trying to understand why low-income populations are choosing not only cheaper but also less healthy foods. Is it about education? Should supermarkets help people to monitor their health? Should the processed food industry focus on improving the nutritional quality of lower cost foods?

**Dr. Drewnowski:** It was not all about money. There were people who were going to low-cost supermarkets but who were still selecting a nutritious diet. There are other aspects of culture, lifestyles and attitudes that affect food selection. Whether the answer lies in education, health promotion, price interventions, supermarket interventions, or food fortification, I can’t tell you at this point.

Whatever the best solutions to obesity prevention are, they need to come from the ground up and be a part of a systems approach. Grassroots initiatives are better than government-imposed taxation, prohibition, or legislation. Something has to happen to shape consumer behavior for the better. In our research, we are just beginning to delineate food shopping behavior. I know that the easy answer is to build more supermarkets, but bringing a supermarket half a mile closer may not affect shopping or eating behavior all that much.

**Dr. St. Jeor:** This is fascinating data, and how it comes together is quite complex. I was just curious if you are working with the food industry. What about commercial development done by city planners because they must be ahead of this in one way or another? And finally, how do you plan to interpret your findings to benefit the obese or the non-obese population?

**Dr. Drewnowski:** We have not worked with a supermarket chain on this research project, but I think that will come. We do work with researchers in architecture and in urban planning and with the local transportation people and with the Seattle city planners. That is our new audience in the area of obesity prevention. We are interested in working with supermarkets and grocery stores as potential partners in fighting the obesity epidemic. National statistics show that 62% of calories in the diet of adults were purchased in a grocery store. By contrast, the amount of calories supplied by fast foods or vending machines is very small. National statistics also show that 72% of added sugars are purchased in a grocery store. Supermarkets and grocery stores are the main sources of calories for obese and lean people.

**Dr. St. Jeor:** But do you have a plan? How can you put some of your findings into action to help with this problem?

**Dr. Drewnowski:** Our research relates to food systems and food policy. It tells us that looking at food retail is very important. Showing where the calories are coming from is an important and overlooked component. The environmental and socioeconomic factors can also supplement the data on the physiology of obesity that we already have. In the systems approach, everything is interconnected. There are many leverage points that can be used to improve diets.

**Dr. Finegood:** I am still stuck on that 8-fold difference in obesity rates by supermarket chain, and I am wondering whether the obese people who live in high-income
neighborhoods go out of their way to find a grocery store where they are going to feel more comfortable because there is a social norm for obesity?

*Dr. Drewnowski:* We can look at that. We have data on obese persons in lean neighborhoods and lean persons in obese neighborhoods. You may think that an obese person in a lean neighborhood may be more stressed because their bodyweight does not correspond to the norm for their census tract or their immediate neighborhood or zip code.

*Dr. Finegood:* Do they go out of their way to shop where they are going to feel more at home?

*Dr. Drewnowski:* That could be. But in Seattle, upper income people lived farther away from any kind of food store and were thinner. So, the distance to the store was not a major determinant of bodyweight.