

ORIGINAL ARTICLE

Diets and Health: How Food Decisions Are Shaped by Biology, Economics, Geography, and Social Interactions

Adam Drewnowski,^{1,*} and Ichiro Kawachi²

Abstract

Health is shaped by both personal choices and features of the food environment. Food-choice decisions depend on complex interactions between biology and behavior, and are further modulated by the built environment and community structure. That lower-income families have lower-quality diets is well established. Yet, diet quality also varies across small geographic neighborhoods and can be influenced by transportation, retail, and ease of access to healthy foods, as well as by attitudes, beliefs, and social interactions. The learnings from the Seattle Obesity Study (SOS II) can be usefully applied to the much larger, more complex, and far more socially and ethnically diverse urban environment of New York City. The Kavli HUMAN Project (KHP) is ideally positioned to advance the understanding of health disparities by exploring the multiple underpinnings of food decision making. By combining geo-localized food shopping and consumption data with health behaviors, diet quality measures, and biomarkers, also coded by geographic location, the KHP will create the first-of-its-kind bio-behavioral, economic, and cultural atlas of diet quality and health for New York City.

Key words: food decisions; nutrition; economics; geography; behavior; public health

Introduction

The seminal work on *Food, Health, and Incomes* (1936) by John Boyd-Orr highlighted the public health problem of malnutrition among the poor in depression-era Great Britain.¹ Boyd-Orr was among the first to look at the socioeconomic gradient in diet quality, link it to food prices, and apply his findings to public policy. As the first Director-General of the Food and Agriculture Organization (FAO) of the United Nations, he worked for a more equitable and affordable global food supply.

The same socioeconomic gradients in diet quality and health can be seen in New York City today. However, the nature of malnutrition has changed. Excess empty calories of minimal nutritional value are now associated with higher rates of overweight, obesity, type 2 diabetes mellitus (T2DM), and metabolic syndrome (MetS). The relative

prevalence of those diet-related diseases can be reliably mapped across diverse New York City neighborhoods.

The recently completed Seattle Obesity Study (SOS) used novel GIS/GPS techniques to bring inequalities in diets and health into sharp relief at the neighborhood level.² Obesity rates varied by as much as fivefold across Seattle neighborhoods, a range far greater than was observed with ethnicity or incomes. Analyses of data for >59,000 insured persons from a local HMO showed that obesity rates among women were predicted by house prices assessed at both tax parcel and at neighborhood level.²

Both in Seattle and nationally, minorities and lower-income groups had lower-quality diets and higher rates of obesity, T2DM, and MetS.²⁻⁴ Diet quality could also be mapped across neighborhoods. In other studies, the

¹University of Washington, Seattle, Washington.

²Harvard University, Cambridge, Massachusetts.

*Address correspondence to: Adam Drewnowski, University of Washington, Seattle, WA, E-mail: adrewnow@fredhutch.org

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observed socioeconomic disparities in diets and health were related to retail food prices and diet costs.⁵ Taken together, this body of work suggests that the multiple influences on food decision making, some economic and some not, strongly influence diet quality and affect likely health outcomes in the long term.

The principal culprits in today's obesity epidemic appear to be excess refined grains, added sugars, and fats. These foods are palatable (some say addictive), energy dense, inexpensive, culturally appropriate, and widely accessible. Even so, some population subgroups show what is called nutrition resilience—the ability to construct diets that are nutrient-rich, affordable, and appealing. How nutrition resilience is shaped by biology, psychology, or economics remains to be seen.

The psychosocial context of diet and disease is highly complex. Public health policy and practice, including the design of key dietary interventions, will benefit from a research focus on the neighborhood food environment and the behavioral economics of food choice. Multiple food-related decisions are made every day. Those decisions may be linked to the underlying neurobiology, but also to economics, culture, or the food environment. What is more, those decisions are influenced by social interactions, and they can vary from one neighborhood to another.

The exact mechanisms that underlie food purchase behaviors and so determine both diet quality and health are not always clear. There are complex interactions among social class, food and built environments, diet quality measures, and obesity rates. A better understanding is also needed of what local factors shape food decision making within the neighborhood context. The next phase of research on food-based decision making will require contributions from neuroscientists, nutritionists, epidemiologists, geographers, and urban planners.

A number of questions in multiple domains will need to be answered:

Question 1. Economic: do healthier diets cost more?

Empirically, the answer to the question "Do higher-quality diets generally cost more?" appears to be yes. Recent reviews and meta-analysis support that conclusion; on average, a healthier diet costs an additional \$1.50 per person per day.⁶ However, healthier diets would not cost more if different food-related decisions were made. Based on analyses of diet quality in relation to cost, it appears that some individuals and minority groups (e.g., Mexican Americans) are able to eat better

for less. This phenomenon is called nutrition resilience, given its relation to optimal decision making in face of economic adversity. However, broader cultural acceptance of healthy yet inexpensive foods and the avoidance of calorie-dense packaged foods is one topic that needs further research.

The economic issues extend to food decision making by food assistance recipients. One question is whether Supplemental Nutrition Assistance Program (SNAP) recipients exhibit payday effects; for example eating lower-quality food toward the end of the month when the money runs out. An analysis of inpatient records in California suggests that hospital admissions for hypoglycemia increased 27% in the last week of the month for low-income patients with diabetes compared with the first week.⁷ No such trend was observed among high-income individuals. Since many government checks arrive in the mail at the start of the month, changing the system to more frequent payments might help recipients smooth their consumption and improve their nutritional choices. Such payments may include Social Security, SNAP, and Temporary Assistance for Needy Families (TANF). More broadly, research is needed to understand the potential effects of regular food insecurity on stress response and health.

Question 2. Environmental: should access to healthy foods continue to be measured in terms of physical distance?

These issues relate to the distribution of the food supply in urban centers such as New York City. The relevant question is "Do residents of low-income/minority neighborhoods in New York City face poorer food choices?" Research shows that food choices in a given neighborhood depend directly on the purchasing power of that neighborhood. Access to healthy foods may be largely economic in nature and have less to do with physical distance. Building new supermarkets in low-income neighborhoods may not improve nutritional status in the absence of economic interventions. Build it and they may not come.

A key topic of research in the KHP is to understand better where low-income residents shop for food and what compromises they make. This is related to the extent to which "food deserts" really matter. In the SOS, it was found that people did not shop at the nearest supermarket—rather, they selected one within their price range.⁸ One thought is that food access ought to be measured in terms of economic access. In the New York City

context, transport will make a difference, since many people do not have cars and do not load a week's worth of groceries into the trunk.

Question 3. Eating in or eating out?

One common idea is that "time poverty" forces low-income families to rely on prepared packaged foods or source meals from fast-food restaurants. Seattle-based studies show that the frequency of home-cooked meals and the time spent on food preparation, cooking, and cleaning were all linked to higher-quality diets. More likely to eat away from home were young working adults and single-parent families, who placed a greater premium on time and convenience.⁹ Preliminary analyses of the nationally representative National Health and Nutrition Examination Survey (NHANES) suggest that most likely to cook at home were large families, Latinos, and groups of lower education and incomes. Again, food decisions may be influenced by ethnicity and culture. For example, the traditional Mexican American diet can be prepared from relatively inexpensive ingredients, and traditions of food preparation may vary across social groups. Another key issue here is the nature of the family unit. To what extent do households in which several generations either share the same roof or live very close together share food preparation? In such cases, do members of the older generations lighten the load on younger members of the family who are working?

Question 4. Psychological: Do nutrition-related attitudes count?

An important and unanswered question is whether low socioeconomic status (SES) shoppers are more susceptible to advertising claims on packaged junk foods such as "organic" or "gluten-free." Generally speaking, high SES shoppers are more likely to be "label literate," that is, to understand and act on information provided to consumers. Another question concerns the extent to which those with chronic conditions, such as diabetes and obesity, shop in a health-conscious way, selecting zero-calorie or lower-calorie beverages and diet foods. Also of interest is how this relationship itself is moderated by SES. The value of the KHP in this regard is clear, since there are limited data on this topic. In the SOS, survey questions based on the NHANES consumer module revealed that positive attitudes toward nutrition improved diet quality. The fact that this appeared to be true at every level of education and income suggests that this may not contribute to

inequality-related diet quality.¹⁰ However, it is a question that is profound interest for its own sake and that remains little understood.

Question 5. Biological: what are the biomarkers of behavior?

KHP will make it possible to study the biological-mediating mechanism in the pathway between SES and health outcomes. Researchers have focused on stress and response to stress.¹¹⁻¹³ Stressors can be personal or environmental (traffic noise, pollution, crime). The biomarkers that have been studied include cortisol and inflammation biomarkers such as c-reactive protein. At least some of these biomarkers have been related to SES. Telomeres, a marker of accelerated aging, have also been tied to SES, stress, and low-quality diets.¹¹⁻¹³

An important tool in understanding the above mechanisms will be a socioeconomic and bio-behavioral diet and health atlas for New York City. By combining biomarkers data with geo-localization techniques, the KHP will be well positioned to create the first-of-its-kind such atlas. In this respect, the KHP can build on the insights identified in the SOS. As indicated, the SOS explored links between multiple characteristics of neighborhoods, such as SES, social capital, physical and economic access to food sources, and opportunities for physical activity and obesity rates. The neighborhood variables were both real (assessed by GPS/GIS methods) and perceived (assessed by questionnaire self-report). The SOS helped to advance obesity research by transforming geographic and economic data into individual-level variables for use in studies on diets, health, and weight. Importantly, it distinguished between physical access to food sources, measured in terms of distance, and economic access to foods, measured in terms of food prices and diet costs. Perceived physical access was measured in terms of perceived distance and/or length of travel to principal food sources, including supermarkets, convenience stores, and fast-food outlets. Economic access was measured in terms of perceived food expenditures per week at various shopping and eating locations. The SOS team has devised methods to assess the price of a market basket across supermarket chains, as well as new procedures to estimate diet cost, real and perceived. Perceived expenditures were validated using actual expenditures backed by 2-week receipts for all foods at home and away from home.

One important focus of the SOS was on food retail and food shopping decisions. Obese shoppers were much more likely to shop in lower-cost grocery stores; the prevalence of obesity varied dramatically by store type.⁸ Shoppers at the lowest-price stores consumed fewer fruit and vegetable servings compared with those shopping at the highest-price stores and were more likely to be obese (body mass index $>30\text{ kg/m}^2$). Few people shopped for food in their residential neighborhood or home census tract. In Seattle, distance to the food destination varied by race/ethnicity, income, and education. Whites were more likely to shop at the closest supermarket (1.5 miles), whereas African Americans showed the largest disparity between the closest supermarket and the one used (3 miles).

Implementation in the KHP

Investigation of factors that contribute to food decisions would utilize the following KHP data sets, amongst others: (a) Dietary data would be collected via periodic food diaries, complemented by mining for food purchases in financial data (credit cards, debit cards, checks). (b) Data on decisions to eat in or eat out and physical distance to different food sources would be available via geo-location data from smartphones and activity trackers, mapped to GIS. (c) Information on financial status and participation in government assistance programs (SNAP, Social Security, TANF) would be available via financial data gathered using a combination of automated and survey-based methodologies. (d) Attitudes toward healthy foods would be assessed via questionnaires on smartphones or tablets. (e) Levels of “life stress” would be measured via self-administered psychological questionnaires on digital devices. In addition, cortisol levels in saliva would be measured triennially, starting at study intake. (f) Demographics and race/ethnicity data would be available via the KHP questionnaire at study intake.

The impact of food decisions on health would be analyzed via the following KHP data sets, amongst others: (a) Medical information on study participants’ health would be available from the medical history and records going forward (EMRs, doctors’ notes, hospital records, dental records). Prescription data would be gathered via the New York State Prescription database. This information would be

complemented by the SPARCS database and the KHP’s own tests: blood tests (blood metals, vitamins, lipids, glucose, and other biomarkers), urine tests, and hair tests (smoking, alcohol, and substance use) every 3 years. (b) Information on genetic variation at the individual and family levels would be gathered via whole genome sequencing of blood samples for adults (saliva for children) performed at study intake. In addition, data on variation in epigenetics would be gathered via triennially performed assays. (c) Cognitive function would be measured via self-administered psychology questionnaires/tests on smartphones and tablets at intake and periodically thereafter.

Conclusion

The importance of decision-making processes in food selection cannot be overstated. Food purchase decisions and hence diet quality depend on a host of environmental factors, some modifiable and some not. All of those factors need to be studied in their neighborhood context. Identifying the key biological, economic, and environmental influences on these complex processes is of immense importance to public health.

Author Disclosure Statement

No competing financial interests exist.

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Abbreviations Used

- FAO = Food and Agriculture Organization
T2DM = type 2 diabetes mellitus
MetS = metabolic syndrome
SOS = Seattle Obesity Study
SNAP = Supplemental Nutrition Assistance Program
TANF = Temporary Assistance for Needy Families
NHANES = National Health and Nutrition Examination Survey
SES = socioeconomic status
SPARCS = Statewide Planning and Research Cooperative System
EMRs = electronic medical records