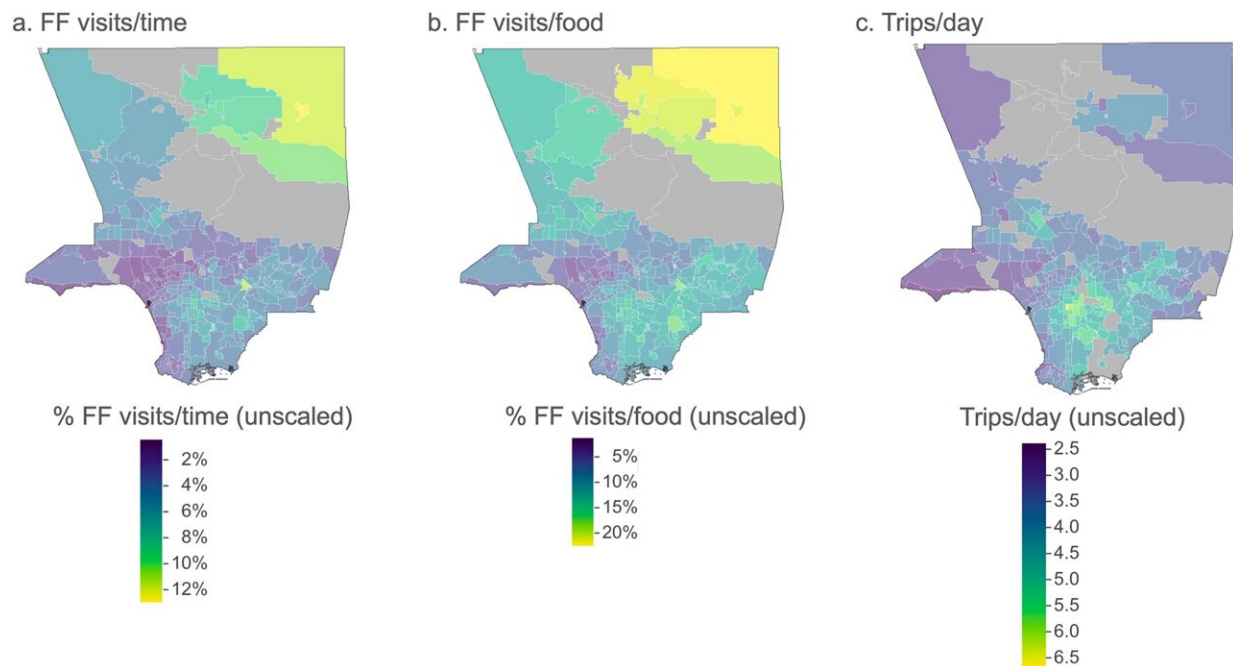# Are you at risk for diet-related disease? Where you spend your day plays a role

November 30 2023

Geographic distribution of the unscaled mobility variables across Los Angeles County neighborhoods. Credit: *npj Digital Medicine* (2023). DOI: 10.1038/s41746-023-00949-x

How many fast-food joints do you come across throughout your day and what does that have to do with your health? "A lot," says Abigail Horn, a lead scientist at USC's Information Sciences Institute (ISI).

Horn led a multidisciplinary team that included researchers from three USC schools (Viterbi School of Engineering; Dornsife College of Letters, Arts and Sciences; and Keck School of Medicine), MIT, and Sabancı University in Turkey; and worked in collaboration with the LA County Department of Public Health.

The research team's paper, [Population mobility data provides meaningful indicators of fast food intake and diet related diseases in diverse populations](link), has been published *npj Digital Medicine*.

They set out to ascertain whether smartphone mobility (i.e., location) data could provide a way to measure people's individually-experienced dynamic food environments, at scale across large and diverse populations and diverse physical environments.

Horn explained, "The question was: can we use [mobility data](link) to measure people's visits to [food outlets](link)? Because that's a good proxy for eating food at that outlet. And then, can we go a step further to see whether visits to food outlets observed in the mobility data are predictive of people's dietary disease rates?"

"It's well established that the physical environment can impact people's eating decisions and therefore their diet-related [health outcomes](link), but what we don't know is the extent to which that is true," said Horn, who is a Research Assistant Professor in the Daniel J. Epstein Department of Industrial and Systems Engineering at the USC Viterbi School of Engineering.

Physical food environments are the actual spaces where people acquire food. "The food outlets in their neighborhood, or around their workplace, or any location along their daily path. Things like [grocery stores](link), restaurants, or corner markets," explained Horn.

These environments have been shown to impact people's diets and therefore health outcomes—including diet-related diseases—in several ways. First, said Horn, "When people have low physical access to healthy foods, that can induce unhealthy choices out of convenience or necessity." And second, "People can be cued by food environments. So, for example, if throughout your day you're seeing fast-food outlets over and over again, that can cue or trigger certain behaviors" (i.e., eating more fast food).

There are a number of studies looking at people's home neighborhood food environments and associating these with food choices and diet-related diseases. But the findings have been mixed, as have the results of public health initiatives that have focused on home neighborhood food environments.

Horn explained, "In the last decade or so, over a billion dollars have been invested in public health interventions in home food environments. This could mean building a grocery store in a food desert [a home neighborhood with limited access to nutritious food] or stocking the corner stores in that neighborhood with fresh fruit and vegetables." But, she continued, "There's been no measurable impact in increasing people's healthy food purchases or health outcomes. So what's going on here?"

Kayla de la Haye is one of the members of the research team who could help answer that question. De la Haye is the Director of the Institute for Food System Equity at USC Dornsife Center for Economic Research, and has a background in public health, nutrition, and psychology. "One of my roles in this research was to bring expertise in how people make decisions about what to eat, and the consequences of food environments that inundate people with unhealthy options and put them at risk for many diet-related diseases like obesity and diabetes."

Looking beyond the neighborhood market

De la Haye has worked with families across LA—from Lancaster to LA's eastside—helping them with strategies to avoid unhealthy foods and adopt healthier eating habits. She said, "So I brought this real-world knowledge of the challenges Angelenos face in eating a healthy diet to our research project."

The team knew from their own experiences, and from the experiences of families they've worked with in healthy eating programs, that people don't just eat in their home neighborhood. But they needed the data to prove this at the population scale.

Horn said, "We thought that the lack of data showing all of the places where people actually go to eat and where they're spending the most time might explain why we're not seeing associations between the home neighborhood food environment and people's diet and health outcomes."

So they turned to smartphones for the data.

For most of us, our smartphone is always tracking our location, and we probably share that data with several apps. Location data companies aggregate this data—called "mobility data"—and sell it for advertising. But increasingly, it is being made available for research, such as by Spectus.ai through their Social Impact Program, through which the data for this study was obtained.

Esteban Moro led the team at MIT that would help access and analyze this data. Moro, a Research Scientist at MIT Connection Science said, "Our group has a great deal of experience analyzing and using mobility data in problems like segregation, transportation, urban planning, and commercial activity. We are experts in analyzing large datasets of human behavior and transforming them into insightful tools for urban problems.

So, our main role in this research was to provide and analyze population-wide mobility data about food consumption."

Bringing together all the data

Using census block data for Los Angeles County to indicate home neighborhoods, and big mobility data to track daily trajectories, the researchers could see all of the proximity—the "exposures"—people would have to food outlets throughout their days.

The team looked specifically at fast-food outlets because fast food is commonly consumed and strongly linked with disease risk. Using "point of interest" data they identified fast-food outlets within LA County. To bring in the health piece of the puzzle, they accessed survey data from the LA County Health Department.

"The Los Angeles County Health Department does a health survey of the LA population every three years. We formed a collaboration with them, and they were able to share anonymized individual-level data with us on socio-demographics, obesity rates, diabetes rates, and very importantly, fast-food intake frequency for a representative sample of the LA population," said Horn.

By analyzing the data, the researchers confirmed that your home neighborhood matters when it comes to your risk of diet-related disease, but so does your commute, the path you take to run your daily errands, how you get from point A to point B and all the way to point Z in your day, and what those points are.

The results

"We know there is a relationship between fast-food outlet visits and fast-

food intake, as well as between fast-food intake and diet-related diseases, but wow, this data source does a really good job of capturing that," said Horn.

Moro added, "The most surprising result is that mobility data works like an 'honest signal,' i.e., visits to fast-food outlets were a better predictor of individuals' obesity and diabetes than their self-reported fast-food intake, controlling for other known risks."

De la Haye emphasized, "This work demonstrates that large-scale mobility data is in fact a valuable indicator of where and what people eat, and their risk for diet-related disease."

"Measuring what people eat is really difficult. In fact, many large public health surveys and surveillance tools have stopped asking people about their food intake because the data is often unreliable (in part because people often forget the details of what they ate, and also because they don't always want to tell researchers about their less healthy food choices). So, this gives us a new tool to track dietary patterns, like eating [fast food](link), for large populations such as residents of cities, counties, or the entire country."

What's next?

"What I'm excited about as a researcher is that this opens up mobility data for all kinds of investigations into the food environment. Things like: where are people getting food at different times of day? Who are these people? When are they most influenced by the options available (or unavailable) to them?" said Horn.

"We can really investigate this with big mobility data, because it allows us to look at eating behaviors in large and new dimensions: at scale across the population, across diverse population groups, diverse

environmental surroundings, and over long periods of time."

De la Haye underscores the importance of this, "data on population dietary patterns is a powerful tool needed to make public health programs and policies, and ultimately reduce health risks from one of the leading causes of illness and death in the U.S.: unhealthy diets."

More information: Abigail L. Horn et al, Population mobility data provides meaningful indicators of fast food intake and diet-related diseases in diverse populations, *npj Digital Medicine* (2023). DOI: 10.1038/s41746-023-00949-x

Provided by University of Southern California