

Pandemic Protocols, Native Nutrition: Grocery-Store Access from American Indian Reservations During COVID-19

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Regular consumption of fresh and nutritious foods affects long-term health. However, residents of American Indian reservations travel substantially more than others for grocery shopping. These inequalities in access to amenities and infrastructure are mirrored in various health outcomes. Currently, Native Americans have 3.5 times the infection rate and 1.5 times the death rate from COVID-19 compared to non-Hispanic whites. We demonstrate that the social distancing policies, intended to slow the spread of the epidemic, may have additional, unanticipated effects on economic and health outcomes. We estimate the effect of Non-pharmaceutical Interventions (NPIs) on the type of grocery stores visited by individuals residing on and off of American Indian reservations during the COVID-19 pandemic. Using cell phone tracking data we examine how social distancing measures affected the average distance traveled to grocery stores. We find that there is a larger reduction in the overall distance traveled to grocery stores for on reservation households relative to off-reservation households. We also find evidence that the relative share of trips to convenience stores increases for reservation residents compared to those living off reservations. The shift toward convenience stores, which are less likely to sell fresh and nutritious foods, may exacerbate underlying morbidities and further increase health disparities in the long run.¹

Keywords: Mobility, Native Americans, COVID-19, Food deserts.

JEL Codes: H73, I18, R12.

1 Introduction

The COVID-19 pandemic has affected the U.S. particularly hard; in October 2020 there are in excess of 8 million cases, the highest for any country in the world and the case rate per one hundred thousand citizens is one hundred eighteen which exceeds that of Canada (43 per 100,000), Germany (45 per 100,000) and Mexico (25 per 100,000) combined ([Times, 2020](#)). Within the U.S., there are substantial differences in the health effects of COVID-19 for different demographic groups and communities. African Americans, Hispanics and American Indians have experienced substantially higher levels of COVID-19 infection and death. American Indians, in particular, are

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quite vulnerable to COVID-19; death rates have been 1.5 times those for non-Hispanic Whites while infection rates are 3.5 times those for non-Hispanic whites ([Atlantic, 2020](#); [Hatcher et al., 2020](#)). The underlying causes may stem from employment in high exposure occupations, overcrowded homes, reliance on public transportation, and pre-existing co-morbidities that exacerbate the effects of COVID-19 infections. ([Rodriguez-Lonebear et al., 2020](#); [Walker, 2020](#)) To mitigate the health effects of the pandemic, various jurisdictions of the U.S. implemented non-pharmaceutical interventions (NPI) such as shelter-in-place mandates with the primary goal to limit the spread of infection by restricting the movement of non-essential workers.

These interventions have independent effects on the social and economic standing, health and wellbeing of the affected populations. Understanding these secondary effects is important for designing policies and interventions to manage current and future epidemics. For Native Americans the effects of these NPIs have not been extensively studied. In particular, we know little about the impact of social distancing policies on the residents of tribal reservations that tend to have lower levels of infrastructure and resources than neighboring towns or cities. We study some of these effects using mobile phone data for the years 2019 and 2020. We investigate how the implementation of NPIs affected travel to convenience stores and supermarkets on American Indian lands relative to the rest of the country. We compare the average distance traveled and the type of grocery store destination for those households residing on reservations to those residing off reservations over the two years. A public health emergency such as the pandemic and the resulting restrictions and closures could further impede access to quality food for populations that customarily have less availability of fresh food options.

Access to supermarkets and fresh foods has become an important topic for policymakers and health advocates. The U.S. Department of Agriculture estimates that residents of American Indian reservations face some of the longest commutes for groceries relative to other groups ([Kaufman et al., 2014](#)). A large proportion of households on American Indian reservations report having to travel more than 20 miles to the nearest supermarket ([Love et al., 2019](#)). Existing research has demonstrated that the greater the distance to supermarkets as compared to convenience stores, the less likely it is that households have a healthy diet and mix of fresh fruits and vegetables ([Larson et al., 2009](#); [Rose and Richards, 2004](#)).

In turn, meta analysis on published studies conclude that there is a strong relationship between the consumption of fresh fruits and a decrease in mortality; a similar relationship, though not as strong, holds with the consumption of vegetables ([Aune et al., 2017](#)). This has particular implications for American Indians residing on reservations as they have higher levels of high blood pressure, obesity and diabetes than the general public ([Pindus and Hafford, 2019](#); [Love et al., 2019](#)). Therefore, if the social distancing measures affect the type of food consumed by these communities, they may add to existing long-term health disparities and morbidities.

Our analysis has two main contributions. First, we find that the average distance traveled

for grocery shopping after the NPI mandates is reduced by more for those living on reservations. Our second finding is that reservation households tend to increase their share of grocery shopping at convenience stores relative to supermarkets during the pandemic. Thus, the relative difference in distance traveled under social distancing policies arises from visits to different food sources for the on and off reservation households. Those living off reservation are traveling to *closer* supermarkets, while those on-reservation are switching *from* supermarkets *to closer* convenience stores. Ordinarily, this type of analysis would not be possible using survey or publicly available data, as the representation of reservation residents is low in standard data sets. We use a novel dataset based on cell phone tracking data to conduct this analysis.

The results demonstrate that there are secondary effects of NPI mandates that have not been previously noted. In communities with limited access to supermarkets and fresh fruits and vegetables, social distancing policies further restrict the available food options. Policies intended to induce behavioral changes create unintended consequences for these populations; shopping for groceries at convenience stores may exacerbate or worsen already existing health disparities or chronic diseases such as diabetes and obesity in the long run.

2 Methodology

2.1 Data

Our analysis is based on weekly cell phone mobility traffic aggregated at the level of U.S. Census tract geographies. SafeGraph location data comes from signals, or ‘pings’, that identify the location of a particular smartphone at a moment in time.² These pings are used to track visits to individual points of interest (POIs), which are themselves classified in categories such as retail shopping, hospitals and other commercial destinations. We focus on grocery stores and their subcategories of supermarkets and convenience stores and use the term POI to refer to those locations from here on. We match home locations to tribal land boundaries and county boundaries for non-tribal areas. The SafeGraph data cover tribal areas well. In fact, coverage of these areas is similar to other areas – 97.12% of census tracts that contain tribal lands are represented in the SafeGraph data, compared with 96.79% of census tracts outside of reservations nation-wide.³ In January 2020, the SafeGraph data provided information on more than 45 million devices, with an approximate coverage of 16% of all smartphones in the US. We use data from the first seventeen weeks of 2019 and 2020 for our analysis.

Data on casino closures was collected from Casino City Press trade publication and subscription service *Gaming Directory Data*. This data identifies the tribal casino location, closure and (if

²The pings are also used to determine the home location, at the census tract level, of the phone user.

³In terms of population, using census tract population from the 2010 census, we observe that the data sample covers 96.34% of population of tribal areas and 96.76% of non-tribal areas.

Table 1: Summary Statistics

	On Reservation	Off Reservation
Avg Distance Traveled to Grocery Stores (2019)	7.83	7.13
Avg Distance Traveled to Grocery Stores (2020)	7.47	6.73
Avg Distance Traveled to Convenience Stores (2019)	7.75	7.17
Avg Distance Traveled to Convenience Stores (2020)	7.42	6.83
Avg Distance Traveled to Supermarkets (2019)	7.90	7.09
Avg Distance Traveled to Supermarkets (2020)	7.52	6.65
Convenience Store Share of Avg Trips (2019)	31.1%	30.7%
Convenience Store Share of Avg Trips (2020)	27.8%	26.6%
Census Tracts Total	12,758	58,510
Supermarkets per 100k	20.75	21.25
Convenience stores per 100k	12.88	14.21
Percent of Counties with NPIs	54%	87%

Note: Distances are given in miles. The percent of counties with NPIs is measured by Census Tract aggregated up to the county for both the on and off reservation locations.

applicable) re-opening dates.

We construct two dependent variables for our analysis. The first is the average distance traveled to grocery stores from a Census tract centroid to one of these POIs for a given week. All grocery stores are divided into two broad categories using Google Places classification: standard supermarkets and convenience stores. The first provides a wider selection of food and especially fresh foods while the second has a smaller selection of mostly pre-packaged and canned foods. The second dependent variable is the share of grocery store trips to convenience stores by Census tract for a given week.

In Table 1, we provide the means for our first outcome variable. We show the average distance traveled to different grocery store types by household location in miles for the two years 2019 and 2020. In general, we find that the average distances traveled by reservation households to grocery stores (either supermarkets or convenience stores) is greater than the average for the rest of the country. There is a difference in the distance traveled between the same time period in 2019 and 2020. Distance traveled during the pandemic decreases for both the on and off reservation households.

We next provide the means for our second outcome variable. We show the share of convenience store shopping for all grocery store trips for 2019 and 2020 by household location. The percentage of trips to convenience stores is higher for the on-reservation households in both years, but it is proportionately larger in 2020 after the imposition of NPIs.

Our analysis contains over twelve thousand Census tracts for the reservation households and almost sixty thousand Census tracts for the off reservation households. Our data indicates that the number of supermarkets per 100,000 people is approximately similar for the on and off reservation households (20.75 and 21.25 per 100,000 respectively). We find that there are slightly more

convenience stores for 100,000 people living off tribal lands.

The next set of variables indicate the NPI closure measures used in our analysis. We calculate that 54% of all counties with reservations had an NPI implemented. We consider casino closures on tribal lands as an important social distancing measure. The casino closures were explicitly implemented to decrease interaction and increase social distancing between reservation residents and guests. Tribal casinos are usually the largest employer and the driver of economic activity on tribal lands. Thus, closing the casino has substantial implications for social mobility. There are 328 American Indian reservations in our data. More than half of them - 189 - have at least one tribal casino operating on their land. During the first few months of the COVID-19 pandemic, 167 reservations closed their casinos to prevent the spread of COVID-19. Our analysis includes American Indian reservations without casinos and we code those without explicit closures as open over this time period; however, our results are robust to a subsample where we drop all reservations that have no casinos. These analyses are included in Appendix Table A1. The timing of these closures spans the middle of March 2020 to the middle of April 2020 and differs by week for different American Indian reservations; tribal nations implement NPIs independently of state or county NPIs as well as other tribal nations.

For non reservation locations, we merge county-specific and state-specific NPI adoption dates from Keystone Strategy, a consulting firm, and the Johns Hopkins Coronavirus Resource Center data assembled by Killeen et al. (2020). The percentage of off-reservation locations with shelter-in-place mandates was 87 percent. In this analysis, we only consider shelter-in-place policies off-reservation and casino closures on-reservation. Other, less stringent NPIs were implemented at different times and in most locations. These measures are harder to interpret in comparison to casino closures.

2.2 Regression Analysis

Our analysis focuses on whether the imposition of social distancing measures had an effect on the behavioral response of reservation residents in the choice of grocery store destinations. A priori, it is not clear how NPIs would affect grocery travel for those located on reservations relative to non-reservation households. On the one hand, supply disruptions may increase the distance traveled, as households shop around for goods affected by shortages. On the other hand, in order to reduce social exposure, or due to restricted travel options, household members could make fewer grocery store trips and prefer shopping at closer locations. If the latter channel dominates, then we should see a decline in distances traveled. This, coupled with the lower availability of supermarkets on reservations, could result in an increase in the proportion of grocery trips to convenience stores relative to non reservation households during the NPI mandates.

Our observations are at the census tract-week cell. We use a difference in difference specification to estimate the impact of NPIs on the outcomes of interest, Y_{it} , namely the average distance traveled

from household locations to grocery stores, and the share of total grocery trips to convenience stores. The regressions include calendar week fixed effects and county fixed effects and we cluster standard errors at the Census tract level. Our analysis is restricted to the first 6 months of 2019 and 2020. Results are robust to the inclusion of month fixed effects in place of week fixed effects. Equation 1 presents the main specification. The variable NPI_{it} indicates whether a casino was closed (for reservation households) or a stay-at-home order (for non-reservation households) was mandated in week t in census tract i . $Reservation_i$ is time invariant and indicates whether the census tract is located in a reservation. We include an interaction between NPI_{it} and $Reservation_i$ which indicates differential effects of NPIs in reservation lands.

Our main estimating equation is the following:

$$Y_{it} = \alpha + \beta \times Reservation_i + \gamma \times NPI_t + \delta \times Reservation_i \times NPI_t + \theta_c + \mu_t + \epsilon_{it} \quad (1)$$

The coefficient β indicates the average effect of being located on a reservation relative to off reservation location on the outcome variable. The coefficient γ indicates the average effect of NPIs after the mandate begins (casino closures on reservation households and stay-at-home orders for off-reservation households). The coefficient δ estimates the differential impact of NPI mandates for households on reservations relative to off reservation households on the outcome variable. The county and week fixed effects are included so that our cell phone traffic can be held constant across time and county. We include ϵ_{it} as the usual idiosyncratic error term.

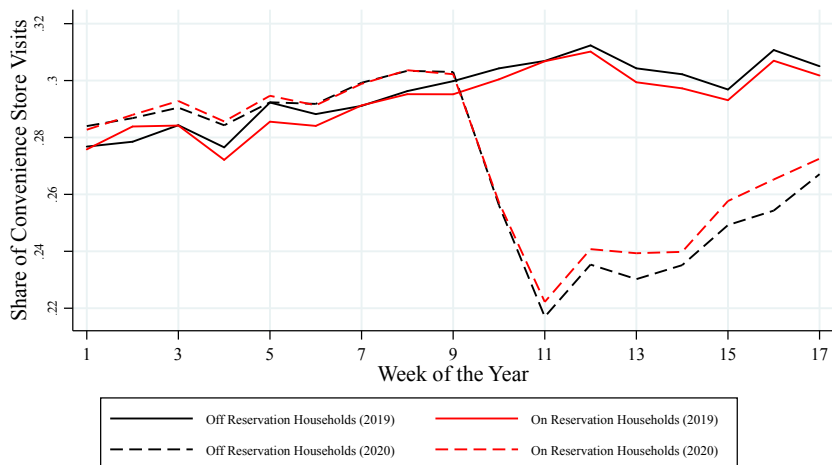
3 Research Results

Figure 1 illustrates graphically the results that will be replicated in regression analysis that follows. The figure shows the share of weekly household visits to convenience stores for reservation and non-reservation households. The two solid lines represent on and off reservation households for the year 2019. These two lines are quite similar throughout the first five months of 2019; we estimate that the share of convenience store trips is never more than a third of all grocery trips for either group. We note that there is some seasonality in the visits, but it is not different across locations. With the exception of the second week in January 2019, the share of trips to convenience stores is the same or smaller for reservation households for all of the 2019 data.

The two dashed lines show the proportion of trips to convenience stores for the same period in 2020. The trends for both types of households are quite similar to the patterns from 2019 until week 9 of 2020. After that, there is a steep decline in the share of trips to convenience stores. This eight percentage point drop is almost a 26% decrease relative to the early weeks of 2020. The reduction in trips is approximately the same for both on and off reservation households between week 9 and 11. However, by week 12, the reduction in the share of trips to convenience stores is less severe for the on reservation households as it is for the off reservation households. This finding is

consistent with the second hypothesis posited above, namely that the pandemic and NPIs affect the distance traveled for grocery shopping and also the choice of food store. Over time, we find that the reduction in the share of convenience store trips remains consistently lower for the off-reservation households than it is for the on-reservation households.

Figure 1: **Share of Trips to Convenience Stores out of All Grocery Trips in 2019 and 2020 by Location**



While Figure 1 shows the share of trips to convenience stores across Census tracts and weeks, this figure does not account for the differences in implementation of NPIs. Depending upon the region of the country and local conditions, NPIs were implemented at different times – both for the on and off reservation jurisdictions. In the difference in difference regression analysis below, we take this variation into account and regress the NPI mandates by reservation location on two different outcome variables – average distance traveled to any grocery store (inclusive of convenience stores and supermarkets) and share of grocery trips to convenience stores.

Table 2 provides the regression results. The last two rows provide the mean and standard deviation for the outcome variables. In column 1 we provide the regression results for average distance traveled to grocery stores. On average, households from reservation locations travel about two extra miles to get to any grocery store. These longer distances are consistent with a lower availability of grocery stores on reservations. The implementation of NPIs reduces the distances traveled by all households by about a tenth of a mile on average. Finally, the estimated coefficient on the difference in difference variable is negative and statistically significant at conventional levels. Reservation households reduced their travel to grocery stores by an additional four tenths of a mile after the implementation of tribal NPIs. This additional reduction in distance traveled could arise from different sources. For example, reservation households could be substituting travel to farther supermarkets to closer ones, thus potentially exacerbating the probability of shortages and

Table 2: Effect of NPIs on Distance Traveled and Share of Trips to Convenience Stores

	Average Distance Traveled to Grocery Store	Share of Total Grocery Trips to Convenience Stores
Reservation	2.236*** (0.179)	0.000632 (0.00329)
NPI	-0.108*** (0.0165)	-0.00545*** (0.000579)
Reservation x NPI	-0.430*** (0.119)	0.0277*** (0.00318)
Mean	7.043	0.293
SD	(5.138)	(0.169)
Observations	1,948,176	1,794,128
R2	0.372	0.446
Adj R-squared	0.371	0.445

Note: Week and county fixed effects and a constant are included in both specifications. The observation level is census tract and week cells. The standard errors are clustered at the census tract level. $*p < .10$, $**p < .05$, $***p < .01$

crowding. Or they could be changing their destination for food shopping altogether.

In column 2 of Table 2, we replicate the difference in difference analysis for the share of trips to convenience stores as the outcome variable. The results mirror those found in Figure 1. We find that, in the absence of NPIs, the share of trips to convenience stores is about the same for the on and off reservation locations. The implementation of NPIs reduces the share of visits to convenience stores for all households by a half of a percentage point. The estimated difference in difference coefficient indicates that there is an increase in the share of trips to convenience stores by reservation households after NPI implementation by about 3 percentage points (or about a 10 percent relative to the mean of the dependent variable). These results indicate a relatively large behavioral adjustment where the the proportion of grocery shopping at convenience stores increases by 10% in a relatively short amount of time. In places where viable and closer supermarkets do not exist, there are potential impacts of NPIs on household diets and consumption of fresh foods and vegetables. The switch to convenience store shopping could be driven by different channels - travel restrictions, behavioral change, or economic hardship. It is beyond the scope of this work to investigate which mechanism dominates. Still, the results do not seem to be driven by differences between the prevalence of the rural nature of most reservations; they are robust to the inclusion of indicator variables that control for the rural location of Census tracts.

4 Discussion and Conclusion

We examine the effect of social distancing measures imposed in order to contain a public health crisis on a relatively understudied population - American Indians - and their behavioral responses

as measured by their trips to grocery stores. Using cell phone data over the first six months of 2019 and 2020 for households located on and off reservations, we find that NPIs reduce average distance traveled for grocery trips. Households residing on reservations reduce the distance traveled proportionately more than their off reservation counterparts. Most importantly, we find evidence that subsequent to the NPI mandate, reservation households substitute away from supermarket shopping to convenience store shopping; the share of convenience store shopping increases by ten percent in this period for the reservation households.

Switching from supermarkets to convenience stores likely results in a change in the types of foods that households consume. An increase in grocery shopping at convenience stores is important as this affects household diets and the consumption of pre-made and processed foods. These types of stores regularly stock less fresh fruits, vegetables and meats than a typical supermarket. Foods sold in convenience stores are also more likely to be high in sodium and fats ([Andreyeva et al., 2008](#)), to be pre-processed and have low nutritional value. Thus, increased consumption of processed and canned foods during the pandemic appears to be an unintentional side effect of NPI mandates especially for remotely located households. Given the connection between processed and canned foods and specific health outcomes such as heart disease, obesity and Type 2 diabetes, this behavioral change may bring about a worsening of existing co-morbidities among this already at-risk population.

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A Appendix

Table A1: Effect of NPIS on Distance Traveled and Share of Trips to Convenience Stores for Reservations with Casinos Only Relative to Off-Reservation Locations

	Average Distance Traveled to Grocery Store	Share of Total Grocery Trips to Convenience Stores
Reservation	2.484*** (0.188)	0.0000479 (0.00349)
NPI	-0.125*** (0.0166)	-0.00501*** (0.000593)
Reservation x NPI	-0.479*** (0.115)	0.0277*** (0.00314)
Observations	1,904,024	1,750,637
R2	0.373	0.448
Adj R-squared	0.372	0.447