

Introduction

On March 28, 2020, as the COVID-19 pandemic took hold of the U.S. and in an attempt to balance public health priorities with the simultaneous need to keep critical sectors of the economy afloat, officials at the Department of Homeland Security (DHS) Cybersecurity and Infrastructure Security Agency (CISA) issued guidelines specifying which industries were essential to the U.S. economy. Though the guidelines were advisory, many states instituted so-called stay-at-home orders and used the guidelines as a template for determining which sectors of the economy, and therefore which workers, were considered essential for the continued functioning of society. As the U.S. experienced subsequent waves of increased transmission of the virus, the government responded with new orders, such as revised guidelines on essential workers in December 2020 and a variety of policies and pronouncements made at the state or municipal levels. In turn, these orders limited and expanded social and economic activity based on the evolving level of COVID-19 cases nationally and across different states and municipalities.

Preliminary research on the characteristics of workers deemed essential by the federal guidelines has found that while there is heterogeneity in racial identity, educational attainment and earnings among essential workers, workers from racial and ethnic minority groups with lower educational attainment and lower earnings disproportionately comprise workers deemed essential (Blau, Koebe, and Meyerhofer 2020; Dubay et al. 2020; Kerwin and Warren 2020). Additional research incorporates a growing understanding that some essential workers were able to effectively work at their jobs remotely, while others needed to appear at a workplace (Bick, Blandin, and Mertens 2020; Blau, Koebe, and Meyerhofer 2020; Dey et al. 2020; Dingel and Neiman 2020; Kaplan, Moll, and Violante 2020). This latter group constitutes the essential frontline workforce (i.e., unable to work remotely). Measuring the size and the characteristics of

the essential frontline workforce is important because these are the workers who have kept the economy afloat since the COVID-19 pandemic began and have borne the brunt of risk that accompanies spending time in the workplace when virus transmission in communities around the U.S. is at its worst and avoiding contracting the virus is most difficult.

Essential frontline workers who are employed in occupations where maintaining physical distance is difficult, if not impossible, may be most at risk. Media accounts provide substantial evidence in support of this conclusion, highlighting the disproportionate way that low-wage workers of color in a variety of industries have been ravaged by COVID-19 (Swanson, Yaffe-Bellany, and Corkery 2020; Tully 2020). Further, as communities of color disproportionately lack access to health insurance and often live in overcrowded residential conditions that make quarantining after contracting the virus more difficult, there may be a link between the risky working conditions that many essential frontline workers of color experience and high rates of COVID-19 infection and mortality found more generally in communities of color (Figueroa et al. 2020; Gross et al. 2020; Holtgrave et al. 2020). Thus, the prevailing characteristics of essential frontline workers also throws into sharp relief the glaring inequalities in U.S. society over who is best positioned to protect themselves from contracting the virus and prevent the spread of the virus to others once a COVID-19 infection occurs.

In this article we make three primary contributions to the emerging literature on essential workers during the COVID-19 pandemic. First, we follow the lead of other researchers in defining essential workers in the U.S. workforce, but incorporate a more nuanced estimate of which workers are frontline workers by virtue of their inability to work remotely rather than at a work site. We believe that our estimate of essential frontline workers provides a more accurate account of how the potential risk of COVID-19 exposure and infection in the workplace is

spread across workers. Second, we assess how essential frontline worker status is distributed across nativity and among immigrant workers by legal status. This contribution allows us to highlight the disproportionate risk experienced by unauthorized workers during the COVID-19 pandemic. Further, we assess how the variety of social and economic characteristics of unauthorized immigrant essential frontline workers may complicate their ability to manage the risks associated with potential exposure to the COVID-19 virus in the workplace. More generally, our analysis helps to explain why COVID-19 mortality rates for immigrants are higher than mortality rates for native-born residents (Garcia et al. 2021). Third, by identifying the legal status characteristics of immigrant workers the government considers to be essential frontline workers, our analysis allows us to quantify the importance of unauthorized workers for the continued functioning of the economy in the U.S.

Our analysis reveals that foreign-born workers are disproportionately represented among essential frontline workers relative to native-born workers, and that unauthorized immigrants are dramatically overrepresented among essential frontline workers relative to native born workers and immigrant workers with other legal statuses. About 56 percent of foreign-born workers are considered essential frontline workers, compared to just under half of native-born workers. Among foreign-born workers, about 70 percent of unauthorized immigrant workers are considered essential frontline workers, compared to about half of naturalized workers and 54 percent of authorized non-citizen workers.

Relative to other essential frontline workers, unauthorized essential frontline workers have characteristics that may make mitigating the risk associated with greater potential exposure to the COVID-19 virus in the workplace more difficult. Lower levels of human capital, including low levels of English fluency and educational attainment, along with higher rates of poverty and

lower rates of access to health insurance all suggest that essential frontline workers who are unauthorized immigrants may face challenges in navigating and accessing COVID-19 vaccines and healthcare services if a COVID-19 infection occurs. These challenges may exacerbate the low levels of health care utilization already observed among unauthorized residents of the U.S. given fears that seeking care will result in the government discovering their unauthorized status and exercising removal proceedings (Hacker et al. 2015). Compared to other essential frontline workers, unauthorized immigrant essential frontline workers are more likely to live in overcrowded living conditions and use carpools or public transportation for commuting, making self-quarantine more difficult, opening other potential vectors of exposure to the COVID-19 virus and making the potential for increased community transmission more likely should a COVID-19 infection occur.

The remainder of this article proceeds in four sections. We first review the literature on vulnerability of immigrant workers in the U.S., with a particular focus on unauthorized immigrant workers, and the existing state of knowledge on the essential worker designation during the COVID-19 pandemic. Second, we introduce our methodology and the data we use to estimate the size and composition of the essential frontline workforce. Third, we discuss the results of our analysis, highlighting the different demographic, human capital, economic, and family structure characteristics among unauthorized immigrant essential frontline workers that make mitigating the risk associated with contracting COVID-19 difficult for this group of workers. Fourth, we conclude with a discussion of how our results contribute to a simultaneously deeper understanding of the importance of unauthorized workers to the U.S. economy and their vulnerability within U.S. society.

Literature Review

Immigrants are overrepresented in the U.S. labor force, suggesting that immigrant workers have been vital for maintaining the production of critical goods and services in the U.S. during the COVID-19 pandemic. According to data from the Bureau of Labor Statistics (2020), foreign-born individuals made up 17.4 percent of the U.S. labor force in 2019. In comparison, results from the 2019 American Community Survey (ACS) reveal that foreign-born individuals comprised 13.7 percent of the U.S. population in 2019. Immigrants' age distribution (Bureau of Labor Statistics 2020; Mosisa 2006) and strong motivation to work (Massey et al. 1993) may help to explain their over-representation in the labor force. Further, unauthorized immigrants face even greater motivations to work given their lack of eligibility for public aid and the challenges of finding new work with a vulnerable legal status (Flynn, Eggerth, and Jacobson Jr. 2015; Orrenius and Zavodny 2009b; Passel and Cohn 2018).

Although immigrants occupy a prominent place in the workforce, they disproportionately work at the low and high skill ends of the labor force, due in part to the large proportions of immigrants with low and high levels of educational attainment and legal status that channels unauthorized workers into more casual, lower paying work arrangements. Immigrants are over three times more likely than the native-born to lack a high school diploma and just as likely to have a bachelor's degree, corresponding to their concentration at the low and high skilled ends of the workforce (Budiman 2020; Pew 2015). Legal status is another driving force behind this distribution, as immigrant groups with larger shares of unauthorized immigrants tend to have lower rates of high-skilled employment (Bennett 2020). Native-born workers out-earn immigrant workers at nearly every educational level (Bureau of Labor Statistics 2020). Yet, immigrants are

often bound to their jobs regardless of the working conditions or pay, due to their vulnerable social position (Flynn, Eggerth, and Jacobson Jr. 2015; Moyce and Schenker 2018).

Overall, immigrants are more likely to work in low-skilled industries and occupations, contributing to their vulnerable position in the workforce (Bennett 2020; Pew 2015). Immigrant workers are largely relegated to the so-called secondary labor market that is marked by low wages, minimal opportunity for upward mobility (Massey et al. 1993), and therefore an ascribed lack of social value (Alonso-Villar, del Río, and Gradín 2010; Catanzarite 2000). Immigrant-heavy work sectors face heightened stigma due to the racialization of unauthorized legal status, the effects of which often extend to the greater racial or ethnic group associated with unauthorized immigrants (Asad and Clair 2018). Immigrant workers' perceived or actual legal status often means they are confined to the secondary labor market and must tolerate its work conditions (Sisk and Donato 2016; Saucedo 2017).

Immigrant workers' vulnerability in the workforce may contribute to their increased exposure to occupational hazards. Immigrants are more likely to work in job sectors with high injury rates and face higher rates of occupational injury on the job (Moyce and Schenker 2018; Orrenius and Zavodny 2009a; Pransky et al. 2002; Seabury, Terp, and Boden 2017). Immigrant workers face more adverse consequences from injury than most groups of native-born workers, including higher median time of lost work and higher rates of work-related disability (Pransky et al. 2002; Seabury, Terp, and Boden 2017). Immigrant workers also face higher risks of fatality across industry and occupation, a disparity that is particularly pronounced among Latino immigrants and unauthorized immigrants more generally (Flynn et al. 2013; Hall and Greenman 2015; Orrenius and Zavodny 2009a).

Immigrant workers' social position compounds their vulnerability to occupational hazards. Immigrants lack access to occupational safety and health training due to their contingent work nature, as well as language and literacy differences (de Castro et al. 2006; Flynn et al. 2013; Gany et al. 2011; Moyce and Schenker 2018; Pransky 2002). Further, many immigrant workers do not report work-related injuries or file compensation claims for fear of contact with authorities and fear of workplace repercussions that could include job loss (de Castro et al. 2006; Fine and Lyon 2017; Flynn, Eggerth, and Jacobson Jr. 2015; Gany et al. 2011; Moyce and Schenker 2018). This suggests there are minimal incentives for employers to improve work conditions, and many employers may develop a preference for immigrant workers who demonstrate a tolerance for poor work conditions and remain hard-working (Saucedo 2017).

The COVID-19 pandemic has magnified the daily risks that immigrant workers face. As COVID-19 began to spread throughout the U.S. in 2020, the DHS CIA issued guidance to identify essential workers who were to continue working in person during stay-at-home orders. Estimates indicate that immigrant workers are overrepresented both in the work sectors hit hardest by pandemic closures *and* those considered essential (Gelatt 2020; Kerwin and Warren 2020). Immigrant workers have been particularly impacted by work closures, exacerbating the precarious economic situation of many. Recent data indicates unemployment for immigrants rising faster than unemployment for native born workers (Clark et al. 2020; Ku and Brantley 2020), reversing a long-held employment advantage held by immigrant workers (Borjas and Cassidy 2020). This is likely driven by immigrants' underrepresentation in jobs that can be performed at home (Borjas and Cassidy 2020; Couch, Fairlie, and Xu 2020; Dey et al. 2020).

On the other hand, continuing to work in person poses serious health risks for immigrant workers. Immigrant workers confront language barriers, cultural differences, and social

exclusion factors that complicate developing a workplace safety culture that a pandemic necessitates (Alahmad et al. 2020; Skiba 2020). Further, immigrant workers face increased barriers to making claims to legal rights regarding their health and safety, exacerbated by the non-binding nature of workplace guidance such as that of the Center for Disease Control (CDC) and Occupational Safety and Health Administration's (OSHA) regarding safety in meatpacking and poultry processing during the pandemic (Fine and Lyon 2017; Flynn, Eggerth, and Jacobson Jr. 2015; Kerwin and Warren 2020).

The public health risks that immigrant workers face in continued in-person work are further compounded by societal inequities (Alahmad et al. 2020; Guadagno 2020). Immigrants are overrepresented in COVID-19 "hotspot" areas which tend to be economic centers that attract immigrant workers (Guadagno 2020). Immigrant workers are more likely to use public transit to get to work and to do essential tasks, meaning they cannot significantly reduce their mobility in order to curb COVID-19 risk (Chang et al. 2020; Clark 2020). Further, immigrant families are more likely to live in multigenerational homes and tend to live in more crowded conditions, making quarantining difficult if someone contracts the virus (Clark 2020; Kerwin and Warren 2020).

Immigrants also face barriers in accessing aid that could help them mitigate the negative impacts of the pandemic. Immigrants are uninsured at high rates (Clark 2020; Gelatt 2020; Kerwin and Warren 2020), which is particularly problematic when early diagnosis may be essential for mitigating the effects of COVID-19 (Joseph et al. 2020). Many immigrant workers also lack access to public aid programs that could alleviate additional vulnerabilities such as food insecurity (Clark 2020). Among workers in industries facing closures due to COVID-19, immigrant workers live in poverty and are uninsured at higher rates compared to their native

born counterparts (Gelatt 2020). Yet, many immigrants are ineligible for public aid programs or avoid them despite eligibility in the wake of the February 2020 Public Charge rule which expanded the receipt of public aid programs that would count against immigrants adjusting their status in the future (Bernstein et al. 2020; Clark 2020; Kerwin and Warren 2020). The March 2020 Coronavirus Aid, Relief, and Economic Security Act also denied relief to many immigrant families due to its requirement that all taxpayers in the household have filed their returns with a valid Social Security number (Clark 2020; Kerwin and Warren 2020; Sönmez et al. 2020).

The risks immigrant workers must confront during the pandemic have public health implications for their families and communities. The disparities related to COVID-19 infection rates by race and socioeconomic status are well documented (Chen, Waterman, and Krieger 2020; Figueroa et al. 2020; Holtgrave 2020). Recent public health literature highlights racial disparities throughout the COVID-19 infection experience, from lower numbers of tests administered in low income communities of color (Lieberman-Cribbin et al. 2020), to higher rates of infection, hospitalization and mortality among Black and Hispanic adults compared to their white counterparts (Holtgrave et al. 2020).

In addition to race and ethnicity, studies assessing the prevalence of COVID-19 among immigrant communities suggest that factors such as nativity and monolingualism are associated with higher rates of COVID-19. Evidence suggests that geographic areas with higher proportions of Black and Latino residents, foreign-born residents, crowded households and households in poverty are associated with higher rates of COVID-19 (Figueroa et al. 2020; Rodriguez-Diaz et al. 2020; Strully, Yang, and Liu 2021). Rodriguez et al. (2020) found higher COVID-19 diagnosis rates among U.S. counties with greater Latino representation, less unemployment and more monolingual Spanish speakers. Though they do not directly assess nativity, the researchers

interpret this finding to mean that immigrants' occupational exposure is a prominent risk factor (Rodriguez-Diaz et al. 2020).

Existing estimates of immigrant essential workers offer insight into the magnitude of this risk. Kerwin and Warren use the DHS CIA guidelines and 2018 American Community Survey (ACS) data to estimate that 69 percent of immigrant workers are essential workers, compared to only 65 percent of native-born workers (2020). Unauthorized workers are even more starkly overrepresented with 74 percent considered essential workers (Kerwin and Warren 2020). Dingel and Neiman (2020) add to the understanding of critical workers by classifying which occupations can be done from home, finding that only about 37 percent of jobs can be performed remotely. Blau, Koebe and Meyerhofer (2020) use Dingel and Neiman's (2020) classification to estimate the essential workers who must continue to work in person on the frontlines (2020). Blau et al. (2020) further specify frontline workers by excluding the industries that were partially or completely shutdown as the pandemic began as identified by Vavra (2020), finding that on average, frontline workers are less educated, earn lower wages, and have a higher proportion of minorities and immigrants. This profile of frontline workers is consistent with analyses of telework feasibility during the pandemic. Studies indicate that workers with the ability to work remotely tend to be white, highly educated and highly paid, while minorities, workers with only high school degrees, and low-skill and low-wage workers are less likely to be able to work remotely (Bick, Blandin, and Mertens 2020; Dey et al. 2020; Desilver 2020; Dingel and Neiman 2020; Kaplan, Moll, and Violante 2020).

Though existing estimates show that immigrant workers make up a large share of essential and frontline workers, there are not yet estimates of the impact of immigrants' legal status and associated vulnerabilities This article builds from existing estimates of immigrant

frontline workers to examine how occupational hazard is spread along these additional dimensions.

Data and Methods

This paper has two main data innovations. The first innovation, particularly important for the COVID-19 literature, is that it compares a wide set of definitions for essential workers in the United States and uses the most reliable method for identifying frontline workers. Specifically, we adapt the methodology from Blau et al. (2020) to identify essential workers and then refine their identification of frontline workers using a four-digit occupation identification rather than a two-digit occupation classification. Our second innovation is that we couple the nationally representative data from the American Community Survey (ACS) provided by IPUMS at the University of Minnesota (Ruggles et al. 2020) with the logical edit method for identifying unauthorized immigrants. These innovations allow us to study the unauthorized immigrant workforce.

There are different methods for estimating the number of unauthorized adults in the United States (Baker and Rytina 2012; Capps et al. 2013, 2018; Passel 2016; Van Hook et al. 2015; Warren 2014; Warren and Warren 2013). The logical edit method is as follows. First, using ACS data, a provisional estimate of the population of likely authorized adults is derived using the following variables: employed in an occupation requiring legal status (lawyer, government employee, etc.), having temporary legal status in the United States (based on date of U.S. entry and other characteristics), having immediate relatives in the United States, receipt of public benefits (SSI, TANF, etc.), age 60 or older at U.S. entry, and originating from a likely refugee sending country. Second, external “population controls” are derived using data from non-ACS

sources, e.g., Statistical Yearbooks from the Department of Homeland Security (DHS) (Warren 2014:321-322). Specifically, starting with an estimate of the foreign-born population by country of origin and year of U.S. entry, a provisional estimate of the population of likely unauthorized adults is derived after adjusting for annual admissions of legal permanent residents (LPRs) and refugees, emigration from the United States, death, undercount, and temporary legal status (Warren 2014; Warren and Warren 2013). Third, going back to the ACS data, a final estimate of the population of likely unauthorized adults is derived. This is achieved by calculating the proportion of likely unauthorized adults across the aforementioned population controls. This proportion is then applied to (i.e., multiplied by) those in the ACS that were not included in the provisional estimate of the population of likely authorized adults. Because this proportion is less than 1.0, the selection of individuals in the ACS is done randomly (Warren 2014).

Results

Table 1 presents estimates of the number and proportion of essential frontline workers in the U.S. economy by nativity and immigrant legal status. The estimates correspond to three different definitions of essential frontline workers: (1) essential workers based on the federal guidance issued in March 2020 who worked in industries that were not shutdown due to the pandemic and cannot work remotely (essential frontline no shutdown workers); (2) essential workers based on the federal guidance issued in March 2020 who cannot work remotely (essential frontline workers); and (3) essential workers based on the revised federal guidance issued in December 2020 who cannot work remotely (essential frontline workers expanded). Estimates of the number and proportion of workers based on these different definitions increase from about 65 million, or 37 percent of all workers at the time of the initial round of shutdown orders in Spring 2020, to over 87 million, or 50 percent of all workers after the December 2020

revisions to the federal guidance on essential workers. Across each definition, disparities exist in the proportion of native and foreign-born workers who are classified as essential frontline workers, ranging from a 5.8 percentage point difference to an 8.5 percentage point difference depending upon the definition. These results indicate that foreign-born workers are disproportionately essential frontline workers relative to native-born workers.

Disaggregating foreign-born workers by legal status reveals that unauthorized immigrant workers drive much of the disparity in essential frontline worker status found between native-born and foreign-born workers. Across all definitions, the proportion of naturalized citizens who are essential frontline workers is only slightly higher than the proportion of native-born essential frontline workers. Similarly, the proportion of authorized non-citizen workers who are essential frontline workers is modestly higher than the proportion of native-born essential frontline workers. In contrast, the proportion of unauthorized workers who are essential frontline workers is around 20 percentage points higher than the proportion of native-born essential frontline workers across the different definitions of essential frontline workers. Using the essential frontline worker expanded definition, 49 percent of native-born workers are essential frontline workers, compared to 70 percent of unauthorized workers.

Table 1. Essential Workers - Workers who worked last year						
	All	Native-born	Foreign-born	Foreign-born Breakdown		
				Naturalized	Authorized	Unauthorized
Total Population	328,941,635	283,451,479	45,490,156	23,024,064	12,117,209	10,348,883
Total Workers	174,638,559	144,986,115	29,652,443	15,036,871	7,265,679	7,349,893
Essential Frontline No Shutdown						
<i>Total Essential Workers</i>	64,802,784	52,366,594	12,436,190	5,699,216	2,852,868	3,884,106
<i>Percent Workers Essential</i>	37.1	36.1	41.9	37.9	39.3	52.8
	(37.03 - 37.18)	(36.04 - 36.20)	(41.74 - 42.14)	(37.64 - 38.16)	(38.87 - 39.66)	(52.38 - 53.31)
Essential Frontline						
<i>Total Essential Workers</i>	82,514,059	66,426,324	16,087,735	7,278,314	3,731,941	5,077,480
<i>Percent Workers Essential</i>	47.2	45.8	54.3	48.4	51.4	69.1
	(47.17 - 47.32)	(45.73 - 45.90)	(54.05 - 54.45)	(48.14 - 48.67)	(50.96 - 51.77)	(68.65 - 69.51)
Essential Frontline Expanded						
<i>Total Essential Workers</i>	87,312,376	70,593,073	16,719,303	7,638,429	3,924,263	5,156,611
<i>Percent Workers Essential</i>	50.0	48.7	56.4	50.8	54.0	70.2
	(49.92 - 50.07)	(48.61 - 48.77)	(56.19 - 56.58)	(50.53 - 51.06)	(53.61 - 54.41)	(69.73 - 70.58)

A large concentration of unauthorized immigrant workers in some key industries that were declared essential in the federal guidance issued in December 2020 and the requirement that much of the work performed in those industries occur on-site helps to explain why unauthorized workers are disproportionately represented among essential frontline workers. Table 2 presents the distribution of essential frontline workers across major industry groups by nativity and immigrant legal status. There are relatively few major industry groups with disparities in the proportion of native-born and foreign-born essential frontline workers. In the major industry groups where disparities do exist, the differences in the proportion of foreign-born essential frontline workers and native-born essential frontline workers are modest. For example, nearly 16 percent of foreign-born essential frontline workers worked in construction, compared to 10.5 percent of native-born essential frontline workers. In contrast, about nine percent of foreign-born essential frontline workers worked in retail trade compared to 14 percent of native-born essential frontline workers. In most other major industry groups, native-born and foreign-born essential frontline workers are closer to parity in terms of the proportion of each group working in the industries.

Disaggregating foreign-born essential frontline workers by immigrant legal status provides a more nuanced picture, revealing substantial differences by immigrant legal status. Underscoring the strikingly different areas of the economy inhabited by unauthorized immigrant and native-born workers (Eckstein and Peri 2018), a comparison of the distribution of native-born and unauthorized immigrant essential frontline workers across major industry groups reveals that the two groups of workers are close to parity in very few industries. Instead, there is a collection of major industry groups where native-born essential frontline workers are disproportionately represented relative to unauthorized immigrant essential frontline workers, and another set of major industry groups where the opposite is true. In many cases, the disparities in representation in major industry groups between native-born and unauthorized immigrant essential frontline workers are substantial. For example, over one-quarter of unauthorized immigrant essential frontline workers worked in construction and nearly 20 percent worked in arts, entertainment and recreation, and accommodation and food services. In comparison, only 10.5 percent and 13.8 percent of native-born essential frontline workers worked in construction and arts, entertainment and recreation, and accommodation and food services, respectively. On the other hand, over 14 percent of native-born essential frontline workers worked in retail trade, double the proportion of unauthorized immigrant essential frontline workers working in retail trade. Even more extreme, 22 percent of native-born essential frontline workers worked in educational services, and health care and social assistance, more than triple the proportion of unauthorized immigrant essential frontline workers in these industries.

Table 2. Industries	All Workers	Native-born	Foreign-born	Foreign-born Breakdown		
				Naturalized	Authorized	Unauthorized
				Total Essential Workers	87,312,376	70,593,073
Agriculture, Forestry, Fishing, and	3.0	2.8	4.0	1.9	4.7	6.6
	(3.00 - 3.07)	(2.77 - 2.85)	(3.87 - 4.09)	(1.77 - 1.97)	(4.43 - 4.91)	(6.30 - 6.87)
<i>Crop production</i>	43.9	37.5	62.9	57.2	64.2	64.5
	(43.29 - 44.42)	(36.88 - 38.08)	(61.51 - 64.25)	(54.39 - 59.95)	(61.85 - 66.63)	(62.45 - 66.63)
Construction	11.5	10.5	15.8	9.3	14.6	26.4
	(11.41 - 11.55)	(10.39 - 10.53)	(15.57 - 15.98)	(9.03 - 9.48)	(14.16 - 14.96)	(25.85 - 26.86)
Manufacturing	11.5	11.5	11.4	12.0	11.2	10.6
	(11.45 - 11.59)	(11.47 - 11.62)	(11.23 - 11.58)	(11.78 - 12.28)	(10.86 - 11.57)	(10.28 - 10.99)
Wholesale Trade	1.6	1.6	1.6	1.5	1.7	1.8
	(1.58 - 1.64)	(1.58 - 1.63)	(1.57 - 1.71)	(1.38 - 1.56)	(1.56 - 1.85)	(1.68 - 1.99)
Retail Trade	13.2	14.1	9.2	10.5	9.2	7.3
	(13.10 - 13.25)	(14.04 - 14.20)	(9.05 - 9.37)	(10.25 - 10.72)	(8.90 - 9.56)	(6.99 - 7.59)
Transportation and Warehousing, and	8.0	7.9	8.3	10.2	8.5	5.5
	(7.92 - 8.04)	(7.83 - 7.96)	(8.18 - 8.49)	(9.92 - 10.39)	(8.22 - 8.85)	(5.22 - 5.75)
Information	0.7	0.8	0.5	0.6	0.5	0.3
	(0.70 - 0.74)	(0.76 - 0.80)	(0.43 - 0.50)	(0.55 - 0.67)	(0.38 - 0.53)	(0.19 - 0.31)
Finance and Insurance, and Real Estate,	1.8	1.8	1.6	2.0	1.5	1.1
	(1.76 - 1.82)	(1.81 - 1.87)	(1.51 - 1.64)	(1.87 - 2.08)	(1.34 - 1.62)	(0.94 - 1.17)
Professional, Scientific, and Management, and Waste Management Services	5.3	4.6	8.2	5.5	8.4	12.2
	(5.28 - 5.38)	(4.59 - 4.69)	(8.09 - 8.40)	(5.31 - 5.66)	(8.07 - 8.70)	(11.85 - 12.60)
Educational Services, and Health Care and	21.8	22.3	19.8	28.9	19.4	6.5
	(21.70 - 21.88)	(22.17 - 22.37)	(19.57 - 20.01)	(28.59 - 29.29)	(18.95 - 19.85)	(6.26 - 6.83)
Arts, Entertainment, and Recreation, and	14.1	13.8	15.5	12.2	16.2	19.7
	(14.03 - 14.18)	(13.71 - 13.87)	(15.25 - 15.66)	(11.98 - 12.49)	(15.77 - 16.61)	(19.21 - 20.12)
<i>Traveler accommodation</i>	11.2	9.5	17.7	21.3	16.8	14.9
	(11.03 - 11.42)	(9.32 - 9.71)	(17.12 - 18.22)	(20.35 - 22.16)	(15.77 - 17.89)	(13.96 - 15.82)
<i>Restaurants and other food services</i>	88.8	90.5	82.3	78.7	83.2	85.1
	(88.58 - 88.97)	(90.29 - 90.68)	(81.78 - 82.88)	(77.84 - 79.65)	(82.11 - 84.23)	(84.18 - 86.04)
Other Services, Except Public	1.8	1.8	1.7	1.4	1.8	2.1
	(1.75 - 1.80)	(1.76 - 1.82)	(1.64 - 1.79)	(1.36 - 1.54)	(1.62 - 1.92)	(1.91 - 2.24)
Public Administration	4.5	5.1	2.0	3.4	2.1	0.0
	(4.43 - 4.52)	(5.01 - 5.11)	(1.95 - 2.10)	(3.24 - 3.52)	(1.89 - 2.21)	(0.00 - 0.00)
Military	1.2	1.4	0.4	0.7	0.3	0.0
	(1.18 - 1.23)	(1.37 - 1.43)	(0.35 - 0.42)	(0.60 - 0.72)	(0.28 - 0.41)	(0.00 - 0.00)

An examination of the demographic characteristics of essential frontline workers reveals similarities and differences in the sex, age and racial distributions across nativity and immigrant legal status for essential frontline workers. Understanding these characteristics matters since males and older adults are more susceptible to serious illness and have higher mortality rates after contracting COVID-19 than females and younger adults (Yanez et al. 2020). In addition, substantial disparities in COVID-19 mortality rates exist by race, with consistently higher rates of COVID-19 mortality for Black and Latino populations relative to White populations (Gross et al. 2020). Thus, while different nativity and immigrant legal status groups may experience

comparable risks associated with proximity to others and exposure to COVID-19 in their workplaces, differences in the demographic characteristics of these groups may signal different risks for these groups associated with experiencing serious illness or death after contracting COVID-19.

Overall, the demographic characteristics of foreign-born essential frontline workers, and the demographic characteristics of unauthorized immigrant essential frontline workers in particular, indicate a potentially greater health risk associated with COVID-19 for these workers compared to native-born essential frontline workers. Greater health risk associated with COVID-19 for foreign-born and unauthorized immigrant essential frontline workers is not related necessarily to work conditions that make it more difficult to maintain physical distance from others during their work. As Table 3 shows, the measure of proximity to others associated with the working conditions of workers by nativity and immigrant legal status shows little difference in the contextual risk experienced by workers. The proportion of male essential frontline workers among native-born (60 percent) and foreign-born workers (61 percent) is close to parity, but 68.5 percent of unauthorized immigrant essential frontline workers are male.

On the other hand, the age distribution among unauthorized immigrant essential frontline workers may place them at lower risk of serious illness or death after contracting COVID-19 compared to native-born essential frontline workers and foreign-born essential frontline workers with other immigrant legal statuses. Among native-born essential frontline workers about 38 percent are aged 45 years or older compared to about 47 percent of foreign-born essential frontline workers. Disaggregating foreign-born essential frontline workers by immigrant legal status reveals that naturalized citizens have the oldest age distribution (nearly 60 percent aged 45 years or older), while unauthorized immigrants have a substantially younger age distribution

(only 30 percent aged 45 years or older). Thus, the age distribution of unauthorized immigrant essential frontline workers may mitigate some of the risk these workers experience from potential exposure to COVID-19 compared to the risk associated with the age distribution of native-born essential frontline workers and foreign-born essential frontline workers from other immigrant legal statuses.

The racial distribution among foreign-born essential frontline workers further suggests greater risk of serious illness or death from COVID-19 for these workers compared to native-born essential frontline workers. With emerging evidence that Black and Latino individuals have higher mortality rates due to COVID-19 compared to Whites (Gross et al. 2020; Holtgrave et al. 2020), a racial distribution with a higher proportion of Blacks and Latinos would suggest a greater level of risk associated with COVID-19. Table 3 indicates that just over one-quarter of native-born essential frontline workers identify as either Black or Latino compared to about two-thirds of foreign-born essential frontline workers. Among unauthorized immigrant essential frontline workers the proportion of Black and Latino workers is even higher at 87 percent. In summary, unauthorized immigrant essential frontline workers tend to be younger than native-born essential frontline workers or foreign-born essential frontline workers from other immigrant legal status groups, but have larger proportions of males and workers who identify as Black or Latino.

Table 3. Demographics	All Workers	Native-born	Foreign-born	Foreign-born Breakdown		
				Naturalized	Authorized	Unauthorized
Total Essential Workers	87,312,376	70,593,073	16,719,303	7,638,429	3,924,263	5,156,611
Context score	68.3 (68.26 - 68.33)	68.4 (68.38 - 68.45)	67.8 (67.72 - 67.90)	69.7 (69.55 - 69.80)	67.2 (66.99 - 67.34)	65.5 (65.37 - 65.70)
Female (%)	40.0 (39.90 - 40.11)	40.3 (40.19 - 40.42)	38.8 (38.48 - 39.02)	43.6 (43.18 - 43.94)	38.9 (38.33 - 39.43)	31.5 (31.00 - 32.07)
Age 16-44 (%)	60.4 (60.28 - 60.49)	62.1 (61.97 - 62.19)	53.2 (52.96 - 53.52)	40.3 (39.89 - 40.65)	55.8 (55.28 - 56.41)	70.5 (69.95 - 71.00)
Age 45-64 (%)	34.0 (33.88 - 34.08)	32.1 (32.02 - 32.24)	41.8 (41.49 - 42.04)	51.8 (51.39 - 52.15)	39.2 (38.63 - 39.74)	28.9 (28.40 - 29.44)
Age 65+ (%)	5.6 (5.58 - 5.68)	5.8 (5.73 - 5.84)	5.0 (4.87 - 5.11)	8.0 (7.75 - 8.17)	5.0 (4.72 - 5.21)	0.6 (0.51 - 0.69)
White (%)	56.9 (56.83 - 57.05)	67.7 (67.63 - 67.85)	11.3 (11.16 - 11.51)	15.4 (15.13 - 15.68)	13.1 (12.67 - 13.44)	4.0 (3.77 - 4.22)
Af.American (%)	13.2 (13.12 - 13.27)	13.9 (13.80 - 13.96)	10.3 (10.13 - 10.46)	13.8 (13.53 - 14.06)	10.2 (9.84 - 10.53)	5.2 (4.93 - 5.44)
AI/AN (%)	0.7 (0.64 - 0.68)	0.8 (0.78 - 0.83)	0.1 (0.04 - 0.07)	0.1 (0.06 - 0.11)	0.0 (0.01 - 0.05)	0.0 (0.00 - 0.04)
Asian (%)	5.2 (5.18 - 5.28)	1.7 (1.67 - 1.73)	20.1 (19.91 - 20.36)	28.5 (28.11 - 28.81)	19.9 (19.49 - 20.40)	8.0 (7.65 - 8.27)
Other (%)	0.2 (0.22 - 0.24)	0.2 (0.14 - 0.16)	0.5 (0.51 - 0.59)	0.6 (0.51 - 0.62)	0.5 (0.45 - 0.61)	0.5 (0.46 - 0.62)
Multi (%)	2.0 (2.00 - 2.06)	2.3 (2.23 - 2.30)	1.1 (1.00 - 1.11)	1.4 (1.34 - 1.52)	1.2 (1.07 - 1.31)	0.4 (0.33 - 0.47)
Hispanic (%)	21.7 (21.62 - 21.80)	13.5 (13.37 - 13.54)	56.6 (56.30 - 56.85)	40.3 (39.88 - 40.64)	55.1 (54.50 - 55.63)	81.9 (81.46 - 82.34)

Compared to native-born essential frontline workers and foreign-born essential frontline workers from other legal statuses, unauthorized immigrant essential frontline workers have lower levels of formal education and lower levels of English fluency. As Table 4 indicates, nearly half of unauthorized immigrant essential frontline workers lack a high school degree, compared to 10 percent of native-born essential frontline workers, one-fifth of naturalized immigrant essential frontline workers, and one-third of authorized immigrant essential frontline workers. Similarly, about half of unauthorized immigrant essential frontline workers speak no or poor English, compared to less than one percent of native-born essential frontline workers, 14 percent of naturalized immigrant essential frontline workers, and 36 percent of authorized immigrant essential frontline workers. These human capital factors help to explain the overrepresentation of unauthorized workers in low-skilled industries that have lower barriers to entry (Hall and Greenman 2015), but that have been categorized as essential industries in federal guidelines and

often require that labor be performed at places of work rather than remotely. The low levels of human capital present among unauthorized immigrant essential frontline workers also suggest that compared to native-born essential frontline workers and essential frontline workers from other immigrant legal statuses, unauthorized immigrant essential frontline workers may experience difficulty navigating complex bureaucratic systems associated with obtaining vaccines and healthcare services to help prevent or treat COVID-19 infections (Hacker et al. 2015).

Table 4. Human Capital	All Workers	Native-born	Foreign-born	Foreign-born Breakdown		
				Naturalized	Authorized	Unauthorized
No Schooling (%)	1.3 (1.30 - 1.35)	0.6 (0.57 - 0.60)	4.4 (4.33 - 4.56)	3.6 (3.43 - 3.72)	5.2 (4.91 - 5.42)	5.2 (4.93 - 5.44)
Less than HS (%)	12.9 (12.85 - 13.00)	9.6 (9.58 - 9.72)	26.8 (26.53 - 27.03)	16.1 (15.80 - 16.37)	28.2 (27.65 - 28.67)	41.6 (41.01 - 42.13)
HS or equiv. (%)	32.6 (32.50 - 32.70)	33.7 (33.57 - 33.79)	28.0 (27.79 - 28.29)	26.6 (26.27 - 26.95)	28.2 (27.73 - 28.75)	30.0 (29.47 - 30.52)
More HS (%)	33.6 (33.46 - 33.67)	36.6 (36.45 - 36.68)	20.9 (20.68 - 21.13)	26.5 (26.19 - 26.87)	18.8 (18.39 - 19.28)	14.2 (13.75 - 14.55)
BA (%)	13.2 (13.14 - 13.29)	13.4 (13.29 - 13.45)	12.6 (12.41 - 12.78)	16.7 (16.43 - 17.00)	12.2 (11.86 - 12.61)	6.8 (6.48 - 7.05)
Higher than BA (%)	6.4 (6.31 - 6.42)	6.2 (6.10 - 6.22)	7.2 (7.10 - 7.39)	10.5 (10.26 - 10.73)	7.4 (7.07 - 7.66)	2.3 (2.16 - 2.50)
Speaks no or poor english (%)	6.1 (6.08 - 6.19)	0.5 (0.50 - 0.54)	29.9 (29.60 - 30.11)	14.1 (13.87 - 14.41)	36.4 (35.85 - 36.94)	48.2 (47.58 - 48.73)

In addition to the demographic and human capital factors examined above, unauthorized immigrant essential frontline workers face structural inequalities that may reduce their ability to mitigate the risks associated with working in essential frontline jobs during the COVID-19 pandemic. As Table 5 indicates, foreign-born essential frontline workers are substantially less likely to have health insurance compared to native-born essential frontline workers. This disparity in access to health insurance is important because lack of health insurance is associated with lower utilization rates of preventative health care services and higher incidence of comorbidities, such as obesity and diabetes (Lillie-Blanton and Hoffman 2005), that are associated with more serious illness if an individual contracts COVID-19. A closer look at access to health insurance for essential frontline workers by immigrant legal status reveals a wide

disparity between unauthorized workers and all other groups. Among unauthorized immigrant essential frontline workers, only 43 percent have access to health insurance, representing less than half the rate of access to health insurance for native-born and naturalized citizen essential frontline workers. These disparities in access to health insurance take place within a larger context of high poverty rates for foreign-born essential frontline workers compared to native-born essential frontline workers. While the difference in poverty rates between native-born and foreign-born essential frontline workers are relatively narrow, differences in poverty rates between unauthorized immigrant essential frontline workers and any other group of essential frontline workers considered in Table 5 are wider by considerable margins. These differences suggest that unauthorized immigrant essential frontline workers experience a greater challenge in affording basic needs and therefore potentially more difficulty avoiding or mitigating the risks associated with contracting COVID-19 than other essential frontline workers because of the dire financial consequences associated with missing work.

Table 5 also reveals that the housing conditions experienced by unauthorized immigrant essential frontline workers may make them more vulnerable to the risks associated with COVID-19. Unauthorized immigrant essential frontline workers are more likely to rent their homes and more likely to live in a housing cost burdened state, paying 30 percent or more of their household incomes for housing costs, than nearly all other groups considered in this analysis. Over two-thirds of unauthorized essential frontline workers rent their homes compared to only 35 percent of native-born essential frontline workers, 33 percent of naturalized citizen essential frontline workers, and 56 percent of authorized non-citizen essential frontline workers. Similar proportions of unauthorized immigrant and authorized non-citizen essential frontline workers are housing cost burdened (44 percent), eclipsing the rates of housing cost burden for naturalized

citizen essential frontline workers (40 percent) and native-born essential frontline workers (36 percent). The large proportion of unauthorized immigrant essential frontline workers who rent their homes and experience housing cost burden may make them particularly vulnerable to high rates of housing instability that have only been checked by an eviction moratorium put in place by the federal government during the pandemic (Jones and Grigsby-Toussaint 2020). Finally, no matter whether overcrowding is measured as the number of persons living in a dwelling per room or per bedroom, unauthorized immigrant essential frontline workers are substantially more likely to live in overcrowded housing than other groups of immigrant essential frontline workers and native-born essential frontline workers. Limited space in housing may make it difficult for individuals living in households with unauthorized immigrant essential frontline workers to self-quarantine if a COVID-19 infection occurs, increasing the chance of transmission of the virus within the household (Jones and Grigsby-Toussaint 2020).

Table 5. Vulnerability

	All Workers	Native-born	Foreign-born	Foreign-born Breakdown		
				<i>Naturalized</i>	<i>Authorized</i>	<i>Unauthorized</i>
Has any health insurance (%)	84.7 (84.65 - 84.80)	87.8 (87.75 - 87.91)	71.6 (71.38 - 71.88)	88.1 (87.83 - 88.33)	77.1 (76.60 - 77.56)	43.1 (42.55 - 43.69)
Below poverty line (%)	8.1 (8.01 - 8.13)	7.8 (7.75 - 7.88)	9.1 (8.98 - 9.30)	5.5 (5.29 - 5.64)	10.6 (10.27 - 10.99)	13.4 (13.06 - 13.84)
Below 150% of poverty line (%)	15.3 (15.18 - 15.34)	14.3 (14.17 - 14.34)	19.4 (19.19 - 19.64)	12.3 (12.06 - 12.57)	22.1 (21.66 - 22.62)	27.8 (27.33 - 28.36)
Owns (%)	62.5 (62.43 - 62.64)	65.3 (65.19 - 65.42)	51.1 (50.77 - 51.33)	66.9 (66.58 - 67.30)	43.9 (43.32 - 44.48)	33.0 (32.41 - 33.49)
Rents (%)	37.5 (37.36 - 37.57)	34.7 (34.58 - 34.81)	48.9 (48.67 - 49.23)	33.1 (32.70 - 33.42)	56.1 (55.52 - 56.68)	67.0 (66.51 - 67.59)
<i>Total Renters</i>	11,677,783	8,252,870	3,424,913	979,167	926,800	1,518,946
<i>House burden (%)</i>	38.0 (37.81 - 38.21)	36.2 (35.97 - 36.42)	43.2 (42.80 - 43.68)	40.1 (39.39 - 40.85)	44.2 (43.37 - 45.02)	44.9 (44.17 - 45.63)
<i>Extreme house burden (%)</i>	15.5 (15.34 - 15.64)	14.7 (14.53 - 14.86)	17.8 (17.45 - 18.12)	16.1 (15.57 - 16.67)	18.3 (17.63 - 18.92)	18.7 (18.11 - 19.26)
Overcrowded (PPR) (%)	2.1 (2.05 - 2.11)	1.3 (1.25 - 1.30)	5.4 (5.30 - 5.56)	3.5 (3.37 - 3.65)	6.4 (6.11 - 6.68)	7.5 (7.24 - 7.85)
Overcrowded (PPB) (%)	6.8 (6.77 - 6.88)	4.6 (4.59 - 4.70)	15.9 (15.68 - 16.09)	10.4 (10.12 - 10.59)	18.0 (17.51 - 18.41)	22.5 (22.01 - 22.97)

Compared to native-born workers, larger proportions of foreign-born essential frontline workers live with other essential frontline workers, increasing potential exposure to COVID-19. Table 6 shows that nearly 60 percent of foreign-born essential frontline workers live in a

household with at least one other essential frontline worker, compared to 46 percent of native-born essential frontline workers. Disaggregating foreign-born essential frontline workers by legal status reveals an even more striking disparity, as two-thirds of unauthorized essential frontline workers live with at least one other essential frontline worker. Potential COVID-19 risk also characterizes the intimate relationships of many foreign-born essential frontline workers. Among essential frontline workers who are married, nearly half of foreign-born essential frontline workers are married to another essential frontline worker, compared to 41 percent of native-born essential frontline workers. These disparities indicate that potential workplace COVID-19 exposure may be exacerbated by the household composition of foreign-born essential frontline workers and unauthorized immigrant essential frontline workers in particular.

Trends in family composition indicate that unauthorized essential frontline workers may face heightened stressors in their home life. Table 6 shows that 46 percent of unauthorized immigrant essential frontline workers have children in their households, while only 28 percent of native-born essential frontline workers do. An examination of the ages of children in the household reveals that nearly 20 percent of unauthorized essential frontline workers have children under the age of five at home, compared to 13 percent of native-born essential frontline workers. Further, while only about 10 percent of native-born essential frontline workers have children between the ages of five and ten at home, over double that proportion of unauthorized essential frontline workers do. This could introduce challenging situations related to childcare for unauthorized essential frontline workers and their spouses, a large proportion of whom are also categorized as essential frontline workers. Foreign-born essential frontline workers have elders in the household who could theoretically help with childcare at slightly higher rates than native-born essential frontline workers, but this pattern does not hold true for unauthorized essential

frontline workers. In essence, higher proportions of unauthorized essential frontline workers have children that likely need daily care at home if they are not in daycare or attending school in person, but these households may lack the flexibility or capacity to supply needed childcare while simultaneously maintaining employment.

Table 6. Family Composition	All Workers	Native-born	Foreign-born	Foreign-born Breakdown		
				Naturalized	Authorized	Unauthorized
Single (%)	39.3 (39.20 - 39.42)	42.5 (42.35 - 42.58)	26.0 (25.75 - 26.24)	18.7 (18.42 - 19.02)	23.5 (23.01 - 23.97)	38.7 (38.11 - 39.22)
Married (%)	43.2 (43.14 - 43.35)	40.5 (40.37 - 40.61)	54.9 (54.61 - 55.16)	60.8 (60.45 - 61.20)	59.1 (58.56 - 59.68)	42.9 (42.29 - 43.43)
Spouse Essential (%)	42.4 (42.26 - 42.54)	41.1 (40.90 - 41.21)	46.9 (46.60 - 47.29)	44.8 (44.37 - 45.29)	46.4 (45.72 - 47.11)	51.3 (50.55 - 52.08)
Any Other Essential Worker in HH (%)	48.3 (48.16 - 48.38)	45.8 (45.73 - 45.96)	58.5 (58.24 - 58.79)	53.9 (53.51 - 54.28)	57.3 (56.76 - 57.88)	66.3 (65.73 - 66.82)
Two Generation Household (%)	52.7 (52.56 - 52.78)	51.0 (50.91 - 51.15)	59.6 (59.30 - 59.84)	57.9 (57.48 - 58.24)	57.6 (57.07 - 58.19)	63.6 (63.03 - 64.13)
Three Generation Household (%)	8.6 (8.54 - 8.66)	7.7 (7.68 - 7.81)	12.2 (12.05 - 12.42)	13.3 (13.06 - 13.58)	12.3 (11.88 - 12.62)	10.6 (10.26 - 10.97)
Number of Adults	2.24 (2.24 - 2.25)	2.16 (2.16 - 2.16)	2.60 (2.59 - 2.60)	2.47 (2.46 - 2.48)	2.56 (2.54 - 2.57)	2.80 (2.79 - 2.82)
Any Elders in Household (%)	15.9 (15.79 - 15.95)	15.8 (15.70 - 15.87)	16.3 (16.05 - 16.46)	22.9 (22.56 - 23.21)	14.5 (14.09 - 14.89)	7.8 (7.48 - 8.10)
Number of Elders	0.21 (0.21 - 0.21)	0.21 (0.21 - 0.21)	0.22 (0.21 - 0.22)	0.31 (0.30 - 0.31)	0.19 (0.19 - 0.20)	0.10 (0.10 - 0.10)
Any Own Children (%)	30.9 (30.75 - 30.95)	28.2 (28.11 - 28.32)	42.0 (41.71 - 42.26)	39.4 (38.99 - 39.74)	42.1 (41.57 - 42.69)	45.8 (45.19 - 46.33)
Number of Own Children	1.90 (1.90 - 1.91)	1.85 (1.85 - 1.86)	2.04 (2.03 - 2.05)	1.95 (1.93 - 1.96)	2.02 (2.00 - 2.03)	2.20 (2.18 - 2.22)
Presence of Children Under Five (%)	13.3 (13.19 - 13.34)	12.6 (12.47 - 12.63)	16.3 (16.07 - 16.49)	13.4 (13.16 - 13.68)	17.5 (17.03 - 17.89)	19.6 (19.16 - 20.07)
Number of Children 0-5	1.35 (1.34 - 1.35)	1.36 (1.35 - 1.36)	1.30 (1.30 - 1.31)	1.32 (1.30 - 1.33)	1.30 (1.29 - 1.32)	1.29 (1.28 - 1.31)
Presence of Children 5-10 (%)	12.5 (12.42 - 12.57)	11.2 (11.16 - 11.31)	17.8 (17.61 - 18.03)	15.6 (15.28 - 15.83)	17.3 (16.90 - 17.76)	21.6 (21.08 - 22.02)
Number of Children 5-10	1.27 (1.26 - 1.27)	1.27 (1.27 - 1.28)	1.25 (1.24 - 1.26)	1.25 (1.24 - 1.26)	1.26 (1.24 - 1.27)	1.24 (1.23 - 1.26)
Presence of Children 10-18 (%)	17.1 (17.06 - 17.22)	14.9 (14.79 - 14.95)	26.7 (26.48 - 26.97)	25.8 (25.51 - 26.19)	25.4 (24.95 - 25.94)	29.0 (28.48 - 29.52)
Number of Children 10-18	1.46 (1.46 - 1.46)	1.47 (1.46 - 1.47)	1.44 (1.43 - 1.45)	1.43 (1.42 - 1.44)	1.45 (1.44 - 1.47)	1.45 (1.44 - 1.47)

Finally, Table 7 shows that foreign-born essential frontline workers use shared transportation when commuting to work at higher rates than native-born essential frontline workers, leading to increased potential COVID-19 exposure risk. Table 7 shows the distribution of commuting mode choice for essential frontline workers by nativity and immigrant legal status. Results show notable disparities in public transit use. Over eight percent of foreign-born essential frontline

workers use public transit, nearly triple the proportion of native-born essential frontline workers. Still, the majority of essential frontline workers across nativity and immigrant legal status distinctions drive to work. Among those who drive to work, only about 83 percent of foreign-born essential frontline workers drive alone, compared to 90 percent of native-born essential frontline workers. On the other hand, 18 percent of foreign-born essential frontline workers carpool, nearly double the proportion of native-born essential frontline workers. Disaggregating foreign-born essential frontline workers who carpool by immigrant legal status reveals that nearly one-fourth of unauthorized essential frontline workers carpool, more than double the proportion of carpoolers in the native-born essential frontline worker population. These comparisons highlight the increased potential exposure risks that foreign-born essential frontline workers, and the unauthorized in particular, sustain by sharing contained space in vehicles with other people when commuting to work.

Disparities by nativity and legal status grow more pronounced when analyzing the number of people in the carpools. Logically, potential exposure to COVID-19 increases with each additional person in the carpool, as each person may come from a different household with their own unique COVID-19 risk factors. Among those who carpool to work, 35 percent of unauthorized immigrant essential frontline workers carpool with at least two other people, compared to 31 percent of foreign-born essential frontline workers and 22 percent of native-born essential frontline workers. This suggests that among workers who carpool, larger proportions of the native-born have access to relatively safer carpools as defined by the number of passengers compared to foreign-born essential frontline workers in general and unauthorized immigrant essential frontline workers in particular.

Table 7. Transportation	All Workers	Native-born	Foreign-born	Foreign-born Breakdown		
				Naturalized	Authorized	Unauthorized
				Drives to work (%)	88.3 (88.20 - 88.34)	89.4 (89.30 - 89.45)
Drives alone (%)	88.6 (88.55 - 88.71)	90.0 (89.95 - 90.11)	82.5 (82.31 - 82.79)	87.3 (87.01 - 87.58)	81.7 (81.15 - 82.20)	75.9 (75.37 - 76.47)
Carpools (%)	11.4 (11.29 - 11.45)	10.0 (9.89 - 10.05)	17.5 (17.21 - 17.69)	12.7 (12.42 - 12.99)	18.3 (17.80 - 18.85)	24.1 (23.53 - 24.63)
<i>With one other (% of carpools)</i>	75.4 (75.07 - 75.70)	78.0 (77.62 - 78.31)	69.0 (68.33 - 69.72)	72.9 (71.87 - 73.92)	71.3 (69.92 - 72.72)	64.7 (63.42 - 65.93)
<i>With two others (% of carpools)</i>	13.8 (13.56 - 14.06)	12.6 (12.36 - 12.92)	16.7 (16.14 - 17.27)	15.4 (14.52 - 16.18)	16.2 (15.09 - 17.37)	18.1 (17.05 - 19.07)
<i>With three or more (% of carpools)</i>	10.8 (10.57 - 11.03)	9.4 (9.15 - 9.64)	14.3 (13.74 - 14.80)	11.8 (11.01 - 12.50)	12.5 (11.43 - 13.47)	17.3 (16.27 - 18.26)
Takes public transport to work (%)	4.2 (4.20 - 4.29)	3.2 (3.20 - 3.29)	8.3 (8.11 - 8.43)	7.2 (7.03 - 7.45)	9.9 (9.59 - 10.31)	8.6 (8.23 - 8.90)
Takes other transport to work (%)	4.3 (4.23 - 4.33)	4.1 (4.05 - 4.15)	5.0 (4.88 - 5.13)	3.4 (3.26 - 3.55)	6.1 (5.85 - 6.43)	6.5 (6.22 - 6.80)
Worked at home (%)	3.1 (3.01 - 3.09)	3.1 (3.06 - 3.15)	2.8 (2.74 - 2.94)	3.0 (2.90 - 3.18)	3.3 (3.11 - 3.54)	2.2 (2.02 - 2.37)

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