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Immigrant Legal Status among Essential Frontline Workers in the U.S. during the COVID-19 Pandemic Era

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Introduction

Emerging evidence suggests that the COVID-19 pandemic has extracted a disproportionate toll on immigrant communities in the U.S. Media accounts highlight the way that low-wage immigrant workers in a variety of industries have been ravaged by COVID-19 (Swanson, Yaffe-Bellany, and Corkery 2020; Tully 2020). Epidemiological studies indicate high rates of COVID-19 infection and mortality among racial and ethnic minorities in general (Figueroa et al. 2020; Gross et al. 2020; Holtgrave et al. 2020), including immigrants (Garcia et al. 2021; Rodriguez-Diaz et al. 2020; Strully, Yang, and Liu 2021). The fact that immigrants often lack access to health insurance and frequently live in overcrowded residential conditions that make quarantining after contracting the virus more difficult are cited as potential explanations for why COVID-19 has affected immigrants so severely (Garcia et al 2021).

An additional potential explanation for the prevalence of COVID-19 infections and mortality among immigrants in the U.S. is their disproportionate representation as workers in industries deemed essential by the U.S. government during the pandemic (Kiester and Vasquez-Merino 2021; Ramos et al. 2020). 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 in March 2020 and revised these guidelines in December 2020. 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. Some essential workers were able to work at their jobs remotely, while others, called the essential frontline workforce, needed to appear at a workplace

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and had greater potential for exposure to COVID-19 as a result. The most recent estimates indicate that immigrant workers are substantially overrepresented among essential frontline workers (Blau, Koebe, and Meyerhofer 2020).

While the characteristics of essential frontline workers in the U.S. are becoming clearer, the extent to which unauthorized immigrants are present among essential frontline workers remains relatively unexplored. An accurate assessment of the role unauthorized immigrants play as essential frontline workers is important given the centrality of unauthorized workers to key industries in the U.S. economy (e.g., construction) (Pew Charitable Trust 2015) and likely difficulties achieving high rates of COVID-19 testing and vaccination for unauthorized workers given their tendency to avoid the health care system (Hacker et al. 2015). Given the substantial vulnerability of unauthorized immigrants in any number of areas, including within the workplace, some have speculated that they are more at risk of contracting COVID-19 and may be at higher risk of severe illness compared to other groups of immigrants and those born in the U.S. (Page and Flores-Miller 2021).

Estimates of unauthorized immigrants among essential workers that do exist indicate that nearly three-quarters of unauthorized workers are classified as essential, a proportion that is substantially larger than the proportion of essential workers among native-born workers and workers from other immigrant legal statuses (Warren and Kerwin, 2020). These estimates appear to confirm some of the concerns about potential risks experienced by unauthorized immigrants during the COVID-19 pandemic. At the same time, these estimates are limited to the distribution of unauthorized immigrant workers among essential workers, rather than essential frontline workers who may face greater risk given the larger amount of time they likely spend in the workplace. In addition, existing estimates fail to explore the characteristics of unauthorized

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essential workers with enough depth to reveal the extent of their vulnerabilities to COVID-19 and their ability to mitigate the risks they may experience in the workplace. Further, the estimates are based on data from 2018, raising questions of how well they reflect the U.S. workforce during the pandemic that began in the U.S. in 2020. An estimate of unauthorized immigrants among essential frontline workers using more recent data on the labor force would provide a more accurate assessment of the role unauthorized immigrants have played in keeping the economy going during the pandemic, the potential risks they have faced from the COVID-19 pandemic, and approaches policymakers might take to improve the ability of unauthorized immigrants to avoid or recover from COVID-19.

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 use 2019 data and 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 than other published estimates of essential workers. Second, we assess how essential frontline worker status is distributed across nativity and immigrant legal status. This contribution allows us to highlight disproportionate risk experienced by foreign-born workers in general, and unauthorized immigrant workers in particular, during the COVID-19 pandemic. We assess how the demographic, 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 provide a plausible explanation for why COVID-19 mortality

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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 underscore the importance of unauthorized workers for the general functioning of the economy in the U.S.

Our analysis reveals that foreign-born workers are disproportionately represented among essential frontline workers compared 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. Our estimates of unauthorized essential frontline workers are comparable to existing estimates, but we identify greater disparities in the proportion of essential frontline workers by nativity and immigrant legal status compared to estimates made by others (Warren and Kerwin 2020). Relative to other essential frontline workers, unauthorized immigrant essential frontline workers have characteristics, such as low levels of human capital, high rates of poverty, low rates of health insurance, and a high reliance on carpools and transit for commuting, that may make mitigating the risk associated with greater potential exposure to the COVID-19 virus in the workplace more difficult.

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 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 may make mitigating the risk associated with contracting or managing COVID-19 difficult for this group of

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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.

Nativity, Immigrant Legal Status and Workforce Vulnerability

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) help to explain their over-representation in the labor force.

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 Charitable Trust 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

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vulnerable social position (Flynn, Eggerth, and Jacobson 2015; Moyce and Schenker 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). 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). 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; Moyce and Schenker 2018; Pransky 2002). Further, many immigrant workers, including unauthorized immigrant workers, do not report work-related injuries or file compensation claims for fear of contact with authorities and workplace repercussions that could include job loss (de Castro et al. 2006; Fine and Lyon 2017; Flynn, Eggerth, and Jacobson 2015; Moyce and Schenker 2018). These findings suggest low incentives for employers to improve work conditions, and may result in some employers developing a preference for immigrant workers who demonstrate a tolerance for poor work conditions and remain hard-working (Saucedo 2017).

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The COVID-19 pandemic has magnified the daily risks that immigrant workers face and represents another occupational hazard they must confront. As COVID-19 began to spread throughout the U.S. in 2020, the DHS CISA 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 severely impacted by work closures, with recent data indicating unemployment for immigrants is rising faster than unemployment for native born workers (Clark et al. 2020; Ku and Brantley 2020). This is likely driven by immigrants' underrepresentation in jobs that can be performed remotely (Couch, Fairlie, and Xu 2020; Dey et al. 2020).

On the other hand, continuing to work in person during the COVID-19 pandemic poses potential health risks for immigrant workers. Most obvious is the increased risk of potential exposure to the COVID-19 virus that accompanies interacting with others in a workplace (Kiester and Vasquez-Merino 2021; Ramos et al. 2020), a risk that may be exacerbated by cramped working conditions and inadequate ventilation found in some industries and occupations where large numbers of immigrants work. Other root causes of heightened health risks may be less obvious. For example, immigrant workers confront language barriers, cultural differences, and social exclusion factors that complicate developing a workplace safety culture that a pandemic necessitates (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 issued by the Center for Disease Control (CDC) and Occupational Safety and Health Administration's (OSHA) (Fine and Lyon 2017; Flynn, Eggerth, and Jacobson 2015; Kerwin and Warren 2020).

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The public health risks that immigrant workers face in continued in-person work during the pandemic are further compounded by societal inequities. 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, and may not have other viable modes of transportation that could reduce their interaction with others and curb COVID-19 risk (Chang et al. 2020; Clark 2020). Further, compared to native-born families, 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 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 severity of COVID-19 (Joseph et al. 2020). Many immigrant workers also lack access to public aid programs, including programs specifically aimed at supporting households during the COVID-19 pandemic, or avoid them despite eligibility due to concerns of being labelled a public charge jeopardizing their ability to adjust their status in the future (Bernstein et al. 2020; Clark 2020; Kerwin and Warren 2020).

The risks immigrant workers confront during the pandemic have public health implications for their families and communities. 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). These disparities manifest spatially, with evidence

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suggesting 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).

Existing estimates of immigrant essential workers offer insight into the magnitude of this risk and how it is spread across the U.S. workforce. Kerwin and Warren use the DHS CISA guidelines and 2018 American Community Survey (ACS) data to estimate that 69 percent of immigrant workers are essential workers, compared to 65 percent of native-born workers (2020). Unauthorized workers are more starkly overrepresented with 74 percent considered essential workers (Kerwin and Warren 2020). Blau, Koebe and Meyerhofer (2020) incorporate a classification of occupations who are unlikely to work from home and exclude workers from industries that were partially or completely shutdown as the pandemic began to estimate the essential workers who must continue to work in person on the frontlines. Their results suggest that on average, essential frontline workers are less educated and earn low wages (Blau, Koebe and Meyerhofer 2020). This profile of essential frontline workers is consistent with analyses of telework feasibility during the pandemic, which suggests that those with the ability to work remotely tend to be white, highly educated and highly paid, while racial 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; Dingel and Neiman 2020).

Data and Methods

Since it is the most recent nationally-representative data available and was collected before the economy reacted to the arrival of the COVID-19 pandemic, we use data from the 2019 American Community Survey (ACS) to estimate and describe the characteristics of the essential

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frontline workforce in the U.S. during the COVID-19 pandemic (Ruggles et al. 2020).[1] We augment the 2019 ACS in four ways. First, we incorporate various methods for defining essential workers in the ACS data, ultimately adopting the methodology developed by Blau, Koebe and Meyerhofer (2020). Second, we identify frontline workers (workers who likely could not work from home) by adapting the methodology used in Blau, Koebe and Meyerhofer (2020) with a finer understanding of the degree to which a worker's specific occupation is able to work remotely (Dingel and Neiman 2020). Third, we add data on the physical proximity to others that workers experience in their occupations maintained by the Occupational Information Network (O*NET) Program, a U.S. Department of Labor sponsored initiative that contains descriptive data on occupations present in the U.S. economy.[2] We use this measure as a proxy for the potential risk of exposure to COVID-19 experienced by workers in their occupations. Fourth, we implement a logical edit method used in Warren (2014) for identifying unauthorized immigrants, which allows us to describe the characteristics of unauthorized essential frontline workers and compare them to other essential frontline workers in the U.S. during the COVID-19 pandemic.

Identifying essential workers

Defining the essential workforce in the U.S. during the COVID-19 pandemic fundamentally relies on mapping DHS CISA guidance describing which industries were considered essential during the pandemic onto the industries of respondents in the ACS who reported being in the workforce. In general, scholars have identified two main approaches to designating a worker as essential. Starting with the list of identified critical infrastructure industries in the DHS CISA guidance, the first approach is to map industries deemed essential in

[1] 2020 ACS data is expected to be released in September of 2021. Other more current data sources with data during the pandemic period such as the Census Bureau's Household Pulse Survey are not suitable for our analysis because it lacks the information necessary for inferring the authorization status of an immigrant worker.

[2] https://www.onetonline.org/find/descriptor/result/4.C.2.a.3?a=1

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DHS CISA guidance as closely as possible to the North American Industry Classification System (NAICS) codes associated with a worker's job as reported in the ACS (Kearney and Pardue 2020; Blau, Koebe and Meyerhofer 2020; Montenovo et al. 2020; Gupta et al. 2020). The second approach expands on this industry classification by including occupations that might also be considered essential in other industries that do not necessarily map to the DHS CISA guidance. This approach removes occupations from industries that might not be considered essential despite the industry being listed in the DHS CISA guidance (Kerwin and Warren 2020). On the margin, these two approaches differ only by the inclusion of certain occupations within non-essential industries and the exclusion of a relatively small number of occupations within essential industries.

In this article, we use an industry-based classification methodology as developed by Blau, Koebe and Meyerhofer (2020). We identify three main definitions of essential workers who are unlikely to be able to work remotely: (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 could not work remotely (essential frontline no shutdown workers); (2) essential workers based on the federal guidance issued in March 2020 who could not work remotely (essential frontline workers); and (3) essential workers based on the revised federal guidance issued in December 2020 who could not work remotely (essential frontline workers expanded).

In simple terms, the methodology for determining essential worker status is as follows. Starting with the DHS CISA guidelines, Blau, Koebe and Meyerhofer (2020) map the 14 categories defined as essential to 196 NAICS-defined industries out of a total of 287 industry categories (about 70 percent of all industries). Further, to identify those who were working during the beginning of the pandemic (March and April 2020), Blau, Koebe and Meyerhofer

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(2020) identify industries that were shutdown or running with limited demanded (e.g., restaurants and food services, travel services, air transportation, and certain manufacturing industries) in the early months of the pandemic (Vavra 2020). We use this mapping strategy to assign essential worker status to workers in the 2019 ACS working in essential industries not shutdown in the early months of the pandemic based on the March 2020 guidance. We then produce a second mapping by adding industries shutdown in the early months of the pandemic back into the list of essential industries. We use this mapping to identify essential workers in the 2019 ACS. Blau, Koebe and Meyerhofer (2020) then used the expanded December 2020 DHS CISA guidelines on essential industries to identify additional industries considered essential (e.g. education sector) as the pandemic evolved. We use this expanded definition of essential industries to conduct a third mapping that assigns essential worker status based on the December 2020 guidance to workers in the 2019 ACS.

Identifying frontline workers

To identify frontline workers, Blau, Koebe and Meyerhofer (2020) use pre-pandemic O*NET data to classify the feasibility of working remotely for 968 occupations defined in the O*NET-Standard Occupational Classification (SOC) taxonomy (Dingel and Neiman 2020). This approach codes occupations defined by 6-digit SOCs as 0 (cannot work remotely) or 1 (can work remotely) based on responses from two O*NET surveys, including the "Work Context Questionnaire" and the "Generalized Work Activities Questionnaire." Dingel and Neiman (2020) then aggregated the 6-digit SOC classifications into 2-digit SOC major groups, using the Bureau of Labor Statistics 2018 Occupational Employment Statistics' employment counts. If a majority of the workers within a 2-digit SOC code are considered frontline workers based on the 6-digit SOC code total employment counts, then all the workers within that 2-digit SOC code are

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considered frontline. Instead of using this 2-digit mapping approach, we take advantage of the fine grain detail available on remote work at the 6-digit SOC level. This approach allows us to identify specific occupations as frontline occupations and produce a coding scheme that more accurately identifies workers who were likely unable to work in their jobs remotely. We use this frontline occupation coding scheme at the 6-digit SOC level to determine which of the essential workers identified using the methodologies described above were also frontline workers.

Identifying context scores

The O*NET Program also maintains work context data, which measures the physical proximity to others associated with working in different occupations. The work context data are based on a survey of workers that includes the question, "To what extent does this job require the worker to perform job tasks in close proximity to other people?" Respondents provide responses ranging from 0 ("I don't work near other people (beyond 100 feet)") to 100 ("Very close (near touching)"), with responses tallied and averaged at the 6-digit SOC level.[3] We match the average work context score for occupations from these data to the reported occupations of essential frontline workers to determine the work context score for essential frontline workers in the 2019 ACS.

Identifying unauthorized immigrant workers

There are various methods for estimating the number of unauthorized adults in the US (Baker and Rytina 2012; Capps et al. 2013, 2018; Van Hook et al. 2015; Warren and Warren 2013), but in this research we use the logical edit method developed by Warren (2014) for use with ACS data. First, the population of likely authorized adults is derived using the following

[3] Work context data are available at the following website: https://www.onetonline.org/find/descriptor/result/4.C.2.a.3?a=1 (accessed on May 25, 2021).

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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, population controls based on country of origin and year of U.S. entry are estimated using the statistics from the Statistical Yearbooks from the Department of Homeland Security (DHS). These controls estimate the population of likely unauthorized adults by 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, using these population controls, these proportions are used to randomly select those in the ACS that were not included in the provisional estimate of the population of likely authorized adults. Ultimately, these steps result in a set of likely unauthorized immigrants such that their total populations closely match the population controls. A fourth and final step adjusts the ACS population weights to account for the underreporting to the ACS with a higher underreporting adjustment given to those who more recently migrated to the US (i.e., recently migrated respondents are less likely to respond to the ACS than those who have lived in the US longer).

Analytic Methods

Our analysis produces a set of descriptive statistics for essential frontline workers using population weights that have been adjusted for underreporting of unauthorized immigrants (sensitivity analysis using non-adjusted weights are available upon request). Following Blau, Koebe and Meyerhofer (2020), the final analytic sample is all essential workers (which varies

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depending on the definition used) who reported working during the previous calendar year.[4] As part of our sensitivity analysis, we examine how other methodologies for defining frontline workers affect our results (Appendix Table 1). We present our results in a set of tables that reveal our estimates for the number of essential frontline workers and how these workers are distributed across nativity and immigrant legal status, and the industry, demographic, human capital, socioeconomic, family composition, and commuting characteristics of essential frontline workers by nativity and immigrant legal status.

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, foreign-born workers are disproportionately classified as essential frontline workers relative to native-born

[4] WORKEDYR indicates whether the person had worked at all for profit, pay, or as an unpaid family worker during the previous year. For the census samples, the reference period is the previous calendar year; for the ACS and the PRCS, the reference period is the preceding 12 months.

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workers, with disparities ranging from a 5.8 percentage point difference to an 8.5 percentage point difference depending upon the definition.

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 and authorized non-citizens who are essential frontline workers is only slightly 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 immigrant workers. The disproportionate representation of unauthorized immigrant workers who are essential frontline workers is robust to the methodology for identifying essential workers. In Appendix Table 1, we estimate essential workers by nativity and immigrant legal status using different methodologies for identifying essential workers currently present in the literature. Across each of these methodologies, the percentage point difference between native-born and unauthorized workers ranges from 10 to nearly 25 points.

- Table 1 here -

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 in the workplace helps to explain why unauthorized workers are disproportionately represented among essential frontline workers in our estimates. Table 2 presents the distribution of essential frontline workers across major

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industry groups by nativity and immigrant legal status. In this table, and all subsequent tables we present in our analysis, we adopt the definition of essential frontline worker based on guidance issued by the federal government in December 2020. 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 relatively 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

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immigrant essential frontline workers worked in construction compared to only 10.5 percent of native-born essential frontline workers. On the other hand, 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 here -

Demographic Factors

Based on existing research that examines the association between demographic characteristics and serious illness or mortality due to COVID-19, some characteristics of foreign-born essential frontline workers, and particularly unauthorized immigrant essential frontline workers, indicate a potentially greater health risk if they contract COVID-19 compared to native-born essential frontline workers. This greater health risk is not necessarily related to work conditions that make it more difficult to maintain physical distance from others during work. As Table 3 shows, the work context score, which measures physical proximity to others associated with the working conditions of a worker's occupation, by nativity and immigrant legal status shows that contextual risk experienced by essential frontline workers is uniformly high. Given research findings indicating that males experience worse health outcomes after contracting COVID-19 (Yanez et al. 2020), the larger proportion of males among unauthorized immigrant essential frontline workers compared to the proportion of males among native-born essential frontline workers suggests greater health risks for frontline essential unauthorized immigrant 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.

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On the other hand, the age distribution among unauthorized immigrant essential frontline workers may 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). Given the propensity for workers to exit the labor force as they age, only small proportions of essential frontline workers in each group are aged 65 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 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 health 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

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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, perhaps lowering their risk of serious illness if they contract COVID-19. On the other hand, a larger proportion of unauthorized essential frontline workers are male and identify as Black or Latino, characteristics associated with having a higher risk of serious illness if an individual contracts COVID-19.

- Table 3 here -

Human Capital Factors

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

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other immigrant legal statuses, unauthorized immigrant essential frontline workers may experience difficulty navigating complex bureaucratic systems associated with obtaining vaccines, tests and healthcare services to help prevent, identify or treat COVID-19 infections (Hacker et al. 2015; Kiester and Vasquez-Merion 2021).

- Table 4 here -

Structural Inequalities

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

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poverty rates between unauthorized immigrant essential frontline workers and all other groups 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 potentially dire financial consequences associated with missing work (Kiester and Vasquez-Merino 2021; Page and Flores-Miller 2021).

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

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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 here -

Family Structure

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.

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Trends in family composition also indicate that unauthorized essential frontline workers may face heightened stressors in their home life. Table 6 shows that nearly half 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 about 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 11 percent of native-born essential frontline workers have children between the ages of five and ten at home, nearly 22 percent 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 here ---

Commute Mode Choice

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.

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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. Some recent literature points to the significance of transmission via respiratory droplets in crowded and confined spaces, in particular if passengers are not wearing masks (Luo et al. 2020) and considering variation in mask quality, the challenge of maintaining six feet distance on some transit, and new and more transmissible COVID-19 variants (Edwards et al. 2021). 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. These comparisons highlight the increased potential exposure risks that foreign-born essential frontline workers, and the unauthorized in particular, sustained 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

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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. To ensure that differences in the ability to work from home are not driving these results, we assess commute mode choice after excluding people who reported working from home and find only negligible differences in our results (results not shown).

--- Table 7 here ---

Discussion

The ongoing COVID-19 pandemic in the U.S. has clarified the importance of unauthorized workers in the economy, but also the disparate risks and vulnerabilities they face. Our analysis suggests that unauthorized workers were disproportionately represented among essential workers who were unlikely to work remotely during the COVID-19 pandemic. By acknowledging the ability of some essential workers to work remotely in our analysis, our estimates provide a more accurate assessment of which workers faced the greatest risk of exposure to COVID-19 while engaging in work than much of the existing research on essential workers. Our estimates of the proportion of unauthorized workers who are essential frontline workers is slightly lower than existing estimates of unauthorized essential workers (Warren and Kerwin 2020). However, our analysis reveals startling disparities between unauthorized workers and U.S.-born workers and workers from other immigrant legal statuses in the proportion designated as essential frontline workers. As a result, though they lack legal authorization to work in the U.S. and have been consciously excluded from some benefits designed by the federal government to support households, unauthorized workers have been instrumental in keeping the economy afloat during the COVID-19 pandemic.

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As essential frontline workers, a variety of factors magnify the vulnerability that unauthorized immigrant essential frontline workers face relative to native-born essential frontline workers and foreign-born essential frontline workers with other legal statuses. Compared to other essential frontline workers, a larger proportion of unauthorized immigrant essential frontline workers are male and over 80 percent are Latino, characteristics associated with higher risk of severe illness if a COVID-19 infection occurs. In addition, unauthorized immigrant essential frontline workers have relatively low levels of human capital and face high rates of structural inequalities, including poverty, lack of access to health insurance, overcrowded living conditions, and a high level of reliance on transit and carpooling when commuting to work, that compound the risk of potential exposure to COVID-19 that they experience in the workplace.

Thus, the prevailing characteristics of essential frontline workers also throws into sharp relief the 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 should a COVID-19 infection occur. While we do not attempt to directly link frontline essential worker status to higher rates of COVID-19 infection or mortality, these findings provide an empirical basis for a plausible explanation for the disparities in COVID-19 infection and mortality rates experienced by different racial and nativity groups (Clark et al. 2020; Garcia et al. 2021). Ultimately, our findings sharpen our understanding of the depth of the workplace vulnerabilities faced by unauthorized workers in the U.S. and point to the ethical quandary associated with relying on a set of workers who experience substantial health risks while working to keep the economy open during a pandemic, but are not legally eligible to work, often cannot advocate for basic workplace protections, and face chronic anxiety about being deported (Fine and Lyon 2017).

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There is some evidence that the centrality of unauthorized workers to the economy during the COVID-19 pandemic has created new potential avenues for immigration reform in the U.S. The estimates presented in Tables 1 and 2 indicate that unauthorized workers represented about four percent of all U.S. workers in 2019, but six percent of all essential frontline workers. In some industries over 10 percent of essential frontline workers are unauthorized, including construction (13.6 percent unauthorized) and agriculture (13.0 percent unauthorized). Stymied by decades of political polarization in the U.S. that have made immigration reform intractable, some scholars and elected officials have used the COVID-19 pandemic and emerging evidence of the importance of foreign-born workers for keeping the economy open to argue that they are owed immigration reform that includes a path to citizenship for unauthorized essential workers and their families (Citizenship for Essential Workers Act 2021; Warren and Kerwin 2020). While such a move would surely be welcome for many immigrants and immigrant advocacy organizations, it also calls into question the ethics of relying on frames of deservedness that depend upon vulnerability or economic performance for the conferral of legal status, rather than more universal claims that are less prone to favor some unauthorized immigrants over others (Chauvin and Garces-Mascarenas 2014).

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Table 1. Estimates of Essential Workers, by Nativity and Immigrant Legal Status

	All	Native-born	Foreign-born	Immigrant Legal Status		
				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						
Total Essential Workers	64,802,784	52,366,594	12,436,190	5,699,216	2,852,868	3,884,106
Percent Workers Essential	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						
Total Essential Workers	82,514,059	66,426,324	16,087,735	7,278,314	3,731,941	5,077,480
Percent Workers Essential	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						
Total Essential Workers	87,312,376	70,593,073	16,719,303	7,638,429	3,924,263	5,156,611
Percent Workers Essential	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)

Note: Universe for workers includes all persons 16 years or older who reported working in the last year. All results are population weighted and adjusted for underreporting. 95 percent confidence intervals reported in parentheses. Authors' calculations using 2019 ACS from ipums.org.

Funding from the Minnesota Population Center, grant (P2C HD041023) from the Eunice Kennedy Shriver National Institute for Child Health and Human Development NICHD.

Table 2. Estimates of Essential Frontline Workers, by Major Industry Group

	All Workers	Native-born	Foreign-born	Immigrant Legal Status		
				Naturalized	*Authorized*	*Unauthorized*
Total Essential Frontline Workers	87,312,376	70,593,073	16,719,303	7,638,429	3,924,263	5,156,611
Agriculture, Forestry, Fishing, and Hunting, and Mining (%)	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)
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)
Utilities (%)	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)
and Rental and Leasing (%)	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)
Management, and Administrative,	5.3	4.6	8.2	5.5	8.4	12.2
and Waste Management Services (%)	(5.28 - 5.38)	(4.59 - 4.69)	(8.09 - 8.40)	(5.31 - 5.66)	(8.07 - 8.70)	(11.85 - 12.60)
and Social Assistance (%)	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)
Accommodation and Food Services (%)	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)
Administration (%)	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)

Funding from the Minnesota Population Center, grant (P2C HD041023) from the Eunice Kennedy Shriver National Institute for Child Health and Human Development NICHD.

Note: Industry breakdown using the 2017 Census industrial classification system. Universe for workers includes all essential frontline workers based on December 2020 federal guidance who reported working in the last year. All results are population weighted and adjusted for underreporting. 95 percent confidence intervals reported in parentheses. Authors' calculations using 2019 ACS from ipums.org.

Table 3. Demographic Characteristics of Essential Frontline Workers, by Nativity and Immigrant Legal Status

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

Note: Universe for workers includes all essential frontline workers based on December 2020 federal guidance who reported working in the last year. All results are population weighted and adjusted for underreporting. 95 percent confidence intervals reported in parentheses. Authors' calculations using 2019 ACS from ipums.org.

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Table 4. Human Capital Characteristics of Essential Frontline Workers, by Nativity and Immigrant Legal Status

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

Note: Universe for workers includes all essential frontline workers based on December 2020 federal guidance who reported working in the last year. All results are population weighted and adjusted for underreporting. 95 percent confidence intervals reported in parentheses. Authors' calculations using 2019 ACS from ipums.org.

Funding from the Minnesota Population Center, grant (P2C HD041023) from the Eunice Kennedy Shriver National Institute for Child Health and Human Development NICHD.

Table 5. Socioeconomic Characteristics of Essential Frontline Workers, by Nativity and Immigrant Legal Status

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

Note: Universe for workers includes all essential frontline workers based on December 2020 federal guidance who reported working in the last year. All results are population weighted and adjusted for underreporting. 95 percent confidence intervals reported in parentheses. Authors' calculations using 2019 ACS from ipums.org.

Funding from the Minnesota Population Center, grant (P2C HD041023) from the Eunice Kennedy Shriver National Institute for Child Health and Human Development NICHD.

Table 6. Family Composition Characteristics of Essential Frontline Workers, by Nativity and Immigrant Legal Status

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

Note: Universe for workers includes all essential frontline workers based on December 2020 federal guidance who reported working in the last year. All results are population weighted and adjusted for underreporting. 95 percent confidence intervals reported in parentheses. Authors' calculations using 2019 ACS from ipums.org.

Funding from the Minnesota Population Center, grant (P2C HD041023) from the Eunice Kennedy Shriver National Institute for Child Health and Human Development (NICHD).

Table 7. Commute Mode Choice of Essential Frontline Workers, by Nativity and Immigrant Legal Status

	All Workers	Native-born	Foreign-born	Immigrant Legal Status		
				Naturalized	*Authorized*	*Unauthorized*
Drives to work (%)	88.3	89.4	83.8	86.2	80.5	82.7
	(88.20 - 88.34)	(89.30 - 89.45)	(83.58 - 84.01)	(85.93 - 86.48)	(80.00 - 80.96)	(82.22 - 83.12)
Drives alone (%)	88.6	90.0	82.5	87.3	81.7	75.9
	(88.55 - 88.71)	(89.95 - 90.11)	(82.31 - 82.79)	(87.01 - 87.58)	(81.15 - 82.20)	(75.37 - 76.47)
Carpools (%)	11.4	10.0	17.5	12.7	18.3	24.1
	(11.29 - 11.45)	(9.89 - 10.05)	(17.21 - 17.69)	(12.42 - 12.99)	(17.80 - 18.85)	(23.53 - 24.63)
With one other (% of carpools)	75.4	78.0	69.0	72.9	71.3	64.7
	(75.07 - 75.70)	(77.62 - 78.31)	(68.33 - 69.72)	(71.87 - 73.92)	(69.92 - 72.72)	(63.42 - 65.93)
With two others (% of carpools)	13.8	12.6	16.7	15.4	16.2	18.1
	(13.56 - 14.06)	(12.36 - 12.92)	(16.14 - 17.27)	(14.52 - 16.18)	(15.09 - 17.37)	(17.05 - 19.07)
With three or more (% of carpools)	10.8	9.4	14.3	11.8	12.5	17.3
	(10.57 - 11.03)	(9.15 - 9.64)	(13.74 - 14.80)	(11.01 - 12.50)	(11.43 - 13.47)	(16.27 - 18.26)
Takes public transport to work (%)	4.2	3.2	8.3	7.2	9.9	8.6
	(4.20 - 4.29)	(3.20 - 3.29)	(8.11 - 8.43)	(7.03 - 7.45)	(9.59 - 10.31)	(8.23 - 8.90)
Takes other transport to work (%)	4.3	4.1	5.0	3.4	6.1	6.5
	(4.23 - 4.33)	(4.05 - 4.15)	(4.88 - 5.13)	(3.26 - 3.55)	(5.85 - 6.43)	(6.22 - 6.80)
Worked at home (%)	3.1	3.1	2.8	3.0	3.3	2.2
	(3.01 - 3.09)	(3.06 - 3.15)	(2.74 - 2.94)	(2.90 - 3.18)	(3.11 - 3.54)	(2.02 - 2.37)

Note: Universe for workers includes all essential frontline workers based on December 2020 federal guidance who reported working in the last year. All results are population weighted and adjusted for underreporting. 95 percent confidence intervals reported in parentheses. Authors' calculations using 2019 ACS from ipums.org.

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Appendix Table 1. Estimates of Essential Workers Using Different Definitions, by Nativity and Immigrant Legal Status

	All Workers	Native-born	Foreign-born	Immigrant Legal Status		
				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						
Total Essential Workers	64,802,784	52,366,594	12,436,190	5,699,216	2,852,868	3,884,106
Percent Workers Essential	37.1%	36.1%	41.9%	37.9%	39.3%	52.8%
Blau et al. (2020) Frontline No Shutdown						
Total Essential Workers	62,342,422	50,184,164	12,158,258	5,496,841	2,805,056	3,856,361
Percent Workers Essential	35.7%	34.6%	41.0%	36.6%	38.6%	52.5%
Essential Frontline						
Total Essential Workers	82,514,059	66,426,324	16,087,735	7,278,314	3,731,941	5,077,480
Percent Workers Essential	47.2%	45.8%	54.3%	48.4%	51.4%	69.1%
Blau et al. (2020) Frontline						
Total Essential Workers	78,339,454	62,863,155	15,476,299	6,890,924	3,607,579	4,977,796
Percent Workers Essential	44.9%	43.4%	52.2%	45.8%	49.7%	67.7%
Essential Frontline Expanded						
Total Essential Workers	87,312,376	70,593,073	16,719,303	7,638,429	3,924,263	5,156,611
Percent Workers Essential	50.0%	48.7%	56.4%	50.8%	54.0%	70.2%
Blau et al. (2020) Frontline Expanded						
Total Essential Workers	83,110,924	67,015,297	16,095,627	7,247,821	3,792,395	5,055,411
Percent Workers Essential	47.6%	46.2%	54.3%	48.2%	52.2%	68.8%
Kerwin and Warren (2020)						
Total Essential Workers	77,888,627	62,575,106	15,313,521	6,919,138	3,577,966	4,816,417
Percent Workers Essential	44.6%	43.2%	51.6%	46.0%	49.2%	65.5%
Kearney and Pardue (2020)						
Total Essential Workers	64,590,723	52,292,200	12,298,523	5,888,367	2,865,099	3,545,057
Percent Workers Essential	37.0%	36.1%	41.5%	39.2%	39.4%	48.2%

Note: Universe for workers includes all persons 16 years or older who reported working in the last year. All results are population weighted and adjusted for underreporting. 95 percent confidence intervals reported in parentheses. Authors' calculations using 2019 ACS from ipums.org.

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