Immigrant Legal Status among Essential Frontline Workers in the United States during the COVID-19 Pandemic Era

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Abstract

Emerging evidence suggests that the COVID-19 pandemic has extracted a substantial toll on immigrant communities in the United States, due in part to increased potential risk of exposure for immigrants to COVID-19 in the workplace. In this article, we use federal guidance on which industries in the United States were designated essential during the COVID-19 pandemic, information about the ability to work remotely, and data from the 2019 American Community Survey to estimate the distribution of essential frontline workers by nativity and immigrant legal status. Central to our analysis is a proxy measure of working in the primary or secondary sector of the segmented labor market. Our results indicate that a larger proportion of foreign-born workers are essential frontline workers compared to native-born workers and that 70 percent of unauthorized immigrant workers are essential frontline workers. Disparities in essential frontline worker status are most pronounced

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for unauthorized immigrant workers and native-born workers in the secondary sector of the labor market. These results suggest that larger proportions of foreign-born workers, and especially unauthorized immigrant workers, face greater risk of potential exposure to COVID-19 in the workplace than native-born workers. Social determinants of health such as lack of access to health insurance and living in overcrowded housing indicate that unauthorized immigrant essential frontline workers may be more vulnerable to poor health outcomes related to COVID-19 than other groups of essential frontline workers. These findings help to provide a plausible explanation for why COVID-19 mortality rates for immigrants are higher than mortality rates for native-born residents.

Keywords
essential workers, COVID-19, segmented labor market, social determinants of health, unauthorized immigration

Introduction

Emerging evidence suggests that the COVID-19 pandemic has exacted a disproportionate toll on immigrant communities in the US. State-level analyses of death certificates find age-adjusted COVID-19 mortality rates among foreign-born populations that exceed those of the native-born, especially among Latino immigrants (Garcia et al. 2021; Horner, Wrigley-Field and Leider 2022). The disparate mortality rates identified in these studies fit within the broader picture painted by epidemiological studies that 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 (Rodriguez-Diaz et al. 2020; Strully, Yang and Liu 2021).

One potential explanation for the prevalence of COVID-19 infections and mortality among immigrants in the United States is their disproportionate representation as workers in industries deemed essential by the US government during the pandemic (Kiester and Vasquez-Merino 2021; Lyttelton and Zang 2022; 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 US 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. Essential workers reported to work during times when stay-at-home orders were in effect and may have experienced greater risk of

exposure to COVID-19 through workplace interactions compared to non-essential workers. The most recent estimates indicate that immigrant workers are overrepresented among workers considered essential by government guidelines in the United States (Blau, Koebe and Meyerhofer 2021).

It is unlikely that all essential workers were equally at risk of exposure to COVID-19 while working. As suggested by segmented labor market theory, labor markets in developed industrial economies are divided into primary and secondary labor markets (Doeringer and Piore 1971). Characterized by high skilled, high wage jobs, the primary labor market confers greater prestige and power to workers than the low skilled, low wage jobs of the secondary labor market (Piore 1986). Immigrants are distributed across the primary and secondary sectors of the labor market but are disproportionately represented in the secondary sector (Piore 1986). In the context of the COVID-19 pandemic the concentration of immigrants in the secondary sector matters because relative to workers in the primary sector those in the secondary sector have less ability to influence working conditions, including mitigating the risk of exposure to COVID-19 while working (Goldman et al. 2021). For example, work in the secondary sector is often defined by manual labor that is specific to a workplace, making remote work less feasible for these workers. Workers in the secondary sector may lack the power to advocate for adjustments to the workplace that would make access to personal protective equipment, physical distancing, and other COVID-19 mitigation measures possible. In contrast, the knowledge-intensive work that defines the primary sector makes the ability to work remotely more common in this sector, and primary sector workers may have more power to demand COVID-19 mitigation measures in the workplace.

It seems reasonable to conclude that essential workers may have experienced greater risk of exposure to COVID-19 compared to non-essential workers, with differential risk among essential workers in the secondary and primary sectors. This conclusion is supported by the finding that sickness-related absences believed to be caused by COVID-19 increased dramatically in 2020 during the early months of the pandemic in occupations with characteristics typically associated with the secondary sector, such as an inability to work remotely, low wages, and workers disproportionately comprised of racial minorities and immigrants (Lyttelton and Zang 2022). Part of the explanation for disparities in COVID-19 mortality rates between immigrants and the native-born may be due to differences in essential worker status and other circumstances of employment that resulted in immigrant workers bearing more risk of exposure to COVID-19 than native-born workers (Kiester and Vasquez-Merino 2021; Page and Flores-Miller 2021; Ramos et al. 2020).

Compounding the increased risk of potential exposure to COVID-19 faced by immigrant workers are the social and economic circumstances faced by these workers that could complicate their ability to treat their illness or reduce the risk of exposing others if they become infected with COVID-19. Literature on the

social determinants of health argues that factors such as income, educational attainment, neighborhood conditions, and immigration status are important sources of stratification in society that directly and indirectly influence the health status of individuals (Castañeda et al. 2015). Among immigrants, those without authorization to be in the United States may face even greater disadvantages in health outcomes given their low socioeconomic standing, lack of access to health insurance, and precarious legal status that could dissuade them from seeking health care (Asad and Clair 2018; Marrow and Joseph 2015).

Immigrants, and particularly unauthorized immigrants, may face a double jeopardy during the COVID-19 pandemic. First, social and economic characteristics related to their status as immigrants are more likely to channel them into work in the secondary sector. When paired with essential worker status, work in the secondary sector of the labor market may increase the risk of exposure to COVID-19 for immigrants. Second, many of the same social and economic characteristics that help to channel immigrants into the secondary sector of the labor market are also linked to poor health outcomes. Of particular concern during the COVID-19 pandemic is the fact that immigrants are less likely to have health insurance, more likely to have incomes below the poverty line, and more likely to live in overcrowded conditions or multigenerational households than native-born residents. These factors may make treating a COVID-19 infection and preventing the spread of COVID-19 more difficult for immigrants relative to native-born residents (Hacker et al. 2015; Page and Flores-Miller 2021).

In this article, our primary contribution is an estimate of essential frontline workers (EFWs) across nativity and immigrant legal status, considering the occupational standing of workers. By "frontline," we mean workers who were unlikely to be able to work remotely. To date, scholars have provided estimates of EFWs by occupational standing (Goldman et al. 2021) and estimates of essential workers by nativity and immigrant legal status (Kerwin and Warren 2020), but we still lack an understanding of the role that immigrants have played as EFWs across different groups of occupational standing. Our research results indicate that foreign-born workers are disproportionately represented among EFWs compared to native-born workers, and that unauthorized immigrants are dramatically overrepresented among EFWs. Drawing on segmented labor market theory (Piore 1986), we account for EFW sorting into the primary and secondary labor markets with results indicating even wider gaps between estimates of native and foreign-born EFWs working in the secondary labor market. Finally, and informed by literature on social determinants of health, we assess how social and economic characteristics of foreign-born and particularly unauthorized immigrant EFWs, such as lack of access to health insurance, poverty, and living in overcrowded housing, may complicate their ability to manage the risks associated with potential exposure to the COVID-19 virus in the workplace. Though we stop short of making a causal argument that links EFW status to higher COVID-19 mortality rates, our analysis helps to provide a plausible explanation for why COVID-19 mortality rates for immigrants

are higher than mortality rates for native-born residents (Garcia et al. 2021; Horner, Wrigley-Field and Leider 2022) and indicates a more pronounced risk around COVID-19 for immigrant workers than suggested in the existing literature (Kerwin and Warren 2020).

The remainder of this article proceeds in four sections. We first review the literature on the segmented labor market and social determinants of health, with a focus on immigrants and unauthorized immigrants, and connect these literatures to the existing state of knowledge on the essential worker designation in the United States during the COVID-19 pandemic. Second, we introduce our methodology and the data we use to estimate the size, composition, and characteristics of the essential frontline workforce. Third, we present the results of our analysis, highlighting the distribution of nativity and immigrant legal status across EFWs and characteristics of EFWs that may make mitigating the risk associated with contracting or managing COVID-19 difficult for immigrant EFWs. Fourth, we conclude with a discussion of how our results contribute to a deeper understanding of the vulnerability of immigrant workers, with a particular focus on unauthorized workers.

Nativity, Immigrant Legal Status, and Workforce Vulnerability

Although immigrants are overrepresented in the US workforce (Bureau of Labor Statistics 2020), their position is not equal to that of native-born workers in the context of the segmented labor market that characterizes the United States. As a common characteristic of developed industrial economies, segmented labor markets are composed of primary and secondary labor markets (Doeringer and Piore 1971). The primary labor market includes jobs based on knowledge-intensive work that is compensated with high wages, elevated social status, and stable employment. In contrast, the secondary sector is more likely to involve low-skilled, manual labor that commands low wages, lesser social status, and unstable work. There is a large proportion of immigrants in the United States without a high school degree; thus, many immigrants are sorted into the secondary sector of the labor market and earn low wages with limited prospects for positive economic mobility (Hudson 2007; Piore 1986; Portes 2020). This is especially true for unauthorized immigrant workers, whose low levels of educational attainment are compounded by their precarious legal status, making them less likely to engage in high-skilled employment (De Genova 2002; Portes 2020). Unauthorized workers most directly bear the vulnerability imposed by the state creation of migrant illegality, but the racialization of immigrant legal status means that other members of a racial or ethnic group associated with unauthorized legal status also experience spillover effects in the labor market (Asad and Clair 2018; De Genova 2002). Immigrant workers' perceived or actual legal status often means they have few employment choices outside

of the secondary sector of the labor market and must tolerate the poor working conditions typically found there (Saucedo 2017; Sisk and Donato 2016). Working in the secondary sector, including in the informal economy where there are few legal protections, may be especially common for unauthorized immigrant workers, making the work they perform even more precarious.

Risky conditions in secondary sector workplaces combined with immigrant workers' disadvantaged social positions have negative effects on immigrant workers' health and safety. Immigrants are more likely to work in jobs with high injury rates and face higher rates of occupational injury and fatality on the job than native-born residents (Hall and Greenman 2015; Moyce and Schenker 2018; Orrenius and Zavodny 2009). Immigrant workers' social position compounds their vulnerability to occupational hazards. Structural racism impacts immigrants' ability to mitigate health and safety risks, as health-enhancing resources like money, prestige, and freedom are disproportionately granted to White US-born populations (Castañeda et al. 2015; Phelan and Link 2015). For instance, when confronting risks in the workplace, immigrants lack access to occupational safety and health training due to their contingent work nature, as well as language and literacy differences, and may not report work-related injuries for fear of contact with authorities or the threat of 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).

The COVID-19 pandemic has magnified the daily risks that immigrant workers face and represents another occupational hazard they must confront with resources limited by structural racism and, in the case of unauthorized immigrants, precarious legal status. As COVID-19 began to spread throughout the United States 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 were overrepresented in the work sectors considered essential (Gelatt 2020; Kerwin and Warren 2020). An obvious risk during the COVID-19 pandemic is the potential exposure to the COVID-19 virus that accompanies interacting with others in a workplace (Kiester and Vasquez-Merino 2021; Ramos et al. 2020). The risk of exposure to COVID-19 may be exacerbated by employment in occupations that involve working near others—common for large numbers of immigrants (Lyttelton and Zang 2022)—and work that includes frequent exposure to disease or infectious agents (Baylis et al. 2022). Other root causes of heightened health risks during the pandemic 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 or making claims on legal rights regarding their health and safety (Fine and Lyon 2017; Skiba 2020).

Social determinants of health help to explain the structural conditions that constrain immigrant workers' ability to mitigate COVID-19 risk and poor health outcomes that may result. Racism and socioeconomic status are two fundamental determinants of health that shape access to health-enhancing resources, as well as exposure to health risks in working and living conditions (Phelan and Link 2015). Immigrant status influences health outcomes by systematically excluding individuals from health-protective resources (Perreira and Pedroza 2019) and layering on burdens that increase psychosocial stressors, such as living with the daily possibility of deportation for unauthorized immigrants (Castañeda et al. 2015). As social determinants of health, racism and immigration status work in tandem since the experience of most immigrants in the United States is deeply racialized and the distribution of unauthorized immigrant legal status disproportionately affects racial and ethnic minorities (Asad and Clair 2018).

Recent research on immigrants and COVID-19 provides examples of the impacts of the social determinants of health. 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 lessen COVID-19 risk (Chang et al. 2020; Clark et al. 2020). Further, compared to native-born families, immigrant families often live in multi-generational households and tend to live in more crowded housing, making quarantining difficult if someone contracts the virus (Clark et al. 2020; Kerwin and Warren 2020). Immigrants are uninsured at high rates (Clark et al. 2020; Gelatt 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 labeled a public charge and jeopardizing their ability to adjust their status in the future (Clark et al. 2020; Kerwin and Warren 2020).

The risks immigrant workers confronted 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 (Figueroa et al. 2020; Holtgrave et al. 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 Latino adults compared to their White counterparts (Holtgrave et al. 2020). These disparities manifest spatially, with evidence 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).

Some scholars have also speculated that an overrepresentation of immigrants as essential workers has played a role in exposing them to COVID-19 and widening disparities in COVID-19 infection and mortality rates between immigrants and native-born residents (Kiester and Vasquez-Merino 2021; Ramos et al. 2020). Existing estimates of essential workers during the COVID-19 pandemic offer insight into the magnitude of this potential risk and how it is spread across the US workforce. Kerwin and Warren (2020) 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. Blau, Koebe and Meyerhofer (2021) incorporate a classification of occupations who are unlikely to work from home and exclude workers from industries that were partially or completely shut down as the pandemic began to estimate the EFWs who must continue to work in person. Their results suggest that on average, EFWs have lower educational attainment, earn lower wages, and are more likely to be racial minorities and immigrants than workers not classified as essential frontline (Blau, Koebe and Meyerhofer 2021). Other estimates focus on frontline workers and incorporate nuanced measures of potential risk of exposure to COVID-19 given differences in work context, including occupational standing, and the type of labor that workers engage in while working (Goldman et al. 2021). While Goldman et al. (2021) do not incorporate nativity or immigrant legal status into estimates of frontline workers, their results indicate that Black and Latino frontline workers are more concentrated in low prestige occupations than White frontline workers and speculate they face higher risk of COVID-19 exposure as a result.

Estimates of unauthorized immigrants among essential workers are rare, but those that do exist indicate that 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 (Kerwin and Warren 2020). These estimates are limited to the distribution of unauthorized immigrant workers among essential workers, rather than EFWs who may face greater risk given the larger amount of time they spend in the workplace. Further, the estimates are based on data from 2018, raising questions of how well they reflect the US workforce during the pandemic that began in the United States in 2020. Estimates of nativity and immigrant legal status among EFWs using data on the labor force immediately before the pandemic began would provide a more accurate assessment of the role unauthorized immigrants have played in keeping the economy going during the early stages of the pandemic, the potential risks they have faced from the COVID-19 pandemic. These estimates would also help to assess how the pandemic is related to existing disadvantages in the secondary labor market and social determinants of health for immigrants.

Data and Methods

Since it 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 frontline workforce in the United States during the early stages of the COVID-19 pandemic (Ruggles et al. 2021).[1] The ACS is a nationally-representative annual survey that includes data on nearly 3.5 million people per year and covers a broad range of questions including, but not limited to, educational attainment, income, employment, place of birth, and housing characteristics. We augment the 2019 ACS data in five ways. First, we identify essential workers in the ACS data by adopting the methodology developed by Blau, Koebe and Meyerhofer (2021). Second, we identify frontline workers (workers who likely could not work from home) by adapting the methodology used in Blau, Koebe and Meyerhofer (2021) 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 US Department of Labor sponsored initiative that contains descriptive data on occupations present in the US 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 incorporate a measure of occupational standing that we use as a proxy for working in the primary and secondary sectors of the labor market. Fifth, we implement a logical edit method used in Warren (2014) for identifying unauthorized immigrants, which allows us to describe the characteristics of unauthorized EFWs and compare them to other EFWs in the United States during the COVID-19 pandemic.

Identifying Essential Workers

Defining the essential workforce in the United States during the COVID-19 pandemic fundamentally relies on mapping DHS CISA guidance describing which

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[1] The 2019 ACS provides the most accurate picture of the labor workforce at the onset of the pandemic. More current ACS data from 2020 is not suitable for our analysis because it reflects the substantial dislocation of workers and therefore would provide a skewed perspective on the profile of EFWs. Furthermore, the pandemic had a drastic impact on the data collection of the 2020 ACS resulting in a substantial decrease in response rates that was highest for under-represented populations (Shin et al. 2021). While the Census Bureau provides experimental weights that correct for these biases, their methodology for correcting bias does not consider the unauthorized immigration status of a respondent (Rothbaum et al. 2021). As a result, it is unclear how reliable the 2020 ACS with experimental weights will be for estimates of the unauthorized immigrant population. For these reasons, this study does not present results with 2020 ACS data.

[2] Following Dingel and Neiman (2020), we use the 24.2 release of the O*NET database: https://www.onetonline.org/

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 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 (Blau, Koebe and Meyerhofer 2021; Gupta et al. 2022; Kearney and Pardue 2020; Montenovo 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 small number of occupations within essential industries.

In this article, we use an industry-based classification methodology developed by Blau, Koebe and Meyerhofer (2021) and revised federal guidance on essential industries from December 2020 to identify essential workers who are unlikely to be able to work remotely. Starting with the DHS CISA guidelines, Blau, Koebe and Meyerhofer (2021) 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 (2021) identify industries that were shut down 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 shut down 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 and use this mapping to identify a second estimate of essential workers in the 2019 ACS. Blau, Koebe and Meyerhofer (2021) 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. This last mapping forms the basis of the analysis we present in this article, though we include the other estimates based on the first two mappings in Appendix Table A1 to illustrate how the population of essential workers changed as the COVID-19 pandemic evolved.

Identifying Frontline Workers

To identify frontline workers, Blau, Koebe and Meyerhofer (2021) 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 most 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 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 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 Proximity Scores

The O*NET Program also maintains work proximity data, which measures the physical distance from others associated with working in different occupations. The work proximity 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 could select from five possible answers: 0 ("I don't work near other people (beyond 100 feet)"), 25 ("I work with others but not closely (e.g., private office)"), 50 ("Slightly closely (e.g., shared office)"), 75 ("Moderately closely (at arm's length)"), and 100 ("Very close (near touching)"). Survey responses were tallied and averaged at the 6-digit SOC level.[3] In line with analysis from other scholars (Goldman et al. 2021), we match the average work proximity score for occupations from these data to the reported occupations of EFWs to determine the work proximity score for EFWs in the 2019 ACS.

Identifying Primary and Secondary Sector Workers

We estimate a proxy measure of working in the primary and secondary sectors of the labor market based on occupational standing. Following a logic developed by

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[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).

Goldman et al. (2021), we divide the occupations reported by workers in the 2019 ACS into quartiles based on the percent of all workers in each occupation who reported completing at least one year of college education.[4] It is important to note that this approach divides occupations into four groups with approximately 25 percent of occupations in each, rather than 25 percent of workers. We then assign an occupational standing quartile value to each EFW based on their reported occupation. Using this scheme, EFWs with occupational standing in the bottom two quartiles approximate the secondary sector, while EFWs with occupational standing in the top two quartiles approximate the primary sector. Though it is straightforward to define the primary and secondary sectors of the labor market using this method, it is admittedly simplistic given the complexity inherent to defining sectors in segmented labor markets (Hudson 2007). In anticipation of this criticism and in hopes of drawing a clearer distinction between the primary and secondary sectors, we emphasize the top quartile of occupational standing as the clearest approximation of the primary sector and the bottom quartile of occupational standing as most representative of the secondary sector when discussing the results of our analysis.

Identifying Unauthorized Immigrant Workers

There are various methods for estimating the number of unauthorized adults in the United States (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. The general methodology has four steps. First, 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 (examples of these nonimmigrants include students, foreign government officials, and temporary workers and families), having immediate relatives (spouse of a US citizen, unmarried child (under 21 years) of a US citizen, parent of a US citizen who is at least 21 years old, or an orphan adopted abroad or in the US by a US citizen) in the United States,[5] receipt of public benefits (SSI, TANF, etc.), age 60

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[4]We rely on the EDSCOR90 variable from IPUMS USA for this analysis (Ruggles et al., 2021).

[5]These noncitizens are assumed to be legal residents because the citizenship status of their immediate relatives likely allows them to become lawful permanent residents. Since the goal of the logical edit is to remove noncitizens who are *likely* to be authorized and the waiting period for immediate relatives of US citizens is considerably shorter than other family preference categories, these noncitizens are assumed to be authorized. The exceptions to this logical edit are noncitizens from El Salvador, Guatemala, Honduras, and Mexico who arrived after 2000. Noncitizens from these countries are more likely to have entered the US without inspection and therefore likely subject to the 3- and 10-year bars. For more information on the underlying logic of these edits, see Warren (2014).

or older at US entry (research shows that a low percentage of unauthorized immigrants are 55 years and older), and originating from a likely refugee sending country. Importantly, these sets of logical edits are not intended to capture the idiosyncrasies of every noncitizen's particular situation but are intended to find the general population of noncitizens who are *likely* to be authorized based on the characteristics available in the ACS. Second, population controls based on country of origin and year of US 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. 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 United States (i.e., recently migrated respondents are less likely to respond to the ACS than those who have lived in the United States longer).

Analytic Methods

Our analysis produces a set of descriptive statistics for EFWs 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 (2021), the final analytic sample is all frontline essential workers who reported working during the previous calendar year.[6] As part of our sensitivity analysis, we examine how other methodologies for defining frontline workers affect our main results on the distribution of frontline essential worker status by nativity and immigrant legal status (Appendix Table A1). We present our results in a set of tables that reveal our estimates for the number of EFWs and how these workers are distributed across nativity and immigrant legal status. Given our interest in understanding the distribution of EFWs in the context of the segmented labor market and informed by social determinants of health, we examine select social, economic, and household characteristics of EFWs associated with economic and health vulnerability stratified by occupational standing quartile.

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

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

	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 porkers	174,638,559	144,986,115	29,652,443	15,036,871	7,265,679	7,349,893
Essential frontline workers						
Total essential frontline workers	87,312,376	70,593,073	16,719,303	7,638,429	3,924,263	5,156,611
Percent workers essential frontline	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 with 95 percent confidence intervals reported in parentheses. Authors' calculations using 2019 ACS from ipums.org.

Results

Table 1 presents estimates of the number and proportion of EFWs in the US economy by nativity and immigrant legal status. Based on the revised federal guidance issued in December 2020, estimates indicate that over 87 million, or 50 percent of all workers are EFWs. Foreign-born workers are disproportionately classified as EFWs relative to native-born workers, with a disparity of 7.7 percentage points. Disaggregating foreign-born workers by legal status reveals that unauthorized immigrant workers drive much of the disparity in EFW status found between native-born and foreign-born workers. The proportion of naturalized citizens and authorized non-citizens who are EFWs is only slightly higher than the proportion of native-born EFWs. In contrast, the proportion of unauthorized workers who are EFWs is almost 22 percentage points higher than the proportion of native-born EFWs.

The disproportionate representation of unauthorized immigrant workers who are EFWs is robust to different methodologies used for identifying essential workers. In Appendix Table A1, 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. Much of the variation in estimates is due to whether the estimates include industries that were shut down at the beginning of the pandemic.

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 EFWs in our estimates. Table 2 presents the distribution of EFWs across major industry groups by nativity and immigrant legal status. There are few major industry groups with disparities in the proportion of native-born and foreign-born EFWs. In the major industry groups where disparities do exist, the differences in the proportion of foreign-born EFWs and native-born EFWs are modest. For example, almost 16 percent of foreign-born EFWs worked in construction, compared to 10.5 percent of native-born EFWs. In contrast, about nine percent of foreign-born EFWs worked in retail trade compared to 14 percent of native-born EFWs. In most other major industry groups, native-born and foreign-born EFWs are closer to parity in terms of the proportion of each group working in the industries.

Disaggregating foreign-born EFWs 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 EFWs across major industry

Table 2. Industry Breakdown of Essential Frontline Workers, by Nativity and Immigrant Legal Status.

	All Workers	Native-born	Foreign-born	Foreign-born Breakdown		
				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 (3.00–3.07)	2.8 (2.77–2.85)	4.0 (3.87–4.09)	1.9 (1.77–1.97)	4.7 (4.43–4.91)	6.6 (6.30–6.87)
Construction	11.5 (11.41–11.55)	10.5 (10.39–10.53)	15.8 (15.57–15.98)	9.3 (9.03–9.48)	14.6 (14.16–14.96)	26.4 (25.85–26.86)
Manufacturing	11.5 (11.45–11.59)	11.5 (11.47–11.62)	11.4 (11.23–11.58)	12.0 (11.78–12.28)	11.2 (10.86–11.57)	10.6 (10.28–10.99)
Wholesale trade	1.6 (1.58–1.64)	1.6 (1.58–1.63)	1.6 (1.57–1.71)	1.5 (1.38–1.56)	1.7 (1.56–1.85)	1.8 (1.68–1.99)
Retail trade	13.2 (13.10–13.25)	14.1 (14.04–14.20)	9.2 (9.05–9.37)	10.5 (10.25–10.72)	9.2 (8.90–9.56)	7.3 (6.99–7.59)
Transportation and warehousing, and utilities	8.0 (7.92–8.04)	7.9 (7.83–7.96)	8.3 (8.18–8.49)	10.2 (9.92–10.39)	8.5 (8.22–8.85)	5.5 (5.22–5.75)
Information	0.7 (0.70–0.74)	0.8 (0.76–0.80)	0.5 (0.43–0.50)	0.6 (0.55–0.67)	0.5 (0.38–0.53)	0.3 (0.19–0.31)
Finance and insurance, and real estate, and rental and leasing	1.8 (1.76–1.82)	1.8 (1.81–1.87)	1.6 (1.51–1.64)	2.0 (1.87–2.08)	1.5 (1.34–1.62)	1.1 (0.94–1.17)
Professional, scientific, and management, and administrative, and waste management services	5.3 (5.28–5.38)	4.6 (4.59–4.69)	8.2 (8.09–8.40)	5.5 (5.31–5.66)	8.4 (8.07–8.70)	12.2 (11.85–12.60)
Educational services, and health care and social assistance	21.8 (21.70–21.88)	22.3 (22.17–22.37)	19.8 (19.57–20.01)	28.9 (28.59–29.29)	19.4 (18.95–19.85)	6.5 (6.26–6.83)
Arts, entertainment, and recreation, and accommodation and food services	14.1 (14.03–14.18)	13.8 (13.71–13.87)	15.5 (15.25–15.66)	12.2 (11.98–12.49)	16.2 (15.77–16.61)	19.7 (19.21–20.12)
	1.8	1.8	1.7	1.4	1.8	2.1

Table 2. (continued)

| | All Workers | Native-born | Foreign-born | Foreign-born Breakdown | | |
				Naturalized	Authorized	Unauthorized
Other services, except public administration	(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)

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

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 EFWs are disproportionately represented relative to unauthorized immigrant EFWs, 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 EFWs are substantial. For example, over one-quarter of unauthorized immigrant EFWs worked in construction compared to only 10.5 percent of native-born EFWs. On the other hand, 22 percent of native-born EFWs worked in educational services, and health care and social assistance, more than triple the proportion of unauthorized immigrant EFWs in these industries.

Occupational Standing

Stratifying EFWs across occupational standing quartiles by nativity and immigrant legal status reveals that foreign-born workers, and unauthorized workers especially, are disproportionately represented in the secondary sector of the labor market. Table 3 shows the proportion of EFWs working in different quartiles of occupations based on occupational standing. Confirming previous findings that immigrant workers are more likely to work in the secondary sector than native-born workers (Piore 1986), nearly 37 percent of foreign-born EFWs work in the lowest quartile of occupations, our proxy for the secondary labor market, compared to only 22 percent of native-born EFWs. In contrast, about 15 percent of native-born EFWs are employed in the highest quartile of occupations, our proxy for the primary sector of the labor market, compared to about 11 percent of foreign-born EFWs. Among foreign-born EFWs, the distribution of naturalized workers across the quartiles closely mirrors that of native-born workers. On the other hand, the distribution of authorized and especially unauthorized EFWs substantially diverges from the distribution of native-born EFWs. For example, compared to the 22 percent of native-born EFWs in the lowest quartile of occupational standing, 38 percent of authorized immigrant EFWs and 55 percent of unauthorized immigrant EFWs work in the lowest quartile. Comparing the distributions of EFWs across occupational standing confirms expectations that immigrant EFWs are more likely than native-born EFWs to work in the secondary sector, with unauthorized immigrant EFWs the group that is most likely to work in the secondary sector.

The large concentration of foreign-born EFWs in the secondary sector of the labor market may mean that they have less ability to influence their working conditions to reduce the risk of exposure to COVID-19, but an analysis of proximity scores indicates that on average EFWs work at a similar distance from others at their jobs across nativity and immigrant legal status. Table 4 details the average proximity score for EFWs by nativity and immigrant legal status. Native-born and foreign-born EFWs have average proximity scores around 68, which indicates that contextual risk

Table 3. Occupational Standing for Essential Frontline Workers, by Nativity and Immigrant Legal Status.

				Foreign-born Breakdown		
	All Workers	Native-born	Foreign-born	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
% in quartile 1 (lowest occupation standing)	24.8	22.0	36.6	23.1	38.4	55.1
	(24.73–24.91)	(21.91–22.10)	(36.32–36.85)	(22.75–23.40)	(37.81–38.92)	(54.56–55.70)
% in quartile 2	39.9	40.4	38.2	39.7	39.4	35.2
	(39.84–40.06)	(40.24–40.48)	(37.96–38.50)	(39.30–40.06)	(38.80–39.91)	(34.70–35.79)
% in quartile 3	21.0	22.7	14.0	19.1	12.5	7.7
	(20.93–21.11)	(22.60–22.80)	(13.82–14.20)	(18.79–19.40)	(12.08–12.83)	(7.40–8.01)
% in quartile 4 (highest occupational standing)	14.2	14.9	11.2	18.2	9.8	1.9
	(14.13–14.28)	(14.85–15.02)	(11.00–11.35)	(17.86–18.45)	(9.49–10.16)	(1.76–2.08)

Note. Universe for workers includes all essential workers expanded who reported working in the last year. All results are population weighted and adjusted for underreporting, with 95 percent confidence intervals reported in parentheses. Authors' calculations using 2019 ACS from ipums.org. Occupations of workers are broken down into quartiles where each group includes one-quarter of total occupations, not total workers (EDSCOR90).

Table 4. Proximity Scores for Essential Frontline Workers, by Nativity and Immigrant Legal Status.

	All Workers	Native-born	Foreign-born	Foreign-born Breakdown		
				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
Mean proximity score	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)
Mean proximity score, occupational standing quartile 1	61.7	61.9	61.1	59.9	60.2	62.2
	(61.61–61.74)	(61.84–61.98)	(60.94–61.22)	(59.70–60.17)	(59.92–60.47)	(62.02–62.48)
Mean proximity score, occupational standing quartile 2	69.7	69.4	70.8	71.3	71.1	69.8
	(69.64–69.73)	(69.38–69.48)	(70.71–70.95)	(71.11–71.44)	(70.91–71.38)	(69.58–70.06)
Mean proximity score, occupational standing quartile 3	69.1	69.0	69.9	70.3	69.0	69.3
	(69.04–69.17)	(68.93–69.06)	(69.67–70.06)	(70.08–70.57)	(68.56–69.39)	(68.75–69.78)
Mean proximity score, occupational standing quartile 4	78.2	78.2	78.6	79.6	77.9	66.3
	(78.14–78.31)	(78.07–78.25)	(78.32–78.80)	(79.37–79.90)	(77.32–78.43)	(64.98–67.60)

Note. Universe for workers includes all essential workers expanded who reported working in the last year. All results are population weighted and adjusted for underreporting with 95 percent confidence intervals reported in parentheses. Authors' calculations using 2019 ACS from ipums.org. Occupations of workers are broken down into quartiles with each group including approximately one-quarter of total occupations, not total workers (EDSCOR90). Proximity scores based on survey question: *"To what extent does this job require the worker to perform job tasks in close proximity to other people?"* with responses tallied and averaged at the 6-digit SOC level.

experienced by EFWs at work is relatively high across nativity status. Disaggregating foreign-born workers by legal status reveals little variation in average proximity score. Assessing differences in proximity score across occupational standing indicates a uniformly lower average proximity score for EFWs in the lowest quartile compared to the average proximity scores for EFWs in the highest quartile. For EFWs overall the disparity between the primary and secondary sectors is large: a proximity score of 61.7 in the lowest quartile compared to 78.2 in the highest quartile. Compared to other groups of EFWs unauthorized EFWs have the smallest difference in average proximity score for the lowest quartile (62.2) and the highest quartile (66.3), primarily due to their low proximity score in the highest quartile. Unauthorized EFWs have comparable proximity scores to other groups considered in Table 4 except for those who work in an occupation in the highest quartile of occupational standing, where their average proximity score is lower.

Examples of occupations in each quartile of occupational standing helps to explain why proximity scores are larger in the highest quartile compared to the lowest quartile. Table 5 lists the five most common occupations for EFWs in each quartile of occupational standing. Occupations in the lowest quartile are characterized by work that is often completed independently (janitorial work) or in small teams where working in proximity is not typically necessary (laborers within and outside of construction). In contrast, the most common occupations in the highest quartile involve direct and close interaction with others (registered nurses and primary school teachers) or work in office settings where workspaces often involve working close to others. It is important to note that occupations in the highest quartile of occupational standing may have the best access to risk mitigation measures, such as personal protective equipment or flexible work arrangements where increased spacing is possible (Goldman et al. 2021). This may result in less risk for EFWs in the highest quartile than the high proximity scores noted for common occupations in this quartile suggest. In fact, we suspect that replicating this analysis with results from pandemic era O*NET surveys used to measure the proximity to others while working would result in lower average proximity scores for EFWs in the highest quartile of occupational standing, but little if any difference in proximity scores for workers in lower quartiles.

Factors Aggravating the Risk of Workplace COVID-19 Exposure

Given their overrepresentation among EFWs and in occupations with the lowest occupational standing, foreign-born workers, and especially unauthorized immigrant workers, may bear more risk of exposure to COVID-19 in the workplace compared to native-born workers. Compounding this risk, relative to native-born EFWs foreign-born EFWs are more likely to have characteristics that research on social determinants of health associates with poor health outcomes. This suggests that

Table 5. Top Five Occupations for Essential Frontline Workers, by Occupational Standing Quartile.

	Occupational Standing							
	Quartile 1		Quartile 2		Quartile 3		Quartile 4	
Rank	Occupation	Proximity Score	Occupation	Proximity Score	Occupation	Proximity Score	Occupation	Proximity Score
1	Janitors	56	Truck, delivery & tractor drivers	83	Managers & administrators, nec	81	Registered nurses	91
2	Laborers outside construction	55	Cashiers	82	Supervisors & proprietors of sales jobs	80	Primary school teachers	90
3	Construction laborers	54	Nursing aides, orderlies & attendants	81	Retail sales clerks	79	Computer systems analysts & computer scientists	89
4	Housekeepers, maids, butlers, stewards, & lodging quarters cleaners	53	Cooks, variously defined	80	Customer service reps, investigators & adjusters, except insurance	78	Computer software developers	88
5	Miscellaneous food prep workers	52	Waiter/waitress	79	Secretaries	77	Accountants & auditors	87

Note. Universe for workers includes all essential frontline workers who reported working in the last year. All results are population weighted and adjusted for underreporting with 95 percent confidence intervals reported in parentheses. Authors' calculations using 2019 ACS from ipums.org. Occupations of workers are broken down into quartiles with each group including approximately one-quarter of total occupations, not total workers (EDSCOR90).

Table 6. Health and Economic Vulnerability for Essential Frontline Workers, by Nativity and Immigrant Legal Status.

	All Workers	Native-born	Foreign-born	Foreign-born Breakdown		
				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
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)
Occupational standing quartile 1	74.4	81.2	57.1	82.0	70.6	34.7
	(74.16–74.56)	(81.02–81.41)	(56.65–57.62)	(81.39–82.68)	(69.74–71.47)	(33.93–35.44)
Occupational standing quartile 2	83.6	85.8	73.8	86.5	77.7	49.4
	(83.42–83.68)	(85.64–85.91)	(73.37–74.17)	(86.09–86.94)	(76.90–78.41)	(48.40–50.31)
Occupational standing quartile 3	90.3	91.2	84.3	90.3	83.1	64.1
	(90.15–90.43)	(91.03–91.31)	(83.82–84.84)	(89.79–90.82)	(81.94–84.24)	(62.24–65.93)
Occupational standing quartile 4	96.6	97.0	94.9	96.4	91.7	86.6
	(96.55–96.75)	(96.85–97.06)	(94.61–95.26)	(96.13–96.76)	(90.76–92.63)	(84.16–89.04)
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)
Occupational standing quartile 1	11.3	10.7	12.7	6.8	13.5	15.8
	(11.13–11.42)	(10.55–10.87)	(12.33–12.99)	(6.38–7.23)	(12.85–14.18)	(15.22–16.38)
Occupational standing quartile 2	9.8	9.9	9.3	7.4	10.6	11.4
	(9.71–9.92)	(9.81–10.05)	(9.04–9.57)	(7.05–7.70)	(10.00–11.14)	(10.83–12.04)
Occupational standing quartile 3	5.5	5.5	5.4	3.9	8.2	7.6
	(5.36–5.58)	(5.37–5.59)	(5.09–5.73)	(3.58–4.26)	(7.30–9.03)	(6.55–8.58)
Occupational standing quartile 4	1.9	1.8	1.9	1.3	3.0	6.4
	(1.78–1.93)	(1.77–1.93)	(1.68–2.09)	(1.06–1.44)	(2.41–3.57)	(4.65–8.16)
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)
Occupational standing quartile 1	21.4	19.2	26.5	16.4	28.2	31.9
	(21.17–21.55)	(19.04–19.45)	(26.11–26.98)	(15.76–17.01)	(27.38–29.12)	(31.16–32.64)

(continued)

Table 6. (continued)

	All Workers	Native-born	Foreign-born	Foreign-born Breakdown		
				Naturalized	Authorized	Unauthorized
Occupational standing quartile 2	18.4 (18.24–18.51)	18.0 (17.81–18.11)	20.2 (19.83–20.56)	16.1 (15.68–16.60)	22.5 (21.77–23.32)	24.9 (24.11–25.75)
Occupational standing quartile 3	10.6 (10.49–10.79)	10.5 (10.36–10.66)	11.5 (11.06–11.97)	8.7 (8.19–9.17)	15.3 (14.20–16.47)	17.3 (15.82–18.72)
Occupational standing quartile 4	3.4 (3.29–3.49)	3.4 (3.25–3.46)	3.6 (3.31–3.86)	2.7 (2.46–3.02)	5.6 (4.81–6.37)	7.7 (5.75–9.56)

Note. Universe for workers includes all essential frontline workers 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. Occupations of workers are broken down into quartiles with each group including approximately one-quarter of total occupations, not total workers (EDSCOR90).

foreign-born EFWs may struggle to treat a COVID-19 infection or reduce the like-lihood of spreading a COVID-19 infection if they become ill compared to native-born EFWs.

As Table 6 indicates, foreign-born EFWs are substantially less likely to have health insurance compared to native-born EFWs, and this large disparity is present across each quartile of occupational standing. Among foreign-born EFWs, the health insurance disparity is greatest for unauthorized workers. The proportion of unauthorized immigrant EFWs with health insurance (43.1 percent) is less than half the proportion of native-born EFWs with health insur-ance. A gap in health insurance between these groups of workers persists across each quartile of occupational standing, though it shrinks to a 10-point disparity in the highest quartile of occupational standing. 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.

Disparities in access to health insurance take place within a larger context of higher poverty rates for foreign-born EFWs compared to native-born EFWs. While the difference in poverty rates between native-born and foreign-born EFWs is narrow, differences in poverty rates between unauthorized immigrant EFWs and native-born and naturalized EFWs are wider by substantial margins. These differences suggest that unauthorized immigrant EFWs may experience a greater challenge in affording basic needs and therefore potentially have more dif-ficulty avoiding or mitigating the risks associated with contracting COVID-19 than most other EFWs because of the potentially dire financial consequences associated with missing work (Kiester and Vasquez-Merino 2021; Page and Flores-Miller 2021). The poverty line may understate the vulnerability faced by low-income pop-ulations. Looking at these differences at 150% of the poverty line reveals that the differences are more pronounced across low-income populations that live near poverty.

Household characteristics of foreign-born EFWs indicate that compared to native-born EFWs they may experience additional risk of exposure to COVID-19 because they are more likely to share housing with other EFWs. Given higher risks of expo-sure to COVID-19 in the workplace for EFWs, multiple EFWs in the same household compounds the risk of potential exposure originating from the workplace for all members of the household. Table 7 reveals that 59 percent of foreign-born EFWs live with at least one other EFW, compared to 46 percent of native-born EFWs. This disparity persists but shrinks as the occupational standing quartile of the workers increases, such that the gap in quartile 1 is about 16 percentage points but only about three percentage points in quartile 4. Much of the disparity is driven by unauthorized immigrant EFWs, with two thirds of these workers living with at least one other EFW.

Table 7. Household Characteristics of Essential Frontline Workers, by Nativity and Immigrant Legal Status.

	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
Any other frontline 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)
Occupational standing quartile 1	52.3	47.8	63.5	59.5	61.3	67.1
	(52.04–52.49)	(47.55–48.06)	(63.00–63.95)	(58.71–60.37)	(60.34–62.18)	(66.32–67.81)
Occupational standing quartile 2	49.9	47.7	60.0	55.8	59.4	67.7
	(49.77–50.12)	(47.46–47.84)	(59.61–60.49)	(55.19–56.42)	(58.46–60.25)	(66.78–68.56)
Occupational standing quartile 3	46.3	45.3	53.5	52.2	51.4	60.6
	(46.09–46.56)	(45.03–45.52)	(52.76–54.17)	(51.33–53.07)	(49.83–52.89)	(58.77–62.52)
Occupational standing quartile 4	41.4	40.8	44.3	45.2	42.0	40.6
	(41.08–41.63)	(40.53–41.12)	(43.58–45.06)	(44.37–46.07)	(40.36–43.71)	(37.12–44.15)
Overcrowded (> 2 people per bedroom) (%)	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)
Occupational standing quartile 1	10.2	6.1	20.1	13.0	21.1	24.0
	(10.04–10.32)	(6.00–6.25)	(19.74–20.54)	(12.40–13.54)	(20.33–21.95)	(23.33–24.69)
Occupational standing quartile 2	7.3	5.2	16.4	11.8	18.7	22.0
	(7.22–7.41)	(5.13–5.31)	(16.06–16.74)	(11.43–12.23)	(18.00–19.46)	(21.21–22.79)
Occupational standing quartile 3	4.8	3.8	11.4	9.3	13.0	17.0
	(4.71–4.92)	(3.74–3.94)	(10.95–11.85)	(8.84–9.85)	(11.91–14.04)	(15.55–18.44)
Occupational standing quartile 4	2.9	2.4	6.1	5.1	9.1	9.7
	(2.85–3.04)	(2.28–2.46)	(5.79–6.50)	(4.70–5.45)	(8.09–10.05)	(7.61–11.86)

Note. Universe for workers includes all essential frontline workers who reported working in the last year. All results are population weighted and adjusted for underreporting with 95 percent confidence intervals reported in parentheses. Authors' calculations using 2019 ACS from ipums.org. Occupations of workers are broken down into quartiles with each group including approximately one-quarter of total occupations, not total workers (EDSCOR90).

Data presented in Table 7 also suggests that once infected with COVID-19, over-crowded living conditions create challenges for foreign-born EFWs seeking to limit the spread of the virus. Limited space in housing may make it difficult for individuals living in households with unauthorized immigrant EFWs 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). In this analysis we desig-nate that an individual lives in overcrowded housing if the number of people per bedroom (PPB) in the household exceeds two (Blake, Kellerson and Simic 2007). Among foreign-born EFWs, almost 16 percent live in overcrowded housing com-pared to less than five percent of native-born EFWs. Following a similar pattern present in other characteristics considered above, the disparity in living in over-crowded housing is largest between native-born and foreign-born EFWs in lower quartiles of occupational standing. All groups of foreign-born EFWs are more likely to live in overcrowded housing than native-born EFWs, but unauthorized immigrant EFWs have the largest disparity. Overall, nearly 23 percent of unautho-rized immigrant EFWs live in overcrowded housing, about five times the proportion of native-born EFWs. Existing research indicates that compared to native-born resi-dents foreign-born residents are more likely to live in multigenerational housing (Gubernskaya and Tang 2017), prompting concern that spreading COVID-19 to older, more susceptible household members may be more likely among foreign-born EFWs. Our analysis indicates that foreign-born EFWs were only slightly more likely to live in multigenerational households compared to native-born EFWs, and unautho-rized EFWs were less likely to live in multigenerational households (results not shown).

Discussion

Research on segmented labor markets and social determinants of health have contrib-uted to deeper understandings of vulnerabilities for immigrants and together offer a valuable lens to understand the experiences of immigrants during the COVID-19 pandemic. Evidence from the United States and Europe indicates that immigrants are disproportionately channeled into the secondary labor market where they face structural disadvantages, including low wages, less job security, lower efficacy to limit workplace risks, and reduced prospects for positive economic mobility over time (Constant and Massey 2005; Fellini and Guetto 2019; Hudson 2007; Kreisberg 2019). Similarly, immigration status and immigrant legal status have emerged as important social determinants of health, as immigration is more and more frequently a process that involves protracted negotiations with social, political, and economic institutions that result in poor health outcomes for many immigrants, but especially unauthorized immigrants (Asad and Clair 2018; Castañeda et al. 2015).

Linking these bodies of scholarship provides a perspective to help to explain higher rates of COVID-19 mortality for foreign-born residents relative to native-born

residents (Clark et al. 2020; Garcia et al. 2021; Horner, Wrigley-Field and Leider 2022). Research findings presented in this article suggest that this disparity in mortality rates could be explained at least partially by the disproportionate representation of foreign-born workers as EFWs during the pandemic. Our estimates suggest that fewer than half of native-born workers are EFWs compared to 56 percent of foreign workers, including 70 percent of unauthorized immigrant workers. Higher risk of exposure to the COVID-19 virus may result in higher rates of infection for EFWs, a relationship supported by dramatically increased sick-related absences for workers during the early months of the pandemic in occupations characterized by work unable to be completed remotely (Lyttelton and Zang 2022). Once infected, characteristics of foreign-born EFWs in general, and unauthorized EFWs in particular, may decrease their ability to manage and treat a COVID-19 infection and prevent the infection from spreading to others in their households. For example, compared to other EFWs, our estimates indicate that unauthorized immigrant EFWs face high rates of structural inequalities, including poverty and lower rates of health insurance that are associated with less access to medical treatment and poor health outcomes. In addition, unauthorized EFWs experience high rates of overcrowded housing conditions that may reduce their ability to self-quarantine and prevent the spread of infection among others.

To explain why COVID-19 mortality rates for foreign-born residents are higher than COVID-19 mortality rates for native-born residents we have emphasized one potential causal path. Specifically, higher rates of COVID-19 infections may be linked to workplace factors for EFWs, followed by difficulties treating and preventing the spread of the infection to others given social and economic characteristics of EFWs associated with poor health outcomes. However, it is also possible that the causal path runs in the opposite direction: the economic and social characteristics of EFWs could make it more likely that they become infected with COVID-19 and the work conditions of EFWs facilitate the spread to coworkers. No matter which causal path is more accurate in helping to explain the higher COVID-19 mortality rates of foreign-born residents compared to native-born residents, the prevailing work conditions in the segmented labor market and characteristics of EFWs associated with poor health outcomes throw into sharp relief the inequalities in US society over who is best positioned to protect themselves from contracting the virus and to prevent the spread of the virus to others.

In our analysis, accounting for whether EFWs were employed in the primary or secondary labor sectors revealed even more pronounced disparities between native-born workers, foreign-born workers, and unauthorized workers in estimates of EFWs. These disparities in the secondary labor market matter because they highlight the disadvantage that foreign-born EFWs have relative to their native-born counterparts when advocating for safer work conditions to reduce potential health risks in the workplace (Fine and Lyon 2017). More broadly, this finding helps to place the

disadvantages experienced by foreign-born workers during the COVID-19 pandemic in the context of segmented labor market theory, where vulnerabilities of the workers are linked to structural factors of the labor market that result in workers having little power in the workplace (Hudson 2007; Piore 1986). This insight suggests that immigrant workers may face greater risk in contracting COVID-19 than existing research suggests (Kerwin and Warren 2020).

Our research findings have important implications for segmented labor market theory and our understanding of immigrant legal status as a social determinant of health. Paradoxically, our findings indicate that during the pandemic the US economy has disproportionately relied on unauthorized immigrant workers who were not legally eligible to work to keep the economy open and likely experienced substantial health risks as a result. Relative to native-born workers and foreign-born workers more generally, unauthorized immigrant workers were those most likely to work as EFWs in the secondary labor market. While much of the existing research on segmented labor market theory stresses that immigrants face circumstances and structural conditions that channel them into the secondary labor market (Hudson 2007; Piore 1986), our research suggests that immigrant legal status is a crucial factor that explains which immigrants work in the secondary labor market. Similarly, relative to other EFWs, unauthorized immigrant EFWs consistently experienced higher rates of poverty, lack of health insurance and living conditions that exacerbated some of the health risks associated with working during the COVID-19 pandemic. This find suggests that conceiving of nativity as a social determinant of health may be too coarse and can miss the important role that immigrant legal status plays in shaping different health outcomes for immigrants.

We believe there are at least two important directions for future research in this area. First, connecting data on EFW status, immigration status and COVID-19 infection and mortality data would provide an opportunity to assess with more confidence the extent to which EFW status can help to explain observed disparities in COVID-19 related mortality in the US population. Second, COVID-19 has changed aspects of the labor force and the economy in important ways that necessitate reassessing pre-pandemic measures of the workplace. Specifically, emerging evidence suggests that the COVID-19 pandemic will result in long-term changes to the US labor market, providing working arrangements that offer more flexibility and remote-work opportunities primarily for skilled workers (Shutters 2021). In light of these changes, pre-pandemic surveys measuring a workers' ability to work remotely and their proximity to others during work may no longer accurately reflect circumstances faced by workers in many occupations. A new round of surveys or developing alternative measures of workers' ability to work remotely and conditions they experience in the workplace, including proximity to others, would improve researchers' ability to monitor and assess worker risks in a post-pandemic environment and the extent to which these risks continue to be disproportionately born by immigrant workers (see Table A1).

Table A1. Essential Workers Using Different Definitions.

	All Workers	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 (March 2020)						
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%
Essential frontline (March 2020)						
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%
Essential frontline (December 2020)						
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, Koebe and Meyerhofer (2021) Essential 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%
Blau, Koebe and Meyerhofer (2021) Essential 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%
Blau, Koebe and Meyerhofer (2021) Essential 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%

(continued)

Table A1. (continued)

	All Workers	Native-born	Foreign-born	Foreign-born Breakdown		
				Naturalized	Authorized	Unauthorized
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 with 95 percent confidence intervals reported in parentheses. Authors' calculations using 2019 ACS from ipums.org. Essential Frontline No Shutdown (March 2020), Essential Frontline (March 2020), and Essential Frontline (December 2020) are authors' estimates using 6-digit SOC codes rather than the 2-digit SOC codes used in Blau, Koebe and Meyerhofer (2021) to identify the feasibility of working remotely.

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