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COVID-19 Pandemic Burden on Farmworkers in the United States: A Systematic Review

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Abstract

Farmworker communities have an increased risk of COVID-19. Our objective is to inform farmworker health stakeholders about the COVID-19 burden among farmworker communities. We conducted a structured literature search to review articles with data about their experiences. Analysis was conducted in 2022 and 2023. Thirty-three articles were synthesized into themes of burden on social determinants of health, risk and preventative practices, mental health, infection rates and testing, vaccination coverage, and perceptions about the vaccine. These studies cross the United States where farmworker communities are known to be concentrated, such as California, Oregon, Washington, Florida, Georgia, North Carolina, Minnesota, Texas, Mississippi, and Wisconsin and were published in between January 2020 and June 2022. Many of these studies have documented that COVID-19 transmission risk factors are common among farmworkers and that they have experienced disproportionately high infection rates. Individual findings should not be compared with each other; instead, these studies should provide readers with an understanding of the range of the burden of COVID-19 on different farmworker populations in U.S.

Keywords: Agricultural Workers, COVID-19 burden, U.S farmworkers, Farmworker communities, Farmworker health

INTRODUCTION

Farmworkers employed in the United States are a vulnerable population because of multiple structural inequities that increase their risk of contracting infectious diseases and experiencing worse health outcomes.[1] The majority of farmworkers are foreign born, identify as Hispanic, and are most comfortable speaking in Spanish.[2] High concentrations of farmworker populations in the United States are in North Carolina, California, Washington, Oregon, and Florida.[1] Crowded housing, low wages, limited access to health insurance, structural racism, and other factors all contribute to this increased risk experienced by the largely Latino immigrant farm labor force.[3] Confirmed cases of COVID-19 by the Monterey County Health Department showed that farmworkers have an elevated risk of infection of COVID-19 compared to other workers, with incidence rates of 1,569 cases per 100,000 among farmworkers versus 471 per 100,000 among other workers in June 2020.[4] The aim of this review is to provide a systematic synthesis of evidence about the burden of COVID-19 on farmworkers that could support strategies that mitigate the increased risk of COVID-19 in farmworker communities. To date, there is no national comprehensive assessment of COVD-19 burden among farmworkers published. In this paper, we discuss themes reported across studies including COVID-19 risk factors and transmission, prevention practices, vaccinations, and the mental, economic, and social impact of the pandemic on farmworkers.

METHODS

We conducted a search for peer-reviewed publications in the following databases PubMed, Google Scholar, EBSCO, SAGE online journal, and JSTOR. We also searched for gray literature through

[1] To read more about the studied farmworker population, see our Facts about Agricultural Workers fact sheet.

internet searches using the search terms described below, and by reviewing websites of farmworker-serving organizations based in the U.S. We selected articles based on the inclusion criteria that they (1) included quantitative or qualitative data about farmworkers in the United States about COVID-19; (2) were written and published between January 2020 and June 2022; (3) the farmworker population studied resided in the United States and worked in the specific NAICS codes[2] 111, 112, 1151, and 1152; and (4) were published in English. We excluded articles that combined and did not disaggregate farmworkers with other types of workers in the results. Focused areas of study to search for included COVID-19 risk factors, COVID-19 infection rates, hospitalizations, mortality, and testing, documentation of outbreak case studies, assessment about COVID-19 impact on farmworker physical health, mental health, working or living conditions, assessment of COVID-19 prevention or mitigation activities, and COVID-19 vaccination uptake among farmworkers.

The authors used the following search terms: COV* impact and U.S. farmworkers OR U.S. agricultural workers, Corona virus and U.S. agricultural workers OR U.S. farmworkers, pandemic and U.S. farmworkers OR U.S. agricultural workers, vaccination rates and U.S. agricultural workers OR U.S. farmworkers, COV* data and U.S. farmworkers OR U.S. agricultural workers, U.S. agricultural community and COV*. One author reviewed the titles and abstracts or summaries of all identified articles, and eliminated articles that were not relevant. Two authors reviewed the abstracts of 41 publications that were relevant to U.S. farmworkers and COVID-19 to ensure they met all the inclusion criteria and narrowed them down to 33. One author then read all included articles in their entirety. Major themes were identified manually by reviewing and taking notes on key themes in the included articles,

[2] NAICS (The North American Industry Classification System) codes 111, 112, 1151, and 1152 include agricultural industry sub sectors that classify under Crop production, Animal Production and Aquaculture.

and then determining which themes were recurrent across more multiple articles to identify key themes and subthemes to structure the paper.

RESULTS

A total of 33 publications were found to meet all inclusion criteria, 22 of which were peer-reviewed articles and 11 were found in the gray literature. This paper explores four prominent themes that emerged from review of the articles: COVID-19 risk factors and transmission, prevention practices, vaccinations, and the pandemic's impact on farmworkers.

The 33 publications utilized various sampling and recruitment methods, most recruiting farmworkers 18 years and older through worksites, Federally Qualified Health Centers (FQHCs), and farmworker communities. Some studies focused solely on women farmworkers, H-2A farmworkers, or farmworker and non-farmworker families. See Table 1 below for a breakdown of each study's methods.

Table 1: Recruitment and Sampling methods among studies regarding COVID-19 and U.S. farmworkers

#	Author	Place	Time period	Eligible participants	Sample size	Study design	Sampling method	Recruitment method
5	Sara A. Quandt	North Carolina	May-June 2020	Farmworker and non-farmworker families	105	Prospective cohort	Convenience	Recruited through contact with a community-based organization partner
6	Roxana Chicas	Central Florida	January and February 2020 and July 2021	Farmworkers 18–49 years of age	92	Prospective cohort	Convenience	Recruited through contact with a community-based organization partner
7	Joseph A. Lewnard	Salinas Valley, California,	June-November, 2020	Farmworkers 18 years of age and older	1115	Clinical surveillance and cross-sectional	Convenience	Patient electronic medical record data; Cross-sectional participants recruited through contact with a community-based clinic partner
8	Ann. Mora	Monterey County, California	July-November 2020	Farmworkers 18 years of age and older	1115	Cross-sectional study	Convenience	Recruited through contact with a community-based clinic partner
9	Annie J. Keeney	U.S. - Mexico Border	Summer 2021	Women farmworkers	77	Mixed methods	Not stated	Not stated

10	Paul B. Tchounwou	Imperial County, California	June 2021–August 2021	Farmworkers 18 years of age and older	199	Cross sectional	Simple random sample	Recruited through contact with community-based organizations
11	Caroline Johnson	Iowa	August 2020	H-2A farmworkers	590	Surveillance	Establishment based	All H-2A employees of one producer
12	James S. Miller	Okanogan County, Washington	May to August 2020	Employees of one fruit grower	3739	Surveillance	Establishment based	Employees of one producer
13	Khalil Nasser	North Florida	2020	Migrant farmworkers aged 18-67 years	262	Retrospective analysis of surveillance data	Not stated	Referrals from state health department
14	Michael Lauzardo	North Central Florida	May-June2020	Farmworkers 18 years of age and older	100	Surveillance	Establishment-based	Response to outbreak of H-2A workers employed by one labor contractor
16	NCFH	Select counties in California, Florida, Mississippi, New Mexico, Texas	August – December 2021	Farmworkers aged 18 years of age and older	1094	Mixed methods	Cluster stratified random sample; convenience sample	Randomly selected employment, community and housing sites based on agricultural databases and stakeholder information; contacts of community-based organization partners
17	Sara A. Quandt	North Carolina	May- June 2020	67 farmworker families and 45 non-farmworker families	105	Prospective cohort study	Convenience	Recruited through contact with a community-based organization partner
18	Ana M. Mora	Monterey County, California	July-November 2020	Farmworkers 18 years of age and older	1115	Not stated	Convenience	Recruited through contact with a community-based clinic partner
19	Ana M. Mora	Monterey County, California	July-November, 2020	Farmworkers 18 years of age and older	1107	Cross-sectional study	Convenience	Recruited through contact with a community-based clinic partner
20	BMC Public Health	Eastern Coachella Valley, California	August 2020 to January 2021	Farmworkers 18 years of age or older	55	Focus groups & ethnography with community-based participatory research framework	Snowball	Contacts of community health workers of community-based partner; respondent contacts
21	NCFH	Colquitt County, Georgia	March-May 2022	Farmworkers 18 years of age or older	273	Mixed methods	Cluster stratified random sample	Randomly selected employment, community and housing sites based on agricultural databases and stakeholder information

22	Ramirez	California	May-July 2020	Farmworkers	915	Mixed methods	Snowball	Relied on clients to engage others: fellow farmworkers, friends of fellow farmworkers, village networks, and others linked through long-time trusting relationships with members of the organizations
23	Ramirez	California	August-October 2020	Farmworkers aged from 30 to 57	63	Mixed methods	Snowball	Relied on clients to engage others: fellow farmworkers, friends of fellow farmworkers, village networks, and others linked through long-time trusting relationships with members of the organizations
24	NCFH	Collier County, Florida	December 2021	Farmworkers 18 years of age or older	249	Mixed methods	Cluster stratified random sample	Randomly selected employment, community and housing sites based on agricultural databases and stakeholder information
25	NCFH	Calhoun and Coahoma Counties, Mississippi	August - October 2021	Farmworkers 18 years of age or older	197	Mixed methods	Cluster stratified random sample; convenience sample	Randomly selected employment, community and housing sites based on agricultural databases and stakeholder information; contacts of community-based organization partners
26	NCFH	Hidalgo County, Texas	September - October 2021	Farmworkers 18 years of age or older	190	Mixed methods	Cluster stratified random sample	Randomly selected employment, community and housing sites based on agricultural databases and stakeholder information
27	NCFH	El Paso County, Texas and Dona Ana County, New Mexico	September - October 2021	Farmworkers 18 years of age or older	207	Mixed methods	Convenience	Recruited through contacts of community-based organization partners
28	NCFH	California	August – October 2021	Farmworkers 18 years of age or older	251	Mixed methods	Convenience	Recruited through contacts of community-based organization partners
29	Martinez	Oregon	2020	Farmworkers	300	Mixed methods	Snowball	Relied on clients to engage others: fellow farmworkers, friends of fellow farmworkers, village networks, and others linked through long-time trusting relationships with members of the organizations

30	Martinez	Oregon	February – July 2021	Farmworkers	48	Mixed methods	Snowball	Relied on clients to engage others: fellow farmworkers, friends of fellow farmworkers, village networks, and others linked through long-time trusting relationships with members of the organizations
31	COFS Washingt on	Washingto n	August - November 2020	Farmworkers	218	Mixed methods	Snowball	relied on clients to engage others: fellow farmworkers, friends of fellow farmworkers, village networks, and others linked through long-time trusting relationships with members of the organizations
33	Handal, Alexis J.	Minnesota and Wisconsin	2020	Farmworkers and community stakeholders	55	Qualitative, no further information on methods given	Not stated	Not stated

Unavailable data is marked with "Not Stated"

Table 2 summarizes the additional 11 subthemes within the broader themes: Risk factors for infection, risk factors for severe illness, COVID-19 infection rates and testing, workplace practices, individual practices, vaccination uptake, vaccination hesitancy, economic impact, food insecurity, health care access, and mental health impact. Publications related to the subtheme of workplace practices during the pandemic (n=19), with the subtheme of COVID-19 cases and testing (n=15) as the second most published subtheme.

Table 2: Key themes and subthemes in publications regarding COVID-19 and U.S. farmworkers.

Sources	**Themes and subthemes**										
	COVID-19 risk factors and transmission			**Prevention practices**		**COVID-19 vaccinations**		**Pandemic impact on farmworkers**			
	Risk factors for infection	Risk factors for severe illness	COVID-19 cases and testing	Workplace practices	Individual practices	Vaccination uptake	Vaccination hesitancy and access	Economic impact	Food insecurity	Health care access	Mental health impact
Quandt[5]				X				X	X		X
Chicas[6]	X	X	X	X	X	X	X	X			
Lewnard[7]		X	X								

Mora[8]								X	X		X
Keeney[9]						X					X
Tchounwou[10]			X				X				X
Johnson[11]				X		X					
Miller[12]	X		X								
Nasser[13]		X	X								
Lauzardo[14]	X		X								
Joshi[15]											
NCFH[16]	X			X		X					
Quandt[17]				X	X						
Mora[18]	X						X	X	X	X	X
Mora[19]	X		X	X							
BMC Public Health[20]											X
NCFH[21]			X	X		X		X		X	
Ramirez[22]	X			X	X			X	X	X	X
Ramirez[23]	X			X				X	X	X	X
NCFH[24]			X	X		X				X	
NCFH[25]			X	X		X				X	
NCFH[26]			X	X		X				X	
NCFH[27]			X	X		X				X	
NCFH[28]			X	X		X				X	
Martinez[29(p1)]			X	X				X			X
Martinez[30]				X				X		X	X
CIRS Inc.[31]				X	X			X		X	
Maoyong[32]	X										
Fan and Pena[32]		X									
Handal[33]		X		X							
Yung[34]				X						X	
Villarejo[4]	X										
Polaris[35]										X	

COVID-19 risk factors and transmission

COVID-19 prevalence and testing

COVID-19 prevalence and testing data were reported in fourteen articles. Lewnard et. al, found that a higher percentage of farmworkers tested positive (22.1% of 6,864) for infection than non-farmworker adults (17.2% of 7,305) in the Monterey County, California area during July to November 2020.

Multiple publications examined outbreaks amongst farmworkers, however the percentage of positive tests varied widely among outbreaks, ranging from 6% to 91%.[5–7] Okanogan County, Washington (6% percent positive during the outbreak) had a cumulative incidence of approximately 2% during the same time of testing. Researchers also found increased risk for infection for those that were in packing houses compared to those that worked in more solitary roles.[5] The percent of positive tests observed in case studies among farmworkers who were tested for COVID-19 in the absence of an active outbreak were 13% and 22% in two studies with a non-randomly selected farmworker population in Monterey County, California.[8,9] The farmworkers were invited patients of a Migrant Health Center who were receiving the SARSA-CoV-2 TMA test at the location. The percent of farmworkers who tested positive for COVID-19 (22%) in Monterey County, California, during November 2020 was higher than the percent positive among the county's general population at that time, which was 6%.[8]

Several publications also included self-reported access to COVID-19 testing. As part of the Farmworker COVID-19 Community Assessment (FCCA) project which was conducted in 2022 by NCFH, 40% of farmworkers in Colquitt County, Georgia reported taking a COVID-19 test at least once by April 2022, and 32% of respondents who had taken a test said they had a positive result.[10] The percent of farmworkers who reported taking a COVID-19 test in the FCCAs conducted in 2021 in the counties of Collier County, Florida; Monterey, Tulare, and Kern counties, California; Calhoun and Coahoma counties, Mississippi; El Paso County, Texas, and Dona Ana County, New Mexico; and Hidalgo County, Texas, ranged from 23% to 61%. Another report in central California documented that 27% of 199 farmworkers reported having tested positive for COVID-19 within the last 12 months.[11] Of 300 respondents in the COVID-19 Farmworker Survey of Oregon, 37% reported getting tested for COVID-19, 33% of whom self-identified as non-Indigenous and 47% of whom self-reported as Indigenous.[35] See Table 3 for all COVID-19 percent positive data reported across studies.

Table 3: Reported percent positive for COVID-19 among farmworkers in outbreak and non-outbreak scenarios

Percent positive	Community	Total number of farmworkers tested	Time period of data collection	Active outbreak at time of data collection?	Laboratory confirmed or self-reported
32%	Colquitt County, Georgia[21]	109	March – April 2022	No	Self-reported
27%	Imperial County, California[10]	Not reported, total sample = 199	July – August 2021	No	Self-reported
22%	Salinas Valley, California[7]	6,864	June – November 2020	No	Laboratory confirmed
13%	Monterey County, California*[19]	911	July – November 2020	No	Laboratory confirmed
6% (orchard workers) 23% (packinghouse workers)	Okanogan County, Washington[12]	3,013 726	May - August 2020	Yes	Laboratory confirmed
91%	North Central Florida[14]	100	June 2020	Yes	Laboratory confirmed
35%	North Florida[13]	256	2020	Yes	Laboratory confirmed

**Forty percent of assessed farmworkers.

Risk factors for severe illness

One article mentioned comorbidities and the subsequent risk for more severe COVID-19 illness and two articles confirmed the prevalence of those diseases/risk factors among farmworkers. Obesity (Body Mass Index over 30 kg/m^2), high blood pressure, and prediabetes were associated with severe COVID-19 illness and mortality.[13] Farmworkers have been reported to be more likely to have these diseases than others in Sonoma County, California and high rates of these diseases have been reported across studies.[14] In one study of 92 farmworkers in Central Florida, 69% had at least one of these risk factors and 37% had more than one.[13] In California, 42.9% of 1,115 farmworkers surveyed reported being obese.[8] An additional study reported comorbidities among farmworkers that could impact severity including formerly or currently smoking.[6]

Risk factors for infection

The risks for infection subtheme included ten articles. The majority of these articles describe risks for COVID-19 infection that focus on farmworker housing and work environments.[4,7,9,13,15–18,32] Confirmed cases in Monterey County, California showed that farmworkers have an elevated risk of infections of COVID-19 when compared to other workers not in the agricultural industry.[4 9] Seven articles reported different work environment risks for disease transmission, including exposure during transportation, working and living with someone with symptoms of COVID-19, working with someone who had tested positive for COVID-19, and poor sanitation at workplaces.[7,9,13,15–18 19] COVID-19 incidence was higher among farmworkers working indoors packing and sorting than those working outdoors.[5] Additionally, living in close proximity in crowded housing was linked to a higher prevalence of infection.[9] Five different studies gave evidence of overcrowded housing (more than one person to a room) among farmworkers. The National Center for Farmworker Health (NCFH) found that percentages of farmworkers living in overcrowded housing ranged from 26% in El Paso and Doña Ana counties in Texas and New Mexico, to a high of 69% in Calhoun and Coahoma Counties in Mississippi based on cross-sectional data collected from farmworkers identified at randomly-selected housing, work, and community sites.[15] In a study of an outbreak among H-2A workers in North Central Florida, The North Central Florida Health Department reported workers lived six to ten individuals to a hotel room and had a positivity rate of 91%.[7] Demographic characteristics such as education or language spoken at home were also identified as risk factors. Mora et al., found that in a study of 1,107 farmworkers in Monterey County in 2021, COVID-19 prevalence was higher among individuals who spoke a Mesoamerican Indigenous language at home, individuals with lower education levels, and individuals living with children than those with other demographic characteristics surveyed.[9] The COVID-19 Farmworker Survey (COFS) recruited survey participants through partnerships with community-based organizations, and noted that farmworkers surveyed in California who spoke Indigenous languages were twice as

likely to have an increased number of people living in the home as compared to the start of the pandemic in already overcrowded households.

Prevention practices

Workplace prevention practices

Nineteen articles explored workplace practices for prevention and mitigation of COVID-19 in the agricultural industry (see Table 4). Women farmworkers in North Carolina were concerned about the risk of contracting COVID-19 at work.[20] Only 23% of COFS respondents were satisfied with employer responses to the onset of the pandemic in California.[17] Qualitative data from COFS showed farmworkers' concerns about workplace safety went unacknowledged, dismissed, or mocked by leadership in workplaces.[18] The majority of COFS respondents in Oregon said they received training on how to minimize the danger of COVID-19 but there were qualitative reports that they lacked appropriate PPE and could not socially distance despite trainings.[12,21] However, of the farmworker respondents in Washington, 96% said they were wearing masks at work even with 19% saying masks were not provided,[22] Many farmworkers in California, Oregon, and Washington reported the surgical masks being unsuitable for their workplace because of their lack of durability to the heat and intense labor.[17] Quandt et al., found that agricultural employers were not implementing as many safety measures at work as non-agricultural employers in North Carolina.[20] One study reported no significant association between the farmworker's perceived risk of getting sick with the amount of safety measures in place.[13] Safety measures that were reportedly put in place by employers included providing face coverings, conducting body temperature checks prior to workplace entry, and providing COVID-19 safety trainings. Thirty-four percent of 92 farmworkers in Central Florida and 62% of 273 farmworkers in Georgia reported that employers provided face coverings at the time of data collection.[7,13] In 2020, 86% of dairy farm

producers interviewed in Minnesota and Wisconsin reported proving PPE and 14% reported requiring face masks.[23] Some studies also reported temperature checks for farmworkers at their worksite, including 87% of 92 workers in Central Florida and 65% of 1,107 workers in California.[8,13] The percentage of farmworkers who were provided trainings in their native language on hand washing, mask usage, physical distancing, and isolation and quarantine varied.[10,15] Colquitt County respondents in Georgia were least likely among FCCA data, with only 42% reporting receiving such training.[10] Indigenous farmworkers (18%) in Oregon were less likely to receive a training on PPE than non-Indigenous farmworkers surveyed in Oregon (36%).[35]

Access to paid sick leave when workers were infected or ill with COVID-19 also varied among reports. Paid sick leave is an important infectious disease prevention measure as it enables low-wage workers to adhere to isolation and quarantine recommendations, Thirteen percent of those respondents in Colquitt County, Georgia who reported having COVID-19 said they had received paid sick leave. In interviews, farmworkers expressed fear of being fired for taking time off of work due to illness or to seek preventative care, even if their employer had a sick leave policy in place.[10] Sixty-nine percent (769 out of 1,107) of farmworkers in Monterey County, California reported being informed about paid sick leave policy and 92% (1,024 out of, 1,107) reported the employers also informed them of the importance of staying home when they were sick.[9] Farmworkers who spoke Indigenous languages in California were almost twice as likely to not have sick leave during the pandemic than non-Indigenous language speaking workers.[17] A study in Michigan showed evidence of poor working conditions like inadequate sanitation, including limited or no access to hand soap or water as well as unsanitary portable bathrooms that were not regularly cleaned. This study also reported that because of the worker's limited decision-making power and the poor relationship between management and the workers, workers were less likely to report symptoms or illnesses, which may increase the chance of infection spread and outbreaks.[24]

Table 4: Prevalence of workplace COVID-19 prevention practices

Workplace prevention practice	Percentage	Community	Total sample (# of farmworkers)	Study time period
Employer provided face coverings	34% 62% 54% 41%	Central Florida Colquitt County, Georgia California, Oregon, and Washington Minnesota and Wisconsin	92 273 915 37 farms	June 2020 Mar – Apr 2022 May – July 2020 June – July 2020
Any COVID-10 safety measure	52%	North Carolina[5]	67	2021
Maintaining 6 feet of distance	87% 56% 84% 54%	Central Florida California, Oregon, and Washington Minnesota and Wisconsin Oregon	92 915 37 farms 300	June 2020 May – July 2020 June-July2020 May-July 2020
Pre-shift temperature checks	12% 65% 5%	Central Florida Salinas Valley, California Minnesota and Wisconsin	92 1,107 37 farms	June 2020 June – Nov 2020 June -July 2020
Received a training in the workplace on COVID-19 safety in their preferred language*	92% 60% 74% 69% 79% 42% 33% 95%	Monterey, Tulare, and Kern counties, California Hidalgo County, Texas El Paso County, Texas and Doña Ana County, New Mexico Calhoun and Coahoma Counties, Mississippi Collier County, Florida Colquitt County, Georgia Minnesota and Wisconsin	251 190 207 197 249 273 37 farms	Aug - Oct 2021 Sept – Oct 2021 Sept – Oct 2021 Aug – Oct 2021 Dec 2021 Mar - Apr 2022 June - July 2020
Received a talk in the workplace on COVID-19 safety**	83%	California, Oregon, and Washington	915	May – July 2020
Informed about their paid sick leave policy	13% 70%	Colquitt County, Georgia Monterey County, California	273 1,107	Mar - Apr 2022
Provided personal hygiene supplies	59%	California, Oregon, and Washington	915	May – July 2020

*Included information on hand washing, mask usage, physical distancing, isolation and quarantine

**No language specified

One successful documented model to mitigate outbreaks and prevent transmission of COVID-19 included implementing safety measures during transportation of 170 farmworkers from Mexico to Iowa.[25] The model included social distancing, masking, and assigned cohort seating during transportation, testing upon arrival to the farm, contact tracing, and isolating COVID-positive workers and their cohort and close contacts for 10 days or until they tested negative for COVID-19. During isolation, workers had daily check-ins with healthcare staff, access to telehealth services, and meals provided. After implementing this model, only 3.5% of workers tested positive compared to 12.7%

before the implementation of this model. Authors identified collaborating with the employers as essential for success. Partnerships with employers were also recognized as a successful strategy for vaccinating farmworkers during in-depth interviews with local key experts in Colquitt County, Georgia along with pre-planning and bringing vaccination mobile clinics to worksites.[10]

Individual prevention practices

In two studies, one in Central Florida and the other in North Carolina, farmworkers and their families reported frequently washing their hands or using hand sanitizer, avoiding traveling to areas and avoiding contact with people infected with the virus, eating at home instead of restaurants, and using face coverings.[13,26] Quandt et al., reported that women in farmworker families perceived themselves to be less susceptible than non-farmworker men and women respondents to getting the COVID-19 virus and having less self-efficacy to protect themselves from the virus. Additionally, farmworker respondents favored prevention practices that avoided contact with others over other prevention practices.[26] For example, 96% of 67 farmworker families in North Carolina reported avoiding traveling to areas infected by COVID-19 and 91% avoided eating outside of the home, while 58% reported washing their hands with soap and water for 20 seconds, and 15% used disinfectant frequently on touched surfaces.[26] Twelve percent of all the COFS' 915 respondents had no way of isolating safely from infected household members.[17]

COVID-19 Vaccinations

Vaccination uptake

All nine studies reporting on vaccination of farmworkers relied on self-reported data (See Table 5). Vaccination uptake was reported lower among farmworkers in Florida and Mississippi compared to their corresponding general community population.[10,15] Overall, the percentage of farmworkers who did not

want to be vaccinated was low across publications. Vaccination uptake ranged from a low of 40% in October 2021 in Mississippi, to a high of 85% in summer 2021 in rural California.[15,27] In Central Florida, 53% of 81 farmworkers said they were fully vaccinated by July 2021. They were surveyed both for type of vaccine and completion status with Moderna being the most frequently type taken by 38% (n = 16) of farmworkers and secondly, Johnson & Johnson taken by 31% (n = 13).[13]

Table 5: Percentage of farmworkers across studies, nationally who reported being fully or partially vaccinated against COVID-19

Self-reported vaccine uptake	Community	Total sample	Study time period
72%*	Colquitt County, Georgia	273	Mar – Apr 2022
56%*	Collier County, Florida	207	Dec 2021
40%*	Calhoun and Coahoma Counties, Mississippi	197	Aug – Oct 2021
57%*	Hidalgo County, Texas	190	Sept – Oct 2021
64%*	Monterey, Kern, and Tulare Counties, California	251	Aug – Oct 2021
75%**	Imperial County, California	199	Jun – Aug 2021
71%*	El Paso, Texas and Doña Ana, New México	207	Jul 2021
53%*	Central Florida	81	Jul 2021
85%**	Rural California	77	Summer 2021

*Reported percentage who were fully vaccinated against COVID-19. Fully vaccinated was defined as respondents who received one dose of the Janssen/Johnson and Johnson vaccine or two doses of any COVID-19 vaccine approved by the U.S. Food and Drug Administration or the World Health Organization at the time of data collection. (unless otherwise noted).
**Reported percentage that received a COVID vaccine, without defining full or partial vaccination.

Vaccine hesitancy and access

Two articles reported on vaccine hesitancy among farmworkers. In a 2020 study of 92 farmworkers in Florida, 40% were unwilling to receive the vaccine. However, in a follow up survey in 2021, 67% of those unwilling reported they had received at least one dose since last surveyed.[13] The most common reasons reported for not wanting to get the vaccine included concern for side effects, lack of usefulness/utility of the vaccine, and mistrust in the vaccine and distrust of the government.[13,16]

Two articles discussed language as a barrier to access to the vaccine. A study in Imperial County, California reported a positive correlation between difficulty in speaking English and likelihood of receiving the vaccine, as those who had more difficulty with speaking English were more likely to receive the vaccine than those who had less difficulty when communicating in English.[11] However, authors discussed this could be the result of a concerted outreach effort by a local community organization to mitigate linguistic, technological, and informational barriers through a Spanish language hotline. The lack of available Spanish language information was cited as a critical barrier to vaccines for farmworkers among interviewees in Colquitt County, Georgia. Scheduling conflicts due to not having time off work, untimely transportation, and worker migration were also reported as barriers to accessing vaccinations in interviews of Colquitt County local experts.[10]

Pandemic Impact on Farmworkers

Economic impact

Ten publications addressed the economic impacts of the pandemic on farmworkers. Although farmworkers in the United States are considered essential workers, results from studies show farmworkers lost work hours, income, and some were let go or had to leave their job during the pandemic.[10,13,20] This was exemplified in a study with 92 farmworkers in North Florida, where 75% of respondents lost work hours or were fired. Only 18% of these farmworkers self-reported that they were eligible for economic relief provided through the CARES Act, and just 17% said their employer provided some form of economic relief.[13] Additionally, qualitative findings from three studies show that farmworkers had to stop working to care for their children due to the lack of affordable childcare.[13,17,26] Similarly, results from surveys conducted in Colquitt County, Georgia in 2022 show more than one-fourth (27%) of the 273 farmworker respondents lost hours or income during the pandemic.[10] Other economic issues for these farmworkers included difficulty paying rent or mortgage (15%) and food or

utility bills (16%).[10] Surveys from the Phase 1 Covid-19 Farmworker Survey (COFS) of Oregon conducted between August1, and October 31, 2020 reported 60% of farmworker women losing weeks and/or months of wages due to the pandemic while 45% of farmworker men lost weeks and/or months of wages. The same surveys reported that Indigenous farmworkers disproportionately struggled in paying for rent, food, and utilities.[12] In Washington, 51% of Indigenous workers lost work within the first ten months of the pandemic.[22] Forty-nine percent said they had more difficulty paying rent since the pandemic crisis began, and 54% reporting difficulty in paying for food.[22]

Mora et al. reported approximately half of all farmworkers surveyed struggled to pay bills. Additionally, 73% of those sending money to support family members outside of the U.S before the pandemic reported sending less support in 2020.[4,14] Forty percent of farmworkers in Oregon who sent money before the pandemic reported not sending money anymore when surveyed in 2020.[12(p1)] Quandt et al. noted farmworkers expressed concern about paying for health care during the pandemic.[20]

Undocumented farmworker respondents from the COFS study reported not accessing government programs due to reasons such as not qualifying for programs and not wanting to be a financial burden to the public.[18] The FCCAs noted 71% of farmworkers in California and in El Paso and Dona Ana Counties reported receiving public assistance (this population includes H-2A workers) such as food assistance, unemployment, the federal stimulus payment.[29,30] In comparison, 29% of farmworkers in Hidalgo County, Texas, 28% of farmworkers in Calhoun and Coahoma Counties, Mississippi, and 24% of farmworkers in Collier County, Florida reported receiving one or more of those types of economic assistance.[31–33]

Food insecurity

Food security data measures availability and access to enough food in the context of economic, geographic, and systemic factors.[34] Quandt et al. showed two out of three farmworker participants were very likely or somewhat likely to run out of money for food in the upcoming months in 2020. However, farmworker families surveyed in the same study had significantly better food security than the non-farmworker family respondents. It was noted that the farmworker families were the only respondents who reported taking behavioral measures to prevent food shortage, such as getting food from a local food pantry.[20] More than a third (37%) of 1,105 farmworker families surveyed in Monterey County, California reported that they experienced food insecurity since the pandemic started. In that same study, 40% had reported a harder time supplying food for themselves or household compared to before the pandemic.[16,28] The study also noted reports of more overeating and eating unhealthy foods compared to before the pandemic, and identified that foreign-born farmworkers and those living with children were more likely to experience food insecurity than U.S.-born farmworkers or those who did not have children in the household.[16,28]

Health care access

This theme of health care access includes availability of primary and specialty care services during the pandemic but does not include vaccination access. One report on human trafficking among temporary workers with H-2A visas working in agriculture nationally, found that 34% of 2,118 respondents had been denied medical care, 14% higher than before the pandemic.[35] In the Colquitt County assessment of 273 farmworkers, of the 13% who needed health care services within the last 12 months, 14% did not receive the care they needed.[10] Fifteen percent of Mississippi farmworkers received health care services within the last 12 months.[32] Similarly, 15% of those surveyed in Hidalgo County, Texas and 14% of those surveyed in Collier County, Florida received health care within the last 12 months.[31,33] In the

combined communities of El Paso County, Texas and Doña Ana County, New Mexico, 21% of farmworkers surveyed utilized health care services within the last 12 months.[29]

In a survey of 1,105 farmworkers in Monterey County, California, 21% had more difficulty accessing needed medical care or medications during the pandemic as compared to before.[16] More than half of farmworkers surveyed in the COFS said cost was a major barrier for receiving care, and it was reported more often as a barrier by respondents who spoke Indigenous languages. Indigenous farmworkers also were more likely to report lack of information and lack of sick leave as individual barriers to health care.[17] Other qualitative data from the COFS described discrimination being a barrier to receiving health care services.[18] In the Oregon COFS a lower percentage of women than men mentioned costs (44% of women vs 56% of men, respectively), loss of wages (47% vs 53%, respectively) and lack of sick leave (52% vs 48%, respectively) as barriers for medical attention. While a higher percentage of women reported fear of government authorities (76% vs 24%), transportation (75% vs 25%), fear of COVID-19 (75% vs 25%), and childcare issues (81% vs 19%) as barriers to seek medical attention.[12] Qualitative data show that while some farmworker women did have access to some forms of healthcare, few women had access to emotional health support or free/subsidized and safe childcare.[21] A survey among 37 agricultural employers in Minnesota and Wisconsin showed that 60% of these employers reported that their employees have access to health care services if they became ill.[23]

Mental health impact

Ten articles included information on mental health impact of the pandemic on farmworkers. COFS Oregon Report mentioned 82% of farmworkers surveyed had no access to mental health support.[35(p1)] Mental health symptoms reported by farmworkers in qualitative interviews included fear of becoming ill with COVID-19, stress, depression, anxiety, substance abuse, difficulty sleeping, and grief of a passed love one.[16,20,27,28] Twenty-six percent of 1,115 farmworkers interviewed across the United States in 2020

had a loved one become sick or die from COVID-19.[16] In Mora et al., study, farmworker women reported more fear, worry, and anxiety than male farmworkers and risk factors for depression included being single, living with children, and having COVID-19 related symptoms.[28] Some reasons for farmworker women's increased stress explored by Keeney et al., include fear of contracting COVID-19, family members becoming ill with the virus, and fear of spreading the virus to their family members.[11,27]

The burden of childcare was a source of stress to many of the 915 farmworkers surveyed across California, Oregon, and Washington. Since many children could no longer eat at school during lockdown periods, the cost of food for households increased, and 50% of participants reported a financial burden from the costs of childcare. Women were more likely than men to pay for childcare (31% vs 19%) and were more likely to lose work during the pandemic if they had children (51% vs 41%). Perceived financial burden was also more likely among Indigenous language-speaking farmworkers surveyed. COFS reported twice as many Indigenous language-speaking farmworkers paid for childcare than Spanish-speaking respondents and 43% had a harder time paying for it than Spanish-speaking workers as compared to before the pandemic.[17,18] A Mixtec-speaking widowed farmworker explained she had to leave children at home with her eldest child due to lack of childcare while she continued to work to support the six children.[17]

Other reasons for stress among farmworkers include fear of getting COVID-19 and missing work, and loss of employment that could lead to deportation.[36] A study focused on mental health among 77 farmworkers found that almost 40% reported stress levels so high they were considered a clinical mental health risk as defined by the potential for impairing daily functioning using the Migrant Farmworker Stress Inventory (MFSI) measurement.[11,27,3738] Significant stress levels were more common among foreign-born, older farmworkers.[1127]

Multiple studies provide evidence that self-reported substance abuse increased during the pandemic and farmworkers reported increased stress from witnessing substance abuse of co-workers.[11,16,27,28] A study found that farmworkers who reported increased substance use were more likely to be male workers with COVID-19 symptoms.[28] In the study of 1,115 farmworkers in 2020, 6% had increased their use of cigarettes, marijuana, alcohol, pills or other substances since the pandemic started.[16]

Discussion

Multiple studies have documented that many COVID-19 transmission risk factors are common among farmworkers, and that farmworkers in many areas of the country have experienced disproportionately high infection rates. Latinx Californians working in the food and agricultural industry had elevated excess mortality rates during the pandemic as compared to other workers.[39] Vaccination uptake has varied widely across the country, with numerous barriers to vaccines documented in various locations across the country. There is no evidence that farmworkers have lower vaccination numbers than the general population but there is evidence that farmworkers have had more COVID-19 cases than the general population. Low numbers of farmworkers accessed or received health care services during the pandemic. Phase 1 FCCAs reported as low as 14% of farmworkers surveyed received health care services within the last 12 months of being surveyed in 2021. [24,32,26] The highest percentage reported of farmworkers reporting receiving health care services was 21% in the combined communities of El Paso County, Texas and Doña Ana County, New Mexico.[29] These data may provide insight into why vaccination rates were varied across the country and why the numbers of cases and deaths were higher among the agricultural worker population.

Low COVID-19 testing has been noted as a limitation of infection data of farmworkers.[13,15] In Florida, only 11% of 92 farmworkers reported testing at least once for COVID-19 in 2020. Chicas et al., presented that some farmworkers did not get tested due to COVID-19 symptoms being perceived as

symptoms of other illnesses.[13] Despite issues accessing the COVID-19 test, the percent positive of COVID-19 cases among farmworkers was still high, specifically in some areas like Florida and Georgia. Access to COVID-19 testing has varied widely at different points in the pandemic and by location in the U.S., and most of the studies reviewed did not assess farmworker's perceptions of testing or their barriers to testing.

The pandemic has changed rapidly over time, so time of data collection is an important limiting factor when comparing studies and creates limitations to this literature review. The presence of outbreaks and different timing of COVID vaccinations in different parts of the country make many studies non-comparable. Limitations to this review are as follows; one author chose the themes and subthemes of the articles to give a scoping review and there is not a total count of all articles reviewed due to lists of articles being pulled from many databases and sources. Authors of studies did not all utilize the same definition of farmworker, and there are differences in the study populations and methodologies that can impact findings. For example, some of the studies included H-2A guest workers in their sample, and H-2A guest workers were required to receive the primary COVID-19 vaccine series after December 2021, while other farmworkers were not required to do so. The majority of studies did not draw data from representative or randomly selected samples; thus, it is not possible to extrapolate findings beyond the study in most cases. Individual studies should not be compared with each other; instead, these studies should provide readers with an understanding of the range of the impact of COVID-19 on different farmworker populations in U.S. at different points in the pandemic.

Conclusion

This systematic review offers a descriptive summary of the impact of the COVID-19 pandemic on farmworkers, and provides significant insight for farmworker health stakeholders, including health care providers, employers, and advocates. We suggest future research exploring mitigating outbreaks, mental

health support successes, the prevalence and impact of long COVID, and assessing correlations of comorbidities and environmental stressors with COVID-19 severity and incidence.

Acknowledgements

We would like to express our gratitude to Dr. Alfonso Rodriguez-Lainz PhD, DVM, MPVM, from the CDC's Division of Global Migration Health, for his encouragement to begin this research and his thorough reviews of this publication.

Funding

This publication was supported by the Centers for Disease Control and Prevention of the U.S. Department of Health and Human Services (HHS) as part of a financial assistance award totaling $3,000,000 with 100 percent funded by CDC/HHS. The contents are those of the author(s) and do not necessarily represent the official views of, nor an endorsement, by CDC/HHS, or the U.S. Government.

Ethics Statement

No human subjects review was needed for this study because it used existing publications and did not involve human participants.

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