

A Cross-Sectional Legal Epidemiology Study of Associations Between State-Level Labor Laws (LLEI) and Workplace Sanitation and Training Indicators Among Hispanic US Crop Workers Using the National Agricultural Workers Survey (NAWS)

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Objective: Agricultural workers are at a disproportionate risk of work-related injuries and illnesses. We examined how labor laws are associated with agricultural workers' work environments. **Methods:** We conducted a cross-sectional study of Hispanic/Latine participants in the National Agricultural Workers Survey to assess the association between a Labor Law Equity Index (LLEI), which summarizes agricultural worker inclusion or exclusion in workers' compensation, minimum wage, and overtime pay laws across US states, and workplace conditions. **Results:** Higher LLEI scores were associated with an increased odds of employer provision of water (adjusted odds ratio [aOR] = 1.18, 95% confidence interval [CI]: 1.05 to 1.33), toilet (aOR = 1.50, 95% CI: 1.34 to 1.67), hand-washing station (aOR = 1.40, 95% CI: 1.26 to 1.56), and pesticide training (aOR = 1.19, 95% CI: 1.10 to 1.29). **Conclusion:** Our results highlight policy-related opportunities to improve workplace water access, sanitation, and training implementation to better support agricultural worker health.

Keywords: labor laws, occupational health and safety, agricultural worker health

Agricultural workers engage in physically demanding labor and are commonly exposed to pesticides, dust, and high ambient temperatures.¹ Agricultural workers have historically been excluded from protections under numerous labor laws and health and safety regulations, referred to as agricultural exceptionalism, which leaves them vulnerable to work-related illness and injury.² To intervene and address occupational health disparities among agricultural workers, it is important to understand the structural drivers (eg, labor protections) that may further perpetuate the observed disparities.

Agricultural workers plant, cultivate, harvest, and prepare crops for consumption. In 2022, there were 2.6 million full- and part-time

LEARNING OUTCOMES

- Describe the history of labor laws pertaining to agricultural workers.
- Illustrate how labor laws can affect agricultural workers' work environment using occupational safety and health and structural racism conceptual frameworks.
- Examine the association of labor laws and workplace sanitation and training for agricultural workers.

jobs in farms, comprising 1.2% of the total US employment.³ Agricultural workers experience adverse health outcomes due to harsh working conditions.⁴⁻⁶ For example, agricultural workers can face a combination of elevated environmental heat exposure and physically demanding work leading to increased risk of heat-related illness, and repetitive motion and high-force tasks associated with developing work-related musculoskeletal disorders.⁴⁻⁶ Per the US Bureau of Labor Statistics, in 2022, the agriculture, forestry, fishing, and hunting industry had 5 times the fatal injury rates for all US industries, 18.6 deaths per 100,000 full-time workers compared with an all-worker rate of 3.7 deaths per 100,000 full-time workers.^{7,8} In 2021 to 2022, there were a total of 21,020 injuries in agricultural production that were severe enough that they required days away from work.^{7,9} These nonfatal occupational injuries are likely underestimated considering work-related injuries are often unreported because of lack of labor law protections, employer retaliation, lack of awareness of workers' rights, lack of workers' compensation in many states, fear of job loss, and language barriers.¹⁰⁻¹²

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Labor laws are important for understanding the context of occupational health disparities. The National Labor Relations Act (NLRA) in 1935 and the Fair Labor Standards Act (FLSA) enacted in 1938 were the first federal labor laws in the United States to address working conditions.^{13,14} The NLRA provided workers the right to organize without retaliation, while the FLSA established a variety of protections and standards for workers, including the federal minimum wage and overtime pay as well as youth employment standards.^{14,15} Agricultural workers, along with domestic workers or household cleaners, were expressly excluded from both the FLSA and the NLRA, forming the basis for agricultural exceptionalism.¹⁵ At the time these laws were passed, most agricultural workers and domestic workers were Black, and Southern Democrats deliberately excluded these groups of workers to preserve racial segregation and exploitation.^{16–19} This study was informed by various conceptual frameworks. First, we build off of Sorensen et al's²⁰ 2021 conceptual model on work, safety, health, and well-being that incorporates the socioecological framework. In this framework, there is an emphasis on how the sociopolitical and economic environment shape current laws and practices, the work environment, and worker health.²⁰ We also incorporate the framework on structural racism and immigrant health developed by Misra et al, considering that the majority of US agricultural workers are Latine (78%) and foreign born (68%).^{21,22} In this framework, Misra et al highlight critical race theory, which is how racism is embedded in laws and institutions and leads to the marginalization of groups of people at the systemic level, and intersectionality, which is the way that one's social identities (eg, race, gender, class) overlap with power structures and systems that result in disadvantage and unique experiences across one's various marginalized identities.^{22–24} Societal factors such as colonialism, discrimination, racism, prejudice, and classism produce agricultural exceptionalism as a form of structural racism that excludes those working in agriculture, and historically predominantly people of color, from accessing minimum wage, overtime pay, and the right to unionize, which are benefits most other workers have.^{2,14}

Structural and interpersonal racism and limited legal protections can increase mistreatment especially among minoritized and undocumented workers.^{22,25,26} For example, Hispanic/Latine workers who are undocumented may withstand unsafe and dangerous work conditions, because of fear of reporting these conditions to authorities and concerns about being able to find other work without authorization.²⁶ Agricultural workers who are US citizens have more secure and less physically demanding work than undocumented Latine workers.²⁷ Even after accounting for years of experience, language spoken and literacy, employer, region, and crop, undocumented Latine and indigenous workers are paid less per hour than US-born workers.²⁷ These findings highlight likely differential health and safety experiences among crop worker subgroups, and the way that agricultural workers' social identities, including how they are racialized, can influence how they are treated and paid at work. As such, agricultural exceptionalism and legal protections shape the agricultural work environment, including physical environment, workload, tasks, schedule, hours worked, workplace culture, and employee benefits, ultimately impacting worker health.

Legal epidemiology methods were used to create the Labor Law Equity Index (LLEI), which summarized the extent to which three state labor laws included agricultural workers.²⁸ Legal epidemiology is the study of law as an influence in the cause, distribution, and prevention of disease and injury.^{29,30} Legal epidemiology includes the use of systematic and scientific methods to create data from legal documents (eg, statutes, standards, case law) to measure the variation of laws across jurisdictions and over time, evaluate implementation of policies/laws, and analyze the impact of policies/laws and health indicators to further understand health implications of policies/laws.^{29,30} Legal epidemiology methods were used to examine how the inclusion or exclusion of agricultural workers in three state-level labor laws, workers' compensation insurance, minimum wage, and overtime pay eligibility, was associated with agricultural workers' work environment.

For work-related injuries and illnesses, workers' compensation insurance provides medical payments for work-related injury care, and partial wage replacement for those injuries and illnesses that result in lost work time.³¹ This is important as only 52% of crop workers in 2021 to 2022 reported having some form of health insurance,²¹ leaving many agricultural workers without other forms of insurance for work-related injuries and illnesses if they are working in a state with an agricultural worker exemption from mandatory workers' compensation coverage. Currently, there are 14 states that mandate that all agricultural workers have workers' compensation coverage, 21 states have partial exemptions of agricultural workers (eg, small farm or family working on farm exemptions), and 15 states do not mandate employers have workers' compensation insurance for agricultural workers.³² Hourly minimum wage is the minimum rate of pay for workers required by the state or federal government, whichever is higher, and overtime pay is workers being paid time and a half for any hours over 40 worked per week, which directly impacts the income of agricultural workers.^{33,34} These labor benefits are important to agriculture given long work shifts during the harvest months and low pay rates within this industry sector.³⁵ A study that used US Department of Agriculture Farm Labor Survey and the Bureau of Labor Statistics Current Employment Statistics Survey compared the average earnings of nonsupervisory farmworkers with those of production and nonsupervisory workers, a comparable group of non-farmworkers, and found that nonsupervisory farmworkers earn 40% less than nonagricultural workers (average of \$16.62 vs \$27.56 per hour, respectively).³⁶ For reference, the federal minimum wage has been \$7.25 since 2009, five states in the United States do not have state minimum wage laws and default to the federal minimum wage, 16 states have state minimum wage laws that expressly exclude all agricultural workers, 21 states include some agricultural workers, and eight states have state minimum wage laws that include agricultural workers.³⁷ In addition, the FLSA does not mandate overtime pay for agricultural workers, and only six states have laws that provide overtime pay to all or some agricultural workers.³⁸ Income affects other social determinants of health like housing and food security, and there is also evidence that lower income is associated with higher rates of morbidity and mortality.³⁹

We used the National Agricultural Workers Survey (NAWS) data, an employment-based, random-sample survey of US crop workers conducted by the US Department of Labor.⁴⁰ We examined the association of laws on workplace sanitation and pesticide training because these are commonly used measures to assess occupational health and safety, and work environment safety.^{41–43}

The Occupational Safety and Health Administration (OSHA) field sanitation standards require agricultural employers to provide at minimum one toilet and hand-washing station for every 20 workers; a hand-washing station that includes soap, potable water, and single-use towels; and cool drinking water that is available for all workers.⁴⁴ Provision of drinking water mitigates the risk of dehydration and heat-related illness; having access to a restroom helps prevent urinary tract infections and bladder, bowel, and kidney problems; and use of a hand-washing station helps prevent the spread of diseases and exposure to chemical and pesticide residues.⁴⁴ In addition, although the Agricultural Worker Protection Standard requires all employers to provide safety, pesticide application, and hazard information to workers and handlers in efforts to reduce pesticide poisonings and injuries among agricultural workers and pesticide handlers, estimates from NAWS indicate that 64% of agricultural workers did not receive this type of training.^{21,45} Pesticides continue to be a serious hazard for agricultural workers, and 90% of pesticides in the United States are used in the agriculture industry.⁴⁶ Estimates indicate that there are between 13,000 and 15,000 agricultural workers per year experiencing acute pesticide poisonings, and when accounting for undiagnosed workers, some estimate it could be up to 300,000 agricultural workers.⁴⁶ Thus, in line with our conceptual framework, we hypothesized that more protective and inclusive labor laws would be associated with safer work

conditions, in this case, higher provision of drinking water, toilet, hand-washing station, and pesticide training.

METHODS

Data Source

The NAWS is a cross-sectional and employment-based, random-sample survey of US crop workers conducted by the US Department of Labor since 1989.⁴⁰ The NAWS is the largest source of demographic and health information of agricultural workers across the United States.⁴⁰ The NAWS is used to monitor the work conditions of agricultural workers and for occupational injury and health surveillance. Agricultural workers are interviewed in person at their workplace, and data are collected directly from workers by researchers at JBS International, a private research firm that provides research assistance and services for policy analysis and program evaluation to government agencies.⁴⁰ Each year, 1500 to 3600 workers are interviewed from 12 regions in the United States that are aggregated from 17 US Department of Agriculture regions.⁴⁰ Interviews are allocated proportionately to each region based on levels of agricultural employment and conducted at different times of year to capture the seasonal nature of agricultural employment.⁴⁰

Analytic Sample

We used NAWS data that were collected from 2001 to 2017. These years were selected based on the completeness of the workplace health indicator data. This 17-year time frame also allowed for an assessment of changes in labor laws and health indicators during the study period. NAWS collects data on currently employed agricultural workers, both migrant and seasonal, who perform crop-related work. H-2A workers, those coming to the United States with agricultural worker temporary visas, are excluded because of worker contracts. NAWS defines crop-related workers using the North American Industrial Classification System (NAICS), a standard classification system to characterize the primary economic activity of business establishments.⁴⁷ NAWS interviews workers in crop production (NAICS code 111) or support activities for crop production (NAICS code 1151).⁴⁰ NAICS code 111 includes farms, orchards, groves, greenhouses, and nurseries growing crops, plants, vines, or trees. NAICS code 1151 includes supplying labor, dusting or spraying, cotton ginning, cultivating services, farm management services, and vineyard cultivation. We excluded the following states because of low sample sizes in NAWS, which was defined as less than 25 total observations⁴⁸: Iowa, Maine, Maryland, Montana, North Dakota, New Hampshire, Rhode Island, Vermont, Wyoming, Nevada, and South Dakota. There were no agricultural workers from Alaska, Hawaii, and West Virginia included in the 2001 to 2017 NAWS data, and therefore, these states were not included in this study. We also excluded agricultural worker participants under 18 years old and those who did not identify as Hispanic/Latine because of the scope of the project. The University of Washington Human Subjects Division determined this study to be exempt.

Measures

Dependent Variables

We used the following NAWS questions from the 2001 to 2017 data to assess workplace sanitation and personal protective equipment pesticide training (see Table 1 for NAWS variables, questions, and recoding).

Independent Variable - Labor Law Equity Index

The LLEI was developed using legal epidemiology methods to code and score three labor protection laws—workers' compensation, minimum wage, and overtime pay laws—for whether states include agricultural workers in these protections from January 1, 2001, to December 31, 2017. Details of the methods and development of this

TABLE 1. National Agricultural Workers Survey Workplace Sanitation and Personal Protective Equipment Pesticide Training Variables

Measure	NAWS Question	Options	Recode
Workplace sanitation: water	Does your employer provide clean drinking water and disposable cups every day?	- Yes, their employer provided water and/or disposable cups - No, not provided water and/or disposable cups - Don't know	- Yes, their employer provided water and/or disposable cups - "No" or "don't know" were recoded as "no, their employer did not provide water and/or disposable cups"
Workplace sanitation: toilet	Does your employer provide a toilet?	- Yes, their employer provided a toilet - No, not provided a toilet - Don't know	- Yes, their employer provided a toilet - "No" or "don't know" were recoded as "no, their employer did not provide a toilet"
Workplace sanitation: hand-washing station	Does your employer provide water to wash hands?	- Yes, their employer provided a hand-washing station - No, not provided a hand-washing station - Don't know	- Yes, their employer provided a hand-washing station - "No" or "don't know" were recoded as "no, their employer did not provide a hand-washing station"
Personal protective equipment pesticide training	In the last 12 months while working for your current employer, did you receive training or instructions in the safe use of pesticides through video, audio cassette, classroom lecture, written material, informal talks, or by any other means?	- Yes, their employer provided pesticide training - No, not provided pesticide training - Don't know	- Yes, their employer provided pesticide training - "No" or "don't know" were recoded as "no, their employer did not provide pesticide training"
NAWS, National Agricultural Workers Survey.			

index have been published previously, and more details are available in Appendix Tables B to F (<http://links.lww.com/JOM/C246>).²⁸ Higher LLEI scores indicate more protective and inclusive laws for agricultural workers, and lower or negative scores indicate laws that are less protective and exclude agricultural workers. The range of the LLEI scores were from -2 (less protective) to 5 (more protective), and there were five states that had changes within the time frame of interest (see Appendix – Table B, <http://links.lww.com/JOM/C246>). States with zero legislative changes to the three labor protections for agricultural workers within 2001 to 2017 received the same LLEI score for all 17 years. For states with an amendment to any of these three labor protections, scores were updated for the relevant years. For this study, the LLEI data were linked to individuals in states using the NAWS data by the state and year that workers were interviewed.

Covariates

Individual-Level Demographics

Demographic characteristics included age in years, sex (female or male), work authorization (citizen, green card, other work, or unauthorized), indigenous background (yes or no), and race (Black, Native American, white, or other). These covariates were selected based on prior literature that reported associations between these demographic factors and agricultural worker health.^{10,49–53}

State-Level Demographics

State-level variables were included to address endogeneity factors that are often associated with types of laws implemented in states.⁵⁴ These included the percentage of Hispanics/Latines residing in the state using USA IPUMS American Community Survey data,⁵⁵ the unemployment rate using Bureau of Labor Statistics data,⁵⁶ governor's political party affiliation (Democratic, Republican, or Independent),⁵⁷ and whether the state had Medicaid expansion from 2014 (“yes, expanded Medicaid” or “no, did not expand Medicaid”).⁵⁸

Data Analysis

We conducted descriptive statistics for all variables to describe our sample and the state-level covariates. Descriptive statistics included frequencies, percentages, means, standard deviations, and distributions of variables. We also assessed correlations between variables to identify issues of multicollinearity. Unadjusted bivariate logistic regression models were conducted to assess the association between the LLEI and each workplace health indicator. Adjusted multivariable logistic regression models with 95% confidence interval (CI) estimated the odds of each workplace health indicator—provision of training, water, toilet, and hand-washing station, while controlling for covariates. Covariates for adjusted logistic regression models included age, sex, work authorization, indigenous background, race, year, state percentage of Hispanics/Latines, state percentage of unemployment rate, governor's political party affiliation, and Medicaid expansion in 2014. All analyses were conducted using R Version 4.4.3.⁵⁹ We conducted the analysis using the survey package for R to account for the complex and multistage sampling design of the NAWS data.^{60,61}

RESULTS

Participant Characteristics

Table 2 describes demographic characteristics of the Hispanic/Latine participants in the sample ($N = 30,807$). The mean age was 36.5 (standard deviation = 12.5) years, 74% were male, and 61% were unauthorized for work. In terms of workplace health indicators, nearly all participants reported that their employer provided water (94.5%), a toilet (96.8%), and a hand-washing station (96.8%) every day (Table 3). In addition, most participants received pesticide training in the last 12 months (75.3%) (Table 3).

State-Level Characteristics

There was a wide range in the number of survey respondents from each state, from $N = 25$ (Nebraska) to $N = 13,711$ (California) (see Table A, Appendix, <http://links.lww.com/JOM/C246>). For state-level percentage of Hispanic/Latine populations, the overall median was 30.2% but ranged from 1.1% (Mississippi, 2002) to 48.7% (New Mexico, 2017). The median unemployment rate was 6.2% and ranged from 2.5% (Florida, 2006) to 13.1% (Michigan, 2009). Eighteen out of the 36 states expanded Medicaid in 2014. About half of participants were in states with Democratic governors (50.1%) or Republican governors (49.9%), and 0.1% were in a state with Independent governors (Minnesota).

Multivariable Analyses of Workplace Health and Sanitation Indicators

Results from unadjusted and adjusted (age, sex, work authorization, indigenous background, race, state percentage of Hispanic/Latine, state unemployment rate, state governor party affiliation, and state Medicaid expansion in 2014) logistic regression models are presented in Table 4. There were significant associations between LLEI scores and employer provision of water, toilet, water for hand-washing station, and pesticide training in both unadjusted and adjusted models. Adjusted models showed that every one-unit increase in the LLEI score was associated with 18% higher odds of being provided water (adjusted odds ratio [aOR] = 1.18, 95% CI: 1.05 to 1.33), 50% higher odds of being provided a toilet (aOR = 1.50, 95% CI: 1.34 to 1.67), 40% higher odds of being provided a hand-washing station (aOR = 1.40, 95% CI: 1.26 to 1.56), and 19% higher odds of receiving pesticide training (aOR = 1.19, 95% CI: 1.10 to 1.29).

Sensitivity Analyses

Because of the large sample sizes in California ($N = 13,711$) and Florida ($N = 3163$) in the NAWS sample of this study, sensitivity analyses were conducted by excluding individuals in these states and

TABLE 2. National Agricultural Workers Survey Characteristics of Hispanic/Latine Participants, 2001–2017

Variable	Weighted	
	Mean	Standard Deviation
Age (years)	36.5	12.5
	Count	%
Sex		
Female	7,108	25.8
Male	20,656	74.3
Race ^{a,b}		
Other ^c	18,162	65.8
White	7,635	27.6
Native American	1,723	6.2
Black/African American	100	0.4
Indigenous		
Indigenous	3,059	11.0
Not indigenous	24,704	89.0
Work authorization ^a		
US citizen	3,318	12.1
Green card	7,130	25.9
Other work authorization	343	1.2
Unauthorized	16,691	60.7

^aCounts and proportions may not equal 100% because of rounding and/or minimal missing data. Missing data for weighted variables indicate $N = 144$ for race and $N = 281$ for work authorization.

^bIncludes only those who identify as Hispanic/Latine. Asian and Native Hawaiian/PI race and ethnic groups were excluded because of small cell sizes.

^cThese are participants who reported as “Other” for the race category.

TABLE 3. National Agricultural Workers Survey Workplace Sanitation Indicator Reported by Hispanic/Latine Participants, 2001–2017

Dependent Variables	Weighted	
	Count	%
Employer provides water every day ^a		
Yes	26,232	94.5
No	1,518	5.5
Employer provides a toilet ^b		
Yes	26,858	96.8
No	893	3.2
Employer provides water for hand-washing station ^c		
Yes	26,870	96.8
No	878	3.2
Received pesticide training in the last 12 months ^d		
Yes	20,856	75.3
No	6,836	24.7

There were minimal missing data.

^aThere were *N* = 13 missing observations for provision of water.

^bThere were *N* = 13 missing observations for provision of a toilet.

^cThere were *N* = 15 missing observations for provision of a hand-washing stations.

^dThere were *N* = 68 missing observations for receiving pesticide training.

rerunning our multivariable logistic regression models to examine potential changes in model point estimates, CIs, standard errors, and *P* values. California represents the largest proportion of our NAWS sample and had the highest LLEI score of 5 (LLEI scores ranged from −2 to 5 among all states; see Appendix - Table B, <http://links.lww.com/JOM/C246>), while Florida represented the second largest state proportion in our sample. When individuals from California were removed from the analyses, the provision of water was no longer statistically significant (*P* > 0.05), while all other model results were comparable. Model results were not changed by the exclusion of individuals from Florida.

DISCUSSION

Work is where many adults spend the majority of their waking hours and is a critical social determinant of health.⁶² In this study, we assessed how LLEI score, or the overall inclusion of agricultural workers in three labor protection laws, namely, workers' compensation, minimum wage, and overtime pay, was associated with workplace health and sanitation using cross-sectional data from NAWS. Consistent with our hypotheses, we found that higher LLEI scores were associated with increased workplace sanitation, including the provision of water, a toilet, and a hand-washing station, as well as the provision of pesticide training, suggesting labor laws may provide an effective mechanism to promote health and safety among Hispanic/Latine US crop workers.

Although the LLEI did not include laws that specifically address workplace sanitation or training, our hypothesis was driven by occupational health frameworks that describe how laws and policies shape work and community environments and therefore influence health in a myriad of ways, including physical and psychosocial occupational exposures, income, and access to benefits.^{20,63} The OSHA, a result of the Occupational Safety and Health Act of 1970, does have standards on sanitation and personal protective equipment training (29 CFR 1910.141 and 29 CFR 1910.30).^{64,65} These standards apply to all agricultural employers that have 11 or more employees.⁶⁶ The US Environmental Protection Agency (EPA) requires employers to provide pesticide training to agricultural workers and pesticide handlers in the 2015 Agricultural Worker Protections Standard.⁴⁵ Although there are federal standards that require sanitation and pesticide training, there were still differences in the reporting of sanitation and pesticide training among agricultural workers with different LLEI scores in our sample. These findings suggest likely variation in compliance or enforcement of sanitation and pesticide training standards. Further research may be needed to understand the enforcement and implementation of these OSHA workplace sanitation standards and EPA pesticide training requirements. Our results suggest that the states with higher LLEI scores may be states that are complying with, and possibly enforcing, OSHA sanitation standards and EPA pesticide training requirements.

Our sensitivity analyses highlight the relatively large impact of California agricultural health and safety laws on the measured impact of the LLEI on worker sanitation and safety indicators. Given that a substantial proportion of the US crop worker population is employed in California, California state labor laws are likely to exert a relatively large impact on overall US crop worker health and safety. California also had the highest LLEI score (5) of the 36 states within the 2001 to 2017 period (see Appendix - Table B, <http://links.lww.com/JOM/C246>). In the sensitivity analyses, when California was removed, we found that the provision of water was no longer significantly associated with the LLEI, suggesting California labor laws may be especially effective in ensuring provision of water to crop workers. Future work is needed to elucidate the mechanism by which state-level labor laws and/or employer-specific practices may impact the provision of water to crop workers.

This study has many strengths. We tested a measure (LLEI score) that captures agricultural exceptionalism, a form of structural racism experienced by agricultural workers. This study assesses state-level and workplace sanitation and training indicators for Hispanic/Latine US crop workers. By using the LLEI as a tool, we could explore the association of multiple laws with health indicators.⁶⁷ We combine the LLEI and NAWS, multiple years of nationally representative data, to understand more about what is written in laws and how that translates to agricultural workers' experiences. This study is also innovative as it is merging legal epidemiology and occupational

TABLE 4. Unadjusted and Adjusted Logistic Regression Models Estimating Associations Between LLEI and Workplace Sanitation and Training Indicators

Workplace Indicator	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Employer provision of water	1.23 (1.16–1.30)***	1.18 (1.05–1.33)**
Employer provision of a toilet	1.38 (1.29–1.48)***	1.50 (1.34–1.67)***
Employer provision of a hand-washing station	1.28 (1.19–1.37)***	1.40 (1.26–1.56)***
Received pesticide training in the last year	1.14 (1.08–1.19)***	1.19 (1.10–1.29)***

Adjusted models are including age, sex, race, indigenous background, work authorization, year, state-level percentage of unemployment, state-level percentage of Latine, state governor affiliation, and Medicaid expansion.

CI, confidence interval; LLEI, Labor Law Equity Index; OR, odds ratio.

****P* < 0.01.

****P* < 0.001.

health research to further our understanding of how laws shape workplace environments.

This study has several limitations. NAWS data only include agricultural workers actively employed in crop work at the time of the interview and thus are or may be susceptible to healthy worker bias. Healthy worker bias may have skewed results toward the null because our data only included workers who were healthy and well enough to work.⁶⁸ In line with our hypothesis, workers at workplaces with less safe sanitation and training standards would be more prone to injuries or illnesses and thus less likely to be in the NAWS sample in this study. NAWS also excludes H-2A workers, an increasing proportion of all agricultural workers.⁶⁹ H-2A workers are distinct from other agricultural workers in several ways: they are predominately young and male, and their employers are required to provide safe and clean housing, among other things. However, H-2A workers also have employer-specific visas, making them at a greater risk for exploitation.^{69–72}

Another limitation due to the scope and focus of the study, the associations observed apply only to Hispanic/Latine crop workers 18 years and older. In addition, this is an observational study that uses multiple years of cross-sectional data, which limits our ability to make causal inferences between the LLEI and the workplace sanitation and training indicators we assessed. Finally, our outcomes focused on work conditions and not health indicators.

Future studies can use similar methods to build the LLEI with an expanded time frame and with US states that were not included in this study. It would also be relevant and important to include H-2A workers in future research by collecting H-2A worker survey data and/or working with NAWS to expand their data collection efforts to include this group of agricultural workers, similar to a study focused on H-2A workers in Washington State.⁷² There is also value in evaluating the effect of these laws on their intended outcomes. An example is to look at the relationship between minimum wage laws with income and reported work hours to understand if income reported by workers aligns with minimum wages in those states. Another example is examining workers' compensation laws and whether workers reported whether they would be provided medical care and payment while recuperating through their workers' compensation benefits if they got injured. These are variables available in the NAWS data and are more direct measures that could assess if what is written in state laws is what workers are reporting at their work. However, at the initial stages of the study, the primary interest was not directly assessing implementation of these laws but rather understanding the work environment for agricultural workers as described in our conceptual model. Future work can explore whether there are differences across different worker groups, including race, indigenous background, and work authorization (ie, documentation status).^{22,25,26} In addition, our study methods provide an example of how future research can explore how labor laws impact other groups that are differentially excluded from labor laws, like domestic or household workers, for example, especially in studying how labor laws that continue perpetuating systemic racism are related to health.

CONCLUSION

This exploratory study indicates there is an association between LLEI and agricultural workers' workplace sanitation and provision of training. Our findings suggest there may be implications for these laws shaping agricultural workers' work environment. Not only is further research needed to understand the mechanisms by which labor laws are impacting work environment and health, but there is also a need for enforcement of existing laws to ensure these policies are being implemented and followed as intended. Every worker in every industry deserves basic human rights like provision of drinking water, a toilet, and a hand-washing station, and training to safely conduct their job. With labor protections and laws varying tremendously across states, it is important to ensure all workers, especially workers of color, those

working low-wage jobs, and those continually experiencing greater occupational health risks, are safe and well. This is an opportunity for policymakers to deepen their understanding of the ways in which labor protections are affecting agricultural workers.

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