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Occupational exposures and asthma prevalence among US farmworkers: National Agricultural Workers Survey, 2003-2014

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To the Editor

Hired farmworkers are a vulnerable population with routine occupational respiratory health^{1,2} exposures and poor access to health care. Although US farmers may have a lower prevalence of asthma compared to the general population³, little is known about asthma prevalence among the US farmworkers on a national level; previous studies have focused on local farmworkers in North Carolina¹ and California.⁴

Occupational exposures, such as handling tobacco crop², have been shown to adversely affect farmworkers' respiratory health. Pesticide exposure has been associated with adult-onset asthma only in farmers⁵; however, farmworkers have been shown to have increased exposure to pesticides when measuring urinary metabolites⁶. Additionally, farmworkers experience increased barriers to care secondary to cultural and language differences, lack of transportation, cost, and immigration concerns,⁷ which can lead to poor health outcomes.

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We sought to determine the asthma prevalence among US farmworkers and to investigate the association between demographic/occupational factors and reported lifetime or recent asthma, using data from the National Agricultural Workers Survey (NAWS)⁸. NAWS is a nationally representative, employment-based, random sample survey of US hired crop workers sponsored by the U.S. Department of Labor, which uses stratified multi-stage sampling to account for seasonal and regional fluctuations in the level of farm employment. Data are collected through face-to-face interviews conducted in Spanish or English in three cycles throughout each year at the farmworkers' worksite. Occupational exposures that were examined included the type of current crop exposure, type of current task, exposure to pesticide within the last 12 months, number of years performing US farm work, and age starting US farm work.

Lifetime asthma was determined by the question, "Have you ever in your whole life been told by a doctor or nurse that you have asthma?" Recent asthma was determined by the above question and whether participants agreed to either of the following questions: "Are you currently taking medication for asthma?" or "In the last 12 months in the US and/or abroad, have you seen a doctor or nurse for asthma?"

We used balanced repeated replication weights to estimate design-corrected standard errors. Unadjusted and multivariable logistic regression analysis were performed using STATA 14.1 (College Park, TX). We examined associations between demographic factors and occupational exposures with prevalence of lifetime and recent asthma.

Our analysis included data based on interviews from 25,021 farmworkers from 2003 to 2014. Most farmworkers were male, Hispanic, foreign-born, and undocumented (Table I). Approximately 5% [95%CI, 4-6] of the farmworkers were children less than or equal to 18 years of age. Overall, lifetime asthma was 3.1% [95%CI, 2.6-3.5], with a slight decrease over time from 3.3% [95%CI, 2.6-4.1] in 2003-2006 to 2.5% [95%CI, 1.9-3.3] in 2011-2014. Recent asthma was 2.0% [95%CI, 1.6-2.4], with a slight decrease over time from 2.0% [95%CI 1.4-2.9] in 2003-2006 to 1.8% [95%CI 1.3-2.3] in 2011-2014.

After unadjusted analysis was performed (Supplemental Table II), the multivariable model showed that farmworkers who were female, Puerto Rican, and who spoke better English were more likely to report lifetime and recent asthma compared to their respective counterparts (Table II). Midwest farmworkers were less likely to report lifetime and recent asthma compared to California farmworkers. In terms of occupational exposures, only pesticide use was associated with lifetime prevalence of asthma. Type of current crop exposure, number of years performing US farm work, and age starting US farm work were not associated with lifetime or recent asthma.

Approximately 58% of those with lifetime asthma and 89% of those with recent asthma reported seeing a clinician for asthma in the last 12 months (Supplemental Table I). Most farmworkers with recent asthma who sought US care reported that their last healthcare visit was at a private (54%) or migrant/community clinic (29%). Only a small percentage reported care at an Emergency Department (0.5%) or hospital (7%). Among farmworkers

with recent asthma, 37% reported that their last health care visit was self-paid, and the most commonly cited barriers to accessing US care were transportation (60%) and cost (33%).

We found that the US farmworkers' lifetime prevalence of self-reported asthma was 3.1%, consistent with previous studies of farmworkers in North Carolina (3.4%)¹ and in California (6%)⁴. This asthma prevalence was lower than previous reports of asthma prevalence for US farmers (5.1%)⁹, farm operators (7.2%)³, and the general US population (13.8%)³. It is unknown whether this low prevalence of asthma reflects true disease burden or represents under-diagnosis due to decreased healthcare access or quality of care, patient's lack of understanding of disease, and/or the bias of the "healthy worker effect" (i.e., the self-selecting bias in a manual labor workforce due to the good health needed to participate). Additionally, the majority of hired farmworkers were of Mexican ethnicity, a group that has been previously shown to have low asthma prevalence¹⁰.

Farmworkers who were female, Puerto Rican, or who spoke English well were more likely to report lifetime and recent clinician-diagnosed asthma, consistent with previous studies^{4,10,11}. Farmworkers with better English proficiency may be more able to navigate or access the healthcare system. This effect could also be secondary to selective migration of healthier individuals, as migration factors have been previously associated with respiratory health in farmworkers⁴.

Pesticide exposure in the last 12 months was significantly associated with lifetime asthma but not recent asthma. Overall pesticide use has not been associated with asthma among California farmworkers⁴ or adult-onset asthma in male farmers⁵. However, specific pesticides and high pesticide exposure events have been associated with adult-onset asthma⁵, which suggests that the type of pesticide, duration of use, and amount of exposure could explain our finding. We did not find type of crop exposure or the number of years performing US farm work to be associated with asthma, which differs from a previous study of California farmworkers⁴.

Limitations of our study include lack of causal interpretation due to the cross-sectional design, limited exposure history (e.g., pesticide exposure prior to 12 months or in other countries), and lack of clinical data (e.g., smoking status or current symptoms). Additionally, asthma was self-reported and may not represent true disease burden. However, these data are one of the most comprehensive national data regarding this hard-to-reach population.

In summary, US farmworkers report a low asthma prevalence, though occupational pesticide exposure was significantly associated with reported lifetime asthma. It remains unclear whether the low asthma prevalence reflects the self-selection bias of the healthy worker effect or disproportionate rates of undiagnosed disease given decreased access to care. Future work will need to investigate these underlying factors, the causal nature of occupational exposures on their health, and mechanisms to mitigate their exposures. Farmworkers remain one of the most vulnerable populations in this nation and seeking to understand and improve their health remains a critical priority for reducing healthcare disparities.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Clinical Implications

Hired farmworkers report a relatively low prevalence of recent and lifetime asthma, and exposure to pesticides is associated with an elevated lifetime asthma risk. Asthma diagnosis and management are needed in this vulnerable population with decreased access to care.

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Characteristics and their associations with self-reported lifetime and recent asthma; National Agricultural Workers Survey, 2003-2014

Table 1

	Sample population (n = 25,021)		Lifetime asthma (n = 740)		Recent asthma (n = 485)	
	%	[95% CI]	%	[95% CI]	%	[95% CI]
Age (years)						
<= 18	5.1	[4.1, 6.3]	5.7	[3.1, 10.3]	4.3	[2.5, 7.3]
19-30	34.6	[33.1, 36.2]	34.7	[28.3, 41.8]	32.1	[25.5, 39.5]
31-40	25.3	[24.2, 26.6]	23.5	[17.8, 30.3]	21.6	[16.5, 27.8]
> 40	34.9	[33.5, 36.4]	36.1	[30.8, 41.8]	42.0	[35.6, 48.6]
Sex						
Male	75.0	[73.0, 77.0]	63.5	[53.8, 72.3]	56.3	[44.8, 67.3]
Female	25.0	[23.0, 27.0]	36.5	[27.7, 46.2]	43.7	[32.7, 55.2]
Race/Ethnicity						
Non-Hispanic White	17.5	[15.5, 19.6]	34.7	[28.2, 41.8]	29.8	[22.4, 38.5]
Non-Hispanic Black	2.2	[1.8, 2.8]	2.8	[1.7, 4.6]	3.1	[1.7, 5.6]
Mexican	72.9	[70.3, 75.2]	51.2	[44.1, 58.2]	54.8	[44.9, 64.4]
Puerto Rican	1.0	[0.4, 2.3]	4.8	[2.6, 8.7]	6.2	[3.0, 12.3]
Other Hispanic/Other Race	6.4	[5.5, 7.6]	6.6	[3.1, 13.6]	6.1	[1.8, 18.4]
Poverty*						
>= US poverty level	65.0	[63.0, 67.1]	71.5	[64.2, 77.8]	72.6	[64.1, 79.7]
< US poverty level	34.4	[32.4, 36.4]	28.0	[21.8, 35.2]	27.0	[20.0, 35.4]
Country of Origin						
Foreign Born	74.3	[71.9, 76.5]	48.9	[41.7, 56.1]	52.3	[42.1, 62.3]
US Born	25.7	[23.5, 28.1]	51.1	[43.9, 58.3]	47.7	[37.7, 57.9]
Immigration Status						
Undocumented	48.5	[46.0, 51.0]	26.1	[20.3, 33.0]	24.5	[16.9, 34.0]
Green Card [†]	21.0	[19.4, 22.6]	14.5	[10.6, 19.5]	17.8	[12.8, 24.2]
Citizen	29.7	[27.3, 32.2]	59.1	[50.6, 67.1]	57.6	[45.0, 69.3]
English Speaking Proficiency						
No English	33.8	[31.7, 36.0]	13.5	[10.3, 17.5]	12.8	[9.1, 17.7]

	Sample population (n = 25,021)		Lifetime asthma (n = 740)		Recent asthma (n = 485)	
	%	[95% CI]	%	[95% CI]	%	[95% CI]
Some/Little English	37.2	[35.4, 38.9]	31.5	[26.3, 37.2]	34.8	[26.8, 43.7]
Well English	28.7	[26.5, 31.1]	54.9	[47.5, 62.2]	52.4	[41.9, 62.7]
Education						
<= Elementary school	22.8	[21.7, 24.0]	14.4	[10.4, 19.7]	16.9	[12.1, 23.2]
Junior high/High school	67.5	[66.2, 68.9]	62.7	[55.8, 69.2]	63.5	[55.5, 70.8]
College or more	9.6	[8.4, 11.1]	22.8	[16.9, 30.2]	19.5	[12.5, 29.2]
Insurance						
No	68.8	[66.4, 71.0]	57.9	[50.1, 65.3]	55.0	[45.8, 64.0]
Yes	31.2	[28.9, 33.5]	42.1	[34.7, 49.9]	45.0	[36.0, 54.2]
Region of Country						
California	34.1	[30.9, 37.5]	25.2	[18.2, 33.7]	27.1	[17.8, 38.9]
East	14.0	[12.1, 16.0]	19.4	[13.4, 27.2]	21.2	[13.0, 32.7]
Southeast	12.2	[10.4, 14.1]	10.9	[7.3, 16.0]	10.4	[7.0, 15.1]
Midwest	17.7	[15.2, 20.5]	18.0	[12.6, 24.9]	13.8	[8.1, 22.5]
Southwest	7.7	[6.4, 9.4]	9.2	[5.8, 14.2]	11.5	[7.1, 18.1]
Northwest	14.3	[12.1, 16.9]	17.4	[12.0, 24.5]	16.0	[10.8, 23.2]
Migrant Status						
Migrant [‡]	26.0	[24.0, 28.1]	18.0	[13.0, 24.2]	14.6	[9.3, 22.1]
Settled	73.8	[71.7, 75.8]	81.3	[74.0, 86.9]	84.3	[75.5, 90.4]
Type of Current Crop						
Fruit/Nuts	33.4	[30.1, 37.0]	24.0	[18.4, 30.6]	25.2	[17.7, 34.7]
Field	15.9	[13.9, 18.2]	21.2	[15.6, 28.2]	23.5	[16.6, 32.2]
Horticulture	22.2	[19.4, 25.2]	27.4	[20.6, 35.4]	24.7	[16.6, 35.0]
Vegetables	23.9	[20.7, 27.4]	20.0	[13.6, 28.4]	18.7	[11.1, 29.9]
Other	4.6	[3.8, 5.6]	7.5	[4.3, 12.6]	7.8	[4.2, 14.0]
Type of Current task						
Pre-harvest	25.4	[23.1, 27.9]	23.8	[17.1, 32.1]	26.5	[17.9, 37.5]
Harvest	23.8	[21.7, 26.1]	17.8	[13.1, 23.8]	19.3	[13.0, 27.8]
Post-harvest	15.9	[14.2, 17.8]	17.8	[11.3, 27.0]	15.5	[8.9, 25.6]

	Sample population (n = 25,021)		Lifetime asthma (n = 740)		Recent asthma (n = 485)	
	%	[95% CI]	%	[95% CI]	%	[95% CI]
Other	34.8	[32.1, 37.5]	40.5	[33.6, 47.8]	38.6	[32.0, 45.6]
Pesticide Use in Last 12 Months						
No	84.6	[83.1, 86.0]	75.5	[68.4, 81.4]	81.1	[73.7, 86.7]
Yes	15.3	[13.9, 16.8]	24.5	[18.6, 31.6]	18.9	[13.3, 26.3]
# Years of US Farm Work						
< 5	30.7	[28.8, 32.8]	32.2	[25.3, 40.1]	31.2	[22.4, 41.7]
5-9	18.6	[17.5, 19.7]	16.6	[12.4, 21.8]	17.5	[12.1, 24.6]
10-14	14.0	[13.2, 14.8]	14.7	[9.3, 22.6]	15.2	[8.5, 25.5]
15-19	10.1	[9.3, 10.9]	10.5	[7.9, 13.8]	10.7	[7.7, 14.7]
>= 20	26.5	[24.9, 28.0]	25.8	[20.4, 32.1]	25.4	[19.7, 32.0]
Age Starting US Farm Work (years)						
< 14	6.8	[6.0, 7.6]	11.2	[7.5, 16.6]	6.6	[4.0, 10.8]
14-18	33.0	[31.5, 34.6]	31.9	[25.5, 39.2]	31.3	[23.4, 40.5]
> 18	60.1	[58.4, 61.7]	56.7	[50.2, 63.0]	62.1	[53.6, 69.9]

Factors that are significantly associated with lifetime or recent asthma are bolded, based on Pearson χ^2 test on weighted data ($P < 0.05$).

* Poverty level based on Department of Health and Human Services US Federal Poverty Level guidelines

[†] Includes work authorization

[‡] Migrant defined as individuals who work on 2 or more farms located > 75 miles apart, shuttle internationally or work on farms > 75 miles away from home

Table II

Multivariable logistic regression of risk factors for self-reported lifetime and recent asthma; National Agricultural Workers Survey, 2003-2014

	Lifetime asthma		Recent Asthma	
	OR	[95% CI]	OR	[95% CI]
Age (years)				
<= 18	1.06	[0.36, 3.15]	0.71	[0.20, 2.51]
19-30	1.04	[0.60, 1.79]	0.83	[0.45, 1.51]
31-40	1.04	[0.64, 1.69]	0.78	[0.50, 1.24]
> 40	1	(ref)	1	(ref)
Sex				
Male	1	(ref)	1	(ref)
Female	1.86	[1.28, 2.72]	2.42	[1.62, 3.61]
Race/Ethnicity				
Non-Hispanic White	1	(ref)	1	(ref)
Non-Hispanic Black	0.75	[0.38, 1.48]	0.87	[0.42, 1.80]
Mexican	0.83	[0.43, 1.63]	1.11	[0.49, 2.50]
Puerto Rican	4.23	[1.36, 13.15]	5.25	[1.40, 19.74]
Other Hispanic/Other Race	0.84	[0.33, 2.18]	0.89	[0.25, 3.17]
Poverty *				
>= US poverty level	1	(ref)	1	(ref)
< US poverty level	0.87	[0.61, 1.26]	0.83	[0.56, 1.24]
Immigration Status				
Undocumented	1	(ref)	1	(ref)
Green Card †	1.12	[0.72, 1.72]	1.33	[0.88, 2.01]
Citizen	2.10	[1.00, 4.42]	2.38	[0.88, 6.44]
English Speaking Proficiency				
No English	1	(ref)	1	(ref)
Some/Little English	1.99	[1.43, 2.76]	2.28	[1.47, 3.53]
Well English	2.61	[1.43, 4.75]	3.07	[1.67, 5.64]
Education				
<= Elementary school	1	(ref)	1	(ref)
Junior high/High school	0.85	[0.58, 1.25]	0.77	[0.50, 1.18]
College or more	1.28	[0.80, 2.05]	0.97	[0.56, 1.71]
Insurance				
No	1	(ref)	1	(ref)
Yes	0.85	[0.57, 1.26]	1.01	[0.63, 1.62]
Region of Country				
California	1	(ref)	1	(ref)
East	0.75	[0.39, 1.42]	0.82	[0.34, 1.99]
Southeast	0.58	[0.31, 1.10]	0.66	[0.41, 1.06]
Midwest	0.41	[0.21, 0.81]	0.35	[0.15, 0.80]

	Lifetime asthma		Recent Asthma	
	OR	[95% CI]	OR	[95% CI]
Southwest	0.81	[0.39, 1.69]	1.02	[0.42, 2.50]
Northwest	0.99	[0.56, 1.75]	0.95	[0.44, 2.05]
Migrant Status				
Migrant [‡]	1	(ref)	1	(ref)
Settled	0.94	[0.64, 1.37]	1.20	[0.79, 1.80]
Type of Current Crop				
Fruit/Nuts	1	(ref)	1	(ref)
Field	1.16	[0.68, 1.97]	1.39	[0.78, 2.47]
Horticulture	1.16	[0.77, 1.74]	0.91	[0.51, 1.64]
Vegetables	1.16	[0.73, 1.84]	0.94	[0.50, 1.75]
Other	1.80	[0.94, 3.45]	1.76	[0.86, 3.60]
Pesticide Use in Last 12 Months				
No	1	(ref)	1	(ref)
Yes	1.55	[1.10, 2.18]	1.07	[0.72, 1.59]
# Years of US Farm Work				
< 5	1	(ref)	1	(ref)
5-9	0.79	[0.47, 1.32]	0.84	[0.41, 1.72]
10-14	0.95	[0.48, 1.89]	0.96	[0.43, 2.17]
15-19	0.90	[0.44, 1.84]	0.89	[0.39, 2.03]
>= 20	0.75	[0.32, 1.75]	0.61	[0.21, 1.81]
Age Starting US Farm Work (years)				
< 14	1	(ref)	1	(ref)
14-18	0.75	[0.44, 1.26]	1.19	[0.63, 2.24]
> 18	0.76	[0.42, 1.38]	1.27	[0.64, 2.51]

Factors in each category that are significantly associated with lifetime or recent asthma as compared to the reference group are shown in bold (P<0.05).

* Poverty level based on Department of Health and Human Services US Federal Poverty Level guidelines

[‡] Includes work authorization

[‡] Migrant defined as individuals who work on 2 or more farms located > 75 miles apart, shuttle internationally or work on farms > 75 miles away from home