Journal of Agromedicine

ISSN: 1059-924X (Print) 1545-0813 (Online) Journal homepage: http://www.tandfonline.com/loi/wagr20

Asthma among Household Youth on Racial Minority Operated Farms—United States, 2008

Girija Syamlal, Kitty Hendricks & Jacek M. Mazurek

To cite this article: Girija Syamlal, Kitty Hendricks & Jacek M. Mazurek (2018) Asthma among Household Youth on Racial Minority Operated Farms—United States, 2008, Journal of Agromedicine, 23:2, 144-153, DOI: 10.1080/1059924X.2017.1422837

To link to this article: https://doi.org/10.1080/1059924X.2017.1422837

Published online: 12 Apr 2018.

Submit your article to this journal

Article views: 8

View related articles

View Crossmark data

Full Terms & Conditions of access and use can be found at
http://www.tandfonline.com/action/journalInformation?journalCode=wagr20

JOURNAL OF AGROMEDICINE
2018, VOL. 23, NO. 2, 144–153
https://doi.org/10.1080/1059924X.2017.1422837

Taylor & Francis
Taylor & Francis Group

Check for updates

Asthma among Household Youth on Racial Minority Operated Farms—United States, 2008

Girija Syamlal[a], Kitty Hendricks[b], and Jacek M. Mazurek[a]

[a]Respiratory Health Division, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Morgantown, WV, USA; [b]Division of Safety Research, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Morgantown, WV, USA

ABSTRACT

Objectives: Youth on farms are at risk for injuries and illnesses, including asthma, which continues to disproportionately affect minority groups.

Methods: For this study, the 2008 Minority Farm Operator Childhood Agricultural Injury Survey (M-CAIS) data were used to estimate the prevalence of asthma among youth aged 0–19 years living on racial minority-operated farms. Youth were considered to have a lifetime diagnosis of asthma based on an affirmative response to the question "Has he/she ever been diagnosed as having asthma by a health professional?"

Results: In 2008, of the estimated 37,400 youth (0–19 years) who lived on racial minority operated farms, 11% had asthma. Asthma prevalence was highest among males (13%) and youth 10–19 years of age (12%). Asthma prevalence among youth varied by race, ranging from 13% among household youth living on Black/African American operated farms to 7% among youth living on Asian/Native Hawaiian/Pacific Islander operated farms. In 2008, nearly half (46%) of household youth (0–19 years) worked on the farm. The odds of having asthma were higher among working youth compared with non-working youth (POR, 1.5; 95% CI: 1.3–1.8).

Conclusion: Disparities in asthma among youth living or working on racial minority-operated farms were observed. These findings may assist agricultural safety and health researchers, practitioners, and educators in identifying and designing targeted interventions to reduce asthma burden among youth on racial minority-operated farms.

KEYWORDS
Agriculture workers; asthma; asthma attack; minority youth; surveillance

Introduction

Youth working on farms are vulnerable to the hazardous conditions on the farm, including exposure to dangerous weather conditions, farm equipment, pesticides, and others.[1,2] Farm youth, whether living, working, visiting or while accompanying their parents or adults on a farm are often exposed to more hazardous tasks than youth in nonfarm environments.[1,2] Moreover, farm youth are not subject to age restrictions associated with work.[1,3,4] The federal child labor laws set a minimum work age of 16 for most nonagricultural occupations. However, in the agricultural sector youth may legally work at the age of 14 and youth under the age of 12 years can legally work with their parent's permission, they also can work on the farms owned or operated by their parents.[3,4] An additional discrepancy in regulatory coverage is the minimum age for work in hazardous occupations.[3,4] While the Fair Labor Standards Act sets a minimum age of 16 for any agricultural occupations which the Secretary of Labor finds and declares to be particularly hazardous or detrimental to worker's health and well-being, the minimum age for hazardous occupations in nonagricultural occupations is 18 years.[3,4]

Asthma among children imposes a growing burden on the society in terms of morbidity, quality of life, and healthcare costs.[5–9] Asthma is one of the most common chronic diseases and a major public health concern among children in the United States.[5,7] In 2014, approximately 8.6% (6.3 million) of US children had current asthma.[7] Asthma accounts for more school absences and hospitalizations than any other chronic condition.[8] According to Hsu et al., approximately half of children who missed at least 1 school day because of asthma was associated with uncontrolled asthma, asthma episodes/attacks, and asthma-related urgent/emergency care.[8] Several risk factors

CONTACT Girija Syamlal gsyamlal@cdc.gov Epidemiologist National Institute for Occupational Safety and Health/Respiratory Health Division. 1095 Willowdale Road Mail Box HG 900.2

© 2018 Taylor & Francis

have been associated with the development of asthma among children, including environmental (pollutants, both indoor and outdoor mold, fungi, cockroaches, mice, dust mites), and genetic factors.[9–12] Youth living and working on the farm may be exposed to additional agents causing asthma such as farm bacteria, pesticides, pollen, toxic gases, and chemical fumes (ammonia, hydrogen sulfide, and methane gas).[13–17]

Conflicting results regarding prevalence of asthma among children on farms have been previously reported.[14,15] Findings from some studies indicate that children living and growing up on farms are protected from asthma, atopy and allergies.[12,14,15] Exposure to animals (e.g., horses, pigs, sheep, goats, cows), fodder material (e.g., grass, grain), microbial exposures (e.g., bacteria, fungi), and farming lifestyle (e.g., diet, number of siblings, pets, education) early in life have a protective effect for developing asthma, hay fever and allergies.[12–16] Other studies, however, have found a higher prevalence of asthma and asthma-related symptoms among children growing up on farms.[18,19] Children accompanying or assisting parents with farm tasks may commonly be exposed to asthma causing agents present on large animal-feeding operations (AFOs).[19,20] High levels of occupational exposures to respirable dust, endotoxin, hydrogen sulfide, and ammonia, have been associated with asthma, chronic bronchitis, and progressive declines in lung function over time among those working in AFOs.[10,19,20] Merchant et al. reported having both personal and environmental risk factors in the multivariable models.[14] These models indicate that children living on farms that raise swine and add antibiotics to the feed had higher association with asthma health outcomes (e.g., asthma, wheezing, cough, and taking medication for wheeze) compared with those living on farms that did not add antibiotics to the feed.[19] Disparities in asthma prevalence among children growing up on farms suggests the association of unmeasured farm risk factors and health outcomes among children living or working on farms.

Racial and ethnic disparities in asthma prevalence among all US youth exist, and the prevalence remains significantly higher among Puerto Rican (13.9%) and non-Hispanic black (13.4%) youth than non-Hispanic white youth (7.4%).[7] Among youth living on minority operated farms, asthma prevalences varied by the race of the farm operator, from 10% among youth living on black operated farms to 8% among youth living on Asians farms.[2] Furthermore, disparities in hospitalization and death rates due to asthma exist among minority children, with African/American children being almost four times more likely to be hospitalized and seven times more likely to die of asthma than white children.[7,21,22] Higher asthma prevalence among racial and ethnic minority children, the limited information on asthma among youth living on racial minority-operated farms, combined with the increase in the number of youth on minority operated farms,[23] indicate a need to better understand the asthma burden among this subpopulation. This study aimed to estimate prevalence of asthma and asthma attacks among youth aged 0–19 years living or working on racial minority-operated farms.

Methods

Data source

The National Institute for Occupational Safety and Health in collaboration with the US Department of Agriculture, National Agricultural Statistics Service conducted the Minority Farm Operator Childhood Agricultural Injury Survey (M-CAIS). The M-CAIS is a telephone survey of all racial minority farm operators who responded to the 2007 Census of Agriculture. All minority-operated farms were eligible for the 2008 M-CAIS. Racial minority categories included Black/African American, American Indian/Alaskan Native, Asian, Native Hawaiian/Pacific Islander, and multi-racial. Of the 51,736 racial minority farm operators who self-identified on the 2007 Census of Agriculture, 32,972 completed the survey, 1,257 farms were deemed out-of-business, and 15,075 farms could not be contacted (crude response rate: 63%).[24] The response rate by racial category varied from a high of 77% for Black/African American farm operations to a low of 47% for American Indian/Alaska Native (AIAN) operations.[24] Information on asthma was predominantly (74%) reported by the female head of household.

Definitions

A farm was defined as any place from which $1,000 or more of agricultural products were

produced or sold, or normally would have been sold during the census year. Household youth were defined as all youth aged 0–19 years who resided on the minority operated farm. Working status and exposure data for household youth who rode a horse, or operated an all-terrain vehicle or tractor for work or recreation were collected. Youth were considered as having asthma if they have ever been told by a health professional that they had asthma. Those with asthma were further asked whether they had an asthma attack requiring the use of an inhaler, or other medical treatment in the last year; had a serious asthma attack that required an emergency room visit, hospitalization, or other professional medical attention in the last year, and if so, did any such asthma attack occur while doing work.

Sampling weights were calculated based on four levels of stratification: sub-region of the United States, racial category, value of farm sales, and a census adjustment weight. Nine sub-regions were used to stratify the M-CAIS data (Table 1). Racial categories were combined into four categories: Black/African American; AIAN; Asian/Native Hawaiian/Pacific Islander; and multiple races. For the current analysis an assumption was made that all youth living on racial minority-operated farms are the same race as that reported by the operator. For

Table 1. Percent youth (0–19 Years) living on racial minority–operated farms by selected characteristics: 2008 MCAIS data.

	American Indian/ Alaskan Native *N* = 21,106		Asian/Native Hawaiian/Pacific Islander *N* = 4,383		Black/African American *N* = 7,179		Multiple race *N* = 4,775		Overall *N* = 37,443	
Characteristics	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Total	56	55–58	12	11–13	19	18–20	13	12–14	100	
Age group (years)										
≤9	39	37–41	35	32–38	35	32–37	35	31–38	37	36–38
≥10–15	33	32–35	35	32–37	35	32–37	34	32–37	34	33–35
≥16	25	23–26	28	25–30	29	27–31	28	26–31	26	25–27
Unknown/missing	3	2–4	3	2–4	2	1–3	3	2–5	3	2–4
Gender										
Males	50	48–51	51	49–54	53	51–55	51	48–53	51	50–52
Females	48	46–50	46	44–49	46	44–48	47	44–49	47	46–48
Unknown/missing	3	2–3	2	1–3	1	1–2	–	–	2	2–3
Farm type*										
Crops	29	27–33	56	52–60	31	29–34	29	26–33	33	31–35
Live stock	71	68–74	44	40–48	69	66–72	71	68–74	67	65–69
Value of sales										
< $10,000	81	80–83	36	32–40	78	76–81	68	65–72	74	72–75
$10,000–$99,999	14	13–16	28	24–32	19	17–22	23	20–26	18	17–19
≥$100,000	5	4–5	36	32–40	2	2–3	9	7–11	9	8–9
Region†										
North East	1	1–2	4	2–6	1	1–2	5	3–6	2	2–3
North central	9	8–10	17	14–20	4	2–5	21	18–23	10	10–11
South	28	26–29	37	32–41	91	89–93	54	51–58	44	43–46
West	62	60–64	43	39–46	4	3–6	21	17–24	44	42–45
Exposure§										
Horse	43	41–46	10	8–13	20	18–23	33	30–36	34	32–35
ATV	33	31–35	19	16–22	29	26–31	39	35–42	31	30–33
Tractor	19	17–20	15	12–17	23	20–25	28	25–31	20	19–21
Working status										
Working youth	49	47–52	33	30–37	39	37–42	53	50–56	46	45–48
Non–working	48	46–50	65	62–69	59	56–62	44	41–47	52	50–53
Unknown/missing	3	2–4	–	–	2	1–3	3	1–4	2	2–3

CI = Confidence Interval

*Youth might have been on more than one type of farm type.

†Northeast—Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York, Pennsylvania
Midwest—Illinois, Indiana, Michigan, Ohio, Wisconsin, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota
West—Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming, Alaska, California, Hawaii, Oregon, and Washington
South—Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, and Texas.

§For exposure questions respondents were asked if they have driven an ATV, tractor or rode a horse for work or for recreation in the last year
–Relative Standard Error (RSE) >33% are suppressed.

value of sales (VOS), three broad categories were used: sales of less than $10,000; sales of $10,000 to $99,999; and sales of $100,000 or more. The census adjustment weight assigned to each individual farm was based on a complex statistical algorithm.[24] All final weights were expanded to match the 2007 Census of Agriculture's published race-specific farm counts in the nine geographic sub-regions by VOS.[24]

Statistical analysis

SAS® 9.3 software (SAS Institute Inc., Cary, NC) was used to provide statistically weighted unbiased sample estimates and account for the complex sample design for standard error (SE) calculations. Prevalence of asthma and asthma attack was estimated and adjusted prevalence odds ratios (PORs) with corresponding 95% confidence intervals were calculated. PORs were adjusted for age, sex, and VOS. Univariate analysis was done to identify the explanatory variables that were significantly related to asthma. The variables (demographic and farm related) included in the base model were selected from those significantly (p value <.05) associated with asthma. Multivariable logistic regression analysis was done to assess the association between asthma and each racial and minority youth groups. The model was adjusted for age, sex, and farm VOS. The referent group was all youth living on racial minority farm operations other than the youth on racial minority farm operation of interest. The estimates with relative standard errors (RSE, calculated as SE of the prevalence estimate divided by the prevalence estimate) of >33% were not reported.

Results

Of the estimated 37,443 household youth who lived on racial minority operated farms, 51% were males, 74% were living on farms with <$10,000 in VOS, 67% were living on livestock farms, and 44% were living on farms in the South and in the West region of the United States. The highest proportion of youth (56%) lived or worked on American Indian/Alaskan Native operated farms (Table 1).

An estimated 11% of youth who lived on racial-minority operated farms had lifetime asthma. The lifetime asthma prevalence was significantly higher among males (12%) than females (9%); youth aged 10–19 years (12%) than those ≤9 years old (8%); youth living on farms with <$10,000 (11%) and $10,000–$99,999 (11%) in VOS than those on farms ≥$100,000 (7%) in VOS. Asthma prevalence was also significantly higher among working household youth (13%) than non-working youth (9%); and among youth on Black/African American (13%) farm operations than among youth on Asian/Native Hawaiian/Pacific Islander (7%) farm operations (Table 2).

When compared with household youth on all other racial-minority operated farms, youth living on Black/African American farm operations had highest adjusted odds of having asthma (POR, 1.3) and youth living on Asian/Native Hawaiian/Pacific Islander farm operations had the lowest odds of having asthma (POR, 0.6). Of the youth living on Black/African American operated farms, odds of having asthma were significantly high among those, aged 10–15 years (POR, 1.3), males (POR, 1.4), living on livestock farms (POR, 1.2), in the West (POR, 2.0), on farms with a VOS of ≥$100,000 (POR, 2.5), and who rode a horse (POR, 1.5) (Table 3).

Working youth had higher adjusted odds (POR, 1.5) of having asthma than non-working youth. Compared with non-working youth, the odds of youth having asthma were significantly higher among working youth living on American Indian/Alaskan Native farm operations (POR, 1.5), Asian/Native Hawaiian/Pacific Islander-operated farms (POR, 1.8) and Black/African American-operated farms (POR, 1.6) (Table 4).

Among youth with asthma, 58% had an asthma attack requiring the use of an inhaler or other medical treatment in the past 12 months of the survey. An estimated 65% of Black/African American youth with asthma had an asthma attack and of those 18% had an asthma attack while working. Of asthma attacks requiring an emergency room visit/hospitalization, 41% were among youth on Black/African American-operated farms and of those, 23% occurred while working (Table 5).

Discussion

In 2008, an estimated 11% of the 37,000 youth living on racial minority-operated farms had physician-

Table 2. Estimated prevalence of asthma among youth (0–19 years) on racial minority–operated farms by selected characteristics: 2008 MCAIS data.

	American Indian/ Alaskan Native *N* = 21,106		Asian/Native Hawaiian/ Pacific Islander *N* = 4,383		Black/African American *N* = 7,179		Multiple race *N* = 4,775		Overall *N* = 37,443	
Characteristics	P	95% CI	P	95% CI	P	95% CI	P	95% CI	P	95% CI
Total	11	10–12	7	6–9	13	11–14	10	9–12	11	10–11
Age group (years)										
≤9	9	7–16	5	3–7	10	8–13	7	5–9	8	7–10
≥10–15	12	10–14	8	6–11	16	13–18	13	10–16	12	11–14
≥16	12	10–15	8	6–11	13	10–15	11	8–15	12	10–13
Gender										
Males	13	11–14	8	6–10	16	13–18	11	9–13	12	11–14
Females	9	7–10	6	5–8	10	8–12	10	8–12	9	8–10
Farm type*										
Crops	10	8–12	7	6–9	12	9–14	9	6–11	10	8–11
Live stock	11	10–12	7	5–9	13	12–15	11	9–13	11	10–12
Value of sales										
< $10,000	11	10–12	8	6–11	13	11–15	11	9–14	11	10–12
$10,000–$99,999	12	9–14	6	4–9	13	9–16	10	7–13	11	9–12
≥$100,000	6	4–8	7	5–9	14	6–23	–	–	7	5–8
Region†										
North East	–	–	–	–	–	–	–	–	–	–
North central	10	7–13	6	3–9	16	7–25	9	6–12	9	7–11
South	11	10–13	7	5–9	13	11–14	12	9–14	11	11–12
West	11	9–12	8	6–10	18	10–27	8	5–11	10	9–12
Exposure§										
Horse	11	9–13	11	5–16	16	12–19	11	8–14	11	10–13
ATV	13	11–15	12	8–16	15	12–18	12	9–15	13	12–15
Tractor	14	12–17	13	8–17	16	12–20	13	10–17	14	13–16
Working Status										
Working	13	11–14	10	7–13	16	14–19	12	9–14	13	12–14
Non–working	9	7–10	6	4–7	11	9–12	9	7–11	9	8–10

*Youth might have been on more than one type of farm type.

†Northeast—Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York, Pennsylvania
Midwest— Illinois, Indiana, Michigan, Ohio, Wisconsin, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota
West—Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming, Alaska, California, Hawaii, Oregon, and Washington
South—Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, and Texas.

§For exposure questions respondents were asked if they have driven an ATV, tractor or rode a horse for work or for recreation in the last year–Relative Standard Error (RSE) >33% are suppressed.

diagnosed asthma, a 25% increase since 2000 (9%).[2] Asthma prevalence varied among youth by demographic characteristics, by race, and by working status which was similar to the previous findings.[2] The reasons for the increase in the asthma prevalence among youth on racial minority-operated farms are unclear. Findings from previous asthma studies among all US youth and youth on Hispanic operated farms suggests that specific environmental and demographic factors which are unique to a farm setting, such as exposure to livestock and pets, dampness, molds and dust, methods of heating and cooking, environmental tobacco smoke exposure, and dietary habits were some of the factors associated with the high prevalences of asthma among this population.[11,15,21–25] Furthermore, in the United States, racial disparities in asthma have been previously reported, with higher asthma prevalences in non-Hispanic black (13.4%) and Hispanic (8.0%) children than non-Hispanic white (7.4%) children.[7] Socioeconomic factors in combination with other environmental and behavioral risk factors have been reported to be associated with higher asthma prevalence among minority children.[25,26] Nelson et al. examined lifetime asthma prevalence among multiethnic school-age children in a middle class community within the same socioeconomic and residence status from Michigan[27] and found that 12% of African–American children had asthma compared with 6% of white children. No significant differences were observed in income, educational levels and poverty rates in both groups. And authors concluded

Table 3. Racial disparities in estimated asthma prevalence odds ratio among youth (0–19 years) living on racial minority–operated farms, 2008.

	American Indian/Alaskan Native		Asian/Native Hawaiian/Pacific Islander		Black/African American		Multiple race	
Characteristics	POR*	95%CI	POR*	95%CI	POR*	95%CI	POR*	95%CI
Total	1.0	0.9–1.2	0.6†	0.5–0.8	1.3†	1.1–1.5	1.0	0.8–1.2
Age group (years)								
≤9	1.1	0.8–1.5	0.6†	0.4–0.9	1.3	0.9–1.8	0.8	0.5–1.1
≥10–15	0.9	0.7–1.1	0.7	0.5–1.0	1.3†	1.1–1.7	1.1	0.8–1.4
≥16	1.1	0.8–1.4	0.7	0.5–1.1	1.1	0.8–1.4	1.0	0.7–1.4
Gender								
Males	1.0	0.9–1.2	0.6†	0.5–0.9	1.4†	1.1–1.7	0.8	0.6–1.1
Females	1.0	0.8–1.2	0.7†	0.5–1.0	1.1	0.9–1.4	1.2	0.9–1.6
Farm type§								
Crops	1.1	0.8–1.5	0.7†	0.5–0.9	1.3	0.9–1.7	0.9	0.6–1.3
Live stock	0.9	0.8–1.1	0.7†	0.5–1.0	1.2†	1.0–1.5	1.0	0.8–1.2
Region¶								
North East	–	–	–	–	–	–	–	–
North central	1.2	0.7–1.8	0.6	0.3–1.1	1.7	0.9–3.5	0.9	0.6–1.5
South	1.0	0.8–1.2	0.6†	0.4–0.9	1.2	0.9–1.4	1.0	0.8–1.3
West	1.3	0.9–1.7	0.7†	0.5–1.0	2.0†	1.1–3.6	0.7	0.5–1.2
Value of sales								
< $10,000	0.9	0.8–1.1	0.7†	0.5–1.0	1.2†	1.0–1.5	1.0	0.8–1.3
$10,000–$99,999	1.3	0.9–1.7	0.5†	0.3–0.8	1.3	0.9–1.8	0.9	0.6–1.3
≥$100,000	0.9	0.6–1.4	1.0	0.7–1.6	2.5†	1.2–5.1	0.6	0.3–1.3
Exposure**								
Horse	0.8	0.6–1.0	0.9	0.5–1.6	1.5†	1.1–2.0	0.9	0.7–1.3
ATV	1.0	0.8–1.3	1.0	0.7–1.5	1.2	0.9–1.5	0.9	0.6–1.2
Tractor	1.0	0.7–1.3	0.9	0.6–1.6	1.3	0.8–1.6	0.9	0.6–1.3

POR = Prevalence Odds Ratio; CI = Confidence Interval

*PORs represent the odds of a youth having asthma on a specific racial minority farm operation as compared to the odds of youth having asthma in all other farm operations combined. PORs adjusted for age sex and value of sales

†*p*-Value significant at <.05

§Youth might have been on more than one type of farm type.

¶Northeast—Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York, Pennsylvania

Midwest— Illinois, Indiana, Michigan, Ohio, Wisconsin, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota

West—Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming, Alaska, California, Hawaii, Oregon, and Washington

South—Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, and Texas.

**For exposure questions respondents were asked if they have driven an ATV, tractor or rode a horse for work or for recreation in the last year – Relative Standard Error (RSE) >33% are suppressed.

that differences in biologic factors may have been associated with the differences in asthma prevalences among these groups.[27] The overall prevalence of asthma among youth on minority operated farms is comparable with that reported in inner-city multiethnic children.[18,25] However, when compared with the national average, asthma prevalences among minority youth (13%) were 1.5 times higher the prevalences reported from the National Health Interview Survey data for all US children (8.6%).[7] These findings of higher asthma prevalences among youth living on minority operated farms, more so with specific groups, for example youth on Black/African American-operated farms underscore the need for asthma screening programs and prevention efforts that would improve overall health among youth living and working on farms.

Previous studies have shown that children living or growing up on farms are often less likely to develop asthma, hay fever and allergic sensitization than those who do not grow up on farms.[12,13,16] Exposures to endotoxins early in life, contact with livestock and animal feed, have been associated with lower risk of asthma and allergies in farm children.[10,13,16] However, current results indicate that greater than 11% of racial minority youth living on farms reported asthma and the prevalences varied by race. This may be explained, in part, by the type of farming done by minority operators. For example, according to 2007 Census of Agriculture, almost half of all Black/African American-operated farms are classified as beef cattle farms and ranches.[28] Exposure to animals or animal products (i.e., allergens such as dander, hair, scales, fur, saliva, and body wastes) have been

Table 4. Estimated prevalence odds ratios for asthma among working vs. non–working youth (0–19 years) living on minority–operated farms, by selected characteristics, 2008.

	American Indian/ Alaskan Native		Asian/Native Hawaiian/ Pacific Islander		Black/African American		Multiple race		Overall	
Characteristics	POR*	95%CI	POR*	95%CI	POR*	95%CI	POR*	95%CI	POR*	95%CI
Total	1.5†	1.2–1.9	1.8†	1.3–2.7	1.6†	1.3–2.1	1.4	1.0–2.0	1.5†	1.3–1.8
Age group (years)										
≤9	1.5†	1.0–2.3	–	–	1.7†	1.0–2.7	1.3	0.7–2.4	1.6†	1.2–2.1
≥10–15	1.5†	1.0–2.2	1.8	1.0–3.2	1.8†	1.2–2.7	–	–	1.5†	1.2–1.9
≥16	1.0	0.6–1.7	–	–	1.1	0.7–1.8	–	–	1.1	0.8–1.5
Gender										
Males	1.5†	1.1–2.0	1.8†	1.1–3.1	1.4	1.0–1.9	1.3	0.8–2.1	1.5†	1.2–1.8
Females	1.3	0.9–1.9	1.7	0.9–3.2	1.8†	1.2–2.7	1.5	0.9–2.4	1.5†	1.1–1.8
Farm type§										
Crops	1.5	1.0–2.3	1.7†	1.0–2.9	1.7†	1.1–2.7	1.0	0.6–1.8	1.5†	1.2–2.0
Live stock	1.5†	1.1–1.9	2.2†	1.2–4.0	1.6†	1.2–2.1	1.5	1.0–2.3	1.5†	1.3–1.8
Region¶										
North East	–	–	–	–	–	–	–	–	–	–
North central	1.3	0.7–2.4	–	–	–	–	–	–	1.4	0.9–2.1
South	1.4	1.0–1.9	2.5†	1.3–5.1	1.5†	1.2–2.0	1.7†	1.1–2.7	1.5†	1.3–1.9
West	1.6†	1.1–2.2	1.6	0.9–2.9	–	–	–	–	1.6†	1.2–2.1
Value of sales										
< $10,000	1.5†	1.2–2.0	1.8	1.0–3.5	1.4†	1.1–1.9	1.5	1.0–2.2	1.5†	1.2–1.8
$10,000–$99,999	1.4	0.9–2.3	–	–	2.9†	1.7–5.0	–	–	1.8†	1.3–2.4
≥$100,000	–	–	1.6	0.9–2.9	–	–	–	–	1.4	0.9–2.2
Exposure										
Horse	1.2	0.8–1.7	–	–	1.1	0.7–2.0	–	–	1.3	1.0–1.7
ATV	1.3	0.8–2.0	–	–	1.2	0.7–2.0	–	–	1.2	0.9–1.6
Tractor	–	–	–	–	1.3	0.9–1.7	1.3	0.9–1.9	1.4	0.8–2.3

POR = Prevalence Odds Ratio; CI = Confidence Interval
*Reference is non–working household youth
†*p*-Value significant at <.05.
§Youth might have been on more than one type of farm type.
¶Northeast—Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York, Pennsylvania
Midwest— Illinois, Indiana, Michigan, Ohio, Wisconsin, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota
West—Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming, Alaska, California, Hawaii, Oregon, and Washington
South—Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, and Texas.
–Relative Standard Error (RSE) >33% are suppressed.

Table 5. Estimated asthma attack prevalence among household youth (0–19 years) living on racial minority–operated farms, by selected characteristics, 2008 MCAIS.

	American Indian/ Alaskan Native		Asian/Native Hawaiian/ Pacific Islander		Black/African American		Multiple race		Overall	
Asthma attack characteristics	%	95%CI	%	95%CI	%	95%CI	%	95%CI	%	95%CI
Asthma	11	10–12	7	6–9	13	11–14	10	9–12	11	10–11
Attack requiring inhaler/other medical treatment	57	51–62	52	42–62	65	60–71	51	43–59	58	54–61
Occur at work	25	19–31	–	–	18	12–24	24	13–34	22	18–26
Attack requiring ER visit/hospitalization	32	26–38	–	–	41	32–49	16	8–24	31	27–35
occur at work	25	14–36	–	–	23	12–34	–	–	24	16–31

–RSE is >33%, data are suppressed

associated with asthma and other respiratory symptoms previously.[19,20] Current findings indicate that almost 70% of Black/African American youth lived and worked on livestock farms and had 1.2 times the odds of having asthma as compared with youth on all other farms combined.

Despite the effective strategies for asthma treatment and management, asthma continues to affect racial minority children in the United States.[29–32] The National Health Disparities Reports documents that racial and ethnic minorities often receive poorer quality of care and face barriers in seeking preventive care than do non-Hispanic

white children.[29] In the United States, African–American children are twice as likely to be hospitalized and more than four times as likely to die from asthma as non-Hispanic white children.[31] The current results show over half of the youth with asthma on racial minority-operated farms had an asthma attack which required an inhaler or other medical treatment, and one-third experienced an attack which required an emergency room visit or hospitalization. Furthermore, the prevalence of asthma attacks varied by race. These differences might be attributable to variation in levels of exposure to environmental irritants, allergens on the farm, increased social and psychological stresses, economic factors or differences in disease self-management or medical treatment.[10–13,30–33] Continued surveillance of this population is warranted to develop tailored interventions, particularly among those with a higher asthma prevalence.[31,34,35] Future studies are needed to identify factors associated with higher asthma and asthma attack prevalences among youth on racial minority-operated farms.

This study had some limitations. First, because of the cross-sectional nature of the survey data, temporal sequence or causality could not be determined. Second, asthma information on youth was reported by the female head of household rather than objective physiologic tests or pulmonary function measures for asthma diagnosis or asthma severity. Although the validity and reliability of self or proxy report by mother has not been previously established and may have affected the asthma or asthma severity estimates, this method is widely used for assessing asthma prevalence among children/youth.[36,37] Third, information for youth on non-Hispanic white operated farms were not collected in this survey. Finally, the response rates in certain groups were low leading to small sample sizes producing unreliable estimates.

Conclusions

Asthma prevalence among youth aged 0–19 years living on racial minority-operated farms has increased by 25% since 2000. These findings contribute to the limited information on asthma among youth living on racial minority-operated farms. Youth on farms are exposed to multiple exposures, therefore identification of risk factors for asthma and their interactions with factors such as family size, environmental, farm exposures, genetic, dietary habits, dampness, mold, and other exposures are needed for developing effective intervention strategies to improve health outcomes and reduce asthma among youth on farms. Some of these strategies may include asthma screening programs and farm operator education about childhood risk factors.[28,34] For more information on asthma and other respiratory illness please refer to: http://www.extension.org/pages/63439/respirator-illnesses-associated-with-agriculture and http://www.cdc.gov/niosh/topics/asthma/default.html

Acknowledgments

The authors would like to thank Michael Goldcamp and Larry Layne for their helpful comments and editorial suggestions.

Declaration of interest

None declared.

Disclaimer

The findings and conclusions in this report are those of authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

Funding

Study was supported by the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention.

References

1. National Farm Worker Ministry. Farm workers Issue: Children in the fields. http://nfwm-yaya.org/resources/farm-worker-issues/children-in-the-fields. Accessed May 22, 2017.
2. Myers RJ, Hendricks JK, Layne LA, Goldcamp EM. Injury and asthma among youth less than 20 years of age on Minority farm operations in the United States. Volume1: racial minority national data. DHHS (NIOSH) Publication No. 2005-147. https://www.cdc.gov/niosh/docs/2005-147/ Accessed September 19, 2017
3. US Department of Labor. E-laws – employment laws assistance for workers and small businesses. E-laws Fair Labor Standards Act Advisor. http://webapps.dol.gov/elaws/whd/flsa/docs/hours.asp. Accessed May 22, 2017.

4. Fair Labor Standards Act of 1938, as amended (52 Stat. 1060, as amended; 29 U.S.C. 201–219). Revised June 2007. http://www.dol.gov/whd/regs/compliance/childlabor102.pdf. Accessed May 22, 2017.
5. Akinbami LJ. The state of childhood asthma. CDC, United States, 1980–2005. Unites States Department of Labor, Occupational Safety & Health. Youth in Agriculture. https://www.osha.gov/SLTC/youth/agriculture/index.html. Accessed May 22, 2017.
6. Salam MT, Li YF, Langholz B, Gilliland FD. Early-life environmental risk factors for asthma: findings from the Children's Health Study. *Environ Health Perspect*. 2004;112:760–765.
7. CDC. 2015 National health interview survey (NHIS) data. https://www.cdc.gov/asthma/nhis/2015/table4-1.htm Updated February 2017 Accessed May 22, 2017
8. Hsu J, Qin X, Beavers SF, Mirabelli MC. Asthma-related school absenteeism, morbidity, and modifiable factors. *Am J Prev Med*. 2015;51:23–32.
9. Fuhlbrigge AL, Adams RJ, Guilbert TW, et al. The burden of asthma in the United States- level and distribution are dependent on interpretation of the National Asthma Education and Prevention Program Guidelines. *Am J Resp Crit Care Med*. 2002;166:1044–1049.
10. Schwartz DA. Does inhalation of endotoxin cause asthma? *Am J Respir Crit Care Med*. 2001;163:305–306. doi:10.1164/ajrccm.163.2.ed2000a
11. Litonjua AA, Carey VJ, Burge HA, Weiss ST, Gold DR. Exposure to cockroach allergen in the home is associated with incident doctor-diagnosed asthma and recurrent wheezing. *J Allergy Clin Immunol*. 2001;107:41–47. doi:10.1067/mai.2001.111143
12. Braun-Fahrlander C, Gassner M, Grize L, et al. Prevalence of hay fever and allergic sensitization in farmer's children and their peers living in the same rural community. SCARPOL team. Swiss study on childhood allergy and respiratory symptoms with respect to air pollution. *Clin Exp Allergy*. 1999;29:28–34. doi:10.1046/j.1365-2222.1999.00479.x
13. Riedler J, Braun-Fahrländer C, Eder W, et al. Exposure to farming in early life and development of asthma and allergy: a cross-sectional survey. *Lancet*. 2001;358:1129–1133. doi:10.1016/S0140-6736(01)06252-3
14. Merchant JA, Naleway AL, Svendsen ER, et al. Asthma and farm exposures in a cohort of rural Iowa children. *Environ Health Perspect*. 2005;113:350–356. doi:10.1289/ehp.7240
15. Park H, Reynolds SJ, Kelly KM, et al. Characterization of agricultural tasks performed by youth in the Keokuk county Rural Health Study. *Appl Occup Environ Hyg*. 2003;18:418–429. doi:10.1080/10473220301425
16. Adler A, Tager I, Quintero DR. Decreased prevalence of asthma among farm-reared children compared with those who are rural but not farm reared. *J Allergy Clin Immunol*. 2005;115:67–73. doi:10.1016/j.jaci.2004.10.008
17. Chrischilles E, Ahrens R, Kuehl A, et al. Asthma prevalence and morbidity among rural Iowa schoolchildren. *J Allergy Clin Immunol*. 2004;113:66–71. doi:10.1016/j.jaci.2003.09.037
18. Bauer EJ, Lurie N, Yeh C, Grant EN. Screening for asthma in an inner-city elementary school in Minneapolis, Minnesota. *J Sch Health*. 1999;69:12–16. doi:10.1111/j.1746-1561.1999.tb02335.x
19. Heederik D, Sigsgaard T, Thorne PS, et al. Health effects of airborne exposures from concentrated animal feeding operations. *Environ Health Perspect*. 2007;115:298–302. doi:10.1289/ehp.8835
20. Zejda JE, Hurst TS, Rhodes CS, Barber EM, McDuffie HH, Dosman JA. Respiratory health of swine producers. Focus on young workers. *Chest*. 1993;103:702–709. doi:10.1378/chest.103.3.702
21. Akinbami LJ, Rhodes JC, Lara M. Racial and ethnic differences in asthma diagnosis among children who wheeze. *Pediatrics*. 2005;115:1254–1260. doi:10.1542/peds.2004-0897
22. Akinbami LJ, Moorman JE, Simon AE, Schoendorf KC. Trends in racial disparities for asthma outcomes among children 0 to 17 years, 2001–2010. *J Allergy Clin Immunol*. 2014;134:547–553. doi:10.1016/j.jaci.2014.05.037
23. CDC. National Institute for occupational Safety and health. Asthma among household youth on minority farm operations. http://www.cdc.gov/niosh/docs/2004-118/. Accessed May 22, 2017.
24. US Department of Agriculture, National Agricultural Statistics Service. *2007 Census of Agriculture United States: Appendix A. Census of Agriculture Methodology*. Washington, DC: US Department of Agriculture, National Agricultural Statistics Service; 2009. http://www.cdc.gov/niosh/topics/childag/mcais/. Accessed May 22, 2017.
25. Syamlal G, Mazurek JM. Prevalence of asthma among youth on Hispanic-operated farms in the United States—2000. *J Agromedicine*. 2008;13:155–164. doi:10.1080/10599240802397875
26. Forno E, Celedon JC. Asthma and ethnic minorities: socioeconomic status and beyond. *Curr Opin Allergy Clin Immunol*. 2009;9:154–160.
27. Nelson DA, Johnson CC, Divine GW, Strauchman C, Joseph CLM, Ownby DR. Ethnic differences in the prevalence of asthma in middle class children. *Ann Allergy Asthma*. 1997;78:21–26. doi:10.1016/S1081-1206(10)63365-0
28. United States Department of Agriculture. 2007 Census of Agriculture. https://www.agcensus.usda.gov/. Accessed May 22, 2017.
29. Department of Health and Human Services (DHHS). HHS action plan to reduce racial and ethnic health disparities. https://www.minorityhealth.hhs.gov/assets/pdf/hhs/HHS_Plan_complete.pdf. Accessed May 22, 2017.

30. Joseph CL, Havstad SL, Ownby DR, Johnson CC, Tilley BC. Racial differences in emergency department use persist despite allergist visits and prescriptions filled for anti-inflammatory medications. *J Allergy Clin Immunol*. 1998;101:484–490. doi:10.1016/S0091-6749(98)70355-0
31. Smith LA, Hatcher-Ross JL, Wertheimer R, Kahn RS. Rethinking race/ethnicity, income, and childhood asthma: racial/ethnic disparities concentrated among the very poor. *Public Health Rep*. 2005;120:109–116. doi:10.1177/003335490512000203
32. Moorman JE, Person CJ, Zahran HS. Asthma attacks among persons with current asthma—united States, 2001–2010. *MMWR Suppl*. 2013;62:93–98.
33. Leong AB, Ramsey CD, Celedon JC. The challenge of asthma in minority populations. *Clinic Rev Allerg Immunol*. 2012;43:156–183. doi:10.1007/s12016-011-8263-1
34. Valet RS, Perry TT, Hartert TV. Rural health disparities in asthma care and outcomes. *J Allergy Clin Immunol*. 2009;123:1220–1225. doi:10.1016/j.jaci.2008.12.1131
35. Joseph CLM, Peterson E, Havstad S, et al. Web-based, tailored asthma management program for urban African-American high school students. *Am J Resp Crit Care Med*. 2007;175:888–895. doi:10.1164/rccm.200608-1244OC
36. Goodwin RD, Pine DS, Hoven CW. Asthma and panic attacks among youth in the community. *J Asthma*. 2003;40:139–145.
37. Pearce N, Beasley R, Pekkanen J. Role of bronchial hyperresponsiveness testing in asthma prevalence surveys. *Thorax*. 2000;55:352–354.