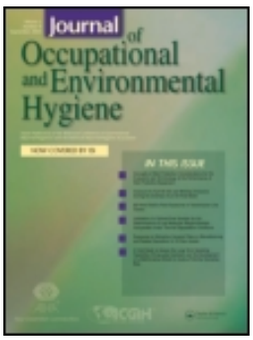

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Ethnic and Gender Differences in Farm Tasks and Safety Practices Among Rural California Farm Youth

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Agricultural work is hazardous and is common among rural youth, especially those living on farms or ranches. Previous work has shown differences in farm work and injury patterns between boys and girls, but little data exist addressing ethnic differences. This study examined ethnic and gender differences in farm tasks, safety attitudes, and use of protective measures among rural California youth working on farms or ranches. The University of California, Davis Youth Agricultural Injury Study is a longitudinal study focusing on agricultural work experience among youth enrolled in an agricultural sciences curriculum in 10 public high schools in California's Central Valley during the 2001–2005 school years. Using cross-sectional data from the initial entrance survey, we studied 946 participants who reported farm work in the previous year. Median annual hours of farm work varied significantly between boys and girls ($p < 0.001$) and between ethnic groups ($p < 0.05$) (Hispanic boys: 624 hr; Hispanic girls: 189 hr; White/Other boys: 832 hr; White/Other girls: 468 hr). Girls and Hispanic students were less likely than boys and White/Other students, respectively, to perform hazardous tasks involving tractors, machinery, and chemicals. Median age for initiating work on selected hazardous tasks was up to 3 years later for Hispanic students. Use of task-appropriate safety measures was low in all groups for most hazardous tasks. Boys were more likely than girls to use task-appropriate safety measures, with the exception of seatbelt use when in a car or truck. Hispanic students were more likely than White/Other students to employ safety measures. Girls and Hispanic youth worked fewer farm hours and had reduced exposure to selected hazardous tasks. Use of task-appropriate safety measures was low for all groups but increased for Hispanic students. Further study should explore reasons for low use of safety measures and develop educational efforts to bring about social norm changes promoting their use.

Keywords agriculture, farm, injury, personal protective measures, risk behavior, youth

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INTRODUCTION

There were approximately 1.1 million youth aged 20 years and younger living on U.S. farms in 2006; 590,000 of these youth worked on the farms, and an additional 307,000 were hired to work.[1] Agricultural work presents substantial hazards for youth. There were 22,648 injuries among persons younger than 20 years of age who lived, worked, or visited a farm or ranch in 2001, representing a cumulative 1-year injury incidence of 12.7/1000 among household and hired youth.[2] Approximately one-third of these injuries were work-related, and the majority occurred among males. In the period 1995–2002, 907 youth died on farms ($8.4/10^5$ youth per year), and 13% of these were work related.[1] Up to 40% of nonfatally injured children are left with a permanent disability.[3–5] Despite the hazards of agricultural work, the legal protective regime for youth in U.S. agriculture is much weaker than in other industries. The Fair Labor Standards Act (FLSA, 1938) allows children to engage in hazardous activities in agriculture at younger ages than for other industries.[6] Moreover, the FLSA does not apply to children working on their family farms.

In the absence of a robust legal and regulatory apparatus to protect children against injury and illness associated with farm work, great importance attaches to engineering approaches to health and safety (e.g., guards for machinery), education regarding hazards and their avoidance, and use of personal protective measures such as eye and hearing protection, respirators, seat belts, and safety helmets. Unfortunately, personal protective measures require an active decision by the operator, in contrast with engineering solutions, such as rollover protection structures (ROPS) on tractors. Inculcating safety habits has been the focus of much effort in the agricultural community. However, previous work in Kentucky, Iowa, and Mississippi has demonstrated low use of personal protective equipment among youth,[7] and available evidence indicates that educational efforts have had little impact on behavior or injury experience.[8,9]

The University of California, Davis Youth Agricultural Injury Study (UCD-YAIS) focuses on rural California public high school students working on farms or ranches and has demonstrated that these youth are at significant risk for injury, including severe injuries with the potential for permanent disability and death.[10,11] There was a marked ethnic and gender difference in injury patterns: Hispanic students were much less likely to be injured than White/Other students, and injuries among boys were more likely to involve machinery and tools, whereas girls were much more likely to be injured from animals. Risk and character of injury vary with exposures and are also likely to be affected by attitudes and use of protective measures. This report summarizes ethnicity- and gender-related differences in tasks, attitudes, and safety-related behaviors among youth in rural California public high schools working on farms or ranches.

METHODS

Study Design Overview

The UCD-YAIS is a longitudinal cohort study of farm work injury comprising an initial cross-sectional survey with annual follow-up among California Central Valley public high school students enrolled in the state-approved agriculture curriculum during the 2002–2005 school years.[11] Ten high schools were selected from a list provided by the California Department of Education based on their location in agricultural communities and participation in the state's agriculture education curriculum. Subjects entered the study and completed an initial self-administered survey between January 2002 and May 2005, with annual follow-up surveys during this period as allowed by subject availability and entrance date into the study. Data for this report are from each subject's initial survey only.

Study personnel visited each participating school to describe the study and provide informational and informed consent documents for interested students to take home for parental review and signature. We again visited the school approximately 1 week later to collect the informed consent materials and administer the questionnaire during class time. During the first two annual cycles of data collection we employed an active consent process, allowing participation for minor students providing a consent form signed by a parent or guardian, as described in our previous publication.[11] This yielded a low participation rate (39.5%), and the UCD IRB subsequently approved a passive consent process in which minor students were allowed to participate unless the parent or guardian provided a written statement prohibiting participation, increasing the participation rate of students present on the days of data collection to 100%. All minor student participants also completed an assent form. Students aged 18 years and older were allowed to provide their own informed consent.

The passive informed consent regime group contained a higher percentage of boys (75.0% vs. 67.4%, $p < 0.01$), a lower likelihood of working on a farm or ranch in the preceding year (48.8% vs. 60.1%, $p < 0.001$), and a lower unadjusted 1-year cumulative incidence of injury (3.8% vs. 8.2%, $p < 0.01$) compared with the active informed-consent group, as described in a previous publication.[11] The two groups appeared otherwise comparable and were therefore combined. The UC Davis Institutional Review Board approved the study.

Survey Questionnaire

Participants completed a 30-min paper questionnaire in class addressing demographic characteristics, health status and habits, sources of agricultural health and safety information, attitudes toward agricultural work, safety habits, smoking and respiratory history, work history, and agricultural injury history, as previously reported.[11] Where possible, we used previously validated questions from standardized questionnaires, e.g., National Health Interview Survey (NHIS) and the National Health and Nutrition Examination Survey (HANES). Questions regarding tasks and use of safety equipment were developed for this survey. A composite safety attitude risk index comprised the numerical values associated with Likert-scale responses to three safety-related questions: (1) "No matter how hard you try to prevent them, serious injuries are going to occur on a farm or ranch," (2) "Safety precautions are important and necessary, even if they slow the job," (3) "I am less likely to be injured doing farm work than other people my age doing the same work." Subjects answered, Strongly agree, Agree, Disagree, or Strongly Disagree. Responses were scored numerically 0–3 such that high values indicated risky attitudes. The scores were then summed as a composite safety attitude risk index ranging from 0 to 9.

It was not feasible to validate these data, e.g., by observing actual use of safety measures to compare with questionnaire response. However, criterion validity for the composite safety risk index has been demonstrated with its correlation with cross-sectional and prospective injury risk.[10,11] Reliability testing of the questionnaire was not conducted. Ethnicity was based on self-report. One hundred and nine (11.6%) subjects categorized themselves as neither White nor Hispanic. This group was statistically similar to Whites and was therefore included with Whites in subsequent analyses.

Data Management and Analysis

The survey instrument was a scannable questionnaire with the Teleform (Cardiff, Vista, Calif.) data processing program and the Stata (StataCorp LP, College Station, Texas) statistical software package for data management and analysis. Continuous variables were summarized with mean and standard deviation (for normal distributions) and median and percentile score (for nonnormal distributions). Categorical variables were summarized as percentages within each category. Initial two-way tabular analyses identified variables associated with injury, followed by stratification to evaluate for potential confounding. Group comparisons utilized the chi-squared or Fisher's exact test (for non-ordinal categorical variables) and the Wilcoxon rank sum test (for continuous and ordinal categorical variables). Logistic regression analysis was employed to compare likelihood of using task-appropriate safety measures among participants performing

TABLE I. Selected Characteristics of 946 Rural California Public High School Students Working on a Farm or Ranch in Prior Year

	Demographic Group					
	Hispanic		White/Other		Statistical Contrast[A]	
Characteristic	Boys n (%)	Girls n (%)	Boys n (%)	Girls n (%)	Boys vs. Girls	Hispanic vs. White/Other
Sample size	195 (20.6)	17 (1.8)	526 (55.6)	208 (22.0)	—	—
Age (years)						
Mean ± standard deviation	15.8 ± 1.33	15.1 ± 1.34	15.8 ± 1.23	15.3 ± 1.18		
Median	16	15	16	15	$p < 0.001$	NS
Annual hours farm work, hr						
Median	624	189	832	468		
Interquartile range	325–1170	33–462	390–1807	182–1040	$p < 0.001$	$p < 0.05$
Number of agricultural courses taken from Grades 7–12						
Mean ± standard deviation	2.0± 1.46	1.6 ± 1.32	2.5 ± 1.81	2.1 ± 1.78		
Median	2	1	2	2	$p < 0.01$	$p < 0.001$
FFA membership	141 (72.3)	14 (82.4)	444 (84.4)	189 (90.9)	$p < 0.05$	$p < 0.01$
4-H membership	1 (0.5)	0 (0.0)	58 (11.0)	47 (22.6)	$p < 0.001$	$p < 0.05$
Acknowledged as "very important" source of agricultural safety information						
Father	134 (68.7)	11 (64.7)	310 (58.9)	117 (56.3)	NS	$p < 0.01$
Mother	108 (55.4)	11 (64.7)	222 (42.2)	97 (46.6)	$p < 0.02$	$p < 0.001$
Other relative	61 (31.3)	6 (35.3)	156 (29.7)	72 (34.6)	NS	NS
High schoolteachers	76 (39.0)	7 (41.2)	203 (38.6)	83 (39.9)	NS	NS
FFA	60 (30.8)	7 (41.2)	166 (31.6)	101 (48.6)	$p < 0.001$	NS
4-H	15 (7.7)	0 (0.0)	67 (12.7)	52 (25.0)	$p < 0.001$	$p < 0.05$
Other source	17 (8.7)	3 (17.7)	56 (10.7)	21 (10.1)	NS	NS
Composite safety attitude risk index[B]						
Mean ± standard deviation	4.1 ± 1.32	4.4 ± 1.00	4.4 ± 1.30	4.3 ± 1.15	NS	$p < 0.01$
Median	4	4	4	4		
Interquartile range	3–5	4–5	4–5	4–5		

Note: University of California, Davis Youth Agricultural Injury Study (UCD-YAIS).

[A]P-values for gender and ethnicity contrasts are based on linear regression (for age, annual hours farm work, number of courses taken, importance of specified sources for agricultural safety information, and composite safety attitude risk index) or logistic regression (for FFA and 4-H membership) incorporating gender and ethnicity as main effects. Interaction terms for gender with ethnicity were not significant and were therefore not included in these models.

[B]The composite safety attitude risk index comprised the numerical values associated with Likert-scale responses to three safety-related questions: (1) "No matter how hard you try to prevent them, serious injuries are going to occur on a farm or ranch," (2) "Safety precautions are important and necessary, even if they slow the job," (3) "I am less likely to be injured doing farm work than other people my age doing the same work." Subjects answered, "Strongly agree," "Agree," "Disagree," or "Strongly Disagree," and these responses were scored numerically 0–3 such that high values indicated risky attitudes. Scores were then summed as a composite safety attitude risk index ranging from 0 to 9.

specified tasks, adjusting for gender, ethnicity (Hispanic vs. White/Other), and annual hours per year spent in farm work (0–300 hr/301–600 hr/601–1500 hr/1501+ hr) as indicated in table footnotes.

RESULTS

Study Sample and Characteristics

Among the 1783 students who completed an initial questionnaire, 946 (721 boys and 225 girls) reported working on a farm in the preceding year (Table I) and were our study subjects. Participants were in their midteen years; 66.0% White, 22.4% were Hispanic, 11.6% were of other or unstated ethnicity, and 91.4% were born in the United States, as described in a previous report.[11] Girls and Hispanic students worked significantly fewer hours on a farm or ranch and took fewer agricultural courses than did boys and White/Other students, respectively (Table I). Girls and White/Other students were significantly more likely than boys and Hispanic students, respectively, to be members of the National FFA Organization (also known as Future Farmers of America, or FFA) and Head, Heart, Hands, and Health (4-H), organizations

TABLE II. Performance of Selected Farm Work Tasks and Median Age at Initiation of 946 Rural California Public High School Students Working on a Farm or Ranch in Prior Year

	Demographic group					
	Hispanic		White/Other		Statistical Contrast[A]	
Specified Task	Boys n (%)	Girls n (%)	Boys n (%)	Girls n (%)	Boys vs. Girls	Hispanic vs. White/Other
Likelihood of performing specified task and median age at initiation						
Operate a tractor	119 (61.0)	2 (11.8)	399 (75.9)	112 (53.9)	$p < 0.001$	$p < 0.001$
Median age at initiation	14	10	11	12	NS	$p < 0.001$
Operate other heavy machinery	92 (47.2)	1 (5.9)	324 (61.6)	57 (27.4)	$p < 0.001$	$p < 0.001$
Median age at initiation	14	14	12	12	NS	$p < 0.001$
Mix chemicals	32 (16.4)	1 (5.9)	201 (38.2)	35 (16.8)	$p < 0.001$	$p < 0.001$
Median age at initiation	14	14	13	13	NS	NS
Apply chemicals	48 (24.6)	0 (0.0)	231 (43.9)	63 (30.3)	$P < 0.02$	$P < 0.001$
Median age at initiation	14	–	13	13	NS	NS
Feed large animals	127 (65.1)	8 (47.1)	365 (69.4)	178 (85.6)	$p < 0.001$[B]	NS[B]
Median age at initiation	11	12	10	9	$p < 0.05$	$p < 0.001$
Feed small animals	137 (70.3)	10 (58.8)	401 (76.2)	192 (92.3)	$p < 0.001$[B]	NS[B]
Median age at initiation	10	10	8	7	$p < 0.001$	$p < 0.001$
Harvest by hand	83 (42.6)	3 (17.7)	138 (26.2)	54 (26.0)	NS	$p < 0.001$
Median age at initiation	13	14	10	10	NS	$p < 0.001$
Welding	105 (53.9)	1 (5.9)	358 (68.1)	58 (27.9)	$p < 0.001$	$p < 0.001$
Median age at initiation	15	13	14	14	NS	$p < 0.001$
Number of selected tasks (above) performed						
Mean ± standard deviation	4.0 ± 2.07	1.7 ± 1.23	4.8 ± 2.12	3.8 ± 1.72	$p < 0.001$[B]	$p < 0.001$[B]
Median	4	1.5	5	4		
Interquartile range	3–6	1–2.5	3–7	2–5		

Note: University of California, Davis Youth Agricultural Injury Study (UCD-YAIS).

[A]P-values for gender and ethnicity contrasts are based on logistic regression (for likelihood of performing specified task) or linear regression (for age at initiation and number of specified tasks performed) models incorporating gender, ethnicity, and hours per year of farm labor (0–300/301–600/601–1500/1501+) as main effects. Where noted, a statistically significant interaction term for ethnicity with gender was included in the model.

[B]Significant interaction of gender with ethnicity.

promoting health and safety among agricultural youth. Girls were also significantly more likely than boys to rate these organizations and their mothers as "very important" sources of agricultural safety information. Hispanics were significantly more likely than White/Other students to rate their fathers, mothers, and 4-H as "very important" sources of agricultural safety information. Median composite safety attitude risk index values were identical for all groups, although means adjusted for gender, ethnicity, and farm work hours indicated higher (i.e., less favorable) scores among White/Other students, especially boys, compared to Hispanics. However, the differences in mean values were less than 10%. Membership in FFA, 4-H, and number of agricultural classes taken did not affect the composite agricultural safety risk index.

ENGAGEMENT IN SELECTED FARM TASKS

Boys were significantly more likely than girls to operate tractors and other machinery, mix and apply chemicals, and weld (Table II). Among Hispanics, boys were also significantly more likely than girls to feed large and small animals, whereas among White/Other students, girls were significantly more likely than boys to feed large and small animals. Hispanics were significantly less likely than White/Other students to do all tasks listed in Table II, with the exception of manual harvesting, which Hispanics were significantly more likely than White/Other students to perform.

Age of Initiation for Selected Farm Tasks

The median ages of initiation for tasks listed on Table II ranged from 7 years (feeding small animals among White girls) to 15 years (welding among Hispanic boys). Feeding small animals was associated with the earliest median age of initiation for all groups. The median ages at initiation for feeding large and small animals were significantly earlier for girls compared to boys (median difference: 1 year among White/Other students). Younger age of initiation for girls for feeding large and small animals was not observed among

TABLE III. Selected Activities Among 946 Rural California Public High School Students Working on a Farm or Ranch in Prior Year

	Demographic Group				Statistical Significance[A]	
	Hispanic		White/Other			
Specified Task	Boys [n (%)]	Girls [n (%)]	Boys [n (%)]	Girls [n (%)]	Boys vs. Girls	Hispanic vs. White/Other
Working with -						
Hammer and nail	181 (92.8)	14 (82.4)	466 (88.6)	173 (83.2)	$p < 0.02$	NS
Electric drill	177 (90.8)	6 (35.3)	469 (89.2)	127 (61.1)	$p < 0.001$	NS
Electric saw	171 (87.7)	3 (17.7)	471 (89.5)	105 (50.5)	$p < 0.001$	NS
Mowing	176 (90.3)	11 (64.7)	449 (85.4)	150 (72.1)	$p < 0.001$	NS
Pesticides	133 (68.2)	4 (23.5)	336 (63.9)	81 (38.9)	$p < 0.001$	NS
Working with -						
Noisy machinery	171 (87.7)	8 (47.1)	481 (91.4)	154 (74.0)	$p < 0.001$	NS
Working with -						
Toxic substances or dust	120 (61.5)	5 (29.4)	357 (67.9)	90 (43.3)	$p < 0.001$	NS
Riding motorcycle or moped	88 (45.1)	5 (29.4)	379 (72.1)	109 (52.4)	$p < 0.001$	$p < 0.001$
Riding all-terrain vehicle	79 (40.5)	2 (11.8)	431 (81.9)	145 (69.7)	$p < 0.001$	$p < 0.001$
Riding in a car or truck	191 (98.0)	17 (100)	520 (98.9)	208 (100)	NS	NS
Operating a tractor	103 (52.8)	2 (11.8)	393 (74.7)	95 (45.7)	$p < 0.001$	$p < 0.001$
Ride in back of uncovered pickup truck in past year						
Never	63 (32.3)	6 (35.3)	94 (17.9)	44 (21.2)		
1–5 times	89 (45.6)	8 (47.1)	202 (38.4)	100 (48.1)		
6–15 times	19 (9.7)	0 (0.0)	72 (13.7)	31 (14.9)		
16+ times	21 (10.8)	3 (17.7)	150 (28.5)	33 (15.9)	NS	$p < 0.001$

Note: University of California, Davis Youth Agricultural Injury Study (UCD-YAIS).

[A]P-values for gender and ethnicity contrasts are based on logistic regression models (linear regression for tractor hours of operation and riding in back of uncovered pickup truck) incorporating gender, ethnicity, and hours per year of farm labor (0–300/301–600/601–1500/1501+) as main effects. Interaction terms for ethnicity with gender were not significant in any of the models and were therefore not included.

Hispanics, but the interaction term for the difference in the effect of gender between Hispanic and White/Other students was not statistically significant for these tasks. Median age of initiation was similar between boys and girls for other tasks shown on Table II.

Hispanic ethnicity was associated with up to 3 years later age at initiation among both boys and girls for the majority of tasks listed in Table II. This pattern was not seen among girls for three tasks: operating a tractor (median ages of initiation for Hispanic and White/Other girls 10 and 12 years, respectively), applying chemicals (not performed by Hispanic girls), and welding (median ages of initiation for Hispanic and White/Other girls 13 and 14 years, respectively). However, few girls performed these tasks, and the interaction term for the difference in ethnicity effect between boys and girls was not significant.

Hazardous Tasks and Associated Safety Habits

Boys were significantly more likely than girls to engage in potentially hazardous activities, except riding in car or truck or in the back of an uncovered pickup truck (Table III). Hispanics were significantly less likely than White/Other students to ride a motorcycle or moped or all-terrain vehicles, and operate tractors. Hispanic students were significantly less likely than White/Other students to ride in the back of an uncovered pickup truck (Table III).

Hispanic students were more likely than White/Other students to use task-appropriate safety measures on an "always or nearly always" basis for all tasks shown on Table IV (statistically significant in all cases except for earplug use), with the exception that Hispanics were less likely to use safety helmets with motorcycles or mopeds ($p < 0.01$) and all-terrain vehicles (NS; Table IV). In both ethnic groups, boys tended to use protective equipment on an "always or nearly always" basis more than girls (significant only with respirator), with the exception of using seatbelts when riding in a car or truck, for which girls reported significantly higher use.

Tractor Operation

Five-hundred and ninety-three (62.7%) participants operated tractors, and this was significantly more frequent among boys and White/Other students compared with girls and

TABLE IV. Use of Protective Equipment Always or Nearly Always with Selected Tasks Among 946 Rural California Public High School Students Working on a Farm or Ranch in Prior Year

	Demographic Group					
	Hispanic		White/Other		Statistical Significance[A]	
Protective Equipment and Specified Task	Boys n (%)	Girls n (%)	Boys n (%)	Girls n (%)	Boys vs. Girls	Hispanic vs. White/Other
Use of safety goggles when working with -						
Hammer and nail	34 (18.8)	2 (14.3)	46 (9.9)	8 (4.6)	NS	$p < 0.001$
Electric drill	74 (41.8)	1 (16.7)	96 (20.5)	25 (19.7)	NS	$p < 0.001$
Electric saw	103 (60.2)	2 (66.7)	211 (44.8)	50 (47.6)	NS	$p < 0.001$
Mowing	35 (19.9)	3 (27.3)	47 (10.5)	9 (6.0)	NS	$p < 0.001$
Pesticides	73 (54.9)	2 (50.0)	123 (36.6)	25 (30.9)	NS	$p < 0.001$
Use of earplugs or muffs when working with -						
Noisy machinery	28 (16.4)	1 (12.5)	52 (10.8)	16 (10.4)	NS	NS
Use of respirator when working with -						
Toxic substances or dust	64 (53.3)	1 (20.0)	105 (29.4)	14 (15.6)	$p < 0.02$	$p < 0.001$
Use of safety helmet when -						
Riding motorcycle or moped	35 (39.8)	0 (0.0)	213 (56.2)	60 (55.1)	NS	$p < 0.01$
Riding all-terrain vehicle	27 (34.2)	0 (0.0)	179 (41.5)	59 (40.7)	NS	NS
Use of seat belt when -						
Riding in a car or truck	143 (74.9)	15 (88.2)	354 (68.1)	177 (85.1)	$p < 0.001$	$p < 0.05$
Operating a tractor	27 (26.2)	0 (0.0)	33 (8.4)	8 (8.4)	NS	$p < 0.001$

Note: University of California, Davis Youth Agricultural Injury Study (UCD-YAIS).

[A]P-values for gender and ethnicity contrasts are based on logistic regression models incorporating gender, ethnicity, and hours per year of farm labor (0–300/301–600/601–1500/1501+) as main effects. Interaction terms for ethnicity with gender were not significant in any of the models and were therefore not included.

Hispanic students, respectively (Table V). Among participants operating a tractor, boys reported significantly more hours per year in operation than did girls, with a five-fold increase (100 vs. 20 hr) in White/Other students. Among Hispanics, hours of operation were comparable between boys and girls (48 and 60 hr, respectively), but these included observations for only two Hispanic girls, and the interaction term for the difference in effect of gender between the ethnic groups was not significant.

ROPS were present in 47.1% of the tractors operated by participants and differed significantly according to ethnicity and gender (61.1% for Hispanic boys, 47.6% for White/Other boys, 30.5% for White/Other girls, and 0% for Hispanic girls). Seatbelts were present on 44.9% of tractors operated by participants; this presence varied significantly with the participants' ethnicity and gender; seatbelts were most likely present on tractors operated by Hispanic boys (63.1%). Power take-off (PTO) devices were present on 56.0% of tractors operated by participants, and were significantly more likely on tractors operated by boys and White/Other students. The PTO shield was in place for 50.9% of these; its being in place varied significantly with participants' ethnicity and gender. PTO shields were most common for PTO-equipped tractors operated by Hispanic boys (56.3% vs. 50.9% in White/Other boys, 35.3% in White/Other girls, and 0% in Hispanic girls).

DISCUSSION

This report addresses ethnic and gender differences in farm work and use of safety measures in the UCD-YAIS cohort of rural California public high school students working on farms and ranches. We found that girls and Hispanic students worked fewer hours per year compared with boys and White/Other students, respectively, and were also less likely to engage in selected hazardous tasks, in particular, those involving machinery and chemicals. Hispanic students also began performing selected hazardous tasks at a later age (up to 3 years later) than White/Other students. Use of protective measures was low in all groups, and there were clear gender and ethnic differences in this regard. Specifically, girls were less likely than boys to use appropriate safety measures when performing various hazardous tasks, with the exception of

TABLE V. Characteristics of Operating a Tractor, 593 Rural California Public High School Students Working on a Farm or Ranch in Prior Year

	Demographic Group					
	Hispanic		White/Other		Statistical Significance [A]	
Tractor Characteristic	Boys n (%)	Girls n (%)	Boys n (%)	Girls n (%)	Boys vs. Girls	Hispanic vs. White/Other
Youths operating tractors	103 (17.4)	2 (0.3)	393 (66.3)	95 (16.0)	$p < 0.001$	$p < 0.001$
Hours of operation in year						
Median	48	60	100	20		
Interquartile range	20–100	60–60	20–355	10–50	$p < 0.001$	NS
Rollover protection structure	63 (61.1)	0 (0.0)	187 (47.6)	29 (30.5)	$p < 0.05$	$p < 0.001$
Seat belts	65 (63.1)	1 (50.0)	170 (43.3)	30 (31.6)	$p < 0.05$	$p < 0.001$
Power takeoff	48 (46.6)	0 (0.0)	267 (67.9)	17 (17.9)	$p < 0.001$	$p < 0.05$
Power takeoff shield in place	27 (56.3)	0 (0.0)	136 (50.9)	6 (35.3)	NS	$p < 0.05$

Note: University of California, Davis Youth Agricultural Injury Study (UCD-YAIS).

[A]P-values for gender and ethnicity contrasts are based on logistic regression models (linear regression for tractor hours of operation per year) incorporating gender and ethnicity as main effects. Interaction terms for ethnicity with gender were not significant in any of the models and were therefore not included.

seatbelt use when driving or riding in a car. Hispanic students, while less likely to engage in selected hazardous tasks, were more likely than White/Other students to use appropriate safety measures in their performance.

These results are consistent with and expand on our earlier reports showing lower farm injury rates among Hispanic compared with White/Other students and that boys and girls had similar risk for injury after accounting for annual hours spent in farm work, yet demonstrated markedly different injury patterns.[11] In particular, boys were more likely to be injured working with motor vehicles, machinery, and tools, whereas girls were more likely to be injured working with animals, findings reflected in other agricultural youth populations.[12] Consistent with this pattern for source of injury, both Hispanic and White/Other boys demonstrated significantly higher work exposure to tractors, machinery, chemicals, and welding compared with girls. Greater exposure among boys is also seen in Hispanic students for manual harvesting and feeding large and small animals, whereas among White/Other students, girls are more frequently engaged in feeding large and small animals than are boys and begin these tasks at an earlier age.

Tractors are an important cause of fatal injury, often related to rollover incidents and power takeoffs.[13] The overall prevalence of ROPS (47.1%) on tractors operated by youth in this study is comparable to national data, which indicate that approximately half of U.S. tractors are equipped with ROPS.[13] Seatbelts were present on 44.9% of tractors, which is below the 58% prevalence for seatbelts observed in a study of tractors in Washington State.[14] The general pattern of increased exposure for boys and White/Other students was present for tractor operation as for most other farm tasks. Presence of protective features (ROPS, seatbelts, PTO shield in place for tractors with a PTO) was highest on tractors operated by Hispanic boys, followed by White/Other boys and White/Other girls. Although we have no data to further explore this finding, it suggests that better-equipped and, perhaps, newer tractors may be available preferentially to Hispanic boys, followed by White/Other boys and White/Other girls.

Agricultural injuries continue to exact a high toll among U.S. farm youth, with over 22,000 injuries (of which approximately one-third are work related) and over 100 deaths (approximately 13% of which are work related) among farm youth annually.[1,2] Economic costs of farm youth injuries are high: an estimated $1 billion per year in 2005 dollars.[15] The traditional approach for injury reduction involves engineering controls to remove or reduce risk (e.g., safety guards, ROPS for tractors), administrative controls to limit work time or hazardous tasks (e.g., Department of Labor Hazardous Orders limiting work for youth), and education. There is general recognition that reliance on education alone does not significantly affect injury risk.[9] Farm youth organizations such as FFA and 4-H promote safety, yet evidence of effectiveness is sparse. A large randomized trial among FFA members, for example, showed no effect of a comprehensive safety education intervention on injury experience.[8] Lack of effect of FFA or 4-H membership on composite safety attitude index scores shown here and on injury risk in our previous report[11] are consistent with the earlier randomized trial findings.

This study, in the context of our prior work, indicates that a significant protective factor among girls and Hispanic students is their reduced work hours compared with boys and White/Other students, respectively. Moreover, girls and White/Other students were more likely than boys and Hispanic students, respectively, to be members of FFA and 4-H,

organizations that promote agricultural safety, and to value them as sources of health and safety information. However, agricultural safety risk attitudes, which were shown earlier to correlate with injury risk,[10,11] differed minimally between the groups. Greater participation in agricultural safety and health organizations among girls and White/Other students was not reflected in the likelihood of using appropriate safety measures with specified tasks, which was consistently higher for boys, especially Hispanics. An important exception to this pattern is that girls were significantly more likely than boys to use seatbelts when driving or riding in a car.

Reduced likelihood for using protective equipment among girls compared with boys has been reported among other farm youth populations. Reed and co-workers[7] studied a group of 593 rural high school youth enrolled in agricultural classes in Kentucky, Iowa, and Mississippi. Girls were less likely than boys to use respirators and hearing protection when appropriate for the task but were more likely than boys to use seatbelts when operating a tractor. Reduced use of hearing protection among girls has also been reported among Wisconsin farm youth.[16] Reduced use of protective measures among women compared with men has also been reported in adult California farm operators.[17]

Ethnic- and gender-specific patterns of safety equipment use among high-school-age youth has also been reported outside the farm environment. Data from the Youth Risk Behavior Surveillance System[18] (YRBSS) for 2009 show males were more likely than females to rarely or never use a seatbelt (11.5% vs. 7.7%), a finding seen in both Whites and Hispanics. Similarly, Whites were more likely than Hispanics to rarely or never use a seatbelt (9.4% vs. 8.8%). Motorcycle helmet use on a rarely-or-never basis was more common among males than females (36.8% vs. 24.3%) and more common among Hispanic than White students (48.3% vs. 24.6%). Thus, the YRBSS data correspond with our findings of greater seatbelt use among females and Hispanics and greater use of motorcycle helmets among White/Other students compared wtih Hispanics, but differ from our findings of reduced helmet use with motorcycle or moped operation among girls.

Reasons for ethnic and gender differences in risk taking and attitudes are imperfectly understood and likely have biological (for gender), social, and cultural roots. In adolescent and adult years, males in general engage in more risk taking than do females.[19] Barriers to use of personal protective measures among girls may include reduced access to information and equipment and poor fit of equipment.[7,20] Self-consciousness and fear of derision by peers have been cited as barriers to bicycle helmet use among school children.[21] Among Latino farm workers, barriers to safety goggle use in harvest operations have included perceived lack of protection, discomfort, undesirable appearance, interference with visual acuity, slowing down the work pace, and the absence of a mandate from employers.[22]

Strengths of this study include the relatively large number of participants and geographic scope involving 10 public high schools in California's Central Valley, one of the world's most productive agricultural regions.[23] Limitations include the fact that participants were public high school students in California, potentially affecting generalizability. However, the consistency of our findings with those of other youth farm populations suggests that these findings are broadly applicable. Although the relatively small number of Hispanic students, especially girls, limits detection of subgroup effects in this group, a general pattern of fewer work hours, lower and later exposure to hazardous tasks, and greater likelihood of using safety measures is nevertheless evident and may contribute to the lower injury risk seen among Hispanics in our earlier report.[11]

Finally, this study relied on questionnaire data for which direct validation was infeasible. We did not assess validity or reliability of survey questions; however, many questions were drawn from standard sources such as the HIS and HANES questionnaires, although questions relating to tasks and use of safety measures were developed for this survey. Moreover, findings from our earlier reports showed that several risk factors, including the composite safety attitude risk index, were consistently predictive of both cross-sectionally obtained and prospective injuries, suggesting reasonable criterion validity.[10,11]

CONCLUSION

This study confirms in rural California farm youth the gender-specific patterns of work and use of safety equipment noted in farm youth populations elsewhere in North America. It also expands on findings from other studies in its focus on ethnicity, about which there is little data because such studies have tended to include primarily White subjects. Whereas girls and White/Other students tended to have lower use of task-appropriate protective measures than boys and Hispanics, respectively, of greatest concern is the low level of use of protective measures in both sexes and ethnic groups. Only for use of seatbelts when riding in a car or truck did a majority of subjects of both sexes and ethnic groups report use always or nearly always. It is unlikely that education alone will have a significant impact on use of protective measures and consequent reduction in injury experience.[9] Rather, a deep-seated change in social norms is likely to be required, modeled not only by parents and other responsible adults but also by influential peers.

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