Compliance with NAGCAT Work Practices Recommendations for Youth Cleaning Service Alleys in Stall Barns

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ABSTRACT. *Unintentional injury is the leading cause of death in the U.S. among persons 1 to 44 years of age. Over one million children and adolescents in the U.S. live, work, and/or play on farms, where injury risk is relatively high compared to other settings. In an attempt to reduce the number of childhood agricultural injuries occurring on farms, the North American Guidelines for Children's Agricultural Tasks (NAGCAT) was developed to assist parents or other caregivers in assigning developmentally appropriate chores to youth exposed to agricultural hazards. The results presented here are from a longitudinal study in which we obtained (self-reported) daily chore, injury, and safety behavior data from children and adolescents. We focused on one NAGCAT chore, cleaning a service alley in a stall barn, in order to estimate the extent of compliance with specific work practice recommendations contained in the NAGCAT. Our results indicated that among the four NAGCAT-recommended safety practices for cleaning service alleys in stall barns (wearing non-skid shoes, leather gloves, a respirator, and eye protection), wearing non-skid shoes was the only safety practice reported with any degree of regularity. Overall, boys were more likely to wear non-skid shoes compared to girls. In addition, older youth were generally more likely to report higher work practice compliance compared to younger youth.*

Keywords. *Agricultural health hazards, Children, Farm safety, Occupational health, Personal protective equipment, Rural health, Youth.*

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In the 2008 edition of the National Safety Council's *Injury Facts*, agriculture is reported to be the "most dangerous" industry in the U.S., with a fatality rate of 28.7/100,000 adult workers (NSC, 2008); the 2008 National Census of Fatal Occupational Injuries (COFI) reported the all-worker/all-industry fatality rate to be 3.6/100,000 full-time equivalent workers, and 29.4/100,000 full-time equivalent workers in the agriculture, forestry, fishing, and hunting industry sector (BLS, 2006). The ratio of the two 2008 agriculture-related death rates to the all-workers/all-industries death rate is on the order of 8. When compared to other industries, agriculture has consistently been associated with higher work-related mortality (and morbidity) among workers of all ages (Castillo et al., 1999; McCurdy and Carroll, 2000).

As should be widely recognized, injuries are the leading childhood health problem in the U.S. (Borse et al., 2009; Crawley-Coha, 2001; MacKenzie, 2000; Miller et al., 2000; Rivara, 1995; Wilson et al., 1991), accounting for the highest proportion of childhood and adolescent deaths when compared to other causes (Heron, 2007). Over one million children in the U.S. live, work, and/or play on farms where injury risks have remained relatively high over the past two decades (NIOSH, 2009; Rivara, 1997). The very nature of production agriculture can expose both adults and youth to many injury hazards. Farming is one of the few industries in which families, who often share the work and live on the premises, are at risk of fatal and non-fatal injuries. Large animals and machinery, for example, pose (unintentional) injury risks to workers of all ages in agricultural settings. As reported by Hendricks (2008), the estimated number of injuries among farm-resident youth less than 20 years of age in the U.S. was 27,321 in 1998, which translates into an injury rate of 19.2/1000 (see table 5 in Hendricks, 2008). In 2006, the number of injured youth living on U.S. farms declined to 11,654, nearly a 60% decrease. The corresponding injury rate is 10.4/1000, approximately a 50% decrease. Other publications particularly relevant here include Hendricks et al., 2005; Myers and Hendricks, 2001; and NIOSH, 2007a, 2007b, 2009.

Age and gender have been the most commonly identified risk factors in previous studies of childhood agricultural injury (CAI) fatalities. Fatal agricultural injuries among the very young (<10 years of age) were reported by Salmi et al. (1989) to occur at an annual rate of 2.4/100,000 rural children. In that study, the rates among males and females were 3.5/100,000 and 1.1/100,000, respectively, more than a three-fold difference between boys and girls. Rivara (1985) examined agricultural fatalities among persons <20 years of age and reported an annual farm fatality rate of 13.2/100,000 (males and females combined), as well as age-specific rates of 16.8/100,000 among 15-19 year olds and 13.7/100,000 among 10-14 year olds, while gender-specific rates were 21.5/100,000 males and 3.8/100,000 females. A more recent study by Schenker et al. (1995) investigated agricultural fatality rates among teenagers in California. That study found annual fatality rates per 100,000 rural population for those <15 years of age to be 1.2/100,000 males and 0.4/100,000 females (a 3-fold difference). In a 1999-2000 study, Goldcamp et al. (2004) estimated that approximately 116 farm-related deaths occurred among U.S. youth <20 years of age during that time period, reflecting an average annual mortality rate of 9.3/100,000. For the period 1995 through 2002, there were an estimated 5.4 fatalities per 100,000 youth; the highest rates occurred among 16-19 year olds (NIOSH, 2007a). Results from the studies cited above generally indicate higher agricultural fatality rates for young males (<20 years of age) compared with young females, with rates tending to increase as age increases. Although the number of fatalities among youth working in agricultural pro-

duction has declined over time, the mortality rates remained relatively constant from the period 1992-1996 to 1997-2002 (Hard and Myers, 2006).

CAI risk appears to peak around ages 3 to 4 and again at ages 13 and 14 (Cogbill et al., 1985; Swanson et al., 1987), with the 13-14 year peak representing the age at which youth generally become more involved with agricultural chores. Further, injuries occur most often in summer (Cogbill et al., 1991; Stueland et al., 1991) and on weekends (Stueland et al., 1991; McCurdy and Carroll, 2000). Of possible relevance to the present study, Swanson et al. (1987) concluded that one underlying cause of agriculture-related injury among youth is inadequate supervision (for younger children) or youth engaging in tasks inappropriate for the child's age (for older children). Approximately 25 years ago, Rivara (1985) discussed the paucity of data on youth developmental skills as related to CAI risk; he concluded that increased CAI risk among children and adolescents represents a mismatch between the physical and cognitive skills demanded by the situation.

In an effort to protect young agricultural workers from injury, the North American Guidelines for Children's Agricultural Tasks (NAGCAT) were developed (and published in 1999), containing recommendations for safety measures appropriate for youth ages 7 to 16 years who work on farms (Lee and Marlenga, 1999). The NAGCAT were intended to serve as a general safety reference to assist parents (or other caregivers) in assigning developmentally appropriate agricultural chores to youth. Variables associated with agricultural tasks that were considered include: specific hazards, injury and disease concerns, safety-related and risk-reducing work practices, age at which youth could perform certain chores, adult supervision, and required training. As a result, a hazard analysis framework was developed for 62 agricultural tasks, as well as a child developmental checklist for each of the 62 tasks. Parent resource posters were created for each task to serve as guidelines for parents when assigning farm chores to youth.

In this article, we describe age- and gender-specific youth compliance with the recommended work practices (WPs) given in the NAGCAT for a specific chore: cleaning a service alley in a stall barn. The data analyzed for this article were collected as part of a study conducted during 2004-2006 that was designed to assess compliance with the NAGCAT WPs and to evaluate the effectiveness of the NAGCAT in reducing CAI risk among youth exposed to agricultural hazards (Wilkins, 2003). We selected cleaning service alleys in stall barns for analysis due to the relatively high frequency with which it was performed by youth in the study. As discussed below, the NAGCAT contain four recommended WPs for cleaning a service alley in a stall barn: wearing nonskid shoes, wearing leather gloves, wearing a respirator, and wearing eye protection.

Methods

Sample Selection

A contiguous 20-county area in central Ohio defined the study region. After a three-year data collection period (2004-2006), more than 300 4-H youth in nine counties had been recruited to participate in the longitudinal study. Selection of the 20 counties was based on several factors, as follows: county-specific number and size of farms, population size, percentage of population living in rural areas, percentage of population between 5 and 19 years of age, and number of age-eligible 4-H youth per

county. Each 4-H member who volunteered was paired with one parent or caregiver, referred to as the parent partner (PP); youth were referred to as youth partners (YPs). The intent of the larger study was to evaluate the effectiveness of an intervention delivered to the PPs, which described the NAGCAT and its relevance to the work being done by YPs in order to persuade PPs to motivate their YPs to follow the guidelines. Usable data were obtained for 207 youth whose PPs received an in-home intervention and 123 youth whose PPs did not (control group). This study ignores intervention vs. control status and focuses on WP compliance of all youth participants ($n = 330$).

Study participants were identified through The Ohio State University Extension's 4-H program. Rosters from County Extension offices were used to identify youth 9 to 17 years old who lived on farms or participated in a large animal 4-H project. A total of 4,481 potential participants were identified. Letters describing the study and an invitation to participate were mailed to 3,141 households. Households were then contacted via telephone to determine eligibility and willingness to participate. Study exclusion criteria for the YPs included: staying at least two nights per week at another domicile, non-English speaking, participation in earlier OSU-based studies, planned vacation of two weeks or more during the study period, and presence of mental retardation or physical disability. Of the 3,141 households contacted by mail, 601 (19.1%) declined to participate, 267 (8.5%) were determined to be ineligible, 417 (13.3%) agreed to participate, and 1,856 (59.1%) were unreachable by phone. Of the 417 who initially volunteered to be in the study, 347 (83.2%) completed the required consent and assent forms and participated in baseline testing. A total of 330 youth (95.1% of youth who completed the consent/assent forms) provided usable data (144 boys and 186 girls).

Data Reporting

As described by Wilkins et al. (2007), in reference to a previous study, data collection for the present investigation relied on a modified form of participant event monitoring (PEM) (Peterson et al., 1996). In brief, all participating youth were expected to complete a semi-structured daily diary, referred to as the daily record book (DRB), which, in part, was designed to obtain relevant information on each chore worked each day (copy available on request). Of the 62 tasks contained in the NAGCAT, 31 were included in our DRB because they reflected agricultural practices in central Ohio. If a YP reported cleaning a service alley in a stall barn on any given day during the 10-week data collection period, then the YP was expected to report the number of minutes spent that day working this chore. In addition, the YP was expected to indicate which of the recommended WPs were followed (wearing non-skid shoes, wearing leather gloves, wearing eye protection, and wearing a respirator). We assumed that if a YP reported compliance with a particular WP, then the YP was in compliance for the total duration of the chore on that day. The total number of daily minutes spent cleaning a service alley in a stall barn was recorded by the youth in the DRB. DRBs were expected to be completed daily and returned to the study office weekly.

To maximize the accuracy of the DRB data, a number of previously used (and shown to be effective) quality control procedures were employed, as described by Wilkins et al. (2007). In that article, it was concluded that "PEM can be successfully implemented to collect reliable daily data on unintentional injuries from 9- to 18-year-old youths over a 13-week reporting period." In addition, we analyzed similar data with a focus on discernable recordkeeping errors (DREs) in a sample of DRBs. For the time

period investigated, fewer than 5% of the DRBs examined contained one or more DREs (Strickland et al., 2006).

Incentives

Before completion of the DRBs began, YPs were given a wristwatch to facilitate accurate reporting of the time spent working chores; periodically, YPs received small gifts on a bi-weekly basis (pens, stickers). In addition, by completing the study, YPs were entered into a raffle to win Ohio State football tickets, Ohio State T-shirts, or gift certificates to local retailers. If the first week's DRB was returned in a timely fashion to the study office, YPs received $1. YPs received an increasing amount of money each week a completed DRB was returned on time; $2 for completing the second week's DRB, $3 for completing the third week's DRB, etc., with the potential to receive up to a total of $55 by the end of the 10-week study period. All study methods and procedures were approved by The Ohio State University IRB. PPs and YPs signed IRB-approved consent and assent forms, respectively.

Measures

Individual-level WP compliance estimates (expressed as percentages and referred to as "rates" in this article) were calculated for each YP by dividing the total number of minutes each youth reported being in compliance with a specific WP by the total number of minutes that same YP reported cleaning service alleys in stall barns. This generated a minute-based WP-specific weighted mean compliance rate for each YP (table 1).

Table 1. Illustrative hypothetical calculation of WP-specific compliance rates by subgroup (e.g., boys).

Boy	Total Days Worked Chore	Day of Study Worked Chore	Minutes Worked Chore	Follow Specific WP[a] (Yes/No)	Assumed Minutes in Compliance	Compliance Rate (% of time in compliance)
1	3	2	30	Y	30	
		16	20	Y	20	
		44	10	N	0	
		Subtotal	60		50	50/60 = 83.3%
2	4	1	5	N	0	
		15	10	N	0	
		29	5	Y	5	
		47	5	N	0	
		Subtotal	25		5	5/25 = 20.0%
3	6	15	20	Y	20	
		16	40	Y	40	
		22	15	Y	15	
		29	15	N	0	
		30	10	N	0	
		39	30	N	0	
		Subtotal	130		75	75/130 = 57.7%
4	2	25	10	N	0	
		61	15	Y	15	
		Subtotal)	25		15	15/25 = 60.0%
Totals		Weighted mean	240		145	145/240 = 60.4%
		Unweighted mean[b]				55.3%

[a] First, second, third, or fourth WP.

[b] Unweighted mean equals arithmetic mean of 83.3, 20.0, 57.7, and 60.0.

WP-specific compliance ogives (cumulative frequency distributions) were created to compare boys and girls. In addition, these data were stratified by tertiles of age to investigate differences in WP compliance by age and gender. We used tertile cutpoints to balance the number of youth in each age group to avoid a possible small-numbers problem in the statistical analysis of the data. It is acknowledged that there are other approaches to age classification.

To study those circumstances where high proportions of youth reported that they were never, or always, in compliance, five discrete and mutually exclusive categories were created, including 0% and 100% as individual strata. The range between 0% and 100% adherence was divided into the following three segments: >0% to ≤33%, >33% to ≤67%, and >67% to <100%.

The two-sample Kolmogorov-Smirnov (K-S) test was used to determine statistical significance in comparing the cumulative frequency distributions, boys versus girls. This non-parametric test compares the distance between two empirical distributions. The null hypothesis tested is that the two-sample distributions are identical. The K-S p-values reported here are exact K-S p-values as estimated by SPSS statistical software. All data analyses were performed using SPSS version 17.0 (SPSS, Inc., Chicago Ill.), and all graphs and tables were created using Microsoft Excel 2003.

Results

Summary Statistics

A total of 330 youth provided usable data (186 girls and 144 boys; table 2). Of the 186 girls, 139 (74.7%) reported cleaning a service alley in a stall barn at least once during the 10-week study period. Of the 144 boys, 88 (61.1%) reported cleaning a service alley in a stall barn at least once. Also presented in table 2 are selected descriptive statistics on exposure to this chore. The cumulative minutes, hours, and days totals are presented for boys and girls, as well as the group mean minutes, hours, and days that the chore was worked per youth. As can be seen in table 2, girls appear, in general, to have experienced more exposure to this chore. Compared to boys, girls exhibited higher group mean minutes, hours, and days. Focusing on the individual-level measures, the mean number of days per week was slightly higher for girls (1.5 vs. 1.0 for boys); boys, however, reported a slightly higher youth-specific mean number of minutes cleaning a service alley per day than girls (42.8 vs. 40.3 for girls).

Selected YP characteristics are summarized in table 3. Girls and boys did not differ with respect to the mean age at which they started working in a stall barn or with respect to having received training for proper lifting or for use of a respirator (table 3). The mean age for boys and girls (reporting cleaning service alleys in stall barns at least once) when age was treated as a continuous variable was not different ($p = 0.710$), but when age was stratified into tertiles, boys and girls differed with respect to age ($p = 0.030$). Further, statistically significant differences were seen for the following characteristics: youth farm residence, history of chemical handling training, and history of doing something dangerous or risky. Farm residence was found to be significantly different between boys and girls, with 76.4% of boys and 58.0% of girls reporting living on a farm ($p = 0.005$). Girls were more likely to have received safe chemical handling training (73.3%) compared to boys (58.4%, $p = 0.021$). Finally,

boys reported a history of engaging in risky or dangerous activities for fun more often than girls ($p = 0.003$).

Selected PP characteristics are presented in table 4. The mean age of the PPs of both boys and girls was similar (41.1 years vs. 42.9 years, respectively; $p > 0.05$). The level of PP education was not statistically different comparing boys and girls, nor was the number of acres rented, owned, or worked by the PP. In addition, the PPs of boys and girls did not differ in terms of physically performing farm tasks. When asked how likely their YP was to be injured within the next year while cleaning a service alley in a stall barn, PPs indicated, in general, that injury was not likely (boy vs. girl comparison $p = 0.112$). Among youth reporting cleaning a service alley, 7.6% of girls' PPs indicated that their YP received constant supervision, compared to only 1.1% of boys' PPs; 22.1% of girls' PPs indicated no supervision for their YP, compared to 23.9% of boys' PPs. These differences approached statistical significance ($p = 0.068$). It should be noted that 25 PPs reported that their YPs did not clean a service alley in a stall barn.

Seasonality of study participation was posited to have the potential to confound possible gender differences in WP compliance. To investigate this, two statistical tests were used to compare the percentage of boys and girls who began recording chore data in the DRBs each month (March to October). Among youth who reported cleaning a service alley in a stall barn at least once, the results of the comparison of boys (of all ages) compared to girls (of all ages) was not statistically significant ($\chi^2 = 6.32$, df = 7, 2-sided $p = 0.503$), nor were the gender comparisons by age tertile (results not shown).

Table 2. Descriptive statistics for youth reporting cleaning a service alley in a stall barn at least once.

Subgroup and Selected Descriptive Statistics		All Boys ($n = 144$)	All Girls ($n = 186$)	Total ($n = 330$)
Number of youth who never worked chore during the 10-week follow-up period		56	47	103
Number (%) of youth who worked chore at least once		88 (61.1)	139 (74.7)	227 (68.8)
Cumulative totals based on youth working chore at least once	Minutes	25,775	63,499	89,274
	Hours	429.6	1,058.3	1,487.9
	Days	788	1,876	2,664
Group means[a]	Minutes/youth	292.9	456.8	393.3
	Hours/youth	4.9[a]	7.6	6.6
	Days/youth	9.0	13.5	11.7
Youth-specific days per week[b]	Minimum	0.1	0.1	0.1
	Median	0.5	0.8	0.6
	Mean	1.0	1.5	1.3
	Maximum	5.5	7.0	7.0
Youth-specific minutes per day[c]	Minimum	1.4	2.3	1.4
	Median	30.0	30.0	30.0
	Mean	42.8	40.3	41.3
	Maximum	300.0	150.0	300.0

[a] Group means based on cumulative totals; for example, 429.6/88 = 4.9 hours per boy.

[b] Calculated as the total number of days that youth cleaned a service alley during the 10-week follow-up period divided by the total number of weeks in the study, which could range from 1 to 10.

[c] Calculated as the total number of minutes that youth cleaned a service alley during the 10-week follow-up period divided by the total number of days they reported working this chore.

Table 3. Selected youth partner (YP) characteristics.

	Boys		Girls		Total		Results of Statistical Comparison[a] (boys vs. girls)
Mean age (SD)[b]	13.8 (2.0)		13.7 (2.3)		13.7 (2.2)		p = 0.710[d]
Mean age when started working in stall barn[c]	9.0 (2.5)		8.7 (2.2)		9.0 (2.4)		p = 0.447[d]
Age (tertiles)	(*n*)	(%)	(*n*)	(%)	(*n*)	(%)	
<12.73	23	26.1	49	35.5	72	31.9	$\chi^2 = 7.016$
12.73 to 14.74	40	45.5	39	28.3	79	35	df = 2
>14.75	25	28.4	50	36.2	75	33.2	p = 0.030*
Missing	0	0.0	1	0.0	1	0.0	
Total	88	100.0	139	100.0	227	100.0	
Farm residence							
Live on farm	68	76.4	76	58.0	144	65.5	$\chi^2 = 7.926$
Does not live on farm	21	23.6	55	42.0	76	34.5	df = 1
Missing	0	0.0	0	0.0	0	0.0	p = 0.005*
Total	89	100.0	131	100.0	220	100.0	
Past safety training							
How to lift properly							
No	14	15.7	27	20.6	41	18.6	$\chi^2 = 0.832$
Yes	75	84.3	104	79.4	179	81.4	df = 1
Missing	0	0.0	0	0.0	0	0.0	p = 0.362
Total	89	100.0	131	100.0	220	100.0	
Use/fit respirator							
No	69	77.5	113	86.3	182	82.7	$\chi^2 = 2.827$
Yes	20	22.5	18	13.7	38	17.3	df = 1
Missing	0	0.0	0	0.0	0	0.0	p = 0.093
Total	89	100.0	131	100.0	220	100.0	
Chemical handling							
No	37	41.6	35	26.7	72	32.7	$\chi^2 = 5.312$
Yes	52	58.4	96	73.3	148	67.3	df = 1
Missing	0	0.0	0	0.0	0	0.0	p = 0.021*
Total	89	100.0	131	100.0	220	100.0	
Did something dangerous or risky for fun							
Never	31	34.8	71	54.2	102	46.4	$\chi^2 = 13.899$
Once or twice	38	42.7	49	37.4	87	39.5	df = 3
Several times	20	22.5	10	7.6	30	13.6	p = 0.003*
Missing	0	0.0	1	0.8	1	0.5	
Total	89	100.0	131	100.0	220	100.0	

[a] df = degrees of freedom; an asterisk (*) indicates significance at $\alpha = 0.05$.
[b] Boys ($n = 88$, missing = 0); girls ($n = 138$, missing = 1); SD = standard deviation of mean.
[c] Boys ($n = 76$, missing = 13); girls ($n = 111$, missing = 20).
[d] Two-tailed p-value from t-test for equality of means, assuming equal variance.

Compliance with WP, Wearing Non-Skid Shoes

Descriptive statistics for the minute-based non-skid shoe compliance rates are presented in table 5 by PP residence status (did or did not live on a farm), YP gender, and YP age. Mean, median, minimum, and maximum cumulative percentage compliance estimates are given in table 5, along with the K-S p-value, which represents a test of the null hypothesis that the cumulative percentage ogives being compared are identical. Also included in table 5 is a column indicating which figure depicts a specific ogive. For wearing non-skid shoes, with one exception (youth <12.7 years living on a farm), boys consistently reported higher mean compliance rates than girls. Further, of the 12 boy-girl comparisons, five exhibited statistical significance (all youth, non-farm

Table 4. Selected parent partner (PP) characteristics.

	Boys		Girls		Total		Statistical Comparison (boys vs. girls)
Mean age (SD)[a]	41.1 (9.0)		42.9 (8.2)		42.2 (8.6)		p = 0.138[b]
Education of PP	(*n*)	(%)	(*n*)	(%)	(*n*)	(%)	
Less than high school	1	1.1	4	3.1	5	2.3	$\chi^2 = 1.871$
High school diploma or GED	26	29.5	46	35.1	72	32.9	df = 3
Some college	36	40.9	46	35.1	82	37.4	p = 0.600
College graduate or higher	25	28.4	35	26.7	60	27.4	
Other	0	0.0	0	0.0	0	0.0	
Missing	0	0.0	0	0.0	0	0.0	
Total	88	100.0	131	100.0	219	100.0	
Acres rented, owned, or worked							
1-9 acres	23	26.1	52	39.7	75	34.2	$\chi^2 = 9.266$
10-49 acres	23	26.1	31	23.7	54	24.7	df = 11
50-99 acres	12	13.6	20	15.3	32	14.6	p = 0.597
100-149 acres	10	11.4	6	4.6	16	7.3	
150-199 acres	3	3.4	4	3.1	7	3.2	
200-249 acres	2	2.3	3	2.3	5	2.3	
250-299 acres	2	2.3	2	1.5	4	1.8	
300-349 acres	0	0.0	1	0.8	1	0.5	
350-399 acres	1	1.1	2	1.5	3	1.4	
400-499 acres	2	2.3	2	1.5	4	1.8	
500-999 acres	7	8.0	6	4.6	13	5.9	
1000 acres or more	3	3.4	2	1.5	5	2.3	
Missing	0	0.0	0	0.0	0	0.0	
Total	88	100.0	131	100.0	219	100.0	
Performs physical part of farm operation							
Regularly	44	50.0	75	57.3	119	54.6	$\chi^2 = 4.26$
Occasionally	28	31.8	29	22.1	57	26.1	df = 3
Hardly ever	2	2.3	8	6.1	10	4.6	p = 0.235
Do not own or operate farm	14	15.9	18	13.7	32	14.7	
Missing	0	0.0	1	0.8	1	0.0	
Total	88	100.0	131	100.0	219	100.0	
While cleaning service alley how likely is your YP to be injured (in upcoming year)?							
Extremely likely	0	0.0	3	2.3	3	1.4	$\chi^2 = 5.989$
Very likely	0	0.0	0	0.0	0	0.0	df = 3
Somewhat likely	4	4.5	13	9.9	17	7.8	p = 0.112
A little likely	29	33.0	46	35.1	75	34.2	
Not at all likely	45	51.1	50	38.2	95	43.4	
Missing	10	11.4	19	14.5	29	13.2	
Total	88	100.0	131	100.0	219	100.0	
Level of adult supervision while YP cleans service alley							
YP does not do chore	8	9.1	17	13.0	25	11.4	$\chi^2 = 10.286$
Constant	1	1.1	10	7.6	11	5.0	df = 5
Nearly constant	9	10.2	22	16.8	31	14.2	p = 0.068
Intermittent	20	22.7	17	13.0	37	16.9	
Periodic	29	33.0	36	27.5	65	29.7	
No supervision	21	23.9	29	22.1	50	22.8	
Missing	0	0.0	0	0.0	0	0.0	
Total	88	100.0	131	100.0	219	100.0	

[a] Based on 85 boys and 120 girls with valid YP gender and PP age; SD = standard deviation of mean.

[b] Two-tailed p-value from t-test for equality of means, assuming equal variance.

Table 5. Minute-based non-skid shoe compliance rates by age, gender, and residence status.

Residence	Subgroup	Figure	n[a]	Mean (SD)[b]	Median	Min.	Max.	K-S Exact p-Value[c]
Any	Boys	1a	88	60.6 (44.3)	88.4	0.0	100.0	0.033*
	Girls	1a	139	46.2 (44.1)	34.1	0.0	100.0	
Farm	Boys	1b	62	56.3 (45.2)	73.3	0.0	100.0	0.418
	Girls	1b	79	47.2 (43.5)	36.3	0.0	100.0	
Non-farm	Boys	1c	25	69.7 (41.6)	95.6	0.0	100.0	0.033*
	Girls	1c	56	44.7 (45.2)	25.6	0.0	100.0	
Any[d]	yBoys	1d	23	48.4 (48.4)	63.4	0.0	100.0	0.556
	yGirls	1d	49	38.6 (43.7)	16.6	0.0	100.0	
	mBoys	1e	40	59.9 (42.0)	75.9	0.0	100.0	0.171
	mGirls	1e	39	45.1 (44.4)	38.2	0.0	100.0	
	oBoys	1f	25	72.8 (42.4)	100.0	0.0	100.0	0.046*
	oGirls	1f	50	53.3 (43.8)	64.3	0.0	100.0	
Farm[d]	yBoys	1g	17	36.1 (45.7)	0.0	0.0	100.0	0.545
	yGirls	1g	24	45.8 (46.5)	28.6	0.0	100.0	
	mBoys	1i	27	64.9 (41.8)	94.5	0.0	100.0	0.124
	mGirls	1i	24	45.7 (42.9)	49.1	0.0	100.0	
	oBoys	1k	18	62.2 (46.0)	89.6	0.0	100.0	0.351
	oGirls	1k	31	49.4 (43.1)	46.2	0.0	100.0	
Non-farm[d]	yBoys	1h	6	83.3 (40.8)	100.0	0.0	100.0	0.006*
	yGirls	1h	24	33.0 (41.0)	1.6	0.0	100.0	
	mBoys	1j	13	49.5 (42.0)	37.3	0.0	100.0	0.784
	mGirls	1j	13	44.2 (49.1)	6.2	0.0	100.0	
	oBoys	1l	6	100.0 (0.0)	100.0	100.0	100.0	0.019*
	oGirls	1l	19	60.1 (45.3	89.0	0.0	100.0	

[a] The number of boys cleaning a service alley at least once during follow-up period = 88 (61.1% of all boys in the study). The number of girls cleaning a service alley at least once during follow-up period = 139 (74.7% of all girls in the study).

[b] Group-level weighted mean, as described in the Methods section; SD = standard deviation of mean.

[c] The p-values are exact and based on two-sample K-S equality-of-distributions test. An asterisk (*) indicates significance at $\alpha = 0.05$.

[d] Subgroup prefix: y = youth <12.7 years, m = youth 12.7 to 14.7 years, o = youth >14.7 years.

youth, youth >14.7 years, non-farm youth <12.7 years, and non-farm youth > 14.7 years).

Ogives for non-skid shoe compliance are shown in figure 1. Note where each distribution intersects the abscissa. In figure 1a, for example, the intersection with the *x*-axis of the plotted line for boys (28.4%) indicates the percentage of boys reporting cleaning a service alley in a stall barn at least once and who reported *never* wearing non-skid shoes; the analogous intersection for girls occurs at 38.2%, meaning more than 38% of the girls who cleaned a service alley at least once during the 10-week data collection period reported that they *never* wore non-skid shoes. Among non-farm residents, boys had a mean compliance of 69.7% compared to 44.7% for girls; figure 1c shows the corresponding ogives (K-S p = 0.033). When age and gender were considered (ignoring farm residence status), mean (and median) compliance was higher among boys compared to girls (figs. 1d, 1e, and 1f). Only the comparison for the oldest boys versus the oldest girls was found to be statistically significant (means of 72.8%, 53.3%, respectively; see figure 1f for the ogive comparison, p = 0.046). No significant differences were observed after stratifying by gender and age among farm residents only. When considering non-farm residents, the youngest boys had higher non-skid shoe compliance compared to the youngest girls (83.3%, 33.0%, respec-

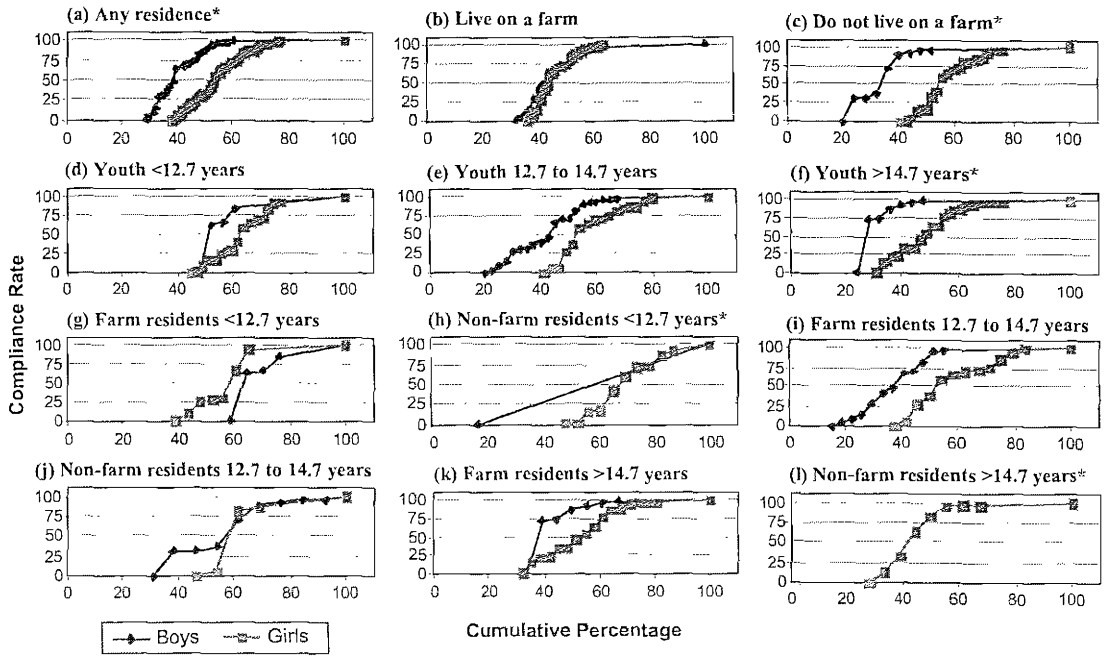

Figure 1. Non-skid shoe compliance ogives, by age, gender, and farm/non-farm residence (* indicates K-S p-value was <0.05).

tively), and the K-S test for the ogives representing these groups (fig. 1h) was significant ($p = 0.006$, table 5). The distributions comparing the oldest non-farm boys and girls were also significantly different ($p = 0.019$), with boys having a mean compliance rate of 100.0% compared to 60.1% among girls.

As described in the Methods section, compliance rates were grouped into five discrete categories (results not shown). Relatively high proportions of youth reported either *always* or *never* wearing non-skid shoes when cleaning service alleys in stall barns. Ignoring age, a higher percentage of boys reported always wearing non-skid shoes as compared to girls (39.8% and 23.5%, respectively). Similarly, a higher percentage of girls reported never wearing non-skid shoes as compared to boys (38.2% and 28.4%, respectively). After stratification by age tertile, the highest percentage of youth reporting 100% compliance was seen among the oldest boys (52.0%), followed by the youngest boys (39.1%), the middle-age boys (32.5%), the oldest girls (24.5%), the youngest girls (23.4%), and the middle-age girls (20.5%). However, the only non-skid shoes categorical compliance rate comparison by gender that was statistically significant was among the oldest boys ($\chi^2 = 9.893$, $df = 4$, $p = 0.048$).

Compliance with WP, Wearing Leather Gloves

Minute-based leather glove compliance descriptive statistics are presented in table 6. Overall, leather glove compliance rates were low, ranging from a mean of 20.7% (as reported by farm resident girls 12.7 to 14.7 years of age) to a mean of 0.0% (as reported by non-farm resident boys >14.7 years of age). The overall mean compliance rates were 9.9% for boys and 10.1% for girls. No statistically significant differences were observed in leather glove compliance while cleaning a service alley in a stall barn by farm/non-farm residence, gender, and age. The highest mean rate estimate for any subgroup was 20.7%, as noted above. However, farm resident boys re-

Table 6. Minute-based leather glove compliance rates by age, gender, and residence status.

Residence	Subgroup	Figure	n[a]	Mean (SD)[b]	Median	Min.	Max.	K-S Exact p-Value[c]
Any	Boys	2a	88	9.9 (25.8)	0.0	0.0	100.0	0.996
	Girls	2a	139	10.1 (26.9)	0.0	0.0	100.0	
Farm	Boys	2b	62	11.2 (27.3)	0.0	0.0	100.0	0.780
	Girls	2b	79	14.9 (32.7)	0.0	0.0	100.0	
Non-farm	Boys	2c	25	7.0 (22.6)	0.0	0.0	100.0	0.837
	Girls	2c	56	4.0 (14.6)	0.0	0.0	96.5	
Any[d]	yBoys	2d	23	3.6 (13.6)	0.0	0.0	63.2	0.938
	yGirls	2d	49	5.2 (20.7)	0.0	0.0	100.0	
	mBoys	2e	40	17.8 (35.0)	0.0	0.0	100.0	0.816
	mGirls	2e	39	15.3 (33.9)	0.0	0.0	100.0	
	oBoys	2f	25	2.9 (8.0)	0.0	0.0	35.6	0.475
	oGirls	2f	50	11.0 (25.8)	0.0	0.0	100.0	
Farm[d]	yBoys	2g	17	3.7 (15.3)	0.0	0.0	63.2	0.584
	yGirls	2g	24	8.8 (28.8)	0.0	0.0	100.0	
	mBoys	2i	27	20.6 (37.1)	0.0	0.0	100.0	0.995
	mGirls	2i	24	20.7 (38.0)	0.0	0.0	100.0	
	oBoys	2k	18	4.1 (9.3)	0.0	0.0	35.6	0.496
	oGirls	2k	31	14.9 (31.0)	0.0	0.0	100.0	
Non-farm[d]	yBoys	2h	6	3.2 (7.9)	0.0	0.0	19.3	0.888
	yGirls	2h	24	1.8 (6.3)	0.0	0.0	28.6	
	mBoys	2j	13	12.0 (30.6)	0.0	0.0	100.0	1.000
	mGirls	2j	13	7.7 (26.7)	0.0	0.0	96.5	
	oBoys	2l	6	0.0 (0.0)	0.0	0.0	0.0	0.698
	oGirls	2l	19	4.2 (9.9)	0.0	0.0	32.0	

[a] The number of boys cleaning a service alley at least once during follow-up period = 88 (61.1% of all boys in this study). The number of girls cleaning a service alley at least once during follow-up period = 139 (74.7% of all girls in this study).

[b] Group-level weighted mean, as described in the Methods section; SD = standard deviation of mean.

[c] The p-values are exact and based on two-sample K-S equality-of-distributions test.

[d] Subgroup prefix: y = youth <12.7 years, m = youth 12.7 to 14.7 years, o = youth >14.7 years.

ported a mean compliance of 11.2%, while non-farm resident boys reported a mean of 7.0%. Similarly, farm resident girls had a mean compliance rate of 14.9%, compared to 4.0% for non-farm resident girls. In addition, youth 12.7 to 14.7 years of age had higher compliance rates compared to the youngest and oldest youth (table 6, any residence).

Results from the leather glove compliance analysis were summarized by the five discrete categories of compliance described above. Results indicated that the low mean leather glove compliance rates were largely explained by the high proportion of youth who reported never being in compliance. Specifically, 80.7% of boys who reported cleaning service alleys in stall barns *never* wore leather gloves while working this chore. A similar percentage of girls reported *never* wearing leather gloves (79.4%). None of the χ^2 tests applied to the categorical comparisons by gender were statistically significant. The low compliance is also apparent from the ogives given in figure 2.

Compliance with WP, Wearing Eye Protection

In general, eye protection usage was even lower than that reported for wearing leather gloves. Table 7 summarizes selected descriptive statistics for this WP's compliance rates, along with K-S p-values for the ogive comparisons (fig. 3). Overall, the

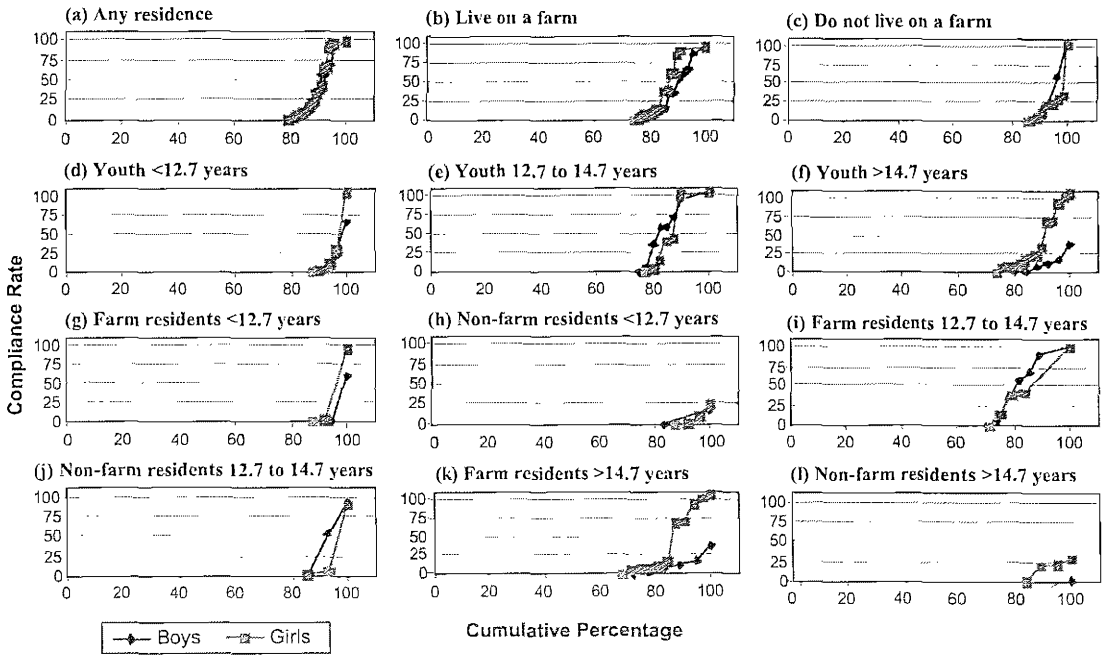

Figure 2. Leather glove compliance ogives, by age, gender, and farm/non-farm residence.

Table 7. Minute-based eye protection compliance rate by age, gender, and residence status.

Residence	Subgroup	Figure	n[a]	Mean (SD)[b]	Median	Min.	Max.	K-S Exact p-Value[c]
Any	Boys	3a	88	3.6 (16.4)	0.0	0.0	100.0	0.379
	Girls	3a	139	2.0 (12.3)	0.0	0.0	100.0	
Farm	Boys	3b	62	0.7 (5.2)	0.0	0.0	41.0	0.862
	Girls	3b	79	0.3 (2.0)	0.0	0.0	16.9	
Non-farm	Boys	3c	25	10.9 (28.8)	0.0	0.0	100.0	0.191
	Girls	3c	56	4.4 (19.2)	0.0	0.0	100.0	
Any[d]	yBoys	3d	23	4.3 (20.9)	0.0	0.0	100.0	0.932
	yGirls	3d	49	2.7 (14.8)	0.0	0.0	100.0	
	mBoys	3c	40	4.7 (18.3)	0.0	0.0	100.0	0.744
	mGirls	3e	39	3.0 (16.2)	0.0	0.0	100.0	
	oBoys	3f	25	1.1 (4.8)	0.0	0.0	24.0	0.931
	oGirls	3f	50	0.5 (2.6)	0.0	0.0	16.9	
Farm[d]	yBoys	3g	17	0.0 (0.0)	0.0	0.0	0.0	1.000
	yGirls	3g	24	0.1 (0.3)	0.0	0.0	1.4	
	mBoys	3i	27	1.5 (7.9)	0.0	0.0	41.0	1.000
	mGirls	3i	24	0.0 (0.0)	0.0	0.0	0.0	
	oBoys	3k	18	0.2 (0.7)	0.0	0.0	2.9	0.434
	oGirls	3k	31	0.8 (3.2)	0.0	0.0	16.9	
Non-farm[d]	yBoys	3h	6	16.7 (40.8)	0.0	0.0	100.0	0.888
	yGirls	3h	24	5.4 (21.0)	0.0	0.0	100.0	
	mBoys	3j	13	11.4 (29.7)	0.0	0.0	100.0	1.000
	mGirls	3j	13	8.9 (27.7)	0.0	0.0	100.0	
	oBoys	3l	6	4.0 (9.8)	0.0	0.0	24.0	0.250
	oGirls	3l	19	0.0 (0.0)	0.0	0.0	0.0	

[a] The number of boys cleaning a service alley at least once during follow-up period = 88 (61.1% of all boys in this study). The number of girls cleaning a service alley at least once during follow-up period = 139 (74.7% of all girls in this study).

[b] Group-level weighted mean, as described in the Methods section; SD = standard deviation of mean.

[c] The p-values are exact and based on two-sample K-S equality-of-distributions test.

[d] Subgroup prefix: y = youth <12.7 years, m = youth 12.7 to 14.7 years, o = youth >14.7 years.

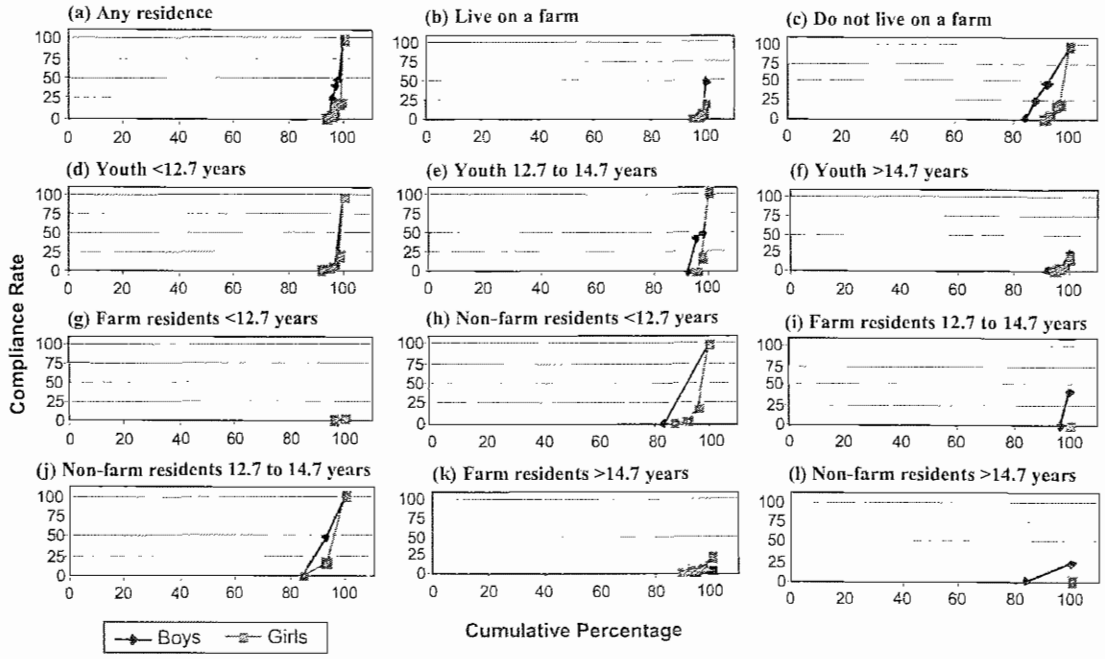

Figure 3. Eye protection compliance ogives, by age, gender, and farm/non-farm residence.

mean compliance rates were 3.6% for boys and 2.0% for girls ($p > 0.05$). Stratification by farm residence, gender, and/or age yielded no statistically significant ogive contrasts. Mean compliance rates ranged from 0.0% to a high of only 16.7% (among the young non-farm boys).

Our analyses also indicated that 93.2% of boys and 93.4% of girls reported *never* wearing eye protection when cleaning a service alley in a stall barn (fig. 3). Of the 22 youngest boys who reported working the chore, only one (4.3%) reported ever wearing eye protection; only 4 (8.5%) of the youngest girls reported ever wearing eye protection. Similarly, 3 (7.5%) of the middle-age boys reported ever wearing eye protection, and only 2 (5.2%) of the middle-age girls reported using any type of eye protection. The numbers for the oldest youth were 2 (8.0%) boys and 3 (6.1%) girls. None of the χ^2 tests for the categorical comparisons by gender were significantly different. The very low compliance rates are shown graphically in figure 3.

Compliance with WP, Wearing a Respirator

Selected descriptive statistics (along with K-S exact p-values for the ogive comparisons) for the minute-based respirator compliance rates are given in table 8. The mean rates are very low (≤2.4% in any subgroup considered). The estimated mean rates were 0.8% for all boys combined and 0.6% for all girls. The ogives for the gender, age, and/or farm residence comparisons are presented in figure 4. None of the comparisons are statistically different (see K-S p-values in table 8). With respect to the grouped compliance rates, it was found that 94.3% of boys and 96.3% of girls reported *never* wearing a respirator. Not a single youth reported 100% compliance, and only 10 youth reported having ever worn a respirator while cleaning a service alley in a stall barn. Not surprisingly, none of the χ^2 tests for the categorical comparisons by gender were statistically significantly different.

Table 8. Minute-based respirator compliance rates by age, gender, and residence status.

Residence	Subgroup	Figure	n[a]	Mean (SD)[b]	Median	Min.	Max.	K-S Exact p-Value[c]
Any	Boys	4a	88	0.8 (3.6)	0	0	24.1	0.478
	Girls	4a	139	0.6 (4.2)	0	0	43.6	
Farm	Boys	4b	62	0.6 (3.3)	0	0	24.1	0.966
	Girls	4b	79	0.7 (5)	0	0	43.6	
Non-farm	Boys	4c	25	1.2 (4.4)	0	0	19.9	0.234
	Girls	4c	56	0.4 (3)	0	0	21.9	
Any[d]	yBoys	4d	23	0 (0)	0	0	0	1.000
	yGirls	4d	49	0.9 (6.4)	0	0	43.6	
	mBoys	4c	40	1.6 (5.2)	0	0	24.1	0.423
	mGirls	4c	39	0.6 (3.5)	0	0	21.9	
	oBoys	4f	25	0.1 (0.6)	0	0	2.9	0.698
	oGirls	4f	50	0.3 (1.3)	0	0	7.9	
Farm[d]	yBoys	4g	17	0 (0)	0	0	0	1.000
	yGirls	4g	24	1.9 (9.1)	0	0	43.6	
	mBoys	4i	27	1.2 (4.9)	0	0	24.1	0.492
	mGirls	4i	24	0 (0)	0	0	0	
	oBoys	4k	18	0.2 (0.7)	0	0	2.9	0.697
	oGirls	4k	31	0.5 (1.7)	0	0	7.9	
Non-farm[d]	yBoys	4h	6	0 (0)	0	0	0	1.000
	yGirls	4h	24	0 (0)	0	0	0	
	mBoys	4j	13	2.4 (6.1)	0	0	19.9	1.000
	mGirls	4j	13	1.7 (6.1)	0	0	21.9	
	oBoys	4l	6	0 (0)	0	0	0	1.000
	oGirls	4l	19	0 (0)	0	0	0	

[a] The number of boys cleaning a service alley at least once during follow-up period = 88 (61.1% of all boys in this study). The number of girls cleaning a service alley at least once during follow-up period = 139 (74.7% of all girls in this study).

[b] Group-level weighted mean, as described in the Methods section; SD = standard deviation of mean.

[c] The p-values are exact and based on two-sample K-S equality-of-distributions test.

[d] Subgroup prefix: y = youth <12.7 years, m = youth 12.7 to 14.7 years, o = youth >14.7 years.

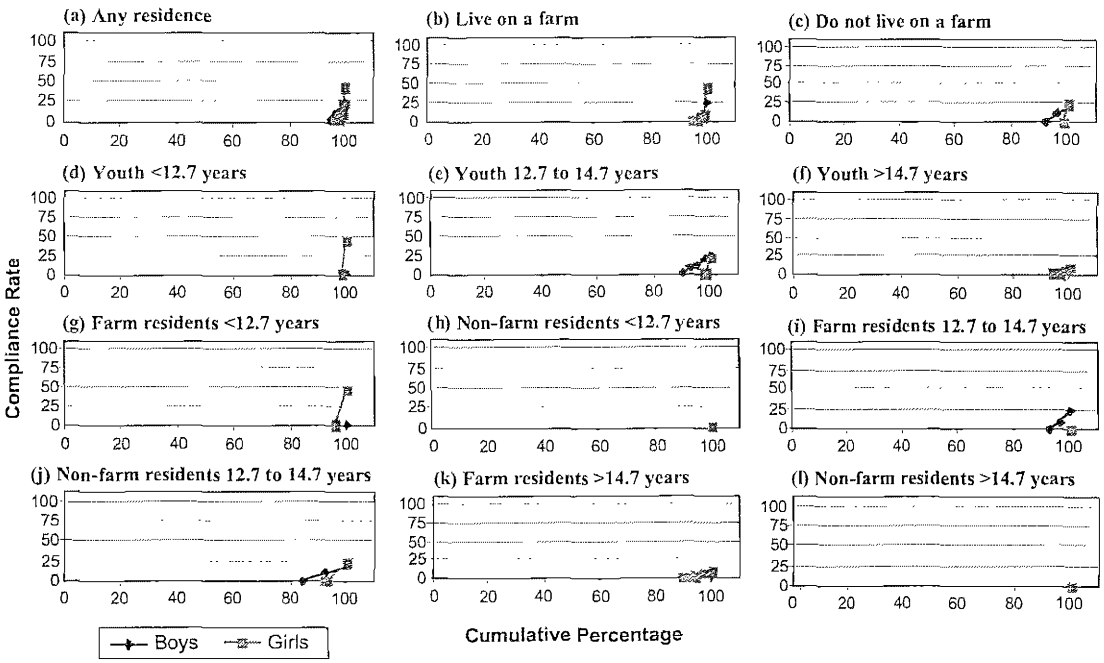

Figure 4. Respirator compliance ogives, by age, gender, and farm/non-farm residence.

Discussion

It is troubling to see such poor compliance with the WPs suggested by the NAGCAT among youth who reported cleaning a service alley in a stall barn in this study. It could be argued that these results are not entirely unexpected. For example, a study by Reed et al. (2006) found that children working on farms had relatively low PPE use when performing agricultural chores. Among youth in the present study who reported cleaning a service alley in a stall barn at least once, wearing non-skid shoes was the most commonly reported NAGCAT WP, although the overall mean non-skid shoes compliance rates were 60.6% for boys and 46.2% for girls. The other three NAGCAT WPs considered (wearing leather gloves, eye protection, or a respirator) were much less frequently reported (for example, about 80% of boys and girls reported *never* wearing leather gloves). Further, more than 93% of boys and girls reported never wearing eye protection or a respirator when cleaning a service alley in a stall barn. Non-skid shoe compliance was better, although roughly one-third of the youth in this study reported never wearing non-skid shoes; on the other hand, 39.8% of boys and 23.5% of girls reported always being in compliance.

When cleaning service alley floors in a stall barn, youth are often confronted with slippery or uneven surfaces and the associated risk of slips, trips, and falls. This risk can be reduced by wearing non-skid shoes and, as evidenced by the results presented here, there is a disconcerting lack of compliance with this WP. Another hazard exists when working in the often dusty environment in a stall barn. In addition to airborne dust, particulates on the floor and in animal bedding may become airborne during the cleaning task, leading to potentially hazardous air conditions. Wearing a properly fitting respirator is a potentially effective method for reducing the mass of inhaled particulates, although in this study there was very low compliance with this guideline (94.3% of boys and 96.3% of girls reported never wearing a respirator). Recent publications suggest that the lung disorders that may disproportionately affect adult farmers (and other agricultural workers) might have their origin in the first or second decades of life (Grigg, 2009; Martinez, 2009; Miller and Marty, 2010; Soto-Martinez and Sly, 2010), underscoring the importance of minimizing early-life exposures to respiratory hazards.

Wearing leather gloves and wearing eye protection also have potential safety benefits, yet these WPs were also rarely followed. At baseline, youth indicated in a self-administered questionnaire the types of safety training they had received in the past. Among previous safety training relevant to cleaning a stall barn (proper lifting, proper use of respirator, and proper chemical handling), only proper chemical handling was different between boys and girls, with a greater proportion of girls reporting having had this training. However, this did not translate into higher WP compliance among girls, suggesting that simply providing training at a discrete point in time (with no additional training) is a relatively weak approach to changing safety behavior.

Overall, boys exhibited higher non-skid shoe compliance compared to girls ($p < 0.05$; table 5 and fig. 1a). A similar gender difference in PPE use by youth working on farms was reported by Reed et al. (2006), where girls were found generally less likely to use PPE. Reed et al. (2006) argued that this may be explained by the nature of the chores assigned and performed, and the familiarity of youth with the equipment they operate. In a study of North Carolina teens, Schulman et al. (1997) reported that boys were more likely than girls to perform more hazardous chores (work with a combine

or power take-off device) and use dangerous equipment like a chain saw. Similarly, our results indicate that boys were more likely to report a history of engaging in dangerous or risky activities (table 3). It thus makes sense that those youth who are exposed to the most dangerous tasks would perhaps be more likely to wear PPE or follow suggested safety practices. Our results also show that a greater proportion of boys lived on a farm compared to girls, suggesting that perhaps farm residence plays some role in the use and/or availability of PPE. However, mean WP compliance rates were not generally higher for farm residents. It is also feasible that living on a farm causes the risks associated with agricultural work to be perceived as less threatening. This may explain why several of our gender/age comparisons reveal higher compliance rates among non-farm residents (tables 5 through 8).

Although the results of the present study focus on only one NAGCAT-defined chore, there are aspects of this chore that might be perceived as more or less hazardous, thus resulting in differential assignment by caregivers or other adults to boys compared to girls. For example, in the NAGCAT, there are several common tasks listed as components of the chore under consideration: sweeping the alley, lifting a bag of lime, pouring the lime into a spreader, pushing the spreader, and operating the dispersal component of the spreader. Some parents and caregivers might consider lifting a heavy bag of lime and operating the spreader to be relatively risky and might therefore assign this chore more frequently to boys. Girls might be more likely assigned to seemingly lower-risk tasks, such as sweeping or scraping the service alley. It follows that boys, who may perform riskier work, might therefore be more likely to use non-skid shoes or leather gloves. As Reed et al. (2006) posited, as compared to boys, girls may have lower access to farm safety information (Leckie, 1996; Schulman et al., 1997), may work chores that require relatively less PPE, and may have reduced access to PPE. In addition, girls may find PPE more uncomfortable (or ill-fitting) than boys.

Youth age appears to have some effect on WP compliance, although this was only evident for wearing non-skid shoes. Too few youth reported engaging in the other WPs to allow meaningful stratification by age. Boys had higher non-skid shoe compliance compared to girls, although the only statistically significant difference was seen in the oldest age tertile contrast. Within-gender comparisons revealed that the older boys and girls had the highest minute-based non-skid shoe compliance compared to the other ages. Similarly, the youngest boys and girls had the lowest mean non-skid shoe compliance. The reason for this might be related to the specific subset of all possible chores assigned to youth of different ages. If it can be assumed that riskier chores are assigned more often to older youth, perhaps those types of chores explain why older youth engage in safety practices more frequently. The higher WP compliance among the older youth may be a product of maturity, i.e., older youth may simply be more likely to recognize the risks associated with the chore.

Limitations of the study should be acknowledged. First, it was assumed that youth who reported compliance with any specific WP were in compliance the entire duration that they reported working a chore on any given day. The assumption that participating youth followed the NAGCAT-recommended WPs the whole time while cleaning a service alley in a stall barn is not, in our opinion, particularly unreasonable. For example, it seems unlikely that youth who reported wearing non-skid shoes while cleaning a service alley in a stall barn would remove them during the work session. Although it may be more likely that youth would remove leather gloves, eye protection, and/or a

respirator while working, it seems reasonable to assume that such WPs were followed the whole time while working the chore, especially since the chore durations are on the order of about 1/2 hour per day (table 2). Further, even if youth did fail to follow the suggested WPs throughout the duration of this particular chore, this indicates even worse compliance than what we have already reported here.

It should be mentioned that a discrepancy exists in the number of PPs who reported that their YP does not clean service alleys in stall barns (table 4) and the number of YPs who reported that they do work this chore. For the 227 youth who reported cleaning a service alley in a stall barn, 219 of their PPs completed a baseline questionnaire in which the PPs indicated their frequency of supervision. Of these 219 PPs, 25 (11.4%) indicated that their YP does not work the chore. This suggests that these parents and caregivers may be unaware of what chores the youth on their farm are working, or that some parents and caregivers and some YPs differ in their understanding of what "cleaning service alleys in stall barns" means.

Another issue that should be addressed is the use of the K-S equality of distributions test when examining differences in the compliance rate ogives. The K-S p-value approximations are conservative and tend to be unreliable with small sample sizes. The K-S test is not considered to be very powerful in detecting differences in the tails of distributions but is effective when evaluating an alternate hypothesis involving clustering in the data (Stata, 2003).

Bearing in mind that not all PPs received the in-home intervention (62.7% did), the singular finding worth emphasizing is that youth ages 9 to 17, in general, are not following WPs as recommended in the NAGCAT when cleaning service alleys. An article that describes compliance by study group (i.e., by intervention versus control) is currently in preparation. As suggested in a childhood farm work study examining the effect of parents' perceptions of risks and the use of the NAGCAT, it could be the case that voluntary safety guidelines are unlikely to be effective (Zentner et al., 2005). In the present study, the highest WP compliance was for wearing non-skid shoes, but the mean compliance rates were only 60.6% for boys and 46.2% for girls. Further, the poor compliance vis-à-vis the other three WPs is quite troubling and therefore deserves further investigation. Hopefully, more effective risk communication messages can be delivered in the future to youth and parents who work on farms (in addition to other potentially influential members of the agricultural community). If youth who are exposed to agricultural hazards can be persuaded to use proper PPE (and comply with effective safety behaviors) when working in agriculture, then the unacceptable burden associated with childhood agricultural injuries may be significantly reduced, which is a worthy goal.

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