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Risk-Accepting Personality and Personal Protective Equipment Use within the Agricultural Health Study

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Abstract

Pesticide exposures can be reduced by use of personal protective equipment as well as proper mixing and application practices. We examined the effects of risk-accepting personality on personal protective equipment (PPE) use and mixing and application practices among private pesticide applicators and their spouses within the Agricultural Health Study (AHS) in Iowa and North Carolina and commercial applicators in Iowa. The AHS follow-up questionnaire included four questions designed to assess attitudes toward risk. Analysis was limited to those who were currently working on a farm or registered as a commercial applicator and indicated current pesticide use (n=25,166). Respondents who answered three or more questions in the affirmative (private applicators: n=4,160 (21%); commercial applicators: n=199 (14%); spouses: n=829 (23%)) were classified as having a risk-accepting personality. Logistic regression was used to evaluate specific work practices associated with risk-accepting attitudes. Among private applicators, the likelihood of using any PPE when mixing or loading pesticides was lower among risk-acceptors compared to risk-averse individuals (odds ratio (OR) = 0.72; 95% Confidence Interval (CI): 0.65 – 0.79). A similar relationship was observed among commercial applicators (OR = 0.77, 95% CI: 0.34 – 1.77) but not among spouses (OR = 1.09, 95% CI: 0.90 – 1.33). Among private applicators, risk-acceptors were more likely than the risk-averse to apply pesticides within 50 ft of the home (OR=1.21; 95% CI: 1.01 – 1.44), compared to further than ¼ mile. Our findings suggest that the decisions to use personal protective equipment and properly handle/apply pesticides may be driven by risk-accepting personality traits.

Keywords

personal protective equipment; risk-accepting behavior; Agricultural Health Study; pesticide

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INTRODUCTION

Evidence suggests agricultural pesticide exposures may be risk factors for a variety of acute and chronic diseases, including several cancers.¹⁻³ In addition to machinery and other engineered control devices, a common way for an individual to reduce pesticide exposures is by wearing special clothing or equipment known as personal protective equipment (PPE), when mixing, loading and applying pesticides.⁴⁻⁵ PPE includes equipment such as chemically resistant gloves and coveralls, face shields, safety goggles and respirators. For example, significant decreases in organophosphorus pesticide exposures, as measured by urinary metabolites, have been reported among individuals who used PPE compared to those who did not use PPE, and use of multiple forms of PPE have been found to further reduce measured exposures.⁵ Similarly, reduced captan exposures have been observed with use of chemically resistant PPE.⁶ Beyond direct handling of pesticides, exposure may also result from routes such as pesticide drift during application, windblown dust containing pesticide residue, pesticide residues on clothing brought into the home, and diet.⁷

PPE usage rates among applicators are low in some populations despite the effectiveness of proper PPE use in reducing exposures.⁸⁻¹⁰ There are many factors associated with the decision to use PPE. Increasing training and knowledge of pesticide safety can be beneficial in encouraging PPE usage.¹¹⁻¹³ However the costs associated with PPE can be a mitigating factor.^{9, 14} Other factors associated with decisions to use PPE include presence of health problems,^{8, 15} perception of the effectiveness of PPE,^{13, 16} workplace initiatives⁷ and social norms.^{15, 17}

Additionally, rates of PPE usage are higher among younger applicators,^{11, 18-20} perhaps due to greater perception and/or knowledge of risks from pesticides.²¹ Indeed, several studies have found perception of risk from pesticide exposure to be positively associated with use of PPE,^{9, 19} although there have been other findings suggesting PPE use is not associated with risk perception.¹³ Based on the findings of risk perception and PPE use we sought to investigate whether risk-accepting personality traits would affect an individual's use of PPE or handling of pesticides. One aspect of pesticide handling, incidents of high pesticide exposure events, has previously demonstrated an association with risk accepting behavior.²² In this study, we defined risk-accepting personality traits among participants in the Agricultural Health Study (AHS), a large cohort of licensed pesticide applicators and their spouses. We then analyzed differences in PPE use as well as chemical storage, mixing, loading and application practices between participants with risk-accepting personalities compared to risk-averse individuals.

METHODS

Study population

The AHS is a prospective cohort of 52,394 licensed private pesticide applicators, 32,346 spouses of these applicators in Iowa and North Carolina and 4,916 commercial applicators in Iowa. The AHS cohort has been described in detail previously.²³ Participants were enrolled from 1993 through 1997. Applicators completed a self-administered enrollment questionnaire that included information on demographic profiles, agricultural practices, and pesticide use. Spouses completed a questionnaire sent home with the applicator. Eighty-two percent of applicators seeking pesticide licenses in either state were successfully recruited as were 75% of spouses. A 5-year follow-up phone interview (Phase II) was completed by 33,457 (64%) private applicators, 23,796 (74%) spouses and 2,885 (59%) commercial applicators from 1999 through 2005. The Phase II questionnaire, which can be accessed at <http://aghealth.nci.nih.gov/questionnaires.html>, included information on PPE use, chemical storage, mixing and application practices, types of pesticide application equipment, and farm

acreage. Informed consent was implied by completion of the questionnaire and the protocol was approved by the institutional review boards of all institutions involved in this research (i.e, National Institutes of Health and its contractors).

Risk accepting personality assessment

In this study the concept of risk-accepting personality refers to the propensity of an individual to seek out or engage in behaviors that are dangerous or harmful, i.e. “risky” behaviors. Four statements, derived from Harrell,²⁴ designed to assess attitudes towards risk were included on the AHS Phase II questionnaire. Respondents were asked to state whether they agreed or disagreed with the following statements; Question 1: “Farming [commercial pesticide work] is more dangerous than jobs in industry or manufacturing”, Question 2: “Accidents are just one of the occupational hazards of farming [commercial pesticide work] that must be accepted if you are going to be in the business”, Question 3: “During a normal work week [as a commercial pesticide worker] it’s common for me, while doing farm work, to experience a number of ‘close calls’ that under different circumstances might have resulted in personal injury or property loss”, and Question 4: “To make a profit [to perform a job], most farmers [commercial pesticide workers] take risks that might endanger their health”. A previous assessment of risk-accepting behavior conducted in this cohort²² considered agreement with three or more of these statements to be indicative of risk-accepting personality. Using this criteria, we identified 5,188 individuals with risk-accepting personality. Respondents who answered fewer than three questions in the affirmative (n=19,978) were not considered to have a risk-accepting personality. Only respondents currently engaged in farming activities or registered as commercial applicators were asked about their attitudes toward risk in the Phase II questionnaire. Participants who completed a Phase II questionnaire and not working on a farm or registered as a commercial applicator at the time of the Phase II questionnaire (n=20,000), not currently handling pesticides (n=7,798) and for which a determination of risk-accepting behavior could not be made, i.e. refused or responded “don’t know” to multiple questions (n=7,174), were excluded.

Data analysis

Analysis was restricted to participants for whom a determination of risk-accepting personality could be made (n=25,166). Logistic regression analysis, rather than simple reporting of percentages, was used to calculate odds ratios (OR) and 95% confidence intervals (95% CI) describing the differences in PPE use and chemical storage/mixing/loading/application practices between risk-accepting and risk-averse individuals. This method of analysis allowed us to investigate potential confounding factors. An OR above 1.00 represents an increased likelihood of engaging in a protective behavior. Many types of PPE and chemical handling practices were considered for inclusion; yes/no response to any PPE use, glove type used (chemically resistant vs non-chemically resistant), chemically resistant boots, chemically resistant coveralls, face shield, and use of respirator. Distances from home or drinking water wells that pesticides were applied or mixed/loaded were also investigated. We also examined use of two or more chemically resistant forms of PPE (affirmative response to ≥ 2 questions regarding chemically resistant PPE vs. affirmative response to < 2 questions regarding chemically resistant PPE), as well as use of chemically resistant and/or waterproof (e.g. rubber or plastic) gloves plus ≥ 1 other form of chemically resistant PPE and use of chemically resistant and/or waterproof gloves plus ≥ 2 other form of chemically resistant PPE.

Analyses examining PPE use during pesticide application was limited to participants who did not indicate use of a vehicle with an enclosed cab (n=14,111). In all multivariate models, we adjusted for farm acreage (0, 1-144, 145-380, 381-775, >775), education (<high school graduate, high school graduate/GED, >high school, something else, missing), gender, age

and state of pesticide license. Farm acreage was calculated as the sum of reported crop acres at the time of the Phase 2 interview. All *p*-values were 2-sided and ORs and 95% CIs were calculated using SAS statistical software version 9.1 (SAS Institute, Inc., Cary, North Carolina). AHS data releases P1REL201005.00, P2REL201007.00 and AHSREL201004.00 were used to conduct all analyses.

RESULTS

A total of 25,166 participants provided information on risk-accepting behavior; of these 5,188 (21%) were classified as having a risk-accepting personality (Table 1). The highest proportion of participants with risk-accepting personality traits were found among private applicators (21% overall, 21% IA, 20% NC), followed by spouses (23% overall, 23% IA, 20% NC), and the lowest proportion was among commercial applicators (14%). A risk-accepting classification could be made for both members of an applicator/spouse pair in only a few cases (*n*=118), due to the small number of spouses currently applying pesticides. Among these applicator/spouse pairs, 27% of applicators classified as having a risk accepting personality were also married to a risk acceptor. Characteristics of participants are shown in Table 1. Fewer risk-acceptors were never smokers compared to the risk averse. Risk-acceptors also tended to be older and less educated. No differences in alcohol use were observed between risk-acceptors and risk-averse individuals.

Unadjusted OR's and 95% CI's for differences in PPE use and chemical mixing/application practices between risk-acceptors and risk-averse individuals are presented in Table 2. Adjustment for potential confounding factors had little effect on estimated OR's (supplemental Table 1). Among private applicators, risk-acceptors were less likely to use any PPE when mixing or loading pesticides (OR = 0.72, 95% CI: 0.65–0.79), compared to risk-averse individuals. Due to a small sample size there was decreased power to detect differences among commercial applicators compared to private applicators. However, OR's for any PPE use among commercial applicators were observed to be of similar magnitude and direction as those calculated among private applicators. We did not observe any differences in the use of any PPE when mixing/loading or applying between risk-acceptors and the risk-averse among spouses. Among both private and commercial applicators, risk-acceptors were less likely than risk-averse individuals to wear chemically resistant boots when applying (OR=0.79, 95% CI: 0.68–0.92 and OR=0.51, 95% CI: 0.29–0.91, respectively) and mixing/loading pesticides (OR=0.87, 95% CI: 0.79–0.97 and OR=0.70, 95% CI: 0.51–0.96, respectively). Risk-acceptors among private applicators were less likely to wear chemically resistant or waterproof gloves when mixing/loading (OR=0.75, 95% CI: 0.60–0.93), compared to other glove types (e.g. fabric or leather).

Comparisons of single types of PPE use, such as chemically resistant gloves, do not account for the fact that participants who may not use one type of PPE, e.g. chemically resistant gloves, may be using other types of PPE. Thus, we also investigated the use of multiple forms of PPE (chemically resistant/waterproof gloves and chemically resistant boots, coveralls, face shield and respirator). Risk-acceptors among private and commercial applicators were less likely to use two or more types of PPE while mixing or loading, compared to risk-averse individuals. Among private applicators, risk-acceptors were also less likely to use multiple forms of PPE when applying (OR=0.80, 95% CI: 0.71–0.92) and mixing/loading (OR=0.86, 95% CI: 0.79–0.93), compared to the risk-averse. A similar pattern was observed among commercial applicators. Risk-acceptors were less likely to wear chemically resistant/waterproof gloves and at least one other piece of PPE compared to risk-averse individuals among private applicators when applying (OR = 0.76, 95% CI: 0.66–0.89) and among private and commercial applicators when mixing/loading (OR = 0.92, 95% CI: 0.84–1.00 and OR = 0.65, 95% CI: 0.47–0.89, respectively). No differences in the use of

multiple forms of PPE were observed among risk-accepting spouses, compared to risk-averse spouses (Table 2).

Risk-accepting private applicators, were more likely than risk-averse private applicators to have their drinking water well located within 50 feet of the closest pesticide mixing/loading area (OR = 1.63, 95% CI: 1.27–2.08), compared to the closest pesticide mixing/loading area being ¼ mile from a drinking water well (Table 3). After adjustment, there was also some evidence that risk-accepting private applicators, were more likely than risk-averse private applicators to have the closest field/orchard on which pesticides were mixed/loaded be within 50 ft of the home (OR = 1.21, CI: 1.01 – 1.44), compared to the closest field/orchard being >1/4 mile from the home (Table 3).

Farming activities, in terms of types of crops and animals farmed, differ between Iowa and North Carolina.²³ In addition, there may be occupational and cultural differences between the states which we were unable to measure entirely. Therefore, we conducted analyses stratified by state. We observed similar patterns of PPE use and pesticide handling practices among risk - acceptors compared to risk-averse in both Iowa and North Carolina (results not shown).

We investigated which of the questions designed to assess attitude towards risk were most discriminating in classifying personality traits among all participants currently using pesticides (Table 4). Question 3: “During a normal work week [as a commercial pesticide worker] it’s common for me, while doing farm work, to experience a number of ‘close calls’ that under different circumstances might have resulted in personal injury or property loss” and Question 4: “To make a profit [to perform a job], most farmers [commercial pesticide workers] take risks that might endanger their health”, were most discriminating in classifying risk-accepting personality type. A small proportion of risk-averse individuals responded to Question 3 or Question 4 in the affirmative, 5% and 17% respectively. By comparison, 61% of risk-acceptors answered Question 3 in the affirmative, whereas 87% of risk-acceptors answered Question 4 in the affirmative. Rates of informative responses to each question among all current farmers (private applicators and spouses) and current commercial applicators (n=32,340) were similar, between 75% and 77%.

DISCUSSION

Use of PPE is an important factor in reducing pesticide exposure.^{4–5} Despite the effectiveness of proper PPE use in reducing pesticide exposures, only a small proportion of applicators in some populations use all required PPE.^{8–10} Decisions to use PPE may be based a variety of factors including; social norms, perceived effectiveness, experiencing of pesticide related health problems, safety training, cost and perception of risk^{11, 15–16, 19} as well as PPE requirements of specific chemicals and comfort (e.g. heat stress). Our study found that an individual’s personality, specifically risk-accepting personality traits, may also influence PPE use and chemical storage/mixing/loading/application practices. To our knowledge, this is the first study to examine differences in use of specific PPE and chemical storage/mixing/loading/application practices by indicators of risk-accepting behavior.

Risk-accepting private applicators were less likely to use any PPE when mixing/loading pesticides compared to risk-averse private applicators. They were also more likely to apply pesticides to a field/orchard in close proximity to their home and mix/load pesticides in close proximity to their drinking water well. Previous research has noted greater use of PPE while mixing pesticides than while applying pesticides.¹¹ Use of chemically resistant/waterproof gloves, the most commonly used form of PPE in this cohort, was also lower during mixing/loading among risk-accepting private applicators compared to the risk-averse.

Use of less common PPE, chemically resistant boots and coveralls, as well as use of multiple forms of PPE were lower among risk-accepting private applicators during both mixing/loading and application of pesticides. Our findings indicate that while PPE use may be generally higher during mixing procedures, PPE use is still relatively lower among those with a risk-accepting personality.

Differences in the use of PPE between risk-accepting and risk-averse commercial applicators exhibited similar patterns as those observed among private applicators; however, in a few circumstances differences in use of PPE, such as any PPE when mixing/loading, did not reach statistical significance ($\alpha = 0.05$) among commercial applicators. Although there were a smaller number of commercial applicators than private applicators in our sample the distinction between private and commercial applicators may also account for this observation as workplace provisions and supervision have been found to be instrumental in the promotion of safety behaviors.⁷ Commercial applicators are “employed by pest control companies or businesses that use pesticides”²³ whereas private applicators are working on their own farm. Commercial applicators, because they work for a company, may have greater access to PPE compared to private applicators. Additionally, chemical safety training and knowledge of pesticide safety, which may be more prevalent among commercial applicators, have also been associated with increased PPE use.^{11, 13}

Our findings are not sufficient to suggest risk-acceptors are not concerned with safety or health hazards associated with pesticides; however, the results do suggest that the manner in which risk-acceptors handle pesticides may differ from risk averse individuals. This may be due to risk-acceptors perception and attitudes about the dangers posed by pesticides. Some previous studies have found risk perception associated with PPE use.^{9, 19} Other research noted only a weak association between risk perception and PPE use.¹⁷

It should be noted that use of engineering controls in pesticide application, which may limit the need for PPE, was not fully captured in AHS questionnaires. We attempted to address this issue by limiting our analysis of PPE during application to participants who did not indicate use of a pesticide application vehicle with an enclosed cab. In addition, use of specific chemicals is not uniform among all applicators and spouses. This is significant because PPE requirements vary by chemical. Additionally, questions regarding use of PPE were not pesticide specific. Therefore we lacked the ability to assess whether nonuse of PPE was due to the fact that PPE was not required for a specific pesticide an individual was handling. However, we did not observe an association between risk accepting personality and type of pesticides used (results not shown). Therefore, confounding due to use of certain chemicals is unlikely in our analyses.

Of the four questions used to assess attitudes towards risk, Question 3: “During a normal work week it’s common for me, while doing farm work, to experience a number of ‘close calls’ that under different circumstances might have resulted in personal injury or property loss” and Question 4: “To make a profit, most farmers take risks that might endanger their health” were the most informative to classifying risk-accepting behavior. Given the nature of these questions, experiencing ‘close call’ doing farm work and willingness to risk health for profit, risky behavior may be driven by economic forces. Kishi¹⁴ concluded that behaviors of Indonesian farmers were due to economic concerns and not knowledge of health effects from pesticides. Further examination by socio-economic factors is warranted.

A limitation of this study is the use of only four questions designed to assess attitudes toward risk. It is not possible to capture full details of one’s attitude toward risk with such a limited questionnaire; however, the questions have been previously identified as indicators of risk-accepting personality traits,²⁴ including in this cohort.²² Therefore, we feel confident

that general trends in risk-accepting behavior have been sufficiently identified. Strengths of this study include detailed information on PPE use and chemical storage/mixing/loading/application practices and a large sample size that allowed for stratification of analyses by applicator type, and the ability to adjust for numerous potential confounders.

In conclusion, we found individuals with risk-accepting personalities were generally less likely to use PPE compared to risk-averse individuals. Risk-acceptors were also more likely to apply pesticides to a field/orchard in close proximity to their home or mix/load pesticides in close proximity to their drinking water well, compared to risk-averse individuals. Taken in their entirety, the results suggest safety practices regarding handling and use of pesticides is to some degree driven by risk-accepting personality traits. Investigation into the association of pesticide exposure and risk-accepting personality beyond use/non-use of PPE is warranted based on our findings. Attitudes toward risk are important factors in the decision making process of farmers and interconnected with economic concerns, willingness to adopt new practices²⁵, as well as safety practices. Further understanding of the drivers of risk-accepting behaviors and how risk-accepting behaviors influence PPE use and pesticide handling practices can be used to enhance estimation of exposure and guide future occupational training programs aimed at reducing chemical exposures.

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Table 1
Characteristics of Agricultural Health Study Participants currently applying pesticides by risk accepting personality at Phase 2 interview (1999–2005)

Characteristics	Risk averse (n=19,978)						Risk accepting (n=5,188)					
	Commercial Applicators			Private Applicators (n=15,914)			Commercial Applicators			Private Applicators (n=4,160)		
	IA (n=1,251)	IA (n=11,029)	NC (n=4,885)	IA (n=2,256)	NC (n=557)	IA (n=199)	IA (n=199)	IA (n=2,910)	NC (n=1,250)	IA (n=688)	NC (n=141)	Spouses (n=829)
Mean Age at follow-up (SD)	48.3(9.4)	49.6(10.8)	51.7(12.2)	48.2(9.6)	50.9(10.3)	47.4(10.8)		51.3(12.1)	53.7(13.4)	49.3(9.7)	50.2(10.1)	
Gender (%)												
Male	96.6	98.5	96.7	0.4	2.3	98.0		98.5	98.2	0.0	2.1	
Female	3.4	1.5	3.3	99.6	97.7	2.0		1.5	1.8	100	97.9	
Education (%)												
<12 yr	1.4	3.3	10.8	1.4	5.6	4.0		4.6	14.7	2.0	1.4	
High school graduate/GED	37.1	44.9	42.7	31.7	33.9	49.8		50.8	43.5	36.5	43.3	
Beyond high school	58.8	49.8	40.3	52.2	45.4	43.7		42.4	35.1	45.6	40.4	
Something else	0.1	0.2	0.1	12.5	9.5	0.5		0.2	0.2	13.5	5.0	
Missing	2.6	1.7	6.1	2.2	5.6	2.0		2.1	6.4	2.3	9.9	
Race (%)												
White	99.1	99.0	92.7	98.1	94.1	99.5		99.1	89.7	98.5	90.8	
Black	0.0	0.0	3.2	0.0	1.3	0.0		0.1	5.7	0.0	0.7	
American Indian/Alaska native	0.0	0.1	1.2	0.1	0.9	0.0		0.0	1.3	0.0	0.0	
Asian or Pacific Islander	0.1	0.0	0.0	0.0	0.0	0.5		0.0	0.1	0.0	0.0	
Other	0.2	0.1	0.1	0.1	0.0	0.0		0.0	0.3	0.0	0.0	
Missing	0.6	0.8	2.8	1.7	3.8	0.0		0.8	3.0	1.5	8.5	
Smoking status (%)												
Never	52.5	63.8	44.1	77.3	65.5	48.7		61.2	41.3	74.3	54.6	
Former	25.3	24.3	28.2	13.5	15.8	18.6		27.1	28.2	13.7	19.9	
Current	20.1	10.0	19.9	5.8	12.7	30.2		9.6	20.9	9.0	15.6	
Missing	2.0	2.0	7.8	3.5	5.9	2.5		2.1	9.6	3.1	9.9	
Alcohol use ^a (%)												
Never	11.1	20.1	49.0	28.5	67.3	11.6		21.5	48.3	27.8	61.0	
Ever	87.3	77.5	41.4	68.9	27.3	86.9		76.0	39.9	69.5	29.8	

Characteristics	Risk averse (n=19,978)						Risk accepting (n=5,188)					
	Commercial Applicators			Private Applicators (n=15,914)			Spouses (n=2,813)			Commercial Applicators		
	IA (n=1,251)	IA (n=11,029)	NC (n=4,885)	IA (n=2,256)	NC (n=557)	IA (n=199)	IA (n=2,910)	NC (n=1,250)	IA (n=688)	NC (n=141)	IA (n=688)	NC (n=829)
Missing	1.6	2.4	9.7	2.6	5.4	1.5	2.5	11.8	2.8	9.2	2.8	9.2
Mean farm acreage (SD)	N/A	700.9(717.4)	390.9(1052.0)	572.1(671.3)	158.0(365.0)	N/A	652.0(824.8)	412.4(850.3)	714.0(810.0)	42.5(82.9)	714.0(810.0)	42.5(82.9)
High pesticide exposure event ^b (%)	9.4	4.6	1.6	1.9	1.4	20.1	8.0	3.6	3.5	2.8	3.5	2.8
Enclosed cab on application vehicle (%)												
Yes	39.0	62.9	30.5	4.0	1.6	57.3	53.2	28.7	3.2	1.4	3.2	1.4
No	19.5	17.8	41.6	5.9	8.6	13.6	21.6	47.8	6.8	9.2	6.8	9.2
Missing/Don't know/Refused	41.5	19.3	28.0	90.1	89.8	29.1	25.2	23.5	90.0	89.4	90.0	89.4

^a within 12 months prior to enrollment

^b high pesticide exposure event since enrollment

Table 2
Unadjusted odds ratios of PPE use and risk accepting personality traits among participants currently applying pesticides in the Agricultural Health Study (1999–2005)

Characteristic	Private (n= 20,074)				Applicator type Commercial (n=1,450)				Spouse (n=3,642)			
	Risk accepting (n=4,160)		Risk averse ^d (n=15,914)		Risk accepting (n=199)		Risk averse ^d (n=1,251)		Risk accepting (n=829)		Risk averse ^d (n=2,813)	
	Affirmative Response (%)	Affirmative Response (%)	Affirmative Response (%)	OR (95% CI)	Affirmative Response (%)	Affirmative Response (%)	Affirmative Response (%)	OR (95% CI)	Affirmative Response (%)	Affirmative Response (%)	Affirmative Response (%)	OR (95% CI)
PPE when applying	46.2%	47.7%	0.93(0.84–1.02)		54.1%	60.8%	0.62(0.33–1.16)		48.9%	46.8%	1.09(0.93–1.27)	
PPE when mixing/loading	76.2%	81.9%	0.72(0.65–0.79)		93.5%	93.4%	0.77(0.34–1.77)		41.1%	38.2%	1.09(0.90–1.33)	
Glove type worm applying: CR vs. non-CR	39.8%	40.2%	1.02(0.78–1.34)		47.1%	50.9%	0.85(0.29–2.52)		34.5%	31.8%	1.17(0.91–1.52)	
Glove type worm mixing/loading: CR vs. non-CR	72.2%	78.5%	0.75(0.60–0.93)		91.0%	90.2%	1.28(0.45–3.67)		31.1%	28.9%	1.01(0.75–1.36)	
CR boots/shoes when applying	10.4%	12.7%	0.79(0.68–0.92)		21.2%	32.9%	0.51(0.29–0.91)		6.3%	5.5%	1.16(0.84–1.61)	
CR boots/shoes when mixing	13.3%	14.9%	0.87(0.79–0.97)		32.2%	40.0%	0.70(0.51–0.96)		5.2%	4.8%	1.05(0.74–1.50)	
Coveralls when applying	7.0%	8.3%	0.83(0.69–0.99)		11.8%	15.7%	0.72(0.35–1.45)		1.5%	0.8%	1.77(0.88–3.57)	
Coveralls when mixing/loading	8.7%	10.0%	0.87(0.78–0.99)		19.6%	22.6%	0.82(0.57–1.20)		1.1%	0.8%	1.28(0.59–2.79)	
Face shield when applying	3.7%	4.2%	0.88(0.69–1.13)		7.1%	7.9%	0.91(0.37–2.19)		0.7%	1.1%	0.67(0.28–1.62)	
Face shield when mixing/loading	7.4%	8.0%	0.94(0.82–1.07)		11.1%	16.3%	0.63(0.39–1.01)		1.0%	1.2%	0.74(0.34–1.61)	
Respirator when applying	9.5%	11.3%	0.83(0.71–0.97)		4.7%	12.7%	0.33(0.12–0.94)		1.5%	1.2%	1.23(0.63–2.39)	
Respirator when mixing/loading	10.6%	11.2%	0.97(0.87–1.08)		11.6%	11.5%	1.00(0.62–1.59)		1.7%	1.1%	1.54(0.81–2.92)	
^b Multiple PPE when applying	15.8%	18.5%	0.80(0.71–0.92)		28.2%	37.7%	0.55(0.32–0.94)		6.1%	5.3%	1.17(0.83–1.63)	
^b Multiple PPE when mixing	24.1%	27.6%	0.86(0.79–0.93)		44.2%	54.2%	0.64(0.47–0.87)		5.8%	5.0%	1.12(0.79–1.57)	
* CR gloves + 1 PPE ^c when applying	14.9%	17.7%	0.76(0.66–0.89)		27.1%	35.9%	0.56(0.29–1.09)		5.7%	5.0%	1.05(0.73–1.51)	
CR gloves+ 1 PPE ^c when mixing	23.7%	27.3%	0.92(0.84–1.00)		44.2%	53.6%	0.65(0.47–0.89)		5.4%	5.0%	1.02(0.70–1.47)	
CR gloves + 2 PPE ^c when applying	6.0%	7.8%	0.75(0.61–0.91)		11.8%	14.9%	0.80(0.38–1.69)		0.7%	0.7%	1.04(0.41–3.73)	
CR gloves + 2 PPE ^c when mixing	8.3%	9.8%	0.91(0.80–1.03)		20.6%	22.9%	0.86(0.59–1.25)		0.8%	0.9%	0.88(0.38–2.06)	

^a reference group
^b summation of responses to chemically resistant gloves and boots, coveralls, face shield and respirator

C summation of responses to chemically resistant boots, coveralls, face shield and respirator

* CR=chemical-resistant

Table 3
Odds ratios (95% CI) of pesticide handling practices and risk accepting personality traits among participants currently applying pesticides in the Agricultural Health Study

Pesticide Handling Characteristic	Private Applicator (n= 20,074)						Spouse (n=3,642)					
	Risk accepting (n=4,160)			Risk averse ^a (n=15,914)			Risk accepting (n=829)			Risk averse ^a (n=2,813)		
	^c Response (%)	Private	Adjusted ^b	^c Response (%)	Private	Adjusted ^b	^c Response (%)	Private	Adjusted ^b	^c Response (%)	Unadjusted	Adjusted ^b
Home's distance from field/orchard where pesticide applied (ft)												
<50	5.7%	1.16(0.97–1.39)	1.21(1.01–1.44)	5.0%	1.16(0.97–1.39)	1.21(1.01–1.44)	11.5%			8.9%	1.21(0.84–1.76)	1.21(0.83–1.76)
50–99	11.9%	1.04(0.90–1.20)	1.06(0.91–1.23)	11.6%	1.04(0.90–1.20)	1.06(0.91–1.23)	17.2%			16.6%	0.98(0.69–1.37)	0.96(0.68–1.35)
100–199	23.8%	0.99(0.87–1.12)	0.99(0.87–1.13)	24.2%	0.99(0.87–1.12)	0.99(0.87–1.13)	24.1%			23.8%	0.96(0.69–1.32)	0.91(0.65–1.27)
200 –1,320 (1/4mile)	47.6%	1.01(0.90–1.13)	1.00(0.89–1.12)	47.7%	1.01(0.90–1.13)	1.00(0.89–1.12)	38.8%			42.4%	0.86(0.63–1.18)	0.83(0.61–1.14)
>1,320 (1/4mile) (reference)	10.5%	1.00	1.00	10.6%	1.00	1.00	7.5%			7.0%	1.00	1.00
Distance of well from pesticide application (ft)												
50	8.8%	1.17(0.97–1.41)	1.17(0.96–1.42)	7.6%	1.17(0.97–1.41)	1.17(0.96–1.42)	10.6%			9.5%	1.19(0.79–1.79)	1.13(0.75–1.71)
50–99	7.5%	1.02(0.84–1.24)	1.03(0.84–1.25)	7.3%	1.02(0.84–1.24)	1.03(0.84–1.25)	8.7%			9.9%	0.93(0.61–1.42)	0.90(0.58–1.37)
100–199	15.5%	0.91(0.77–1.07)	0.90(0.77–1.07)	17.1%	0.91(0.77–1.07)	0.90(0.77–1.07)	20.8%			18.9%	1.17(0.82–1.67)	1.10(0.77–1.57)
200 –1,320(1/4mile)	55.7%	1.00(0.87–1.15)	0.98(0.85–1.13)	55.7%	1.00(0.87–1.15)	0.98(0.85–1.13)	47.0%			47.5%	1.05(0.77–1.45)	0.99(0.72–1.37)
>1,320 (1/4mile) (reference)	10.8%	1.00	1.00	10.8%	1.00	1.00	10.4%			11.1%	1.00	1.00
Distance of well from pesticide mixing/loading (ft)												
<50	3.7%	1.63(1.27–2.08)	1.54(1.20–1.97)	2.4%	1.63(1.27–2.08)	1.54(1.20–1.97)	8.5%			5.4%	1.39(0.91–2.13)	1.30(0.85–2.01)
50–99	5.5%	1.15(0.94–1.41)	1.07(0.87–1.31)	5.1%	1.15(0.94–1.41)	1.07(0.87–1.31)	11.8%			11.0%	0.95(0.65–1.38)	0.89(0.61–1.30)
100–199	17.1%	1.09(0.94–1.25)	1.01(0.87–1.16)	16.5%	1.09(0.94–1.25)	1.01(0.87–1.16)	19.6%			19.5%	0.89(0.64–1.24)	0.83(0.59–1.17)
200 –1,320(1/4mile)	47.1%	1.02(0.91–1.15)	0.98(0.87–1.10)	48.2%	1.02(0.91–1.15)	0.98(0.87–1.10)	32.2%			38.0%	0.75(0.55–1.01)	0.71(0.52–0.97)
>1,320 (1/4mile) (reference)	16.8%	1.00	1.00	17.6%	1.00	1.00	13.5%			11.9%	1.00	1.00

^areference group

^badjusted for farm acreage, education, gender, age, state

^cdoes not sum to 100% due to some participants indicating no use of pesticides in this manner

Table 4

Percent of questions assessing attitudes toward risk answered in the affirmative among risk accepting and risk averse participants in the Agricultural Health Study

Question	Risk averse (n=19,978)	Risk accepting (n=5,188)
Q1: Farming is more dangerous than jobs in industry or manufacturing	57.0	93.7
Q2: Accidents are just one of the occupational hazards of farming that must be accepted if you are going to be in the business	43.5	91.2
Q3: During a normal work week it's common for me, while doing farm work, to experience a number of 'close calls' that under different circumstances might have resulted in personal injury or property loss	5.0	60.7
Q4: To make a profit, most farmers take risks that might endanger their health	16.8	86.8