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Structural Equation Modeling of the Relationships Between Pesticide Poisoning, Depressive Symptoms and Safety Behaviors Among Colorado Farm Residents

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ABSTRACT. *Purpose:* To use structural equation modeling (SEM) to test the theory that a past pesticide poisoning may act as a mediator in the relationship between depression and safety practices. Depression has been associated with pesticide poisoning and was more strongly associated with safety behaviors than workload, social support or health status of farm residents in a previously published report.

Methods: A cross-sectional survey of farmers and their spouses was conducted in eight counties in northeastern Colorado. Depressive symptoms were assessed using the Center for Epidemiologic Studies-Depression (CES-D) scale. Exploratory and confirmatory factor analyses were used to identify symptoms most correlated with risk factors for depression and safety practices. SEM was used to examine theoretical causal models of the relationship between depression and poor health, financial difficulties, a history of pesticide poisoning, and safety practices.

Results: Exploratory factor analysis identified three factors in the CES-D scale. The SEM showed that poor health, financial difficulties and a history of pesticide poisoning significantly explained the depressive symptoms. Models with an excellent fit for the safety behaviors resulted when modeling the probability that the pesticide poisoning preceded depression, but no fit was possible when reversing the direction and modeling depression preceding pesticide poisoning.

Conclusions: Specific depressive symptoms appeared to be significantly associated with primarily animal handling and farm machinery. The order of events, based on SEM results, was a pesticide poisoning preceding depressed mood in relation to safety behaviors. doi:10.1300/J096v11n03_05

KEYWORDS. Farmers, agriculture, occupational health, depression, pesticides, safety behaviors

BACKGROUND

Agricultural injuries are well established as a significant public health issue in North America. The associations between farm injuries and type of agricultural production on farms[1-6] and exposure to equipment and animals among agricultural workers have been well docu-

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mented,[1,2,7] but less has been reported on the relationship between injury risk and safety behaviors and factors that influence those behaviors on farms.[8] Intervention studies have shown that injuries can be prevented when safety behaviors are consistently exercised[9] and the focus of farm safety prevention has been to change attitudes and behaviors.[10] Safety interventions may not be effective in individuals with mood disorders and the symptoms of irritability and lack of concentration that accompany mood disorders. Identifying and treating depressed individuals prior to intervening to change safety behaviors may decrease the risk of injury.

A prospective study of 290 male Iowa farmers showed a farmwork-related injury odds ratio (OR) of 3.15 (95% confidence interval (CI) 1.32, 7.50) among individuals scoring 16 or higher (indicative of depression) on the CES-D scale.[11] The number of hours spent working with animals was associated with injury, but the OR was smaller (OR 2.14; CI 1.04, 4.44).[11] A nested case-control study of risk factors for animal-related injury found an elevated, but not statistically significant, OR for doctor-diagnosed depression and depression using the 11-item abbreviated CES-D scale.[12] A case-control study of male Ohio farmers found an increased risk of agricultural injury in those with higher scores on emotional symptoms questions, including feeling irritable and sleeping more than usual.[13] After grouping 24 symptoms into domains, the emotion domain was significantly associated with injury.[13]

Specific neuropsychological symptoms were associated with a history of pesticide poisoning and with safety behaviors in a Colorado farm resident population where feeling depressed was associated with not keeping moving equipment parts shielded, feeling irritable with not being calm around animals and not using restraining gates when handling animals, and difficulty concentrating with not wearing ear protection, not keeping chemicals out of the reach of children, not keeping passageways clear of slippery substances and not reading instruction manuals for farm machinery.[14] These safety behaviors reflect common farm injuries related to farm machinery, animal handling, falls and loss of hearing.[11,13,15,16]

Structural equation modeling (SEM) can be used to determine the extent to which a theoretical model is supported by data and provides evidence of the likely temporal sequence of events in cross-sectional data. Although it cannot be used to prove causality, it can provide evidence for one model fitting the data better than another and is particularly useful for outcomes such as depression, which are not directly measured but based on items from a survey instrument. Further, it has the advantage of modeling complex relationships involving direct and indirect relationships, as well as allowing the variances of the error components to be parameter estimates that must be fit to the data. The relationship of depression to safety behaviors has been previously described and a logical next step is to use SEM to find the model that best explains the temporal patterns of the relationship by evaluating whether depressive symptoms resulted from a pesticide poisoning and then impacted safety behaviors, or alternatively, whether safety behaviors may have caused a pesticide poisoning which then resulted in depressive symptoms.

SEM analysis of safety activities in factories in the United Kingdom and France showed that workplace hazards had an indirect effect on safety activities, and was mediated by individual responsibility, which significantly predicted safety activity.[17] SEM of injuries showed clear directionality where worker safety attitude preceded safety behavior, but perceived workplace hazards combined with actual risk of injury directly predicted the number and severity of injuries.[18] These reports suggested a "human factor" in the pathway between workplace hazards and poor safety behaviors that may result in injuries.

The purpose of this study is to use structural equation modeling (SEM) to test the theory that a past pesticide poisoning may mediate the relationship between depression and farm safety practices.

METHODS

The study population has been described in previous reports.[19] The sample came from an eight county area in northeastern Colorado. Farms were selected based on the probability of a farm operator being a resident on a farm, the land being in agricultural use, and on the average acreage of the farms in the county. A total of 761 principal operators and spouses from 479 farms were recruited into the study between 1992 and 1997. Response rates by county are as follows: Sedgwick 60%; Phillips 47%; Yuma 61%; Logan 52% Washington 54%; Morgan 51%; Weld 59%; and Larimer 80%. The total response rate for eligible farms was 55%.

Enrolled participants completed an in-person interview that took from 45 minutes to 2 hours. A detailed questionnaire was used to obtain information about demographic characteristics, farm activities and products, pesticides used on the farm, health status and farm safety behaviors.

Depressive symptoms were assessed using the 20-question CES-D scale, which assesses symptoms occurring within the previous seven-day period.[20] The scale values can range from 0 to 60 and has been used widely and shown to be a valid screening tool for detecting depression.[20-22] Four positive affect questions were reverse coded. Experiencing a depressive symptom in the past week was coded as: 0 for rarely or none of the time (< 1 day); 1 for some or a little of the time (1-2 days); 2 for occasionally or a moderate amount (3-4 days) and 3 for most or all of the time (5-7 days).

Health status was used as a dichotomous variable with those reporting excellent, very good and good health being the reference group, while those reporting fair or poor health were considered the at-risk group. Financial difficulties were assessed based on a positive response to either having an increase in debt or a decrease in income. Financial difficulties and having a history of pesticide poisoning were dichotomous variables coded as zero for no (reference group) and one for yes (at-risk group). Farm residents were asked to report specific behaviors related to farm safety practices. The five-category safety behaviors were coded as those reporting always, most of the time, sometimes, rarely, or never exercising a safety behavior. A history of pesticide poisoning was based on whether the farm resident reported ever having an illness that occurred in relation to a pesticide exposure and coded as 1 for at-risk and 0 as the reference group.

STATISTICAL ANALYSES

Assumptions underlying latent variable path analysis and SEM include an adequate sample size; identification of the model; continuously distributed variables or, if ordinal, that an underlying continuous distribution exists; and normally distributed residuals.[23] The numbers of participants in this study was adequate for SEM. Identification, meaning whether there are more equations than unknowns, was calculated by counting the unknown parameters to be estimated and checking whether they exceeded the number of observed values being fit in the model (path coefficients, variances and covariances). The variables examined herein represent an underlying continuous distribution. Plots of model residuals were examined for normality.

An exploratory factor analysis was done of the depressive symptoms using squared multiple correlations as prior communality estimates. The principal factor method was used to extract the factors, followed by varimax rotation, an orthogonal rotation that maximizes the variance and creates independent factors. A scree plot was used to visually examine the factors and an eigenvalue of at least 1.0 was used to screen the factors. Factor loadings of at least 0.40 (approximately 15% overlapping variance) were used to extract the factors. The higher the factor loading values, the better the variable measures the factor. Coefficient alpha values were calculated to evaluate the reliability of the scale based on each factor.

Confirmatory factor analysis is an important step in describing how a measured variable is related to a latent factor before adding the causal pathways that are of primary interest, in this case the safety behaviors. CFA was used to describe the relationship between the latent variables (depressive factors) and the manifest indicator variables used to measure those factors (depressive symptoms). A factor-loading minimum of 0.40 was required for inclusion in the CFA. Criteria for model fit included the ratio of the chi-square to the degrees of freedom (df) of less than 2.0, a Bentler's comparative fit index (CFI) and Bentler's and Bonnett's Non-Normed Index (NNI) of at least 0.90, a root mean square error of approximation (RMSEA) of less than 0.06 and normalized residuals centered on zero and no greater than 2.00, all indicative of a well-fit measurement model. A depressive symptom was removed if it loaded on several factors or if it had high normalized residuals. Modifications to the measurement model were based on improvements in the above-mentioned parameters and results of the Lagrange Multiplier and Wald Tests.

The three structural equation models tested were (1) depressive symptoms antecedent to poor health, financial difficulties and pesticide poisoning with a causal pathway to the safety behavior; (2) poor health, financial difficulties, and a history of pesticide poisoning preceding the depressive symptoms with a causal pathway from the depressive symptoms to the safety behavior; and (3) safety behaviors preceding a pesticide poisoning that then resulted in depressive symptoms. Additionally, individual SEMs were tested and compared for each safety behavior for all three models. Adequacy of the SEM model was based on the chi-square to df ratio, the RMSEA, NNI, CFI, significance tests for path coefficients, normalized residuals, Wald tests and Lagrange Multiplier tests. All analyses were done in SAS version 9.2, Cary, North Carolina. SEM has been shown to perform well with non-optimal and ordinal data with only a few categories.[24]

RESULTS

After excluding 51 individuals who did not participate in farm work and 26 who did not answer the CES-D symptom questions, 684 of 761 farm residents remained for analyses. Demographic characteristics are described in Table 1. Approximately 25% had experienced financial difficulties, nearly 10% had a history of pesticide poisoning, and 6% were depressed using a cutpoint of 16 or greater from CES-D scale scores. Table 1 also shows the numbers and percentages of farm workers classified into low-risk (always or most of the time practicing the safety behavior) and high-risk (sometimes, rarely or never practicing the safety behavior), and the number of those who reported the safety behavior did not apply to their farming activities.

Exploratory Factor Analysis

The somatic and depressed components loaded onto a single factor (eigenvalue = 4.84; variance explained = 3.69; alpha = 0.83) (Table 2). The second component was positive affect representing feeling good, being hopeful, being happy and enjoying life (eigenvalue = 1.16; variance explained = 1.62; alpha = 0.68) (Table 2). The factor loadings after varimax rotation indicated that sleeping restlessly, crying spells and talking less than usual did not load strongly on any factor. The scree plot showed the depressed affect to make the largest contribution to the underlying factor structure. Only the depressed/somatic and positive affect factors had eigenvalues of at least one, indicating an adequate representation of the data and were retained for the CFA.

Confirmatory Factor Analysis: The Measurement Model

The eleven depressive symptoms that loaded onto the somatic/depressed affect and three depressive symptoms that loaded onto the positive affect with a factor loading of at least 0.40 from Table 2 were used in the confirmatory factor analysis (chi-square = 281.25; df = 89; chi-square/df = 3.16; CFI = 0.925; NNI = 0.912). Although the factor loadings were all significant, feeling bothered, lonely, blue, depressed, trouble keeping your mind on things, and having no appetite showed a marginally adequate fit with residuals between 3.0 and 5.0. The predicted covariances for these variables were much smaller than the actual covariances, indicating underprediction of the strength of the relationships to the depressed factor. The Lagrange multiplier test showed an improvement in fit if the covariance between the somatic/depressed factor and the positive affect factor (covariance 0.39, standard error 0.05) was included in the model. Further, feeling like life had been a failure and feeling fearful were redundant and interchangeable in the CFA, but since feeling like life had been a failure had a slightly higher residual, it was dropped from the model. Feeling hopeful loaded on both factors and was omitted from the model. After these pathways were deleted, the model fit became

TABLE 1. Characteristics including safety behaviors of male, female and combined farm workers in the study population, Colorado, 1992-1997.

Characteristic	Males % (n) 64.6 (n = 442)	Females % (n) 35.4 (n = 242)	Population % (n) (n = 684)
Age in years			
< 30	2.3 (10)	4.6 (11)	3.1 (21)
30-44	37.8 (163)	35.4 (84)	37.0 (247)
45-64	43.9 (189)	49.4 (117)	45.8 (306)
65 +	16.0 (69)	10.6 (25)	14.1 (94)
Married			
Yes	87.3 (386)	96.3 (233)	90.5 (619)
No	12.7 (56)	3.7 (9)	9.5 (65)
Perceived general health			
Fair/Poor	5.7 (25)	3.7 (9)	5.0 (34)
Good/Very good/Excellent	94.3 (416)	96.3 (232)	95.0 (648)
Financial problems			
Yes	31.8 (140)	31.5 (76)	31.7 (216)
No	68.2 (300)	68.5 (165)	68.3 (465)
Pesticide-related illness			
Yes	12.1 (53)	5.4 (13)	9.7 (66)
No	87.9 (385)	94.6 (227)	90.3 (612)
Depressed by CES-D scale			
Yes	3.8 (17)	9.9 (24)	6.0 (41)
No	96.2 (425)	90.1 (218)	94.0 (643)
Being calm when around animals in close quarters			N/A = 164
Low Risk	95.5 (336)	85.1 (149)	92.0 (485)
High Risk	4.5 (16)	14.9 (26)	8.0 (42)
Replacing protective shields after working on equipment			N/A = 200
Low Risk	88.3 (377)	87.5 (56)	88.2 (433)
High Risk	11.7 (50)	12.5 (8)	11.8 (58)
Using restraining or handling facilities for treating animals			N/A = 252
Low Risk	88.1 (282)	87.0 (107)	87.8 (389)
High Risk	11.9 (38)	13.0 (16)	12.2 (54)
Keeping passage ways clear of slippery substances			N/A = 164
Low Risk	90.0 (331)	94.8 (145)	91.4 (476)
High Risk	10.0 (37)	5.2 (8)	8.6 (45)
Reading instruction manuals for farm machinery			N/A = 161
Low Risk	85.8 (369)	84.4 (81)	85.6 (450)
High Risk	14.2 (61)	15.6 (15)	14.4 (76)
Keeping moving equipment parts shielded			N/A = 159
Low Risk	92.4 (403)	95.6 (86)	93.0 (489)
High Risk	7.6 (33)	4.4 (4)	7.0 (37)

* High-risk are those who sometimes, rarely or never exercise the safety factor.

optimal. Figure 1 shows the final measurement model with path coefficients (chi-square = 14.8; df = 13; ratio = 1.14; RMSEA = 0; CFI = 1.00; NNI = 1.00). All residuals were less than 1.70 and symmetric about zero. With the exception of the variable for feeling as good as others, the path coefficients were 0.56 and above. This two-factor confirmatory factor model was used in the subsequent SEM.

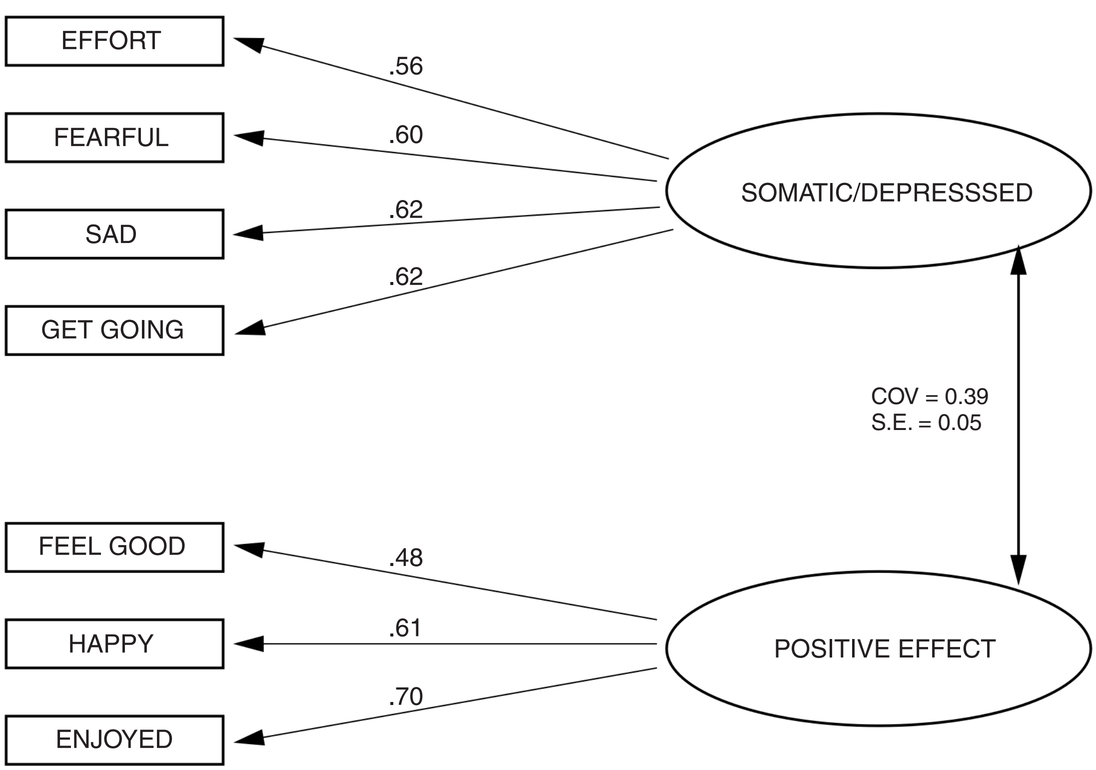
SEM (Path Analysis with Latent Variables)

Using the optimal measurement model with the pertinent depressive symptoms fitting the two latent factors (Figure 1), paths were added to the model and directionality of the variables predicted. Without a path to a safety behavior, the best model included poor health, pesticide poisoning and financial difficulties as preced-

TABLE 2. Factor loadings after varimax rotation and communalities of depressive symptoms in Colorado farm workers, 1992-1997.

Factor with symptoms	Factor loadings after varimax rotation	Item communalities
Factor 1: Depressed and Somatic Affect		
Felt bothered by things that don't usually bother you	0.61	0.39
Not felt like eating; had a poor appetite	0.44	0.22
Felt that you could not shake off the blues	0.66	0.49
Trouble keeping your mind on what you were doing	0.44	0.23
Felt depressed	0.74	0.60
Felt that everything you did was an effort	0.52	0.31
Thought your life had been a failure	0.47	0.33
Felt fearful	0.49	0.33
Felt lonely	0.41	0.27
Felt sad	0.58	0.46
Felt that you could not get going	0.51	0.35
Slept restlessly	0.39	0.20
Talked less than usual	0.33	0.17
Had crying spells	0.26	0.09
Factor 2: Positive Affect		
Felt that you were as good as other people	0.51	0.27
Felt hopeful about the future	0.57	0.36
Felt happy	0.56	0.33
Enjoyed life	0.67	0.46
Factor 3: Interpersonal		
Felt people were unfriendly	0.54	0.32
Felt that people disliked you	0.63	0.46

FIGURE 1



ing the depressive and positive affect factors. The positive affect factor loaded weakly on each safety behavior with poor health, pesticide poisoning, and financial difficulties in the model and was dropped from the analysis. Figure 2 shows the hypothetical model upon which each safety factor model was based. Poor health, pesticide poisoning and financial difficulties led to the somatic/depressed factor of the CES-D scale.

Model 1: Depressive Symptoms Antecedent to Poor Health, Financial Difficulties and Pesticide Poisoning

When depressive factors were modeled as antecedent to pesticide poisoning, financial difficulties and poor health and these preceded any safety behavior, eigenvalues were zero, the residuals were very large, the matrices were not of full rank, standard errors were zero, and the models fit very poorly. Path coefficients could not be computed for these models.

Model 2: Poor Health, Financial Difficulties, and a History of Pesticide Poisoning Preceding the Depressive Symptoms with a Causal Pathway from the Depressive Symptoms to the Safety Behavior

Feeling fearful, feeling sad, feeling like everything was an effort and feeling as if you could not get going described the underlying structure of the somatic/depressed factor. The somatic/depressed factor led to effects on the safety behavior. Table 3 shows the model fit parameters for each final safety factor model. All final models had an insignificant chi-square with a chi-square to degrees of freedom ratio of one or less and high p-values, indicating a good model fit. All residuals were less than two, and the CFI and NNI were all 1.00 with RMSEA values of zero. All models presented are the best models obtained with the variables used in Figure 2.

Two animal-related safety factors were examined. The first was being calm around animals (Figure 3). The model became optimal with the addition of a path from pesticide poisoning to fearfulness and a path from poor health to fearfulness (Figure 3). Feeling like you could not get going was the only significant path coefficient from the depression variables to the safety factor. The second animal model was use of restraining or handling facilities when treating animals (Figure 4). This model showed that a path from pesticide poisoning to feeling sad and a path from fearfulness to the safety gate greatly improved the model fit (Figure 4). In this model the path from pesticide poisoning to the depressed factor was positive with the path from pesticide poisoning to sadness in the model. The factor loading for the path directly from the depressed factor to the safety factor was small.

Three models analyzed safety factors related to farm machinery. Reading instruction manuals for farm machinery is shown in Figure 5. In this model the depressed factor led to reading instructions. Again, a path from pesticide poisoning to feeling fearful greatly improved the model fit. Interestingly, the path coefficient

FIGURE 2

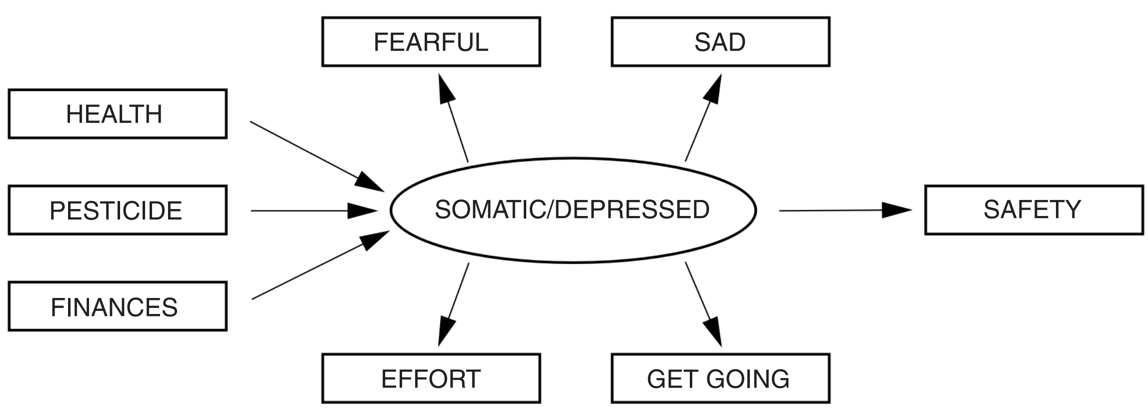


TABLE 3. Model fit characteristics from individual path analyses models of seven safety factors, Colorado farm residents, 1992-1997.

Safety Practice	N	χ^2	df	χ^2/df	CFI	NNI
Using restraining facilities	437	12.51	16	0.78	1.00	1.02
Being calm around animals	520	9.22	15	0.61	1.00	1.01
Reading instruction manuals	518	10.14	15	0.68	1.00	1.02
Replacing protective shields	483	9.03	14	0.65	1.00	1.03
Keeping equipment parts shielded	518	10.91	15	0.73	1.00	1.02
Keeping passage ways clear	515	14.90	14	1.06	0.998	0.996

FIGURE 3

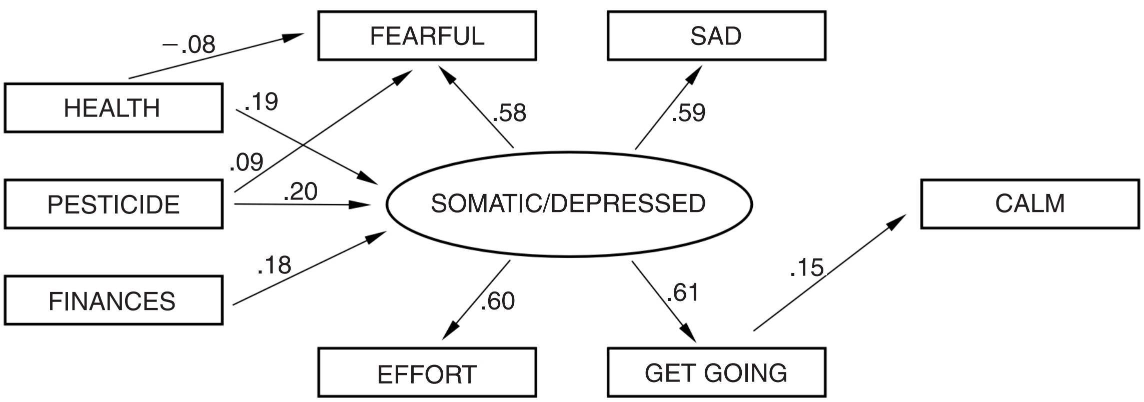
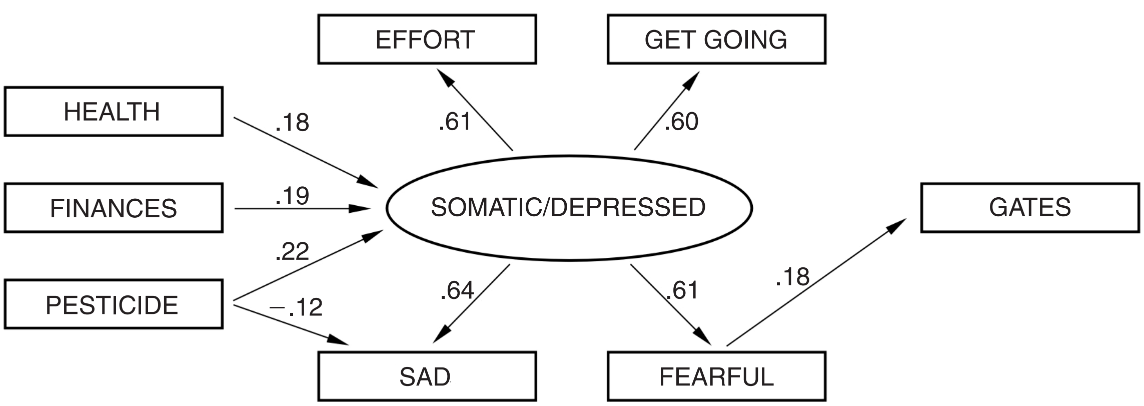


FIGURE 4



from sadness directly to fearfulness showed a strong effect in this model, although the directionality of this path is not certain, as the residuals were only slightly smaller with the arrow pointing from sadness to fearfulness. Nevertheless, there appears to be a correlation between both feeling sad and feeling fearful with pesticide poisoning. The path coefficient could be divided between fearfulness (0.12) and the depressed factor (0.18). Replacing protective shields showed nearly the same result as reading instruction manuals, except that poor health had a direct effect on replacing shields and the depressed factor did not (Figure 6). Keeping

FIGURE 5

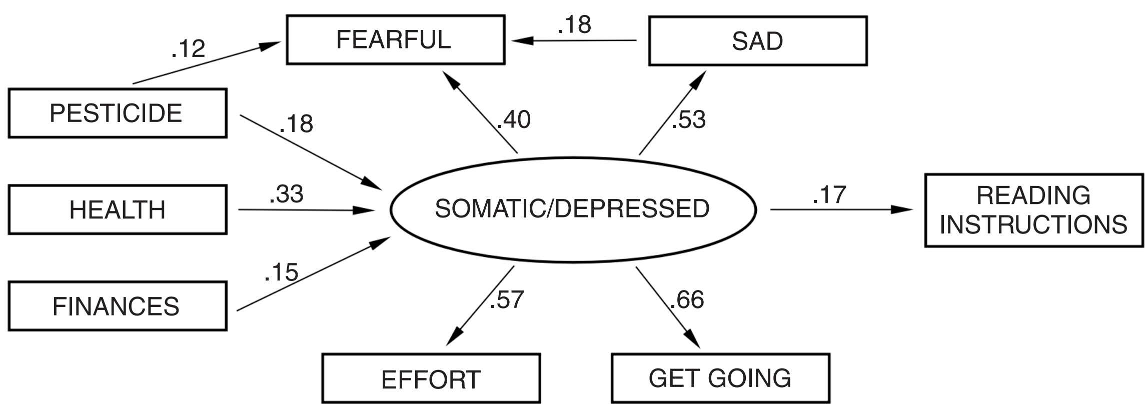
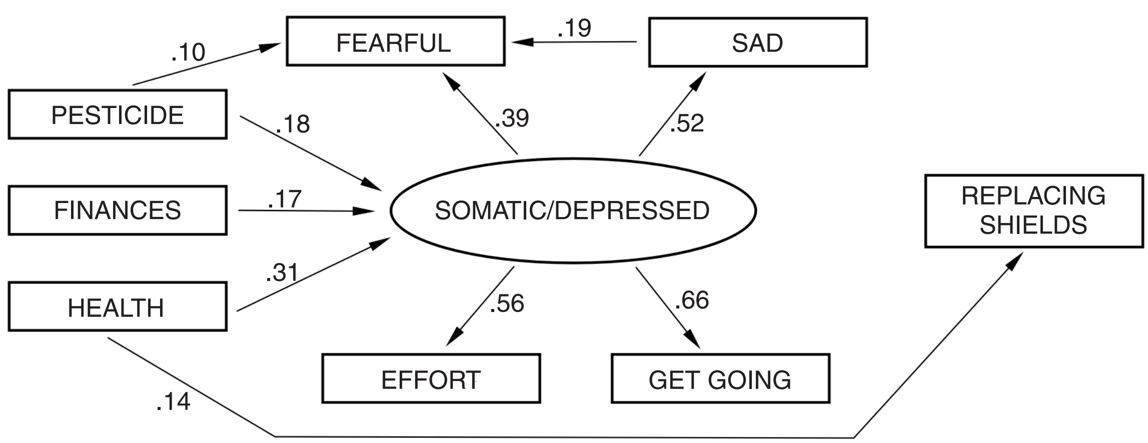


FIGURE 6



equipment parts shielded was very similar to reading instruction manuals (Figure 7).

Keeping passageways clear of slippery substances looked like a combination of being calm around animals and reading instruction manuals (Figure 8). Poor health was negatively associated with feeling fearful, but pesticide poisoning had a significant positive path to feeling fearful. Feeling sad was related directly to feeling fearful and the depressed factor significantly influenced keeping passageways clear.

Model 3: Safety Behaviors Precede Pesticide Poisoning, Financial Difficulties and Health Problems

The final model tested was whether using poor safety behaviors resulted in a pesticide poisoning and that the poisoning resulted in depressive symptoms. The models had insignificant path coefficients between each safety behavior and history of pesticide poisoning and very large residuals (> 10). The Wald and Lagrange Multiplier test indicated that deleting this path would improve the model fit. After deleting this path, model fit improved and residuals showed greater symmetry about zero and were all less than 2. By all parameters used above, this model with only pesticide poisoning predicting depression did not fit as well as the model that included health problems and financial difficulties.

These models suggest an order exists in the predictors of depression, the depression factor and the safety behaviors. It can be shown statistically that poor health, pesticide poisoning and

FIGURE 7

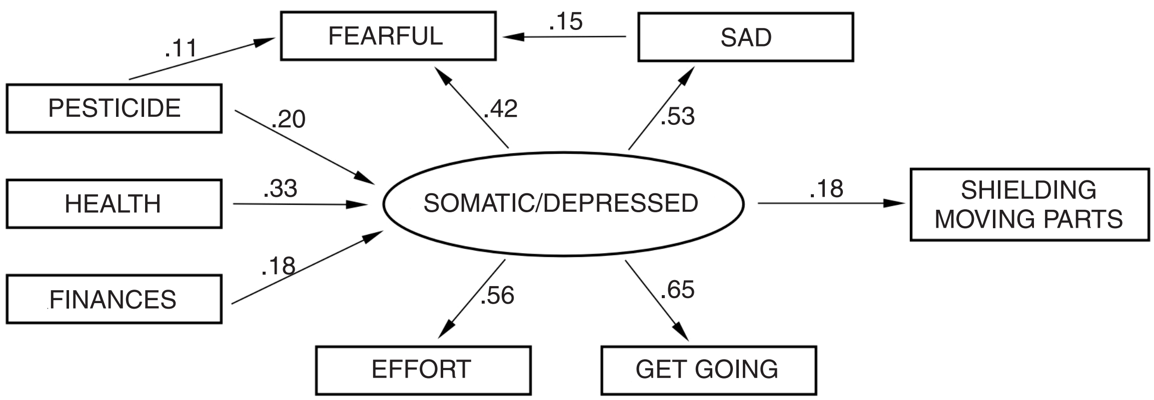
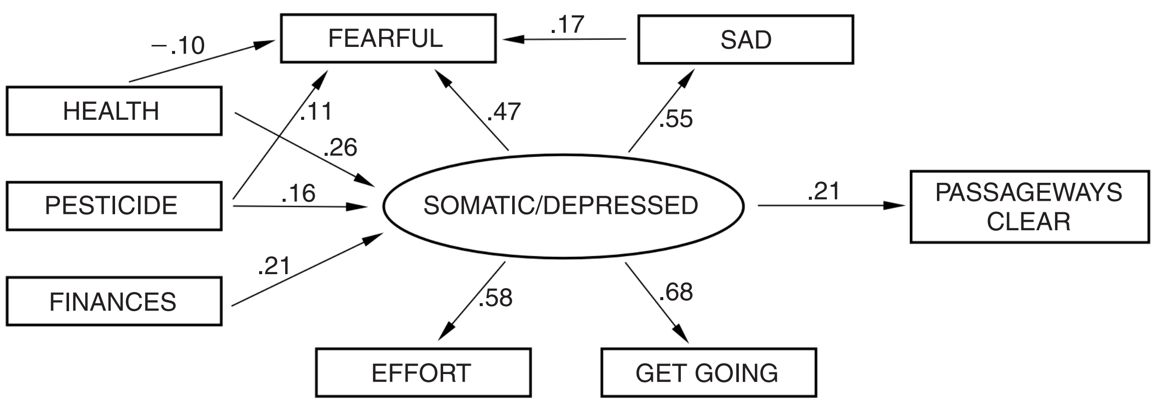


FIGURE 8



financial difficulties were antecedent to the depressive factor and the depressive factor preceded the safety behavior. In all safety models examined, poor health, pesticide poisoning and financial difficulties each improved the fit to the depressed factor. In five of six models, the model fit was greatly improved by adding a path directly from pesticide poisoning to feeling fearful. In three of the models, the depressed factor had less of an effect on safety behaviors than feeling fearful, feeling like you could not get going, or being in poor health. The path coefficients (factor loadings) for feeling that you could not get going were all greater than 0.60, but this depressive symptom did not affect safety behavior directly. All path coefficients between depressive symptoms and safety behavior were relatively small, but consistently ranged from 0.14 to 0.21.

One of the most interesting findings of these models is the reoccurrence of the connection between having had a pesticide poisoning and feeling fearful. This could just as easily have been feeling like life had been a failure because these were nearly identical in the confirmatory factor analysis. This finding suggests that whereas poor health and financial difficulties create an overall depressed affect, which can influence safety behaviors, that pesticide poisoning can specifically create a sense of fearfulness and a sense of failure. When the models were re-run with the variable for failure rather than fearfulness, the results were nearly identical (data not shown). Fearfulness seemed to be associated with sadness and so did failure. When a path between pesticide poisoning and fearfulness was added to the model with a path for poor health and fearfulness, the poor health path coefficient was of similar magnitude but in an opposite direction than the pesticide poisoning to fearfulness path coefficient. The poor health to fearfulness path coefficient was weak without the path between pesticide poisoning and fearfulness in the model, indicating that a pesticide poisoning reverses the relationship between poor health and fearfulness.

DISCUSSION

How Does This Relate to the Literature?

The path coefficients between the depression factor and each safety behavior were modest in this study. As was shown by Tomas et al., 1999, and Cheyne et al., 1998, factors related to human perception of hazards and risks may intervene between the work environment and the exercising of safety behaviors.[17,18] The evaluation of work-site hazards and the perception of risk of injury could easily be influenced by the presence of depressive symptoms, but may be one of many factors. Although the models explain much of the covariance and represent an adequate fit to the data, whether they indicate a possible intervention remains unknown. Future studies should address the nature of the human factor that goes into the perception of hazard and risk in the farming environment. Mood may be an important element, particularly in those with a past pesticide poisoning.

What Are the Benefits of Using SEM?

SEM showed a likely order of events based on the covariance structure of the data, although the reasons for negative eigenvalues may not be related to temporal inconsistency and causation cannot be established. Despite this limitation, certain interesting findings were identified that may not have been seen using logistic regression analysis. These include the observation that symptoms related to feeling as good as others, feeling happy and enjoying life were strongly associated with depression in the confirmatory factor analysis with poor health, pesticide poisoning and financial difficulties in the model, but became much less important with safety behaviors in the model. This result suggests that it is the presence of a negative factor and not the absence of a positive factor that affects safety practices. Also, specific depressive symptoms seemed more highly associated with a history of pesticide poisoning than with having poor health or financial difficulties, raising an interesting question about the nature of depressive symptoms in those with a history of pesticide poisoning.

The data were collected in a cross-sectional manner and the variables are self-reported. It is likely that safety behavior also incorporates the attitudes of the farm resident towards the safety behavior. Using a set of safety knowledge questions in the SEM model as a mediator between the depressive factor and the safety behavior showed a much poorer fit to the data (results not shown). Safety knowledge did not explain additional covariation in the data that was not already explained by the safety behavior. Possibly the relationship of depression to safety behavior is stronger than found here, but reporting bias obscures the connection. Most likely the safety behaviors are performed less often than reported, and this may be differential by depression status because depressed individuals may report differently than those who are not depressed. Since depression can lead to lack of attention to detail, farm residents may not be aware of when or how often they perform certain tasks in a safe manner. Believing that the safety behavior should be practiced during the course of farm work may cause them to over-report their doing so. It is also possible that those who have had a pesticide poisoning may over-report depressive symptoms if they believe the toxins can cause changes in their mental state, but the pesticide questions were at the early part of the interview and depressive symptoms were towards the end of the nearly two hour interview.

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