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Preliminary Tests of an Ecological Model of Hispanic Farmworker Health

Louise S. Ward

ABSTRACT ***Objective:*** The purpose of this study was to propose and test an ecological model to structure research and practice concerning farmworker health in the United States. The research question was, "What is the relationship of selected social, cultural, and economic indicators to the health of adult Hispanic migrant farmworkers?" ***Design:*** A model of biogenetic, social, cultural, economic, individual response, and access factors affecting health was derived from the literature and nursing practice. Data from the 1998 National Agricultural Workers Survey (NAWS), conducted by the U.S. Department of Labor, were used in a secondary analysis to perform preliminary tests of the relationships proposed in the model. ***Sample:*** The NAWS conducts interviews with a nationally representative sample of farmworkers employed in the United States. Because of the importance of theorized cultural factors, the sample for this study was limited to farmworkers who identified themselves as Hispanic, resulting in 1,864 subjects. ***Measurements:*** Variables were used directly from the data or constructed from the available data, and proposed relationships were tested statistically. ***Results:*** Analysis of the data supported the relationships proposed in the model. ***Conclusions:*** The proposed model is a useful tool for organizing variables and giving direction to farmworker health research. Suggestions for future research are made.

Key words: ecological model, farmworker health, theoretical model, migrant workers.

The Institute of Medicine (IOM) report *Unequal Treatment* makes it clear that disparities in health must be examined from a broad perspective, including socioeconomic status, literacy, and access to health care as well as biology (Smedley, Stith, & Nelson, 2003). This holistic approach is entirely consistent with nursing's long history of viewing patients in the context of their physical and social environments, and the work of public health nurses is rooted in a broad community framework. Unfortunately, this makes the study of "health" in its holistic sense a difficult task, as the public health view implicates multiple potential determinants of health.

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The health of non-guest worker farmworkers hired for crop agriculture presents an even greater challenge to researchers, as the social conditions and lifestyle issues surrounding this population are very different from non-farmworker populations. While farmworkers' poverty, low educational levels, and impaired access to health care place them well within the populations included in the IOM report, their seasonal employment, often requiring temporary relocation or migration, cultural issues, and social stigmatization place them apart (Ward & Atav, 2004). Understanding the determinants of farmworker health is an important public health issue from the standpoints of social justice, food safety, and infectious disease control. Because of the complexity of farmworkers' lives, however, organizing potential variables can be a daunting task for the public health nurse, whether the intent is to use primary or secondary data for research or to design health-related interventions.

Ecological models have been proposed as a way to structure the consideration of health problems with increasingly complex etiologies (Grzywacz & Fuqua, 2000; Stokols, 2000). These models are based on the

ecological perspective that multiple aspects of individuals and environments interact to influence health (Grzywacz & Fuqua, 2000). Once the complexity of etiologies is understood, interventions can be planned at the individual, family, community, and societal levels (Haughton, 2006; Stokols, 2000).

The purpose of this study was to propose a model of determinants of Hispanic migrant farmworker health, and to test one of the two pathways in the model using data from the National Agricultural Workers Survey (NAWS). The proposed model (see Fig. 1) was developed by modifying an explanatory model proposed by Dutch researchers (Uniken Venema, Garretsen, & Van Der Mass, 1995). The Dutch model focused on Surinamese, Turkish, and other immigrant groups who commonly migrate to Holland; understandably assumed a universal health system; and was too complex to be useful in most research studies. The model proposed in Figure 1 aggregated and modified some of the variables from the Dutch model, and added access variables, based on U.S. migrant farmworker health literature (David & Rhee, 1998; Derose & Baker, 2000; Flores, Abreu, Olivar, & Kastner, 1998; Sarver & Baker, 2000); the observations and the clinical experience of the researcher were also considered in the development of the Determinants of Hispanic Migrant Farmworker Health model.

Variables were grouped into six categories of potential health determinants and arranged into a conceptual model. The major categories included biogenetic variables (age, gender), social, cultural, and economic variables as the primary influences on health. Major intermediate variable categories were individual response concerns and access to health care. Relationships were then theorized among the variables (see Fig. 1). The research question was, "What is the relationship of selected social, cultural, and economic indicators to the health of adult Hispanic migrant farmworkers?"

Background

The overwhelming majority of farmworkers today are young, male, and of Mexican origins (Carroll, Samardick, Bernard, Gabbard, & Hernandez, 2005); many who are not Mexican come from other Latin American countries. Despite stricter employment rules established in the 1986 Immigration Reform and Control Act, many farmworkers are undocumented, and some are exploited by labor contractors, who serve as "middle men" between the grower and the laborers (Rothenberg, 1998; Taylor, Martin, & Fix, 1997). Although various farmworker migration patterns have been described, in general some individuals work

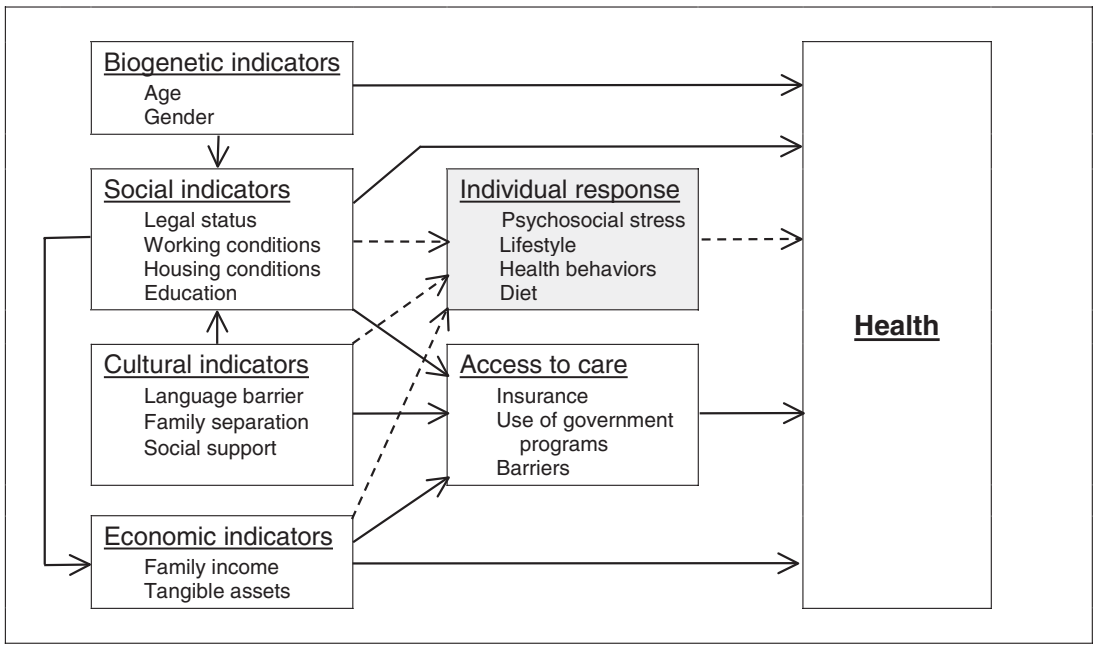

Figure 1. Proposed Theoretical Model of Determinants of Hispanic Migrant Farmworker Health

seasonally in agriculture and do not migrate at all, some migrate annually to work for a single employer and return home at the end of the season, and some "follow the crops," moving throughout the season to perform specialized work such as harvesting strawberries or tomatoes (Migrant Clinicians Network, 2006). Traditionally, migrant patterns have been described as "streams," with downstream regions being those states traditionally considered home-base states: California, Texas, and Florida, and upstream regions being those with shorter growing seasons that would provide more temporary employment (Northwest, Midwest, and Northeast). Research indicates that there is a difference in demand and access to health services between home-base and upstream areas (Dever, 1991). These mobility characteristics of farmworkers' lives place them at an increased risk of illness and poor access to health care.

Poor working and housing conditions also disadvantage this population (Early et al., 2006; Mines, Mullenax, & Saca, 2001). The literature indicates that it is difficult to determine working conditions from a survey format; however, certain proxies have been developed that are considered to be relatively accurate (Mines et al., 2001). Among these are payment by piecework rather than hourly or by salary, requiring payment for transportation to work, and requiring the farmworker to pay for equipment necessary for the job. It should be noted that the proxy of being required to pay for rides to work is not simply having the expense of paying for transportation. It reflects the practice common with some labor contractors of charging a required fee for mandatory labor bus transportation, or requiring workers to pay a third party (*raitero*) for transportation, often standing in the back of a pickup truck. Crowded, inadequate housing is a risk factor for depression (Magana & Hovey, 2003) and makes it difficult to reduce pesticide exposure, thus posing a threat to the physical and mental health and safety of these workers (Early et al., 2006).

Historically, farmworkers have been a marginalized population; since World War II, agricultural work in the United States has become "immigrant" work (Massey, Alarcón, Durand, & González, 1987). Language barriers, regulatory restrictions on the services available, and low educational levels may further impair access to adequate health care.

Increasingly, migrant farmworkers travel without their families and may be separated from them for months to years (Massey, Durand, & Malone, 2002). It is unclear how much and what kinds of social support these laborers have available during the work season. Studies indicate that the migrant lifestyle is stressful and that farmworkers cope with the stress in both typical and unique ways (Clifford, 1999; Kim-Godwin & Bechtel, 2004; Magana & Hovey, 2003).

Agricultural workers are among the poorest of workers in the United States (Runyan, 2000) with mean family incomes of around $10,000 (Carroll et al., 2005). In addition, for many, migratory employment and/or undocumented status prevent access to health insurance. Federally funded Community Health Centers provide inexpensive or free health care to farmworkers, but clinic hours, farm location, poor understanding, and lack of transportation often deter the use of these facilities.

This complexity of context highlights the value of an ecological model when considering farmworker health and its determinants. Preliminary testing of such a model is described in the following section.

Methods

Preliminary testing of the proposed model was performed by secondary analysis of data from the NAWS. The NAWS has the distinction of being one of the largest and most comprehensive sources of data on farmworkers available in the United States. It is a national survey of farmworkers employed in crop agriculture conducted annually since 1989 by the U.S. Department of Labor and made available as a public access data set, with all identifying information removed. The public access data set was analyzed using Statistical Package for Social Sciences (SPSS) 14 for Windows.

Design and sample

The NAWS uses a complex stratified sampling strategy to interview a representative sample of hired farmworkers in the United States (Mehta et al., 2000). Extensive information about the demographics, legal status, education, family size and composition, wages, working conditions in farm jobs, and past and planned participation in the U.S. labor force is collected. Only the 1998 data were used for this secondary analysis since specific health questions change from year to year. In addition, the sample for this study was limited to Hispanic respondents since culture was considered

to be an important variable. With these selection criteria, 1,864 interviews were available for analysis.

All 1,864 respondents had complete information on the dependent variable, but some were missing data on correlate variables, notably *family income*, with 9% of the sample ($n = 168$) not reporting. Those not reporting an income were younger (27.5 years compared with 33.2 years for those reporting), and more likely to be follow-the-crop migrants and undocumented. No attempt was made to impute missing data for these analyses. The logistic regressions (see analytic strategies) were conducted with the 1,672 respondents who had complete data on all variables.

Measures used

The NAWS contained information relating to biogenetic, social, cultural, economic, and health care access indicators, as well as information on health problems. However, no data on variables from the individual response indicator of the proposed model, such as diet, stress-reduction activities, sleep habits, drug, alcohol, or tobacco use, were available in this survey. Therefore, the model to be tested contained fewer variables than the theoretical model. The individual response indicator was eliminated from the present study and relationships of that indicator were not tested, although it is believed that they exert a major influence on individual health and ability to work and thus they remain in the proposed model. The following section describes the selection, transformation, and integration of NAWS variables into the proposed model.

Variables

Using the model as a guide, the NAWS was reviewed for questions that pertained to the variables of interest. When appropriate, missing or "don't know" values were set to zero. Some variables used in this study were taken directly from the NAWS data, some were recoded to better represent the concept of interest, and some were constructed by combining portions of several NAWS questions.

Health status. The dependent variable (*health problems*) was operationalized with a single variable that was available directly from the data set ("In the U.S.A., and in the last 2 years, have you ever had any health problems [injured or gotten sick]?"). This variable was measured dichotomously (yes/no).

Biogenetic indicators. *Age* and *gender* were available directly in the NAWS data.

Social indicators. Social indicators were operationalized using a number of variables. *Number of years as a farmworker* was available directly from the NAWS data. The literature review indicated that specific *legal status* as available in the NAWS was of less concern than whether the farmworker was documented or undocumented, and so a dichotomous variable was created to indicate this differentiation. The discrete *region*s variable available in the NAWS was recoded to reflect whether the farmworker was interviewed upstream or downstream. Initial analysis indicated that farmworkers who "follow the crops" scored differently on many of the variables than either nonmigrants or shuttle migrants. The NAWS variable for type of migrant was therefore recoded into a dichotomous variable, indicating whether or not the interviewee was a *follow-the-crop* migrant.

The working conditions variables of *payment by piecework* rather than hourly or by salary, requiring payment for transportation to work, and requiring the farmworker to *pay for the equipment* necessary for the job were available in the NAWS but required recoding in order to represent the concepts desired. Two questions in the NAWS asked about transportation payment. One asked whether the worker paid someone to take him/her to work, and the other asked whether riding the labor bus was mandatory. These were combined to reflect the concept of *payment for riding to work* in a dichotomous fashion.

The survey provided several options of how a worker's pay may be calculated, such as piecework, salary, hourly, or a combination. Since *piecework* or not piecework was the issue of concern, the variable was recoded to reflect this dichotomous concept. The NAWS asked who *paid for equipment* needed by the farmworker; this was recoded to reflect whether the employer paid, or the worker or someone on his/her behalf paid all or some of the equipment cost.

There were many questions in the survey related to farmworkers' *housing* situations, but most were descriptive rather than indicative of quality. One question available directly from the data was how many people, other than family members, the farmworker lived with at the present time, and this was used to operationalize the housing variable.

The most direct measure of educational level, *highest grade completed*, was available directly in

the NAWS data. *Literacy* is another measure of education, and one that would account for those who self-educated to some degree. Two NAWS questions about English and primary language literacy were combined, reasoning that literacy in two languages would reduce barriers even more than in only one.

Cultural indicators. Three variables reflective of culture were available in the NAWS data: *English-speaking ability*, family *separation*, and *social support*. English-speaking ability, included in this study to represent language barriers, was available directly from the data, while separation and social support required construction from other variables. The measurement of family separation was available in limited form from questions about how many children less than the age of 18 had been left behind and whether or not a spouse had been left behind for those workers who migrate. The responses to these questions were added, and then converted to a dichotomous variable by recoding to indicate leaving family member(s) at home = 1, not leaving family at home = 0. Social support, albeit only material support, was measured in a NAWS question regarding sources of material support (church, family, community organizations, charitable organizations, friends) in the past year. These responses were summed to reflect the number of sources of support, and then recoded so that not having received support = 0, having received support = 1, making this variable dichotomous lost little in the way of data richness, since few farmworkers had used more than one or two sources of support.

Economic indicators. Two measures of economic status were used from the NAWS data. The first, *family income*, was available directly and was recorded in 15 categories ranging from "under $500" to "over $40,000." The second economic measure, *tangible assets*, was constructed from two questions asking whether the respondent owned or was buying any of the following in the United States or in the home country: plot of land, house, mobile home, car/truck, business, other. These were added to produce the tangible assets variable with a theoretical maximum of 12, if the farmworker owned all listed assets in both countries.

Access to care indicators. All three variables used to reflect access to medical care were constructed from other variables available in the data. The barriers variable was constructed from a follow-up to the question "In general, in the U.S.A., would you say that it is easy or difficult for you to get the kind of medical assistance you need?" The follow-up question was "If it is difficult, please explain why" and was followed by a list of potential barriers. These were added to produce the *barriers* variable used in this study; the potential range was 0–11.

Use of government programs targeting the health needs of low-income individuals and families is another variable that could affect health outcomes. The NAWS data included information about use of health-related social programs such as government clinics, Medicaid, and the Women, Infants, and Children's (WIC) nutrition program. These were summed, and then recoded to reflect no use of government program = 0, use of any of the programs = 1.

Insurance is a variable widely accepted as being important to the health of individuals and groups. Employer-provided health and worker's compensation insurance were available in the NAWS data as three questions addressing free health care for on-the-job illness/injuries, recuperation, or off-the-job illness/injuries. The responses to these questions were summed and aggregated into one variable. The variable was then recoded to indicate not having insurance = 0, having any of the forms of insurance = 1. While this variable was intended to address access issues, it also reflects working conditions due to the wording of the questions ("Does your employer provide . . .?").

Analytic strategy

Bivariate analyses were first performed to test the proposed model. Each arrow in the model was considered to be a hypothesis, and the appropriate statistic was performed to assess the relationship among the variables (data not presented). The relationship of the health problems variable and each correlate variable was also examined with bivariate analysis, either an independent samples *t* test or chi-square (see Table 1).

The health problems variable was then regressed on all correlate variables using logistic regression and a stepwise entry, with the first step encompassing biogenetic, social, and economic variables, the second step adding cultural variables, and the third step adding access variables (see Table 2). Health problems were also regressed on all correlate variables using the likelihood-ratio test feature of SPSS, in which the model fit is compared successively with and without each variable, thus selecting the set of variables that

TABLE 1. *Bivariate Relationships of Selected Characteristics With Health Problems (Mean Values or Percent of Total)*

Characteristic	Health problems ($n = 472$)	No health problems ($n = 1,388$)	Significance	95% CI for mean values
Age (mean)	35	32	<.001	−3.99, −1.49
Gender				
Male	22.3%	77.7%	<.001	
Female	42.0%	58.0%		
Legal status				
Documented	31.2%	68.8%	<.001	
Undocumented	19.6%	80.4%		
Follow-the-crop				
No	24.7%	75.3%	.188	
Yes	27.8%	72.2%		
Region				
Downstream	23.6%	76.4%	.020	
Upstream	28.4%	71.6%		
Paid by piecework				
No	25.5%	74.5%	.871	
Yes	25.1%	74.9%		
Pay for ride				
No	25.6%	74.4%	.669	
Yes	24.6%	75.4%		
Pay for equipment				
No	23.8%	76.2%	.012	
Yes	29.6%	70.4%		
Years in farmwork (mean)	10.89	8.85	<.001	−3.00, −1.08
# living with/housing (mean)	3	4	<.001	0.47, 1.37
Highest grade (mean)	6.22	6.04	.333	−0.54, 0.18
Literacy level/7 categories (mean)	3.16	2.83	<.001	−0.47, −0.17
English-speaking ability				
None	19.6%	80.4%		
A little	28.7%	71.3%	<.001	
Somewhat	35.4%	64.6%		
Well	37.3%	62.7%		
Family separation				
No	26.4%	73.6%	.102	
Yes	22.7%	77.3%		
Social support				
No	26.5%	73.5%	.013	
Yes	19.7%	80.3%		
Income/15 categories (mean)	6.90	5.58	<.001	−1.64, −1.00
Tangible assets	1.32	1.16	.001	−0.25, −0.07
Barriers to health care	0.73	0.75	.616	−0.08, 0.14
Use of government programs				
No	23.1%	76.9%	<.001	
Yes	37.1%	62.9%		
Insurance				
No	26.8%	73.2%	.042	
Yes	22.3%	77.7%		

produce the best model fit (Tabachnick & Fidell, 2007). Significant relationships (at the 0.10 level; see Tabachnick & Fidell, 2007, p. 456) from both these regressions, which had most variables in common, were then noted for inclusion in the reduced model.

Finally, the health problems variable was regressed on all variables that were significant in either of the above regressions to produce the reduced model (see Table 3). The large sample ($n = 1,672$ with complete data) of the 1998 cycle of the NAWS

TABLE 2. *OR (95% CI) of Health Problems, Stepwise Regression Analysis (n = 1,199)*

	OR (95% CI)		
Characteristic	Step 1	Step 2	Step 3
Age	1.01 (0.99–1.03)	1.01 (1.00–1.03)	1.01 (1.00–1.03)
Female gender	2.39 (1.70–3.34)	2.36 (1.67–3.35)	2.38 (1.67–3.38)
Undocumented	0.87 (0.61–1.24)	0.89 (0.62–1.27)	0.91 (0.63–1.31)
Follow the crop	1.51 (1.09–2.09)	1.55 (1.12–2.15)	1.59 (1.15–2.14)
Interviewed upstream	1.43 (1.07–1.91)	1.42 (1.06–1.89)	1.49 (1.11–2.00)
Paid by piecework	0.85 (0.60–1.19)	0.86 (0.61–1.22)	0.88 (0.62–1.25)
Pay for transport	1.20 (0.88–1.63)	1.23 (0.90–1.68)	1.21 (0.88–1.66)
Pay for equipment	1.31 (0.97–1.77)	1.30 (0.96–1.76)	1.35 (0.99–1.84)
Years in farmwork	1.00 (0.98–1.02)	1.00 (0.98–1.02)	1.00 (0.98–1.02)
More crowded housing	1.01 (0.98–1.05)	1.02 (0.98–1.05)	1.01 (0.98–1.05)
Highest grade	1.00 (0.95–1.05)	1.00 (0.95–1.05)	1.00 (0.95–1.05)
Better combined literacy	1.13 (0.99–1.28)	1.05 (0.91–1.22)	1.07 (0.92–1.24)
Higher family income	1.10 (1.04–1.16)	1.09 (1.03–1.15)	1.08 (1.01–1.14)
More tangible assets	1.08 (0.92–1.27)	1.10 (0.93–1.30)	1.09 (0.92–1.29)
Better English-speaking ability		1.19 (0.96–1.47)	1.19 (0.96–1.48)
Has social support		1.09 (0.70–1.70)	1.06 (0.67–1.65)
Family separation		0.89 (0.64–1.23)	0.91 (0.65–1.27)
Barriers to health care			1.09 (0.95–1.24)
Had insurance			1.46 (1.06–2.01)
Used government programs			1.20 (0.85–1.69)
Block χ^2 (significance)	76.56 (< 0.001)	3.29 (0.349)	7.77 (0.051)
% with health problems correctly predicted	11.0	12.5	15.0

Note. CI = confidence interval; OR = odds ratio.

provided sufficient numbers to conduct this analysis, exceeding the 50 subjects per variable used to estimate the adequacy of sample size (Wright, 1995).

Results

A description of the sample is presented in Table 4. Ages ranged from 14 to 90 years, but on average this was a young (32.7 years) and largely male (84.5%) sample, with over half reporting lack of legal documentation. They reported 0–55 years of experience in U.S. farmwork (mean 9.4 years). Educational level and literacy were low, and over 50% reported that they spoke no English at all. The mean family income was $7,250.

Findings of bivariate analyses indicated that the relationships among indicators were appropriately represented by the proposed model. Specific findings are not the emphasis of this paper, but all relationships hypothesized by the arrows in the tested model were supported by the analysis of these data (not shown). For example, men were more likely than women to lack legal documentation, and undocumented workers had lower family incomes than documented workers. Those with poorer working conditions (paid by piecework or required to pay for rides) also had lower family incomes.

Bivariate analysis of each predictor variable and the dichotomous health problems outcome variable indicated a variety of significant findings (see Table 1). Individual biogenetic, social, cultural, economic, and

TABLE 3. *Reduced Model for Logistic Regression of Health Problems on Selected Characteristics*

Characteristic	OR	95% CI
Age	1.01	1.01, 1.02
Female gender	2.27	1.70, 3.03
Follow the crop	1.47	1.12, 1.95
Interviewed upstream	1.46	1.15, 1.86
Required to pay for equipment	1.43	1.10, 1.85
Higher family income	1.13	1.08, 1.18
Better English-speaking ability	1.22	1.08, 1.38
Had insurance	1.27	0.96, 1.67

Model χ^2: $p < .001$
Hosmer and Lemeshow goodness-of-fit: $p = .582$
Predicted health problems: 10.4%

Note. CI = confidence interval; OR = odds ratio.

TABLE 4. *Description of the Hispanic Farmworker Sample on Selected Characteristics*

Characteristic	*n*	%	Mean	*SD*
Health problems				
Yes	472	25.4		
No	1,388	74.6		
Biogenetic				
Age (mean)	1,857		32.7	12.0
Gender				
Male	1,572	84.5		
Female	288	15.5		
Social				
Legal status				
Documented	862	46.9		
Undocumented	976	53.1		
Follow the crop				
Yes	429	23		
No	1,435	77		
Region				
Downstream	1,166	62.6		
Upstream	698	37.4		
Piecework				
No	1,464	78.5		
Yes	400	21.5		
Pay for ride				
No	1,424	76.4		
Yes	440	23.6		
Pay for equipment				
No	1,371	73.6		
Yes	479	25.7		
Years in farmwork	1,862		9.36	9.24
# living with/housing	1,853		3.85	4.32
Highest grade	1,854		6.0	3.41
Literacy level (0–6 potential)	1,835		2.92	1.43
English literacy				
Not at all	1,134	60.8		
A little	470	25.2		
Somewhat	114	6.1		
Well	144	7.7		
Native language literacy				
Not at all	129	6.9		
A little	209	11.2		
Somewhat	418	22.4		
Well	1,081	58.0		
Cultural				
English-speaking ability				
None	942	50.5		
A little	607	32.6		
Somewhat	145	7.8		
Well	169	9.1		
Family separation				
No	1,355	72.7		
Yes	509	27.3		
Social support				
No	1,555	83.4		
Yes	309	16.6		
Economic				
Family income	1,696		$7,250	
Tangible assets	1,692		1.2	0.85
Access				
Barriers	1,582		0.75	1.0
Used government programs				
No	1,546	84		
Yes	302	16		
Insurance				
No	585	68.6		
Yes	1,279	31.4		

access variables were associated with health problems in this population. Older individuals, women, those who had worked longer in U.S. farmwork, and those with low incomes were more likely to report health problems.

When all variables were entered into the stepwise logistic regression, the resulting model was superior to the constant-only model ($p < .001$) and correctly predicted 15% of those with health problems. Significant variables again represented all categories of indicators from the proposed theoretical model (biogenetic, social, cultural, economic, and access). Specifically, gender, follow-the-crop status, location of interview, working conditions as represented by being required to pay for equipment, literacy, family income, and insurance were significant in this logistic regression model. The nonsignificant Hosmer and Lemeshow test ($p = .487$) indicated that this model did not differ significantly from the theoretical "perfect" model (Tabachnick & Fidell, 2007). The likelihood-ratio test produced a very similar model in which the additional variables of age and English-speaking ability were identified as contributing to a well-fit model.

The health problems variable was regressed on all significant variables from the above models to produce the reduced model. This produced a model that was superior to the constant-only ($p < .001$), not significantly different from the "perfect" model ($p = .582$), and correctly predicted 10.4% of those with health problems. In this analysis, insurance dropped to being nonsignificant ($p = .093$), but all other variables retained their value as predictors (see Table 3). Thus, the reduced model reflected biogenetic (age, gender), social (follow-the-crop status, region

interviewed, working conditions as represented by being required to pay for equipment), economic (family income), cultural (English-speaking ability), and access (insurance, *ns*) variables.

Discussion

The results of these initial analyses provide some support for use of the Determinants of Hispanic Farmworker Health Model. It is clear that health is a complex concept that responds to numerous determinants, and these analyses indicate that biogenetic, social, cultural, and economic factors are all germane to the study and prediction of health in the Hispanic farmworker population.

The specific findings of this study support many previous reports. For every year of age in this sample, there was a 1% increase in the likelihood of reporting a health problem. Women were almost 2.3 times more likely to report health problems than were men, possibly because of the physically demanding work and possibly because they were more likely to admit to difficulties (Mines et al., 2001). Follow-the-crop migrants and those interviewed upstream were more likely to report health problems, a finding that supports the earlier work of Dever (1991). Not surprisingly, poor working conditions were also associated with a higher likelihood of reporting health problems in this population, as had been previously reported for a California-based sample (Mines et al., 2001).

Three seemingly counterintuitive findings were that better English-speaking ability, higher family incomes, and having insurance were associated with poorer reported health. It is possible that facility in the local language increased the respondents' comfort level in responding affirmatively to the question, or that the effect of acculturation (often measured by language spoken) resulted in a different interpretation of the question. Higher incomes have been associated with poorer self-rated health worldwide (Sadana, Mathers, Lopez, Murray, & Iburg, 2002), possibly related to higher expectations. This phenomenon may partially explain the income finding as well as the insurance finding of the present study. In this population, having insurance and having a higher income may result in a level of confidence that permitted these workers to admit having had health problems.

For the purposes of testing the model, however, the more important issue was that a wide variety of variables were significant in the prediction of the health problems. No single predictor was predominant, and the model that included all 22 variables correctly predicted 15% of health problems, while the more parsimonious reduced model predicted 10%. These findings support an ecological approach to explaining, predicting, and studying health. The model can be used, as it was in this study, to organize data from a large data set, or it could lend structure to smaller, more focused research. The findings from this study indicate that an ecological approach to migrant farmworker health is valid.

This study reinforces what public health nurses who work with migrant farmworkers have always known: more than health service availability is required to improve this population's health. Nurses working in "upstream" areas and those who see follow-the-crop migrants can request funding for more outreach and case-finding services, especially for groups with poorer working conditions. Culturally appropriate health services for female farmworkers are especially needed. This study also lends support for nurses to be politically active in improving housing and working conditions for this essential workforce.

Limitations to this study stem largely from the fact that it was a secondary analysis and therefore constrained to the variables available in the data set, which, while extensive, were sometimes not ideal. The absence of variables pertaining to individual response, where most nursing interventions would be targeted, and the nature of the "health problems" variable are most notable as limitations (Ward, 2007). In addition, the data were cross sectional and therefore causal relationships could not be inferred. An area not addressed in these analyses but clearly critical to farmworkers' health is that of physical environment, including exposure to pesticides and exposure to the elements while working. This could be considered as a future addition to the Determinants of Migrant Farmworker Health Model.

Additional research is needed in almost all areas of farmworker health. For researchers with appropriate language and cultural skills, qualitative studies inquiring what it is like to follow the crops while managing acute or chronic conditions would help health care providers deliver meaningful, appropriate care. Additional inquiry could illustrate whether male and female farmworkers' health concerns are the same,

and how they decide when to seek health care. Perhaps the most pressing need for further research, and critically important to the public health nurse, is the testing of the individual response category. Understanding the status of farmworkers' diets, health behaviors, responses to stress, and sleep would be helpful in guiding nursing actions both in the clinical and policy arenas. This model could also be tested for use with other culturally distinct groups, and could be especially effective if health-related quality of life were the outcome variable.

Multiple factors are involved in the etiology of health problems for Latino farmworkers in the United States, and the health of farmworkers is of critical importance to the public. The findings of this study provide initial support for interventions at the local, community, and policy levels to modify the conditions associated with poorer health in this population. Examining health from this broad perspective provides public health nurses with a framework for both research and interventions with Latino farmworkers.

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