Housing Quality Among North Carolina Farmworker Families

A. L. Gentry, J. G. Grzywacz, S. A. Quandt, S. W. Davis, T. A. Arcury

ABSTRACT. *Substandard housing poses risks for health and safety. Few studies have documented the housing conditions experienced by Latino farmworker families in the U.S. The purpose of this analysis is to assess the quality of housing occupied by farmworker families in eastern North Carolina and determine how individual and family characteristics are associated with housing quality. Interviews were completed in six North Carolina counties with 186 Latino farmworker households that included a child under the age of 18 to document respondent, household, and dwelling characteristics. Most households were crowded, with 69.4% having more than one person per room (excluding bathrooms and kitchens). Dwellings were often located adjacent to fields (46.0%), suffered from structural problems (e.g., 18.3% had roof leaks), and lacked facilities and appliances (e.g., 26.9% did not have a working oven). Most farmworker family dwellings did not meet the U.S. Department of Housing and Urban Development's minimum criteria for health and safety. Respondents in their thirties, who lived in North Carolina for less than five years, moved two or more times in the past year to follow crops, and lived in grower–provided housing had the poorest housing quality. These results demonstrate that North Carolina Latino farmworker families lack adequate housing. Further research is needed to evaluate farmworker housing conditions in all areas of the U.S., and to document the relationship of these housing conditions to health outcomes. The collaboration of researchers, advocates, policy makers, housing developers, health care providers, and educators is needed to improve the housing conditions of farmworker families.*

Keywords. *Environmental health, Farmworkers, Health disparities, Housing quality, Latinos, Minority health, Occupational health.*

Substandard housing threatens the health of adults and children (Bashir, 2002; Krieger and Higgins, 2002; Saegert and Evans, 2003; Shaw, 2004). Substandard housing refers to dwellings with structural deficiencies, such as deterioration of walls, roof, or foundation; broken or out–of–square windows or doors; and in severe circumstances, non–functioning plumbing and faulty electrical wiring. Crowding and unsanitary conditions (e.g., pest infestations or lack of adequate waste disposal facilities) contribute to the spread of infectious disease. Exposure to environmental toxins that are often present in substandard housing can result in chronic health problems. Structural or electrical deficiencies increase the likelihood for injury. Damp, moldy, and cold indoor environments may be associated with anxiety and depression, as well as atopic diseases

Submitted for review in August 2006 as manuscript number JASH 6615; approved for publication by the Journal of Agricultural Safety and Health of ASABE in December 2006.

The authors are **Amanda L. Gentry,** BA, Research Assistant, Department of Family and Community Medicine, **Joseph G. Grzywacz,** PhD, Associate Professor, Department of Family and Community Medicine, **Sara A. Quandt,** PhD, Professor, Department of Epidemiology and Prevention, Division of Public Health Sciences, **Stephen W. Davis,** MA, Assistant Professor, Department of Family and Community Medicine, and **Thomas A. Arcury,** PhD, Professor and Research Director, Department of Family and Community Medicine, Wake Forest University School of Medicine, Winston–Salem, North Carolina. **Corresponding author:** Thomas A. Arcury, Department of Family and Community Medicine, Wake Forest University School of Medicine, Medical Center Blvd., Winston–Salem, NC 27157–1084; phone: 336–716–9438; fax: 336–716–3206; e–mail: tarcury@wfubmc.edu.

 © 2007 ASABE ISSN 1074–7583

such as asthma and eczema. Poor housing quality may also exacerbate poor health by inhibiting health–promoting behaviors.

Children are particularly vulnerable to the negative consequences of substandard and crowded housing. Children spend up to 90% of their time indoors, and their unique behavioral patterns and biological vulnerabilities yield proportionally greater exposure to environmental toxins compared to adults (Landrigan, 2001; U.S. EPA, 2002). Exposure to toxins early in life is more likely to lead to disease than the same exposure later in life (Dedman et al., 2001). Unaffordable housing, because it forces the allocation of more resources towards obtaining shelter, increases the risk of food insecurity and malnutrition (Quandt et al., 2004a).

Minorities and people with low income are more likely to live in substandard housing than whites and the more affluent (Kreiger and Higgins, 2002; HAC, 2004). While most housing and health research in the U.S. has focused on minority and low–income populations in urban areas, few studies have focused on housing conditions for minority and low–income populations in rural areas (HAC, 2004). This housing research is hampered by the lack of universal definitions for such variables as crowding and reference standards for housing quality.

Little research has systematically evaluated the conditions in which farmworkers live or how housing conditions are related to farmworker health. All dwellings of farmworkers residing in "migrant housing" (that is, available only to migrant farmworkers, not the general population) are subject to federal and state regulations and annual inspection (OSHA, 1996), regardless of the number of farmworkers employed or housed. Seasonal farmworkers and those who migrate but do not live in locales considered migrant housing do not have such protections. Most farmworkers are foreign born (78%), identify themselves as Latino (83%), and are native Spanish speakers with limited English language skills (Carroll et al., 2005). Although some farmworkers migrate from Mexico each year, leaving their families, many live with their families in the U.S.; 63% of those who have children are accompanied by at least some of these children. Almost one–third of farmworker families live below poverty guidelines, earning an average of $15,000 to $17,449 a year (Carroll et al., 2005).

Farmworkers generally have compromised health status, resulting from occupational and environmental exposures (Villarejo, 2003), and poor housing exacerbates several of these health problems. Crowding and poor sanitation increase the risks of infectious diseases, such as tuberculosis (Ciesielski et al., 1991; CDC, 1992), and skin disease (Krejci–Manwaring et al., 2006). Substandard housing promotes pesticide use, as well as injuries among farmworkers (Quandt et al., 2004b; Arcury et al., 2006). Crowding increases stress, undermining mental health (Arcury and Quandt, 2007; Grzywacz et al., 2006).

The existing studies of farmworker housing document that it is often crowded, in disrepair, infested with insects and rodents, lacking basic facilities and appliances, located near fields, and costly (Harrison, 1995; Peck, 1999; HAC, 2001; Holden, 2002; Bradman et al., 2005; Early et al., 2006). They also demonstrate that farmworkers experience significant housing disparities in comparison to the U.S. general and rural populations, and have housing problems that are unique and complex (Bradman et al., 2005; Early et al., 2006). Detailed local surveys are needed in order to determine farmworker communities with the greatest housing needs and tailor housing assistance to the needs of distinct farmworker subgroups (HAC, 2001). This study will provide such a detailed local study. The purpose of this study is to assess housing characteristics for farmworker families in eastern North Carolina using a measure constructed from housing performance requirements and determine how individual and family characteristics are associated with housing quality. Besides adding region–specific data to the literature, this study will demonstrate a measure of housing quality that can be used in other regions.

Method

Data for this analysis are from Casa y Campo, a community–based farmworker pesticide safety education project. The project was a collaboration among the Wake Forest University School of Medicine, the North Carolina Farmworkers Project (a non–profit advocacy and service organization), and Student Action for Farmworkers (a non–profit educational and advocacy organization). One goal of Casa y Campo was to conduct research on environmental health problems identified by community members. Housing quality was an important concern identified by the community.

Sampling and Recruitment

Respondents were recruited from Duplin, Harnett, Johnston, Sampson, Wake, and Wayne counties in eastern North Carolina. Agriculture in this region is dominated by the production of tobacco, sweet potatoes, cucumbers, and other vegetables. In 2000, the six counties had over 30,000 farmworkers and their dependents, nearly one–fifth of the state's farmworker population (Larson, 2000). Eligible respondents had at least one child under the age of 18 residing in the household and had been either employed in farm work during the previous year or were residing with another adult who had been employed in farm work during the previous year. In each household, the female head of household was interviewed; if she was unavailable, the male head of household was interviewed.

Eight staff members from the two community–based organizations employed a site–based method of recruitment, locating respondents at Migrant Head Start centers, churches, laundromats, and residential concentrations such as trailer parks (Arcury and Quandt, 1999). This sampling method is appropriate for hard–to–find populations (Parrado et al., 2005). Briefly, site–based sampling provides for researchers to create a list of the possible places one might encounter farmworkers families. A number of families to be recruited in each site is then decided, proportionate to the number of families estimated to be living there. While data to calculate a precise participation rate are not available, participation is quite high because of the time invested by the community collaborators in setting up personal relationships in the farmworker community.

Respondents were told they would receive a small gift, a bag of food, at the end of the study. Study procedures were approved by the Wake Forest University School of Medicine Institutional Review Board.

Data Collection

Questionnaire data were collected from July through August, 2004. Interviews were conducted in the language chosen by the respondent (Spanish in all cases) in respondents' homes. Only one respondent per household was interviewed. Data were collected on respondent characteristics, household characteristics, and dwelling quality. Interviews took approximately 25 minutes to complete.

Measures

Respondent characteristics (table 1) included gender, age, country of origin, marital status, educational attainment, current employment, length of residence in North Carolina, times moved within the past year for any reason, and times moved within the past year to follow crops. Household characteristics (table 2) included tenure, years lived in current dwelling, number of people in household, number of adults in household, number of children in household, crowding (number of people per room excluding kitchen and bath)

Table 1. Respondent characteristics, farmworker families (*N* = 186) in eastern North Carolina, 2004.

Respondent Characteristics		*n*	%
Gender	Female	172	92.5
	Male	14	7.5
Age	Less than 30 years	87	46.8
	30 to 39 years	66	35.5
	40 years or older	33	17.7
Country of origin	Mexico	172	92.5
	United States	11	5.9
	Guatemala	3	1.6
Marital status	Married or living as married	173	93.0
	Single or divorced	13	7.0
Educational attainment	None	11	5.9
	Primary	118	63.4
	Secondary	38	20.4
	Preparatory or higher	19	10.2
Current employment	Not employed	47	25.3
	Employed part time	38	20.4
	Employed full time	101	54.3
Length of residence in North Carolina	Less than 1 year	38	20.4
	1 to 5 years	66	35.5
	More than 5 years	82	44.1
Times moved in last year for any reason	0	99	53.2
	1	40	21.5
	2 or more	47	25.3
Times moved in last year to follow crops	0	124	66.7
	1	30	16.1
	2 or more	32	17.2

(HAC, 2001), number of people per bedroom, and number of people per bathroom. Dwelling characteristics (table 3) included dwelling type, proximity to farm fields, number of rooms excluding kitchen and bathroom, number of bedrooms, number of bathrooms, structural conditions, condition of windows, condition of doors, condition of paint, type of heating system, lack of appliances and fixtures, and presence of vermin or rodent infestation.

A measure for housing quality was created using the Housing Quality Standards promulgated by the U.S. Department of Housing and Urban Development (HUD) for the Housing Choice Voucher Program. This program is the federal government's major program for assisting very low−income families to afford decent, safe, and sanitary housing in the private market (www.hud.gov/offices/pih/programs/hcv/). The Housing Quality Standards describe 13 performance requirements. This study collected data to evaluate six of the performance requirements: sanitary facilities, food preparation and refuse disposal, space and security, thermal environment, structure and roof materials, and sanitary condition. To meet the performance requirement for sanitary facilities, the dwelling needed to include an indoor toilet. To meet the performance requirement for food preparation and refuse disposal, the dwelling unit needed to have a kitchen, a stove and oven, and a refrigerator. To meet the performance requirement for space and security, the dwelling needed a minimum of a living room, kitchen, and bathroom, at least one bedroom for every two persons, lockable windows, and lockable doors. To meet the

Table 2. Household characteristics, farmworker families (*N* = 186) in eastern North Carolina, 2004.

Household Characteristics		*n*	%
Tenure	Grower–provided	41	22.0
	Rented	97	52.2
	Owned	48	25.8
Years lived in current dwelling	Less than 1 year	77	41.4
	1 to 5 years	92	49.5
	More than 5 years	17	9.1
Number of people in household	2 or 3	36	19.4
	4 or 5	84	45.1
	6 or more	66	35.5
Number of adults in household	1	6	3.2
	2	86	46.2
	3	41	22.0
	4 or more	53	28.5
Number of children in household	1	65	34.9
	2	56	30.1
	3 or more	65	34.9
Crowding	1 or fewer persons per room	57	30.6
	More than one person per room	129	69.4
Number of people per bedroom	2 or fewer	103	55.4
	3 or more	83	43.6
Number of people per bathroom	No bathroom	11	5.9
	Less than 3	45	24.2
	3 to 5	94	50.5
	6 or more	36	19.4

performance requirement for thermal environment, the dwelling unit needed to provide adequate heat, and safe heat. Adequate heat was measured by asking respondents whether or not their heating source(s) kept them warm during the winter. Safe heat sources included central heating, a fireplace or wood stove, and electric space heaters. Unsafe heat sources included non–vented kitchen stoves and kerosene space heaters. To meet the performance requirement for structure and roof materials, the dwelling unit must not have had any serious defects such as holes in the roof, interior or exterior walls, and floors. To meet the performance requirement for sanitary condition, the dwelling unit must have been free of vermin and rodent infestation, including cockroaches, water bugs, fleas, ticks, mice, and rats.

If any component of a performance requirement did not meet the Housing Quality Standards, the dwelling received a “0”. If all the components for a performance requirement were met, the dwelling received a “1”. Performance requirement scores were tallied to calculate a Housing Quality Score; thus, each dwelling received a Housing Quality Score of 0 (worst; met none of the performance requirements) to 6 (best; met all of the performance requirements). To account for those houses not occupied when heating was needed, the Housing Quality Scores were divided by the number of performance requirements with complete data (five or six). Then, the scores were categorized by the dividing the scores into thirds based on approximate tertiles. The first bracket, the “best” housing, included the scores from 0.61 through 1.00. The middle bracket included housing with scores from 0.33 through 0.60. The third bracket, the “worst” housing, included homes with scores less than 0.33. The decision to categorize the outcome acknowledges the fact

Table 3. Dwelling characteristics, farmworker families (*N* = 186) in eastern North Carolina, 2004.[a]

Dwelling Characteristics		*n*	%
Dwelling type	Mobile home	155	83.3
	One–family detached house	23	12.4
	Barrack/small apartment	4	2.1
Proximity to farm fields	Next to house or across road	85	45.7
	Between 1/4 and 1 mile	64	34.5
	More than 1 mile	25	13.5
Number of rooms	1 to 3	100	53.8
	4 or more	86	46.2
Number of bedrooms	1 or 2	109	58.6
	3 or more	77	41.4
Number of bathrooms	0	11	5.9
	1	110	59.1
	2 or more	65	35.0
Structural condition[b]	Roof leaks	34	18.3
	Interior walls have holes	37	19.9
	Exterior walls have holes	27	14.5
	Floors have holes	27	14.5
Condition of windows[b]	Do not open and close properly	36	19.3
	Do not have locks	60	32.3
	Have broken glass	69	37.1
	Do not have screens that fit	101	54.3
	Screens with holes/no screens	77	41.4
Condition of doors[b]	Do not open and close properly	16	8.6
	Do not have locks	28	15.1
	Do not have screens	116	62.4
Condition of paint[b]	Exterior paint peeling	71	38.2
	Interior paint peeling	41	22.0
	Window frame paint peeling	44	23.7
Heating system[b]	Central heating	93	58.9
	Fireplace or wood stove	13	8.2
	Kitchen stove	24	15.2
	Kerosene space heater	53	33.8
	Electric space heater	55	35.0
Lack of appliances and fixtures[b]	No working stove	9	4.8
	No working oven	50	26.9
	No working refrigerator	15	8.1
	No working washing machine	63	33.9
	No working dryer	124	66.7
Presence of vermin or rodent infestation	Present	136	73.1
	Not present	50	26.9

[a] Some values may not sum to 186 because of missing data.
[b] Dwellings can be in more than one category.

that only a subset of HUD housing performance indicators were assessed, and to better characterize the overall quality of farmworker housing.

Analysis

Percentages were computed to describe the sample, characteristics of participants' households, and individual characteristics of dwellings indicative of housing quality. The bivariate association of each of the individual and household characteristics with the categorical indicator of housing quality was explored. These bivariate analyses did not include some household characteristics (e.g., number of people per bathroom) because they are indicators of housing quality, the dependent variable. Factors associated with housing quality ($p < 0.10$) are reported. A multinomial logistic regression model was then fit to identify characteristics associated with living in the "worst" and "moderate" in contrast to the "best" quality housing. Following the model building strategy of Hosmer and Lemeshow (1989), all variables with a p−value less than or equal to 0.25 and that were not strongly inter−correlated (Spearman correlation < 0.50) were included in the multivariate analyses. All analyses were completed using SPSS version 12.0 (SPSS, Inc., Chicago, Ill.).

Results

Respondents

Respondents were largely women (92.5%) (table 1). Most were young, with 46.8% under age 30. Most were from Mexico (92.5%), married or living as married (93.0%), and had a primary education (63.4%) or less (5.9%). One−fourth were not employed, while over half (54.3%) were employed full−time. Respondents were mobile; 20.4% had resided in North Carolina for less than one year, and 35.5% for one to five years. More than two−fifths (46.8%) reported having moved one or more times within the past year, and one−third (33.3%) reported having moved one or more times in order to follow crops.

Households

Homeownership was low (25.8%) (table 2). About half (52.2%) rented their dwelling, and 22.0% lived in housing provided by the grower for whom they worked. Two−fifths of the households had lived in their dwelling for less than one year. Half had lived in their dwelling between one and five years. Very few (9.1%) had lived in their dwelling for more than five years. Household size ranged from 2 to 11 people, with a mean of 5.18 (SD = 1.9). Over one−quarter (28.5%) of the households had four or more adults, with 22.0% having three adults; over one−third (34.9%) had three or more children. The majority of households (69.4%) were crowded, defined as having more than one person per room. Crowded bedrooms (more than two people per bedroom) were prevalent (43.6%). More than half (50.5%) shared one bathroom among three people, and many households (19.4%) shared one bathroom among six or more people.

Dwellings

Most dwellings were mobile homes (83.3%) and were often located adjacent to farm fields (45.7%) (table 3). Dwellings were typically small, with over half having three or fewer rooms (53.8%) and one or two bedrooms (58.6%). Eleven (5.9%) had no bathroom, and most had a single bathroom (59.1%). Structural problems included leaking roofs (18.3%) and holes in the exterior walls (14.5%), interior walls (19.9%), or floors (14.5%). Often windows did not open and close properly (19.3%), did not have locks (32.3%), had broken glass (37.1%), had screens that did not fit (54.3%), or had screens with holes or no screen at all (41.4%). Similarly, doors did not open and close properly (8.6%), have locks (15.1%), or have screens (62.4%). Peeling paint was present on the exterior of the dwellings (38.2%), the interior of the dwellings (22.0%), and on window frames (23.7%).

Table 4. Farmworker housing conditions compared to HUD performance requirements, eastern North Carolina, 2004 (*N* = 186).

	Meets HUD Performance Requirements	
Performance Requirements	*n*	%
Sanitary facilities[a]	177	95.2
Food preparation and refuse disposal	131	70.4
Kitchen[b]	176	94.6
Stove and oven[c]	136	73.1
Refrigerator[d]	171	91.9
Space and security	68	36.6
Adequate rooms[e]	174	93.5
Adequate sleeping quarters[f]	103	55.4
Lockable windows[g]	126	67.7
Lockable doors[h]	158	84.9
Thermal environment[i]	74	39.8
Adequate heat[j]	138	74.2
Safe heat[k]	85	45.7
Structure and materials	123	66.1
Roof[l]	152	81.7
Outside walls[m]	159	85.5
Inside walls[m]	149	80.1
Floors[m]	159	85.5
Sanitary condition[n]	50	26.9

[a] The dwelling unit must have an indoor toilet within the unit.
[b] The dwelling unit must have suitable space and equipment to store, prepare, and serve food in a sanitary manner.
[c] The dwelling unit must have a stove and a range (however, a microwave may be substituted).
[d] The dwelling unit must have a refrigerator of appropriate size for the family.
[e] At a minimum, the dwelling must have a living room, kitchen, and bathroom.
[f] The dwelling unit must have at least one bedroom/sleeping room for every two persons.
[g] Dwelling unit's windows that are accessible from the outside must be lockable.
[h] Exterior doors to the unit must be lockable.
[i] 28 participants (15.2%) did not live in the dwelling when heat was needed.
[j] The dwelling unit must be able to provide a thermal environment that is healthy for the human body. It must provide adequate heat.
[k] There must be a safe system for heating the dwelling unit. The dwelling must not contain unvented room heaters that burn gas, oil, or kerosene. Electric heaters are acceptable.
[l] The roof must be structurally sound and weatherproof.
[m] Ceilings, walls, and floors must not have any serious defects such as severe bulging or leaning, large holes, loose surface materials, surface buckling, missing parts, or other serious damage.
[n] The dwelling must be free of vermin and rodent infestation. This includes cockroaches, waterbugs, fleas, ticks, mice, and rats.

More than half of the dwellings (58.9%) had central heat, while the remainder used one or more alternative methods such as fireplace or wood stove (8.2%), a kitchen stove (15.2%), kerosene space heater (33.8%), or electric space heater (35.0%). For a few, the heat source was insufficient (8.1%). Several had not lived in the dwelling when heat was needed (15.2%). Several lacked functioning appliances such as stoves (4.8%), ovens (26.9%), refrigerators (8.1%), washing machines (33.9%), or dryers (66.7%).

Housing Quality

Many dwellings did not meet the performance requirements (table 4). Most dwellings (95.2%) had an indoor toilet and therefore met the performance requirement for sanitary facilities. Many (70.4%) met the requirement for food preparation and disposal. Fewer

Table 5. Correlates of housing quality, farmworker families (*N* = 186), eastern North Carolina, 2004.

	Housing Quality						
	Worst (<0.33)		Moderate (0.33–0.60)		Best (0.61–1.00)		
Predictor	*n*	%	*n*	%	*n*	%	p Value[a]
Total	51	27.4	42	22.6	93	50.0	
Age							0.012
Less than 30 years	24	27.6	29	33.3	34	39.1	
30 to 39 years	17	25.8	10	15.2	39	59.1	
40 years or older	10	30.3	3	9.1	20	60.6	
Length of residence in North Carolina							0.081
Less than 1 year	11	28.9	12	31.6	15	39.5	
1 to 5 years	23	34.8	15	22.7	28	42.4	
More than 5 years	17	20.7	15	18.3	50	61.0	
Number of times moved last year, any reason							0.005
0	33	33.3	15	15.2	51	51.5	
1	3	7.5	13	32.5	24	60.0	
2 or more	15	31.9	14	29.8	18	38.3	
Number of times moved last year for crops							0.001
0	36	29.0	21	16.9	67	54.0	
1	2	6.7	9	30.0	19	63.3	
2 or more	13	40.6	12	37.5	7	21.9	
Tenure							0.003
Grower–provided	14	34.1	14	34.1	13	31.7	
Rented	32	33.0	17	17.5	48	49.5	
Owned	5	10.4	11	22.9	32	66.7	
Length of time in current home							0.039
Less than 1 year	18	23.4	24	31.2	35	45.5	
1 to 5 years	30	32.6	12	13.0	50	54.3	
More than 5 years	3	17.6	6	35.3	8	47.1	

[a] p–values based on chi–squared tests of association.

dwellings (36.6%) provided sufficient space and security, or a suitable thermal environment (39.8%). Two–thirds (66.1%) of dwellings met the performance requirement for structure and materials. One–quarter (26.9%) of dwellings met the sanitary condition performance requirement. The distribution of performance requirement total scores was (0, worst) no dwellings, (1) 20 dwellings, (2) 39 dwellings, (3) 34 dwellings, (4) 56 dwellings, (5) 23 dwellings, and (6, best) 14 dwellings.

Participant age, length of residence in North Carolina, number times moved in the past year (in general as well as to follow crops), tenure, and length of time in current home were all associated with housing quality (table 5). Recognizing that several of these factors are intercorrelated, each was included in a multinomial logistic regression model to identify factors that were independently associated with "worse" and "moderate" housing quality (table 6). Two factors differentiated individuals in the worst versus best housing quality. Relative to individuals who have moved two or more times to follow crops, being in the worst quality housing was less common for those who never moved ($p < 0.10$) and those who moved only once. Being in the worst quality housing was also lower for individuals who were owners than for those in grower–provided housing. Three factors differentiated individuals in moderate and the best quality housing. Being in

Table 6. Multinomial logistic regression model predicting "worst" and "moderate" housing quality for farmworker families in eastern North Carolina.

	Worst versus Best Housing[a]		Moderate versus Best Housing[a]	
	b	SE	b	SE
Age				
Less than 30 years	Reference		Reference	
30 to 39 years	−0.27	0.46	−1.27***	0.51
40 years or older	−0.02	0.58	−2.11***	0.76
Length of residence in North Carolina				
Less than 1 year	Reference		Reference	
1 to 5 years	0.37	0.72	0.06	0.66
More than 5 years	−0.14	0.76	−0.33	0.68
Number of times moved in last year for any reason				
0	0.94	0.78	0.27	0.74
1	−0.91	0.85	0.07	0.67
2 or more	Reference		Reference	
Number of times moved in last year to follow crops				
0	−1.50*	0.80	−1.36*	0.74
1	−2.42**	1.04	−1.28	0.83
2 or more	Reference		Reference	
Tenure				
Grower−provided	Reference		Reference	
Rented	−0.76	0.56	−1.20**	0.59
Owned	−2.11***	0.71	−0.62	0.65
Length of time in current home				
Less than 1 year	Reference		Reference	
1 to 5 years	−0.12	0.67	−0.73	0.65
More than 5 years	−0.70	1.03	0.73	0.93
Intercept	1.34	0.72	1.98	0.74

[a] * = $p < 0.10$; ** = $p < 0.05$; and *** = $p < 0.01$ (two−tailed, based on Wald statistics).

moderate (as opposed to the best) quality housing was less common for adults aged 30 to 39 and those over 40 in contrast to those less than 30. Relative to individuals who moved two or more times in the past year to follow crops, those who did not move were less likely to be in moderate housing ($p < 0.10$). Individuals who rented, relative to those in grower−provided housing, were less likely to be in moderate quality housing.

Discussion

Many farmworker families in eastern North Carolina live in substandard housing. The results of this study are comparable to findings from other studies evaluating housing for farmworker populations that show their housing is in disrepair, lacks basic facilities and appliances, and is crowded (Harrison, 1995; Peck, 1999; HAC, 2001; Holden, 2002; Bradman et al., 2005; Early et al., 2006). The results also indicate that much of the housing for farmworker families in eastern North Carolina does not meet minimum requirements for health and safety. This study also delineates how characteristics of farmworker families are associated with housing quality, showing that farmworkers less than 30, who move frequently to follow crops, and who live in grower−provided housing had poorer housing quality.

Farmworkers and their families experience complex housing problems similar to other rural, poor minorities, such as limited housing stock, limited rental housing, and poor quality housing. Farmworkers are also a special population with unique characteristics that affect their housing needs: they have lifestyles that demand frequent moving, cultural characteristics and languages that differ from the majority population, and access to special housing types (i.e., camps controlled by their employers) (Holden, 2001).

Housing arrangements reported in this study were comparable to those in the most recent National Agricultural Workers Survey (Carroll et al., 2005). In the national survey, 21%, 58%, and 19% of workers lived in grower–provided, non–employer rental, and worker–owned housing, respectively; compared to 22%, 52%, and 26% in the current study.

Grower–provided is a housing type unique to farmworkers and their families. Traditionally, the need to temporarily house farmworkers and their families that migrate for work has been met by growers who have provided housing. In recent years, there has been a decline in the number of growers providing housing. This study demonstrates that farmworker families residing in grower–provided housing were likely to live in poorer quality dwellings compared to those living in owner–occupied housing. This is surprising, as "migrant housing," such as that supplied by growers, is subject to federal regulation and annual inspection (OSHA, 1996). However, the North Carolina Department of Labor, which is responsible for migrant housing inspections, has insufficient staffing to inspect all housing. In addition, housing is inspected before occupancy; conditions may change once the housing is occupied. Research on non–farmworker populations has demonstrated that the type of housing in which low–income families reside (e.g., owner–occupied, privately rented, or public housing) adversely affects their health outcomes (Bashir, 2002). Because grower–provided housing tends to be poorer quality and because research in other populations indicates that housing type is associated with health outcomes, farmworker families living in grower–provided housing, especially children, may be at great risk for adverse health outcomes.

Rental units are an important part of the housing stock for households who cannot afford to purchase their own homes, or need flexibility due to their employment, lifestyle, or family size that cannot be met through homeownership. However, the rural rental stock and needs of rural renters are often overlooked (HAC, 2000). Rental housing is an important option for farmworker families because many have occupational demands and lifestyles that require them to move often, establish temporary homes, and seek housing in multiple locations throughout the year. Approximately one–third of farmworker families in this study had moved at least once in the previous year to follow crops, and these families were more likely to live in poor quality housing than the other farmworker families. Nationally, in 2001–2002, 42% of all farmworkers migrated for work (Carroll et al., 2005). Those families who had resided in North Carolina for fewer than five years were also more likely to live in poorer quality housing than other families. These families may not have the financial or social resources to secure adequate housing.

Homeownership rates are higher among rural households than among general U.S. households. However, farmworkers have very low rates of homeownership compared to the U.S. general and rural populations (HAC, 2001). Approximately 75% of rural households live in owner–occupied dwellings, compared to 66% of general households. One–fourth of farmworker families in this study lived in owner–occupied dwellings. Homeownership may not be a goal for some farmworker families (e.g., those that migrate or intend to return to their country of origin); however, other farmworker families (e.g., seasonal farmworkers) that are settled may seek to own their own homes in the U.S. They experience similar barriers to homeownership as other rural renters (e.g., low income), as well as unique barriers (e.g., limited ability to speak English) (Krivo, 1995).

An important concern for farmworker families that reside in poor housing conditions is their health, especially children's health. With the data for non–farmworker populations that document that housing is an agent for health, safety, and positive life outcomes, farmworkers and their families are vulnerable to health consequences associated with poor quality housing (Shaw, 2004). Furthermore, farmworker families may also encounter special health risks related to their housing, including pesticide exposure and crowding (Quandt et al., 2004b; Arcury et al., 2005; Arcury et al., 2006; Early et al., 2006).

Pesticide exposure among farmworker families is a major concern. Prolonged exposure to pesticides, even in small amounts, increases the risks of infertility, birth defects, neurological damage, and cancer (Eskenazi et al., 1999; Alavanja et al., 2004; Kamel and Hoppin, 2004). Farmworkers are exposed to pesticides through their labor, and their families are exposed to these pesticides through take–home pathways (Quandt et al., 2004b, 2006; Rao et al., 2006). Because farmworker families often live adjacent to farm fields, they are further exposed to agricultural pesticides through drift (Fenske et al., 2002). In addition, because their housing units are poor quality and often have insect and rodent infestations, farmworkers' exposure to residential pesticides is substantial (Quandt et al., 2004b, 2006). Features of their inadequate housing, such as the lack of laundry facilities or few bathrooms, may inhibit farmworkers from practicing safe pesticide behaviors, such as proper laundering practices to remove pesticides and showering when returning home from the fields (Grieshop et al., 1994; Arcury et al., 2001). The housing of respondents in the current study was characterized by a number of these factors associated with pesticide exposure: proximity to fields, inadequate bathing and laundry facilities, and pest infestations.

Crowding is a major problem for farmworker households. Crowding increases the spread of infectious disease (e.g., skin or respiratory infections) and exposure to environmental toxins (e.g., pesticides). Rates of crowding among farmworker households are high, and the reasons for crowding are not entirely understood. In rural areas of the U.S., crowding results from a lack of affordable housing units. It has been suggested that crowding in farmworker households reflects cultural preferences in living arrangements (Myers et al., 1996). Other research suggests that farmworker families believe their housing is crowded and that is has a detrimental effect on their quality of life (Early et al., 2006). Little is known about how farmworker families make decisions about their living arrangements.

The results of this study contribute to the understanding and documentation of the unique and complex housing problems encountered by farmworkers and their families. The results provide new and significant insight into farmworker family housing conditions in eastern North Carolina by evaluating housing quality and considering which farmworker families have the greatest housing needs. In addition, the use of HUD performance requirements suggests a means of comparing farmworker housing in different areas, as well as comparing farmworker with non–farmworker housing. Efforts to improve farmworker housing will likely have a notable impact on the quality of life for farmworkers and their children.

Despite its contributions, this study is limited by several factors. First, the lack of a universal definition or guidelines regarding what is standard or substandard housing makes both measuring housing quality and comparison of farmworker housing across studies difficult. This study adapted a housing quality measure from the Housing Quality Standards put forth by HUD to provide "decent, safe, and sanitary" housing for low–income families participating in Section 8 rental assistance. Second, the housing quality score used in this study included only six of the 13 performance requirements set forth by HUD because data were not collected for the remaining seven performance requirements. While a comprehensive evaluation of housing quality would have been preferred, it is im-

portant to note that only 7.5% of participants passed these six performance requirements, thus reinforcing the overall poor state of farmworker family housing. Third, this study employed a site–based approach to locate participants. Farmworkers are a hidden and relatively inaccessible population (Kamel et al., 2001), and due to the dispersed nature of farmworker residences, a standard random sample design could not be employed. Therefore, the sample may not be representative of the farmworker population. Future housing and health studies within farmworker populations may benefit from a cluster sampling method in order to evaluate neighborhood–level characteristics of housing and community health. Finally, this study used self–reported data and would have been strengthened by direct observation of housing units.

More research is needed to evaluate the housing conditions of farmworker families, as well as other farmworker subgroups (e.g., unaccompanied single men) and farmworker populations in other areas of the U.S. Research needs to address the relationship between housing and health specifically for farmworkers and their families, and should incorporate the interplay between environmental housing conditions and health behavior. Research should also address farmworkers' and their families' beliefs about housing in the U.S., as well as how they make decisions about their living arrangements in order to comprehensively and holistically understand and address their housing needs.

This research supports calls for action to improve housing of farmworkers. This can be accomplished through the collaboration of researchers, advocates, and policy makers, as well as housing developers, health care providers, and educators who serve the farmworker population and can improve the housing conditions of farmworker families. Farmworker families reside in poor housing because regulations for grower–provided housing are not being enforced and because the rural areas in which they live and work lack adequate housing infrastructure. Construction of housing for low–income families is needed in rural areas. Provision of short–term housing is needed to meet the specific needs of migrant families.

Acknowledgement

This research was supported by Grant No. R25 OH07611 from the National Institute for Occupational Safety and Health.

References

Alavanja, M. C. R., J. A. Hoppin, and F. Kamel. 2004. Health effects of chronic pesticide exposure: Cancer and neurotoxicity. *Ann. Rev. Public Health* 25: 155–197.

Arcury, T. A., and S. A. Quandt. 1999. Participant recruitment for qualitative research: A site–based approach to community research in complex societies. *Human Organ.* 58(2): 128–133.

Arcury, T. A., and S. A. Quandt. 2007. Delivery of health services to migrant and seasonal farmworkers. *Ann. Rev. Public Health* 28: 345–363.

Arcury, T. A., S. A. Quandt, A. J. Cravey, R. C. Elmore, and G. B. Russell. 2001. Farmworker reports of pesticide safety and sanitation in the work environment. *American J. Ind. Med.* 39(5): 487–498.

Arcury, T. A., S. A. Quandt, P. Rao, A. Doran, B. M. Snively, S. Davis, D. B. Barr, and J. A. Hoppin. 2005. Organophosphate pesticide exposure in farmworker family members in western North Carolina and Virginia: Case comparisons. *Human Organ.* 64(1): 40–51.

Arcury, T. A., J. G. Grzywacz, S. W. Davis, D. B. Barr, and S. A. Quandt. 2006. Organophosphorus pesticide urinary metabolite levels of children in farmworker households in eastern North Carolina. *American J. Ind. Med.* 49(9): 751–760.

Bashir, S. A. 2002. Home is where the harm is: Inadequate housing as a public health crisis. *American J. Public Health* 92(5): 733–738.

Bradman, A., J. Chevrier, I. Tager, M. Lipsett, J. Sedgwick, J. Macher, A. B. Vargas, E. B. Cabrera, J. M. Camacho, R. Weldon, K. Kogut, N. P. Jewell, and B. Eskenazi. 2005. Association of housing disrepair indicators with cockroach and rodent infestation in a cohort of pregnant Latina women and their children. *Environ. Health Perspect*. 113(12): 1795–1801.

Carroll, D., R. M. Samardick, S. Bernard, S. Gabbard, and T. Hernandez. 2005. Findings from the National Agricultural Workers Survey (NAWS) 2001–2002: A demographic and employment profile of United States Farm Workers. Research Report No. 9. Washington, D.C.: U.S. Department of Labor.

CDC. 1992. Prevention and control of tuberculosis in migrant farm workers: Recommendations of the advisory council for the elimination of tuberculosis. *MMWR* 41(10): 1–15.

Ciesielski, S. D., J. R. Seed, D. H. Esposito, and N. Hunter. 1991. The epidemiology of tuberculosis among North Carolina migrant farm workers. *JAMA* **265(13)**: 1715–1719.

Dedman, D. J., D. Gunnell, G. Davey Smith, and S. Frankel. 2001. Childhood housing conditions and later mortality in the Boyd Orr cohort. *J. Epidemiol. Community Health* 55(1): 10–15.

Early, J., S. W. Davis, S. A. Quandt, P. Rao, B. M. Snively, and T. A. Arcury. 2006. Housing characteristics of farmworker families in North Carolina. *J. Immigr. Minor. Health* 8(2): 173–184.

Eskenazi, B., A. Bradman, and R. Castorina. 1999. Exposures of children to organophosphate pesticides and their potential adverse health effects. *Environ. Health Perspect.* 107(Suppl. 3): 409–419.

Fenske, R. A., C. Lu, D. Barr, and L. Needham. 2002. Children's exposure to chlorpyrifos and parathion in an agricultural community in central Washington State. *Environ. Health Perspect*. 110(5): 549–553.

Grieshop, J. I., N. E. Villanueva, and M. C. Stiles. 1994. Wash day blues: Secondhand exposure to agricultural chemicals. *J. Rural Health* 10(4): 247–257.

Grzywacz, J. G., S. A. Quandt, J. Early, J. Tapia, C. N. Graham, and T. A. Arcury. 2006. Leaving family for work: Ambivalence and mental health among migrant Mexican farmworker men. *J. Immigr. Minor. Health* 8(1): 85–97.

Harrison, P. 1995. Safe, clean, and affordable: California farmworker housing needs. *J. Archit. Plan. Res.* 12(1): 19–34.

HAC. 2000. Why housing matters: HAC's 2000 report on the state of the nation's rural housing. Washington, D.C.: Housing Assistance Council.

HAC. 2001. No refuge from the fields: Findings from a survey of farmworker housing conditions in the United States. Washington, D.C.: Housing Assistance Council.

HAC. 2004. Race, place, and housing: Housing conditions in rural minority counties. Washington, D.C.: Housing Assistance Council.

Holden C. 2001. Housing. *Migrant Health Issues Monograph Series* 8: 40–45.

Holden C. 2002. Bitter harvest: Housing conditions of migrant and seasonal farmworkers: In *The Human Cost of Food: Farmworkers' Lives, Labor, and Advocacy*, 169–193. C. D. Thompson and M. F. Wiggins eds. Austin, Texas: University of Texas Press.

Hosmer, D. W., and S. L. Lemeshow. 1989. *Applied Logistic Regression*. New York, N.Y.: John Wiley and Sons.

Kamel, F., and J. A. Hoppin. 2004. Association of pesticide exposure with neurological dysfunction and disease. *Environ. Health Perspect.* 112(9): 950–958.

Kamel, F., T. Moreno, A. S. Rowland, L. Stallone, G. Ramirez–Garnica, and D. P. Sandler. 2001. Recruiting a community sample in collaboration with farmworkers. *Environ. Health Perspect.* 109(Suppl. 3): 457–459.

Krejci–Manwaring, J., M. R. Schulz, S. R. Feldman, Q. Vallejos, S. A. Quandt, S. R. Rapp, and T. A. Arcury. 2006. Skin disease among Latino farmworkers in North Carolina. *J. Agric. Safety Health* 12(2): 155–163.

Krieger, J., and D. L. Higgins. 2002. Housing and health: Time again for public health action. *American J. Public Health* 92(5): 758–768.

Krivo, L. J. 1995. Immigrant characteristics and Hispanic–Anglo housing inequality. *Demography* 32(4): 599–615.

Landrigan, P. J. 2001. Pesticides and polychlorinated biphenyls (PCBs): An analysis of the evidence that they impair children's neurobehavioral development. *Molec. Genet. Metab.* 73(1): 11–17.
Larson, A. C. 2000. Migrant and seasonal enumeration profiles study: North Carolina. Report prepared for the Migrant Health Program, Bureau of Primary Health Care, Health Resources and Services Administration.
Myers, D., W. Baer, and S. Choi. 1996. The changing problem of overcrowded housing. *J. American Plan. Assoc.* 62(winter): 66–84.
OSHA. 1996. Federal Migrant Housing Regulations. Washington, D.C.: U.S. Department of Labor. Available at: www.usda.gov/oce/labor/laws.htm. Accessed 23 May 2007.
Parrado, E. A., C. McQuiston, and C. A. Flippen. 2005. Participatory survey research: Integrating community collaboration and quantitative methods for the study of gender and HIV risks among Hispanic migrants. *Sociol. Methods Res.* 34(2): 204–239.
Peck, S. 1999. Many harvests of shame: Housing for farmworkers: In *Housing in Rural America: Building Affordable and Inclusive Communities*, 83–90. J. N. Belden and R. J. Weiner, eds. Thousand Oaks, Cal.: Sage Publications.
Quandt, S. A., T. A. Arcury, J. Early, J. Tapia, and J. D. Davis. 2004a. Household food security among Latino farmworkers in North Carolina. *Public Health Rep.* 119(6): 568–576.
Quandt, S. A., T. A. Arcury, P. Rao, B. M. Snively, D. E. Camann, A. M. Doran, A. Y. Yau, J. A. Hoppin, and D. S. Jackson. 2004b. Agricultural and residential pesticides in wipe samples from farmworker family residences in North Carolina and Virginia. *Environ. Health Perspect*. 112(3): 382–387.
Quandt, S. A., M. A. Hernández–Valero, J. G. Grzywacz, J. D. Hovey, M. Gonzales, and T. A. Arcury. 2006. Workplace, household, and personal predictors of pesticide exposure for farmworkers. *Environ. Health Perspect*. 114(6): 943–952.
Rao, P., A. L. Gentry, S. A. Quandt, S. W. Davis, B. M. Snively, and T. A. Arcury. 2006. Pesticide safety behaviors in Latino farmworker family households. *American J. Ind. Med.* 49(4): 271–280.
Saegert, S., and G. W. Evans. 2003. Poverty, housing niches, and health in the United States. *J. Soc. Issues* 59(3): 569–589.
Shaw, M. 2004. Housing and public health. *Ann. Rev. Public Health* 25: 397–418.
U.S. EPA. 2002. Child–specific exposure factors handbook (Interim report). EPA–600–P–002B. Washington D.C.: U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessments.
Villarejo, D. 2003. The health of U.S. hired farm workers. *Ann. Rev. Public Health* 24: 175–193.