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ORIGINAL PAPER

Association Between Housing Quality and Individual Health Characteristics on Sleep Quality Among Latino Farmworkers

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Abstract Although poor sleep quality and associated sleep disorders are associated with increased risk of job injury and multiple mental and physical health problems, scant research has examined sleep quality among Latino farmworkers. Interviews were conducted with 371 male Latino farmworkers working in North Carolina during the 2010 agricultural season. Data on housing quality and sleep quality were collected. Access to air conditioning was significantly and positively associated with good sleep quality. This association remained when other housing characteristics and individual health indicators were controlled. Good sleep quality was associated with low levels of pain, depression, and anxiety. Poor sleep quality among Latino farmworkers was associated with poorer indicators of health. One important indicator of housing quality, air conditioning, was associated with better sleep quality. Further research is required to delineate how to improve the adequacy of farmworker housing to improve sleep quality and other health indicators.

Keywords Latino farmworkers · Housing · Sleep quality · Depression · Anxiety · Musculoskeletal pain

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Introduction

Sleep health, including sleep quality, significantly affects workers' physical and mental health. Sleep disorders, such as untreated obstructive apnea and insomnia, are associated with an increased risk of workplace injury [1–3], physical health problems [4–6], musculoskeletal pain, depression, and anxiety [7–12]. Limited information is available about sleep quality and the prevalence of sleep disorders among the Latino population [13–16]; substantially less is known about the sleep quality of Latino farmworkers [12, 17]. Twenty percent of Latino farmworkers in Texas report poor sleep quality [18]. Between 11 and 20 % of Latino farmworkers in North Carolina (NC) experience elevated daytime sleepiness (EDS) across the season. Furthermore, EDS is positively associated with elevated depressive symptoms [12, 17]. Additional research is needed to determine sleep quality among Latino farmworkers and to analyze environmental and individual factors that detract from sleep quality.

Housing conditions can affect farmworker sleep health in many ways. Noise in the sleeping room, elevated

sleeping room temperatures, and allergic rhinitis negatively affect sleep health [19–26]. Many farmworkers live in substandard and crowded housing that may not be conducive to sleep health [27–29]. Lack of functional windows and screens for ventilation may also contribute to elevated temperatures and poor sleep quality [28].

Physical and mental health affects sleep health. Poorer self-reported health scores are associated with increased prevalence of sleep disorders [30]. Obesity is associated with obstructive sleep apnea, which in turn contributes to sleep-related disorders [31–33]. Musculoskeletal pain, depression, and anxiety appear to be linked to sleep disorders and their symptoms [8–12, 18, 33, 34].

This study addresses gaps in our knowledge about sleep quality among male Latino farmworkers. The purpose of the study is to (1) characterize the sleep quality and sleep characteristics of male Latino farmworkers in NC during the 2010 farming season, and (2) determine the association between sleep quality and housing quality measures and farmworker health using bivariate and multivariate analyses.

Materials and Methods

Data are from a cross-sectional survey of 371 male, Spanish-speaking, Latino, migrant farmworkers and examination of their housing conducted in 16 counties in the NC Piedmont and Coastal Plain from June–October, 2010. Data collectors participated in a 2-day training session led by the principal investigator and field supervisors. After completion of each interview, the questionnaire was independently field edited by the interviewer and field supervisor to minimize missing data. All interviewers were fluent in Spanish. Research staff verbally explained to each participant the purpose of the research study, the issues that would be addressed in the questionnaire and housing inspection, and that their participation was voluntary. The same information was provided in the Spanish version of the consent form. After participants were given the opportunity to ask questions about the study, the participants provided written informed consent. The study protocol was approved by the Wake Forest School of Medicine Institutional Review Board.

To be included in the study, camps were required to have at least three male migrant residents age 18 or older currently employed in farm work. Lists of camps were provided by partner organizations. Camps included barracks and other communal residences or clusters of residences, such as trailers and detached houses, where workers shared housing facilities. Field supervisors expanded the list as they encountered new camps. Recruitment was attempted at 226 camps; growers, contractors, or residents at 40 camps refused participation for a camp refusal rate of 17.7 %. Housing assessments were completed in all but three of the 186 camps. One camp resident changed his mind about participation, and two farmers halted the study before assessments could be completed at two camps.

At each camp, the first three eligible male farmworkers who agreed to participate in the study were included, two to complete the interviewer-administered questionnaire and one to assist with the housing inspection. The final sample included 371 men who completed interviews and 182 men who assisted in the camp assessments; 231 men refused to participate when asked, resulting in 79.5 % (553/784) participation rate. Those who did not want to participate could have avoided the recruiters, lowering the participation rate. Data used for this analysis were collected through the interviewer-administered questionnaire, which incorporated an assessment of multiple rooms in the housing unit, including the sleeping rooms of the participants who completed the questionnaire. Interviewers asked that participants select a private location at the camp for the interview. Most interviews were conducted in the participant's sleeping area. The height and weight of the study participants were recorded. Each questionnaire was completed in Spanish, the language preferred by each study participant. Data from the questionnaires were entered into an electronic database; the data were subsequently checked for accuracy and completeness using standard data cleaning procedures, and edited when needed. Participants received a $30 incentive. Participating camps each received one volley ball.

Measures

Sleep quality was the primary outcome measure. Participants completed the Sleep Timing and Sleep Quality Screening Questionnaire (STSQS) [35]. The STSQS has been found to be highly correlated with the global Pittsburgh Sleep Quality Index (PSQI) [35, 36]. The STSQS was used given its brevity. Participants were asked to rate their usual quality of sleep, 1 indicating "best sleep ever" and 9 indicating "worst sleep ever." Sleep quality that was rated 1–3 was defined as good; sleep quality rated 4 or greater was defined as poor [35]. Farmworkers also reported the time they started trying to sleep, the average length of time it took to fall asleep (sleep latency), the number of times they usually woke up during the night, and the time they usually woke up in the morning. Initial sleep time was calculated by adding sleep latency (in minutes) to the time the participant reported that he started trying to fall asleep. Hours slept was the length of time between the initial sleep time and wake up time.

Housing measures included housing type (trailer, individual house, and barracks or other type of housing), the number of people in the housing unit, and the availability and use of air conditioning in the housing unit. Air conditioning was considered to be present if the housing unit

had central air conditioning or at least one window unit, and air conditioning had been used at least once during the previous month. An index of sleeping room quality was created for each participant's sleeping room using an average of 11 dichotomous measures. Each measure was coded 0 if the condition was absent and 1 if the condition was present: shared room; sleeping room was common room; other activities in sleeping room disrupted participant's sleep; shared bed with another person; lacked functioning windows; lacked functioning screens; height of room violated state regulations (<7 feet high) [37]; the number of people sleeping in the room given the space violates state regulations (<50 square feet per person) [37]; evidence of cockroach and rodent infestation, as measured by visual inspection; and absence of fan use.

Health variables included self-rated health, musculoskeletal pain, depression, anxiety, and obesity. The self-reported health measure was recoded to indicate whether the respondent reported good to excellent health versus fair to poor health. Obesity was included, given its association with sleep-related disorders [31, 32]. Participants were considered obese if their body-mass index (BMI) was ≥30 [38]. Farmworkers reported whether, as a result of their job, they had experienced discomfort or pain in eight distinct body parts (neck, shoulders, elbows, wrists, hands, lower back, knees, and ankles) during the current agricultural season. The questions were adapted from the NIOSH Body Discomfort Interview Guide [12, 39]. For each body part, participants reported frequency of pain, ranging from no experience of work-related discomfort or pain (0) to experiencing daily discomfort or pain (4). Farmworkers who reported work-related pain in a body part rated the severity of the pain or discomfort from no pain (0) to unbearable (4). Pain was dichotomized to distinguish respondents who experienced weekly or daily pain that was moderate to unbearable in at least one body part from those who experienced less frequent or intense pain.

Depression was measured using a short form of the Center for Epidemiological Studies-Depressive Symptoms (CES-D). The 10-item form has good predictive accuracy [40] and has been demonstrated to be appropriate for use among Latino immigrants [41]. Participants were asked how often they felt or behaved in a particular way during the previous week for each of 10 items: rarely or none of the time (0) to most or all of the time (3). The participants' responses were summed; the maximum value for the CES-D 10 item index was 30. The CES-D value was set to missing if any of the 10 items were missing. Those with CES-D scores of 10 or higher were considered to have elevated levels of depressive symptoms ($\alpha = 0.45$) [41].

Anxiety was assessed with the 24-item Personality Assessment Inventory (PAI), which measures cognitive, affective, and physical anxiety [42]. Participants were asked to indicate how they usually feel. Response categories for each item ranged from false, not at all true (0) to very true (3). Several items were recoded so that higher values indicate greater anxiety for all items. Responses were summed; raw scores were transformed into T-scores ($\alpha = 0.88$). The construct validity of the PAI among Mexican and Mexican–American samples has been established [42–45].

Health behaviors and individual characteristics were included as control values. Farmworkers reported whether they currently smoked cigarettes. Alcohol misuse was calculated from the responses to the first three items of the Alcohol Use Disorders Test Consumption (AUDIT-C) questionnaire [46, 47]. Marital status, whether the participants were married or living as married or not, and age being <40 or ≥40, were included.

Analysis

Descriptive statistics were calculated for the housing quality measures and participant characteristics of interest for our entire farmworker sample (n = 371). The mean, standard deviation, and median for the continuous measures, and counts and percentages for the categorical characteristics were calculated. The mean, standard deviation, and median of sleep quality, sleep latency, night awakenings, and hours slept are reported, as are the Spearman correlations between these variables and corresponding p value for each correlation.

A series of bivariate analyses were conducted to analyze the association between sleep quality (poor vs. good) and housing, health, and individual characteristics of interest. The count and percentage of farmworkers falling into the sleep quality category as well as the p value from the Chi squared test for association were calculated for each categorical variable. The mean and standard deviation in each sleep quality category and the p value to test for association were calculated from a t test or non-parametric test when appropriate for each continuous measure.

Finally, a generalized estimating equation (GEE) approach that allowed for adjustment of camp clustering was used for multivariate modeling to further investigate the relationship between predictors of interest and farmworker sleep quality. Multiple indicators, including 11 specific sleeping room indicators that were included in the bivariate analyses, were excluded from the multivariate analysis due to restrictions imposed by the sample size. The results from three distinct models are reported. The predictor variables in model 1 were restricted to those related to housing. Model 2 included the initial housing indicators, while controlling for participants' health. Model 3 retained all the variables from model 2, and controls for individual health behaviors and characteristics. Inclusion of multiple models enabled analysis of whether the

Table 1 Descriptives of housing quality and participant characteristics, male Latino farmworkers, 2010

	N	n	%	Mean	SD
Housing unit indicators					
Number of people in housing unit	370			16.49	16.65
Housing type					
Trailer	371	100	27.0		
House	371	156	42.0		
Other	371	115	31.0		
Air conditioning availability and use in previous month	370	154	41.6		
Sleeping room indicators					
Shares sleeping room	371	313	84.4		
Shares bed	371	49	13.2		
Is common room	371	187	50.4		
Other activities disrupt sleep	359	70	19.5		
Lacks functioning windows	371	42	11.3		
Lacks functioning screen	371	81	21.8		
Height violation	371	13	3.5		
Square foot/crowding violation	364	47	12.9		
Rodent infestation	371	96	25.9		
Cockroach infestation	371	143	38.5		
No fan use	371	80	21.6		
Index of sleeping room quality using average of the 11 SR indicators	371			0.28	0.14
Health indicators					
Self-rated health					
Good to excellent health	368	192	52.2		
Fair or poor health	368	176	47.8		
Elevated musculoskeletal pain	371	58	15.6		
Elevated depressive symptoms	360	60	16.7		
Anxiety t-score	351			48.02	8.68
Obese (BMI $\geq$ 30)	364	83	22.8		
Behaviors					
Alcohol misuse	369	185	50.1		
Current smoker	371	133	35.8		
Individual characteristics					
Age $\geq$40 years	371	99	26.7		
Married or living as married	371	241	65.0		

effect of housing conditions on sleep quality was influenced by participants' health, health behaviors, or characteristics. The odds ratios and 95 % confidence intervals for the covariates in each of the three models are reported. All analyses were conducted using SAS 9.2 (SAS Institute, Cary, NC) and p values of less than 0.05 were considered statistically significant.

Results

Summary Statistics and Correlations

Summary statistics for housing quality, participant health indicators, and participant characteristics are presented in Table 1. Sleep indicators are reported in Table 2. The mean value for sleep quality was 2.72 $\pm$ 1.74; the median value was 2. The mean sleep latency time in minutes was 38.72 $\pm$ 30.59, the mean number of night time awakenings was 0.53 $\pm$ 0.74, and the mean hours slept was 6.08 $\pm$ 1.26. Poor sleep quality was positively and significantly correlated with length of time falling asleep (0.30, $p < 0.001$) and the number of night awakenings (0.20, $p < 0.001$), and negatively associated with hours slept (-0.23, $p < 0.001$).

Bivariate Analysis

Sleep quality was significantly associated with air conditioning use. Forty-five percent of farmworkers who had indicated they had good sleep quality reported having air conditioning in the housing unit, compared to 30 % of farmworkers who stated they had poor sleep quality (Table 3). Neither the number of people in the housing unit nor any of the sleeping room indicators was associated with sleep quality. A greater percentage of participants who reported good sleep quality also had good to excellent health than those with poor sleep quality (56 vs. 42 % respectively, $p < 0.05$). Elevated depressive symptoms and musculoskeletal pain, and higher levels of anxiety were all significantly associated with poor sleep quality (all $p < 0.001$).

Multivariate Analyses

The availability and use of air conditioning in the housing unit significantly increased the odds that farmworkers reported good sleep quality (Table 4). No other housing or sleeping room measures had a statistically significant

Table 2 Descriptives of sleep indicators and spearman correlations, male Latino farmworkers, 2010

Sleep indicators	N	Mean	SD	Median	1	2	3	4
Sleep quality (1)	369	2.72	1.74	2	1.00			
Sleep latency in minutes (2)	368	38.72	30.59	30	0.30**	1.00		
Night awakenings (3)	367	0.53	0.74	0	0.20**	0.10*	1.00	
Hours slept (4)	368	6.08	1.26	6	−0.23**	−0.48**	0.001	1.00

** $p < 0.001$; * $p = 0.052$

Table 3 Differences between poor and high quality sleep by housing, health, and individual characteristics among male Latino farmworkers in North Carolina, 2010

	$N = 369$[b] farmworkers				
	Poor quality sleep (≥4) n = 90		Good quality sleep (<4) n = 279		p value[c]
	n[a]	%	n[a]	%	
Housing unit indicators					
Number of people in housing unit (mean, SD)	15.22	15.57	16.95	17.03	0.63
Housing type					0.84
Trailer	22	24.4	77	27.6	
House	39	43.3	116	41.6	
Other	29	32.2	86	30.8	
Air conditioning used previous month	27	30.0	126	45.3	0.01
Sleeping room indicators					
Shares sleeping room	78	86.7	234	83.9	0.52
Shares bed	8	8.9	41	14.7	0.16
Is common room	48	53.3	138	49.5	0.52
Other activities disrupt sleep	17	19.8	53	19.6	0.97
Lacks functioning windows	13	14.4	29	10.4	0.29
Lacks functioning screen	22	24.4	59	21.1	0.51
Height violation	5	5.6	8	2.9	0.23
Square foot/crowding violation	8	8.9	39	14.3	0.18
Rodent infestation	23	25.6	72	25.8	0.96
Cockroach infestation	41	45.6	101	36.2	0.11
No fan available	19	21.1	61	21.9	0.88
Index of sleeping room quality using average of the 11 SR indicators (mean, SD)	0.29	0.14	0.27	0.14	0.56
Health indicators					
Self-rated health					0.02
Good–Excellent health	37	42.0	155	55.8	
Fair or Poor health	51	58.0	123	44.2	
Elevated musculoskeletal pain	27	30.0	31	11.1	<0.001
Elevated depressive symptoms	30	33.3	30	11.2	<0.001
Anxiety t-score (mean, SD)	51.93	8.63	46.84	8.36	<0.001
Obese (BMI ≥ 30)	19	21.6	62	22.6	0.84
Behaviors					
Alcohol misuse	45	50.0	139	50.2	0.98
Current smoker	30	33.3	101	36.2	0.62
Individual characteristics					
Age ≥40 years	23	25.6	75	26.9	0.80
Married or living as married	60	66.7	180	64.5	0.71

[a] Count (% yes) unless otherwise noted

[b] 2 ppts with missing sleep quality data

[c] χ^2 test for categorical variables, t test/non-parametric for continuous

effect. Multiple health indicators were statistically significant in models 2 and 3. Farmworkers who did not report elevated musculoskeletal pain or elevated depressive symptoms had significantly increased odds of reporting good sleep quality than those with elevated symptoms. Higher anxiety T-scores significantly decreased the odds of reporting good sleep quality, although the magnitude of effect was limited. The significance and direction of these health indicators were consistent across the different models. The association between self-reported health and sleep quality was insignificant.

Discussion

Most Latino farmworkers who participated in this study reported good sleep quality. Sleep latency and the number of night awakenings were significantly and positively

Table 4 Odds of reporting good sleep quality, male Latino farmworkers in North Carolina, 2010[a]

	Model 1 (N = 367)		Model 2 (N = 336)		Model 3 (N = 334)	
	OR	95 % CI	OR	95 % CI	OR	95 % CI
Housing indicators						
Number of people in housing unit	1.01	0.99–1.02	1.02	0.99–1.04	1.02	0.99–1.04
Index—sleep room quality	0.34	0.06–1.88	0.73	0.11–4.77	0.81	0.13–5.13
Air conditioning versus no air conditioning	2.09	1.25–3.49	2.35	1.33–4.17	2.43	1.33–4.43
Health indicators						
Good self-rated health versus poor self-rated health			1.16	0.64–2.12	1.08	0.58–2.04
No or low pain versus elevated pain			3.41	1.77–6.59	3.41	1.76–6.61
Few depressive symptoms versus elevated depressive symptoms			2.91	1.32–6.40	3.19	1.39–7.32
Anxiety t-score			0.96	0.93–0.99	0.96	0.93–0.99
Health behaviors						
Absence of alcohol misuse versus alcohol misuse					0.71	0.39–1.28
Current nonsmoker versus smoker					0.85	0.46–1.58
Individual characteristics						
Age <40 versus ≥40					0.86	0.45–1.64
Not married versus (living as) married					1.28	0.72–2.28

[a] Adjusting for camp clustering

correlated with poor sleep quality. The magnitude of the association between sleep latency and sleep quality was weak, although it was in the same direction as Buysee and colleagues reported [36]. An increase in hours slept was correlated with sleep quality, and is consistent with the association reported by Buysee and colleagues [36].

This is the first analysis to report on the association between housing quality and sleep quality among Latino farmworkers. Among the housing characteristics examined, only air conditioning was significantly associated with sleep quality. The finding that air conditioning was associated with better sleep quality in hot weather is consistent with research in other populations [24, 25]. Furthermore, the availability of air conditioning in farmworker housing in the South had substantial health implications for the Latino farmworkers in this study. A substantial body of research has reported that poor sleep quality and the presence of symptoms of sleep disorders contribute to multiple negative health outcomes [4–12].

The association of the number of residents in the participant's housing unit with sleep quality did not reach statistical significance. Other researchers have noted the effect of environmental noise on sleep [25, 48]. Although increased population in the housing unit could be expected to result in poorer sleep quality due to increased noise from other residents, that association was absent. The construction quality, combined with the particular configuration of the units, may have had a greater effect on the level of noise in the participant's sleeping area than the number of people living in the unit or sharing the sleeping room itself. The noise level in the units during periods of sleep was not recorded; the association between housing unit population and noise could not be analyzed.

Other than air conditioning, general housing and sleeping room quality did not affect sleep quality. Physical activity is associated with better sleep quality [49, 50]. The physical requirements of farmworker labor may have mitigated some of the potential negative effects of housing quality on sleep quality.

Participants' health was significantly associated with sleep quality. A negative assessment of one's health was associated with worse sleep quality in the bivariate analysis. The association between self-rated health and sleep quality became nonsignificant when other health variables, including mood and musculoskeletal pain, were included in the model. This suggests that the respondents who had elevated depressive symptoms, pain, and anxiety may have reported poorer health due to those symptoms. Elevated depressive symptoms and musculoskeletal pain were significantly and positively associated with poor sleep quality in all multivariate analyses. The positive relationship between depression, musculoskeletal pain, and poor sleep quality or symptoms of sleep disorders is consistent with other research [12, 18, 34, 51–54]. The cross-sectional design of the study did not enable us to evaluate the causal order. Other research, however, has suggested that sleep problems may both contribute to depression and musculoskeletal pain and result from them [9].

Bivariate analyses showed a significant association between sleep quality and anxiety. Those with poor sleep quality reported higher anxiety than those with good sleep

quality. The multivariate analysis indicated that greater anxiety reduced the odds that a participant would report good sleep quality when housing characteristics, other health indicators, health behaviors, and individual characteristics were controlled, although the magnitude of the effect of anxiety was limited. Other research has generally found that poor sleep quality or symptoms of sleep disorders are associated with elevated levels of anxiety in bivariate [14, 55] and multivariate analyses [8, 33, 34].

There are several limitations to this study. Sleep quality was restricted to the self-reported measures included in the STSQS. The sleep quality instrument does not enable us to determine the prevalence of specific sleep disorder symptoms among the farmworkers. Inclusion of additional self-reported measure such as the Epworth Sleep Scale [56], Berlin Sleep Apnea Questionnaire [57], and the Insomnia Severity Index [58] would have elucidated the symptoms experienced by farmworkers. Measurements of the temperature and ambient noise during sleeping periods would have strengthened the findings. The restriction of data collection to one southern state from June through October did not allow us to generalize the findings to other states or other times of the year. Also, we are unable to generalize our findings to farmworkers who can communicate in neither Spanish nor English. However, the use of interviewer-administered questionnaires by field staff fluent in Spanish minimized participation barriers due to farmworkers' limited literacy in any language or limited fluency in English. Additionally, the analysis did not enable us to determine how sleep quality and physical and mental indicators varied over the course of the summer or by crop and work task [59]. Despite these limitations, this analysis made a substantial contribution to our knowledge about sleep health among Latino farmworkers.

Conclusion

Poor sleep quality among Latino farmworkers is associated with poorer indicators of health, including poor self-rated health, elevated musculoskeletal pain, elevated depressive symptoms, and greater anxiety. A substantial body of research has reported that sleep disorders, as measured directly or measured indirectly through presence of sleep disorder symptoms, are associated with workplace injuries and multiple chronic health problems. One important indicator of housing quality, air conditioning, was associated with better sleep quality. Availability of air conditioning in farmworker housing has substantial health implications through its positive association with improved sleep quality. Further research is required to delineate how to improve the adequacy of farmworker housing to improve sleep quality and other health indicators.

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Conflict of interest None of the authors has a conflict of interest.

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