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Sleep Quality among Latino Farmworkers in North Carolina: Examination of the Job Control-Demand-Support Model

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Keywords

Sleep; Pittsburg Sleep Quality Index; Latino; Hispanic; organization of work; farmworker

INTRODUCTION

The associations **among** sleep problems, poor sleep quality, and physical and mental health **problems**, including hypertension, insulin resistance, cardiovascular disease, musculoskeletal problems, depression, and anxiety are well documented (1–7). Work organization can also affect sleep quality (8–10). Furthermore, sleep problems, such as untreated obstructive **apnea, insomnia, and** excessive daytime sleepiness, increase individuals' risk of being injured at the workplace (11–13). Sleep difficulties may therefore be particularly harmful to farmworkers who are exposed to hazardous working conditions such as pesticide exposure and dangerous equipment (14–17). However, information about sleep quality of Latino farmworkers in the U.S. is lacking.

Exposures to substances that impair sleep quality (subsequently referred to as “exposures”) and physical and mental health conditions influence sleep quality. Alcohol use disrupts sleep patterns, resulting in poorer sleep quality (18,19). Nicotine exposure, either through smoking cigarettes or occupational transdermal tobacco exposure, can impair sleep quality (20,21). Caffeine consumption can also contribute to sleep difficulties (22,23); pesticide exposure has been identified as a risk factor for sleep disorders (24). Chronic health conditions are also associated with sleep problems. Obesity, having a total body mass index (BMI) ≥ 30 (25), is highly correlated with sleep-disordered breathing (26). Additionally, sleep disorders and

their symptoms are associated with anxiety and depression, including among Latino farmworkers (3, 7).

Research has examined the association of organization of work and health outcomes. The demand-control-support model posits that the intensity and type of workplace demands and the resources available to respond to **these** demands influence workers' experiences of distress or strain, which in turn, **influence** their physical and mental health (27–29). Workers who have high psychological or physical demands and limited control over the work process (e.g., decision making authority) are particularly vulnerable to job strain. Social support at the workplace can buffer the negative effects of job strain (28,30). Workplace demands, control, and social support also appear to exert independent effects on physical and mental health.

Research has examined the association between work organization factors and sleep quality and complaints, although a limited amount of **research** has been conducted in the U.S. Workers who report high strain have an increased risk of reporting sleep problems; lack of social support increases risk of poor sleep quality (8, 9). High work demands, work overload, role conflict, and night shift work are associated with sleep difficulties and poor sleep quality (10,31–34). The effect of control over work processes on sleep quality is more variable. Low **control, as** measured by repetitive work and limited control over decisions relating to **work, is** associated with poor sleep quality in some studies (8,31). Laboring at worksites that have an elevated risk of physical injury and poor safety support, which can also represent low work control, is also associated with poor sleep quality (35). The association between work control and sleep complaints is absent in other studies (36). Furthermore, low social support at work is associated with an increased risk of reporting sleep problems or poor sleep quality (36,37).

Mexican-born men working in the U.S. may be particularly likely to experience high job demand and low job control. They are substantially less likely than those born in the U.S. to have a high school education or speak English fluently (38), thereby limiting their job options and decreasing opportunities to learn about workers' rights. Awareness of anti-immigration rhetoric and deportation activities may curtail Mexican-born men's willingness to report workplace violations, including farmworkers who have H-2A visas that allow them to work in the U.S. for a specified employer for a specific growing season and provide them with specific rights (39).

Agricultural laborers experience substantial physical demands, including bending, heavy lifting, and engaging in repetitive movement (14). Farmworkers are routinely exposed to pesticides (40) and, **among those** working in tobacco, nicotine (41). Elevated temperatures, high humidity, and sustained sun exposure result in extreme working conditions (42–44). Farmworkers often work long hours (45) and have limited control over which tasks they perform or when or how they perform **these** tasks. This research identifies the sleep quality reported by Latino farmworkers in North Carolina (NC), as measured by the Pittsburgh Sleep Quality Index (PSQI) (46). It examines whether the organization of work, specific exposures, and health status are associated with sleep quality.

METHODS

Data for this analysis were drawn from questionnaires administered to Mexican male farmworkers in NC in 2012 as part of a longitudinal study that examines the cognitive and neurological outcomes of pesticide exposure among farmworkers [reference blinded for review]. The parent study restricted participation to men ages 30 and older. NC Farmworkers Project (Benson, NC) was the community partner that recruited farmworkers in this community-based participatory research project. NC Farmworkers Project staff spoke with farmworkers at camps in eastern NC to explain the project, including inclusion criteria, time required for participation, and incentives. Volunteers from farmworker camps who expressed willingness to participate were screened to ensure they met inclusion criteria. All procedures were approved by the [blinded for review] Institutional Review Board; signed consent was provided by each participant.

Sample

Men 30 years of age and older who self-identified as Latino and had worked in agriculture for the past three years were eligible to participate in this study. A total of 235 farmworkers were administered the baseline interviews; 147 (63%) farmworkers provided values for all PSQI items and completed the work organization module. All 147 participants reported they were born in Mexico.

Data Collection

Data for this analysis were collected during the baseline visit and three subsequent contacts at one month intervals. Baseline interviews were conducted in May 2012. The baseline interview included items about demographics, physical and mental health, exposures, and life history of occupational and residential pesticide exposure. The work organization module was administered at contact two. PSQI data, **depressive symptoms**, and weight were collected at contact three.

Questionnaires were developed in English, translated into Spanish, checked for meaning, and pre-tested. Existing Spanish items and scales were used when available. Trained interviewers who were native Spanish speakers administered the interviews. Questionnaires for the baseline and second and third contacts were administered at farmworker camps (47). Study data were electronically entered into a database, managed, and downloaded to statistical packages using Research Electronic Data Capture (REDCap) (48).

Measures

Sleep quality was the primary outcome. Participants completed the **PSQI** questionnaire, an instrument with previously established reliability and validity (46). Its 19 items are categorized into seven component scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction during the last month. Each component score has a range of 0–3; they were summed to create a global score (range, 0–21). A score of > 5 represents poor sleep quality and a substantial degree of sleep disturbance (46). Cronbach's alpha for this analysis was 0.44.

Hours worked and number of days during previous month that the heat index was at least 91°F are markers of workplace demands. *Hours worked* at all jobs was dichotomized into > 40 hours per week (1) and ≤ 40 hours per week (0). *Elevated heat index* indicates the number of days the heat index, as reported by State Climate Office of North Carolina (49), was at least 91°F in the participant's county during the 30 days prior to the administration of the PSQI. According to the Occupational Safety and Health Administration, workers should implement protective measures on days the heat index reaches 91°F to prevent heat-related illness (50).

Workplace control measures included safety climate and flexibility. *Safety climate* represents workplace safety practices, resources, and safety attitudes. Nine items addressed whether participants strongly disagreed (1), disagreed (2), agreed (3), or strongly agreed (4) with perceptions about workplace safety, such as “**workers** have almost total control over personal safety”. One item was reverse scored to indicate a better safety climate. A tenth item asked whether the supervisor seemed to care about the workplace safety (51, 52). Values were summed; the potential range was 10–39, with higher scores representing a better safety climate. Values of 17–24 represented the lowest tertile; values greater than 27 represented the highest tertile for the bivariate analysis. (Cronbach's alpha = 0.60). *Job flexibility* was based on two items that queried whether participants were able make any decisions about **days or hours worked** and the number of hours worked each week. Affirmative responses had a value of 1. Values were summed, and have a maximum value of 2.

Social support from supervisor was measured by four items from the vulnerability factor of the Employment Precariousness Scale. The factor measures “defenselessness to authoritarian treatment” (53). Each participant indicated whether or not he had experienced each situation during the past 12 months at his main job: “[he] felt defenseless against unfair treatment directed toward [him] on [his] job”, “[he] was afraid of being fired, even though [he] did nothing wrong”, “[he was] treated in a discriminatory or unjust way on [his] job”, and “[he was] made to feel that [he] could be easily replaced by a boss or supervisor” (53). Each affirmative response was scored as 1; responses were summed; values ranged from 0–2. Since the distribution was skewed, the variable was dichotomized. Men who **responded** affirmatively to two questions were considered to have poor social support. Alternately stated, men who endorsed two items experienced high levels of vulnerability due to lack of social support.

Alcohol abuse was identified through the CAGE questionnaire. Problem drinkers (1) endorsed two or more of four questions (54, 55). Cigarette tobacco exposure was dichotomized to indicate whether participants had smoked any cigarettes during the past 30 days (1) or not (0). Those who had more than two caffeinated beverages per day were considered to have elevated use (1); others were considered low users (0).

Weight was measured in kilograms using a Tanita BWB-800 scale using the values collected at contact 3; height was measured in meters at **contact 1**. Individuals with a BMI in kg/m² ≥ 30 were considered obese (25). Participants' chronic health status was dichotomized to indicate whether respondents endorsed that they had been diagnosed with one or more of 8

chronic health conditions, **including** arthritis, diabetes, heart disease, high blood pressure, cancer, asthma, Parkinson's Disease, or dementia, (1) or not (0). Depression was measured by a 10-item version of the Center for Epidemiologic Studies Depression Scale (CES-D). It has been demonstrated to have good predictive efficacy, internal consistency, and be appropriate for Spanish speakers (56, 57). For each item, participants were asked how often they felt or behaved in a particular way during the previous week: rarely or none (0) to most or all the time (3). Those whose score was ≥ 10 were considered to have elevated depressive symptoms (58). Cronbach's alpha for this analysis was 0.70. Anxiety was measured using the Personal Assessment Inventory (PAI), a 24-item self-report measure (59, 60). The PAI measures cognitive (e.g., "I often have trouble concentrating because I am nervous"), affective (e.g., "I'm often so worried and nervous that I can barely stand it"), and physical (e.g., "Sometimes I feel dizzy when I've been under a lot of pressure") anxiety. Participants rated items on a 4-point scale, 0 (not true) to 3 (very true), with items being reverse coded so that higher scores reflect more anxiety symptoms (59). Raw scores were transformed to T scores. A raw score of 60 or greater represents anxiety that may impair functioning (59). Cronbach's alpha for this was 0.82. The lifetime pesticide exposure measure was derived from National Institute of Neurological Disorders and Stroke (NINDS) Common Data Elements (61). The baseline interview included questions to identify levels of occupational and residential pesticide exposure during a maximum of eight age periods; the potential value for each time period ranged from 0–13. Values from each time period were summed. (47). Lifetime pesticide exposure values ranged from 1–33.

Those who were married or living as married were categorized as being married (1); others were considered not married (0). Age was recoded to indicate whether the participant was 40 years old (1) or not (0). Education was dichotomized to represent whether the participant had at least a high school education (1) or less than a high school education (0).

ANALYSIS

Means and standard deviations were calculated for each of the **7 components of the PSQI and the PSQI global index**. Descriptive statistics (percentages or means and standard deviations) were calculated for work organization, exposures, health, and personal characteristics. Only 7 and 6 participants reported they did not have an H-2A visa or were **not married**, respectively. Those variables were therefore excluded from subsequent analyses. Chi-square tests were conducted to test the differences between participants who had good sleep quality and those who had poor sleep quality across most variables of interest. T-tests compared the number of days the heat index reached 91°F among farmworkers with poor sleep quality to those with good sleep quality. All participants' anxiety raw scores were < 60 , the level at which anxiety is considered to impair functioning (59). T-tests therefore compared the anxiety T-scores of those with poor sleep quality to those with good sleep quality. All analyses were performed using SAS 9.3 (SAS Institute, Cary, NC); p values < 0.05 were considered statistically significant.

Only participants who provided values for all PSQI items and completed the work organization module were included in this analysis. Individual characteristics of farmworkers were compared to characteristics of farmworkers who either did not complete

the work organization module or had one or more PSQI component values missing. Educational level, age, and marital status were not significantly different between those included in the analysis and those excluded due to missing values ($p < 0.05$).

RESULTS

The mean PSQI score was 3.73 (s.d. 2.02); 83% of the participants reported good sleep quality (Table I). The highest mean score of the PSQI components was sleep latency at 1.05. The lowest component score was use of sleep medication at 0.05.

Descriptive data for work organization, health exposures and conditions, and participant characteristics are reported in Table II. Regarding work characteristics, 61% worked more than 40 hours per work; 70% experienced at least 21 days that the heat index was at least 91° during the last 30 days. Thirty-five percent reported a low workplace safety climate, 95% reported low workplace flexibility, and 16% reported moderate to high vulnerability at the worksite; only 5% reported that they did not have H-2A visas.

Bivariate analyses examined the association between sleep quality and work organization, exposures, health status, and individual characteristics (Table III). None of the work organization factors examined were significantly associated with poor sleep quality; however, long hours approached statistical significance ($p < 0.10$). Among exposures, the association between lifetime pesticide exposure and sleep quality approached statistical significance ($p < 0.10$); those reporting moderate pesticide exposure were least likely to report poor sleep quality. Elevated depressive symptoms were significantly associated with poor sleep quality ($p < .001$). No other exposures or personal characteristics approached statistical significance.

DISCUSSION

In this analysis, Mexican-born farmworkers living in NC reported good sleep quality. Participants reported a mean PSQI score of 3.73. Fewer than 17% reported poor quality sleep during the past month ($PSQI > 5$). The mean PSQI scores is lower, indicating better sleep quality, than other samples of young adult English-speaking Latinos from San Diego County, California (62), English- and Spanish-speaking Mexican-born and U.S.-born Latinos of Mexican descent in San Diego County (mean age of 41) (63), and young adult English-speaking Mexican Americans from a general medicine clinic in Miami, Florida (64). The PSQI scores of young to middle-age adult non-Latinos are also higher than those in our analysis (63, 65). Our analysis is consistent with other research that reports that Mexican-born U.S. immigrants have longer and better sleep than U.S. residents in general and Mexican Americans more specifically (66–69).

Sleep quality may be an example of the “Hispanic Paradox”, which refers to **relatively** superior health of Latino immigrants compared to Latinos born in the U.S. (70). Those with better physical and mental health may be more likely than those with poorer health to migrate to a new country (68). Although there are exceptions (63), other studies generally suggest that poorer sleep is associated with acculturation to U.S. culture (67, 68). Mexican-

born Latinos may perceive that their financial situation is better in the U.S. than it would be in their native country, even if current working conditions are, by U.S. standards, quite poor.

Working more than 40 hours a week approached statistical significance among this relatively small sample of workers who performed physically demanding work in the hot and humid fields of NC. Although not uniform (71), other studies have generally reported that long work hours are associated with sleep difficulties, including difficulty falling asleep and short sleeping hours (10,72,73). Long work hours would reduce time available to relax after work and reach a state of low arousal, a state that is conducive to reduced sleep latency (73, 74).

Several models posit that **insomnia, which is characterized by difficulty initiating or maintaining sleep**, is a disorder of physiological and cognitive hyperarousal (75,76). Limiting the number of required work hours while providing adequate wages may contribute to workers' sleep quality, thereby improving health. Future research should further examine the effect of elevated hours of physically demanding work on sleep quality; attention should also be given to the effect of pesticide exposure on sleep quality (24).

Although working outside when the heat index reaches **91°** can result in heat-related illnesses if precautions are not taken (50), working under these conditions did not appear to affect sleep quality. The lack of association between the number of days that had elevated heat index readings and sleep quality may be due, in part, to the small variation in the number of days that participants were exposed to heat index readings above **91°**. Access to air conditioning during sleeping hours **in hot humid regions**, can significantly influence **individuals'** sleep quality, including among farmworkers (7,77); however, information about presence or absence of air conditioning in farmworker housing was not collected.

Furthermore, individuals whose have inadequate sleep and physically exert themselves in a hot environment have reduced behavioral alertness (78). Farmworkers with poor sleep quality who are exposed to high temperatures at work may therefore have an elevated risk of hurting themselves on the job.

Workplace safety, flexibility, and vulnerability were not significantly associated with sleep quality, although the associations were in the expected direction. Flexibility in work schedule may be less valuable to farmworkers than other workers. Farmworkers wages are based on hours worked or piece rate (79). Hours farmworkers can work depend on tasks required during the specific time of the growing season and the weather. Job flexibility without guaranteed work hours and wages may have limited effect on sleep quality. Workplace vulnerability measures social support from supervisors. Lack of social support from supervisors may have been counteracted by social support among coworkers, which was not collected in the parent study.

The parent project did not collect information about tasks performed during the previous month; we were therefore unable to analyze whether farmworkers who frequently performed more physically demanding work, such as heavy lifting, during the last 30 days reported different sleep quality than farmworkers who performed less physically demanding tasks. However, other research indicates that having jobs that require heavy physical labor increases **workers'** risk of having disturbed sleep (71,80).

There are limitations to this analysis. All measures for this study, except weight and height used to calculate BMI, were based on self-report. We were therefore unable to independently confirm participants' sleep quality, work organization, or lifetime pesticide exposure. This analysis was also limited by the types of data collected in the study. Additional items that measure participants' perceptions about the degree to which they were able to control how they performed their tasks, the pace at which they were expected to work, and task performed during the previous month would have been useful. Although the **cross-sectional** design does not enable us to analyze the causal ordering of poor sleep quality and workplace conditions, other research indicates that work organization contributes to sleep problems (81,82). Participants were lost during the data collection period; however, the retention rate was good for the mobile study population. Furthermore, men younger than 30 were not included in this study due to age restrictions imposed by the parent study. Findings from this study should not be generalized to Mexican-born farmworkers younger than age 30, laborers working in other regions or other occupations, or to Latina farmworkers.

CONCLUSION

This study was undertaken to determine the sleep quality of Mexican-born farmworkers in NC and to evaluate whether work organization appears to affect their sleep quality. A substantial majority of Latino farmworkers reported good sleep quality. Workplace safety, flexibility, and vulnerability were not significantly associated with sleep quality. The only workplace demand that approached statistical significance was working more than 40 hours a week. The findings suggest that lengthy work weeks may negatively affect agricultural workers' sleep quality. Additional research is needed to understand whether other aspects of job demands, job control, and social support from coworkers affect Mexican farmworkers' sleep quality.

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Table I

PSQI Summary Information of Latinos farmworkers in North Carolina, 2012, N = 147

	Mean	Standard Deviation
PSQI Components		
Subjective Sleep Quality	0.61	0.50
Sleep latency	1.05	0.91
Sleep duration	0.43	0.74
Habitual sleep efficiency	0.20	0.54
Sleep disturbances	0.99	0.42
Use of sleep medication	0.05	0.38
Daytime dysfunction	0.40	0.53
PSQ Global Index	3.73	2.02
Poor Sleep Quality (PSQI > 5, %)		
	17.01	

Table II

Descriptive Statistics, Sleep Quality among Latino Farmworkers in North Carolina, 2012, N = 147

	Mean	Standard Deviation	N	% ^a
Work Characteristics				
Hours worked	43.18	12.03		
40			58	39.46
>40			89	60.54
Elevated Heat Index				
0 – 10			1	0.68
10 – 20			43	29.25
>20			103	70.07
Safety ^b				
Low (17–24)			51	34.93
Moderate (25–27)			50	34.25
High (28–36)			45	30.82
Flexibility				
Low (0)			139	94.56
Moderate – High (1–2)			8	5.44
Vulnerability				
Low vulnerability (0)			123	83.67
Moderate to high (1–2)			24	16.33
H-2A status				
H-2A visa			140	95.24
No H-2A visa			7	4.76
Exposures				
CAGE				
Non-problem drinker			91	61.90
Problem drinker			56	38.10
Cigarettes				
Non-smoker			103	70.07
Smoker			44	29.93
Caffeine				
Low			104	70.75
Moderate to high			43	29.25
Lifetime pesticide exposure				
Low (0–10)			46	31.29
Moderate (11–14)			51	34.69
High (15–33)			50	34.01
Chronic Conditions				
None			119	80.95
1			28	19.05

	Mean	Standard Deviation	N	% ^a
Obese				
No			50	65.28
Yes			97	34.01
Depression (CES-D)	3.63	3.24		
<10			138	93.88
10			9	6.12
Anxiety	19.60	9.10		
<60			147	100.0
61			0	0
Personal Characteristics				
Age	39.18	7.50		
< 40			87	59.18
40			60	40.82
Education				
0–6 grade			61	41.50
7–11 grade			74	50.34
12 th grade			12	8.16
Marital Status				
Not married			6	4.08
Married			141	95.92

^a Sums of percentages may not equal 100% due to rounding errors

^b One case missing value

Sleep Quality of Latino Farmworkers in North Carolina by Work Organization, Exposures, Health, and Personal Characteristics, N = 147

Table III

	Good Sleep Quality		Poor Sleep Quality	
	n	%	Mean (s.d.)	n % Mean (s.d.)
Work Organization				
Hours worked ^a				
40	52	89.66		6 10.34
>40	70	78.65		19 21.35
Elevated Heat Index			21.65 (3.69)	21.68 (3.47)
Safety				
Low	39	76.47		12 23.53
Moderate	41	82.00		9 18.00
High	41	91.11		9 8.89
Flexibility				
Low	114	82.01		25 17.99
Moderate to high	8	100.00		0 0.00
Vulnerability				
Low to moderate	104	84.55		19 15.45
High	18	75.00		6 25.00
Exposures				
CAGE				
Non-problem drinker	78	85.71		13 14.29
Problem drinker	44	78.57		12 21.43
Cigarettes				
10 days last month	87	84.47		16 15.53
>10 days last month	35	79.55		9 20.45
Caffeine				
Low	88	84.62		16 15.38
Moderate to high	34	79.07		9 20.93

	Good Sleep Quality		Poor Sleep Quality			
	n	%	Mean (s.d.)	n	%	Mean (s.d.)
Lifetime pesticide exposure ^a						
Low	34	73.91		12	26.09	
Moderate	47	92.16		4	7.84	
High	41	82.00		9	18.00	
Health						
Obese						
No	82	84.54		15	15.46	
Yes	40	80.00		10	20.00	
Chronic Conditions						
None	101	84.87		18	15.13	
1	21	75.00		7	25.00	
Depression (CES-D) ^b						
<10	118	85.51		20	14.49	
10	4	44.44		5	55.56	
Anxiety (T score)			-0.06			0.29
			(1.02)			(0.86)
Personal Characteristics						
Age						
< 40	74	85.06		13	14.94	
40	48	80.00		12	20.00	
Education						
0–6 grade	53	86.89		8	13.11	
7–11 grade	59	79.73		15	20.27	
12 th grade	10	83.33		2	16.67	
^a p < 0.10						
^b p < 0.001						