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ORIGINAL ARTICLE

Correlation Between Sleep Disruption and Musculoskeletal Pain Among Farmers: A Cross-Sectional Study

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ABSTRACT

Background: Farming is a physically demanding occupation involving repetitive movements, heavy lifting, and prolonged awkward postures, all of which place farmers at high risk of musculoskeletal pain. Long working hours and occupational stress may further disrupt sleep, and disturbed sleep is known to heighten pain sensitivity, creating a potentially self-reinforcing cycle. Evidence on this relationship specifically among Indian farmers remains limited. Objective: To assess the relationship between sleep disruption and musculoskeletal pain among farmers, with specific objectives to determine the prevalence and anatomical distribution of musculoskeletal pain, measure the frequency and severity of sleep disruption, and evaluate the statistical correlation between sleep quality and pain intensity. Methods: A cross-sectional survey was conducted among 102 active farmers in Mehsana District, Gujarat, selected through convenience sampling. Musculoskeletal pain was assessed using the Nordic Musculoskeletal Questionnaire and the Numeric Pain Rating Scale, while sleep quality was evaluated using the Pittsburgh Sleep Quality Index. The association between sleep quality and pain intensity was analyzed using Spearman's rank correlation and the Chi-square test. Results: Musculoskeletal pain was reported by 60.8% of participants, most commonly in the lower back (33.3%) and knees (31.4%). Pain intensity was predominantly mild (48.0%) to moderate (37.3%). Poor or very poor sleep quality was reported by 26.5% of participants, and 65.7% reported that their pain worsened after inadequate sleep. Spearman's rank correlation revealed a statistically significant, moderate, negative correlation between sleep quality and pain intensity ($\rho = -0.427$, $p < 0.001$), confirmed by a Chi-square test of association ($\chi^2 = 19.26$, $df = 4$, $p < 0.001$, Cramer's $V = 0.31$). Conclusion: Musculoskeletal pain and sleep disruption are both highly prevalent among farmers and are significantly correlated, such that poorer sleep quality is associated with greater pain intensity. Occupational health strategies for farming communities should address sleep health alongside ergonomic and physiotherapeutic interventions.

Keywords: *Musculoskeletal pain; Sleep disruption; Farmers; Pittsburgh Sleep Quality Index; Nordic Musculoskeletal Questionnaire; Cross-sectional study*

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INTRODUCTION

Agriculture continues to be a principal source of livelihood and food security in many developing countries, yet the workforce sustaining it is increasingly exposed to physically hazardous conditions, including long working hours, repetitive manual tasks, and inadequate ergonomic support. Musculoskeletal disorders (MSDs) — encompassing low back pain, neck and upper-limb complaints, and osteoarthritis of the hip and knee — remain among the most frequently reported occupational health problems in farming populations worldwide, and have been documented across highly diverse agricultural settings, from rice cultivation in Bangladesh to ranching in the United States and tobacco farming in Thailand [1–4]. Systematic evidence from low- and middle-income countries indicates that musculoskeletal complaints represent the most common non-fatal occupational health burden among agricultural workers, with the lower back, knees, shoulders, and neck consistently identified as the regions most affected [1]. Similar patterns have been reported among Korean, Nepalese, and Italian livestock and tea-harvesting farmers, where repetitive bending, load-carrying, and prolonged static

postures were the principal contributing factors [5–7]. Studies from Ghana, Egypt, and Iran have further linked musculoskeletal pain among farmers to reduced quality of life, absenteeism, and diminished productivity, reinforcing that these disorders extend beyond physical discomfort into broader occupational and economic consequences [8–10]. Female agricultural workers appear particularly vulnerable, with vegetable and horticultural farming activities such as prolonged bending and repetitive planting motions frequently implicated [11,12]. Alongside these physical demands, sleep — a basic physiological requirement for tissue recovery and overall wellbeing — is frequently compromised among manual laborers. Poor sleep quality has been associated with a wide range of adverse outcomes, including reduced workplace productivity and heightened accident risk, and its prevalence among industrial and manual worker populations has been reported to be considerably higher than in the general population [13]. Of particular relevance to the present study, sleep disturbance has been shown in long-term prospective research to predict the subsequent development of more severe and more widespread pain, suggesting that impaired sleep may act as a driver of worsening musculoskeletal symptoms rather than merely a consequence of them [14]. Correspondingly, individuals with chronic pain conditions have been shown to experience significantly poorer sleep quality than the general population, with sleep disturbance closely tied to increased pain intensity and reduced quality of life [15]. Despite this growing recognition that sleep and musculoskeletal pain are closely interlinked, the relationship has been investigated predominantly in clinical or general-population samples, and comparatively little research has examined this association specifically among farmers, particularly within the Indian context. Given that agricultural work combines both major risk pathways — intense physical strain that predisposes to musculoskeletal pain, and irregular, often insufficient sleep driven by seasonal workload and environmental conditions — farmers represent an occupational group in which this bidirectional relationship may be especially pronounced and clinically significant. Understanding this relationship is essential, since sleep disturbance may exacerbate pain perception while chronic pain may simultaneously deteriorate sleep quality, creating a self-reinforcing cycle with cumulative effects on health, productivity, and quality of life. The present study was therefore undertaken to assess the relationship between sleep disruption and musculoskeletal pain among farmers, with three specific objectives: to assess the prevalence and anatomical locations of musculoskeletal pain among farmers; to measure the frequency and severity of sleep disruption using standardized tools; and to evaluate the statistical correlation between sleep quality and the intensity of reported pain. Findings from this study are intended to inform the design of targeted preventive and rehabilitative occupational health strategies for farming communities.

MATERIAL AND METHODS

Study Design and Setting

A cross-sectional survey was conducted among active farmers attending physiotherapy clinics across Mehsana District, Gujarat, India, over a period of three months. A convenience sampling method was used to recruit participants.

Study Population and Sample Size

A total of 102 active farmers were included in the study. Participants were required to be between 18 and 64 years of age, of either gender, actively engaged in farming for at least one year, and exposed to a minimum of 4–6 hours of physical farm work per day. Only farmers experiencing musculoskeletal pain in any body region (e.g., back, neck, shoulders, knees) and residing within the selected study area were included, following provision of informed consent.

Farmers were excluded if they had a recent history of trauma or injury, a diagnosed cardiovascular condition, a neurological disorder, a diagnosed sleep disorder, were pregnant, were non-farming workers, or had difficulty understanding or answering the study questionnaires.

Outcome Measures

Musculoskeletal pain was mapped using the Nordic Musculoskeletal Questionnaire (NMQ), a standardized and widely used instrument developed by the Nordic Council of Ministers for assessing musculoskeletal complaints across nine anatomical regions — the neck, shoulders, elbows, wrists/hands, upper back, lower back, hips/thighs, knees, and ankles/feet. The NMQ has been extensively validated and applied in occupational health research across diverse worker populations, including healthcare professionals, surgeons, and garment industry workers, to determine the frequency and distribution of musculoskeletal complaints and to identify associated risk factors [16–19]. Pain intensity was quantified using the Numeric Pain Rating Scale (NPRS), an 11-point self-reported scale ranging from 0 (no pain) to 10 (worst conceivable pain), with scores of 1–3, 4–6, and 7–10 classified as mild, moderate, and severe pain

respectively. The NPRS is widely used in musculoskeletal research owing to its simplicity, reliability, and clinical utility in tracking pain over time [20,21].

Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), the most widely used questionnaire for evaluating subjective sleep quality over the preceding month. The PSQI comprises 19 items across seven domains — subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction — and has demonstrated strong validity and reliability across diverse cultural and linguistic populations, effectively distinguishing between good and poor sleepers [22–25].

Data Collection Procedure

All participating farmers were first informed about the study protocol, and written informed consent was obtained prior to enrolment. A standardized questionnaire incorporating the NMQ was used to identify the presence and anatomical distribution of musculoskeletal pain, followed by the NPRS to quantify pain intensity. Sleep quality and sleep disturbances were then assessed using the PSQI. All collected data were documented and prepared for statistical analysis to determine the relationship between sleep disruption and musculoskeletal pain.

Statistical Analysis

Descriptive statistics (frequencies and percentages) were used to summarize sociodemographic characteristics, the prevalence and anatomical distribution of musculoskeletal pain, and sleep quality parameters. The association between sleep quality and pain intensity (both ordinal variables) was examined using Spearman's rank correlation coefficient. A Chi-square test of association was additionally performed on a cross-tabulation of sleep quality and pain intensity categories; where expected cell counts were below five, categories were collapsed to satisfy the test's assumptions, and Cramer's V was calculated to estimate effect size. A p-value of less than 0.05 was considered statistically significant.

RESULTS AND DISCUSSION

A total of 102 farmers were included in this cross-sectional study. Results are presented according to the study objectives, with relevant findings discussed in relation to existing literature immediately following their presentation.

Sociodemographic Characteristics

Table 1 presents the sociodemographic profile of participants. The largest age group was 41–50 years (38.2%), followed by those above 51 years (23.5%). Males comprised the majority of the sample (75.5%). Regarding farming experience, the largest group (28.4%) had more than 20 years of experience, and crop farming (45.1%) and mixed farming (44.1%) were the predominant farming types. The predominance of middle-aged and experienced farmers is notable, as cumulative physical stress accrued over years of manual agricultural labor is a recognized contributor to musculoskeletal disorder risk.

Table 1. Sociodemographic Characteristics of Participants (N = 102)

Demographic Variable	N	%
Age: 18–30 years	16	15.7
Age: 31–40 years	23	22.5
Age: 41–50 years	39	38.2
Age: Above 51 years	24	23.5
Gender: Male	77	75.5
Gender: Female	25	24.5
Farming experience: <5 years	24	23.5
Farming experience: 5–10 years	25	24.5
Farming experience: 11–20 years	24	23.5
Farming experience: >20 years	29	28.4
Farming type: Crop farming	46	45.1
Farming type: Livestock farming	8	7.8
Farming type: Mixed farming	45	44.1
Farming type: Others	3	2.9

Prevalence and Anatomical Location of Musculoskeletal Pain

Musculoskeletal pain was reported by 60.8% (n = 62) of participants. This figure closely parallels the 63.6% prevalence reported among agricultural workers in rural Tamil Nadu [26] and is consistent with systematic review evidence describing musculoskeletal disorders as a near-universal occupational hazard

among farmers across South and Southeast Asia [27]. The consistency of this prevalence across geographically distinct farming populations suggests that the physical demands intrinsic to manual agriculture, rather than any single regional or cultural factor, are the primary driver of this burden.

Among those reporting pain, the back was the most frequently affected site (33.3%), followed by the knees (31.4%), shoulders (17.6%), multi-site pain (11.8%), and the neck (5.9%) (Table 2, Figure 1). This anatomical pattern mirrors findings from Tamil Nadu, West Bengal, and Southeast Asia, where the lower back and knees were similarly identified as the regions most vulnerable to repetitive bending, squatting, and load-carrying activities [26–28]. This convergence across independent samples strengthens the case that specific, modifiable farming postures and tasks are direct contributors to pain in this population, highlighting the potential value of ergonomic interventions targeting bending and lifting technique.

Table 2: Anatomical Location of Musculoskeletal Pain

Pain Location	%
Neck	5.9
Shoulder	17.6
Back	33.3
Knee	31.4
More than one region	11.8

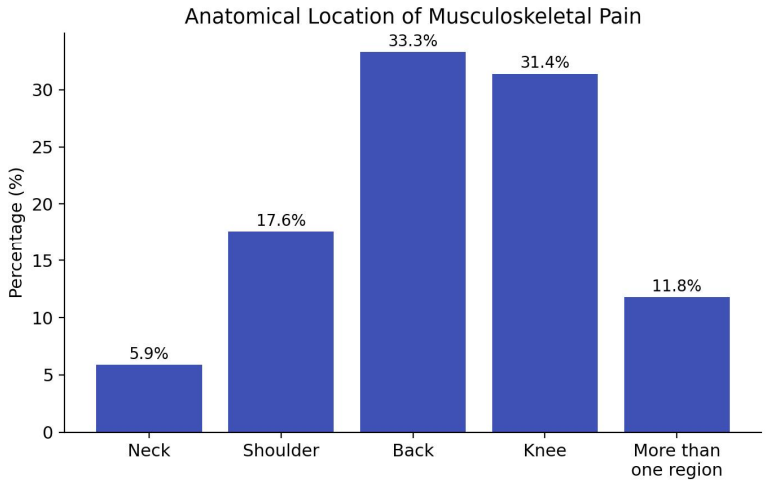


Figure 1: Anatomical distribution of musculoskeletal pain among farmers reporting pain.

Regarding pain intensity, 48.0% of participants reported mild pain and 37.3% reported moderate pain, with severe pain being uncommon (2.0%). Although low severity might appear reassuring, this pattern more plausibly reflects a workforce that continues laboring through persistent discomfort because discontinuing work is not economically viable; unaddressed mild-to-moderate pain of this kind is a recognized precursor to chronic musculoskeletal disability. Pain most frequently affected physical functioning (66.7%), followed by economic (20.6%), social (9.8%), and psychological (2.9%) domains, indicating that musculoskeletal pain among farmers extends beyond physical discomfort to affect work capacity and daily life broadly.

Frequency and Severity of Sleep Disruption

Self-rated sleep quality was good or very good in 73.6% of participants, while 26.5% rated their sleep as poor or very poor (Figure 2). Although most participants reported a seemingly adequate total sleep duration of six to seven hours (53.9%), sleep continuity was frequently disrupted: only 21.6% reported never being woken during the night, while 48.0% experienced occasional interruptions and 30.4% experienced interruptions two or more times weekly (Table 3). This distinction is clinically important, as sleep duration and sleep quality are not interchangeable — fragmented sleep, even within an apparently normal total duration, has been associated with impaired tissue recovery and heightened next-day pain sensitivity.

Table 3: Selected Sleep Parameters

Sleep Parameter	Category	%
Overall sleep quality	Very good / Good	73.6
Overall sleep quality	Poor / Very poor	26.5
Sleep interruption frequency	Never	21.6
Sleep interruption frequency	Occasional (≥1×/week)	48.0
Sleep interruption frequency	2–3×/week or more	30.4
Pain worsened after poor sleep	Sometimes/Frequently	65.7



Figure 2: Self-rated overall sleep quality among farmers (N = 102).

Downstream effects of poor sleep were common: 65.7% of participants reported that their pain worsened after poor sleep (sometimes or frequently), a similar proportion reported reduced work capacity due to sleep loss, and daytime fatigue was reported by half of participants. Notably, 29.4% had reduced their working hours specifically due to lack of sleep, and a further 18.6% due to a combination of pain and poor sleep — findings consistent with reports of widespread poor sleep and burnout among Irish farmers [29] and sleep-related contributions to musculoskeletal pain among older female farmers [30].

Statistical Correlation Between Sleep Quality and Pain Intensity

Participants were cross-classified by overall sleep quality and pain intensity (Table 4). A Spearman's rank correlation revealed a statistically significant, moderate, negative correlation between sleep quality and pain intensity ($\rho = -0.427$, $p < 0.001$), indicating that as sleep quality declined, pain intensity tended to increase (Figure 3, Figure 4). A Chi-square test of association, performed after collapsing sparse categories to satisfy minimum expected-cell-count assumptions, confirmed this relationship ($\chi^2 = 19.26$, $df = 4$, $p < 0.001$, Cramer's $V = 0.31$, indicating a moderate effect size) (Table 5).

Table 4: Cross-Tabulation of Sleep Quality and Pain Intensity

Sleep Quality Category	No Pain	Mild Pain	Moderate Pain	Severe Pain	Total
Very Good	8	18	7	0	33
Good	5	23	14	0	42
Poor	0	8	17	1	26
Very Poor	0	0	0	1	1
Total	13	49	38	2	102

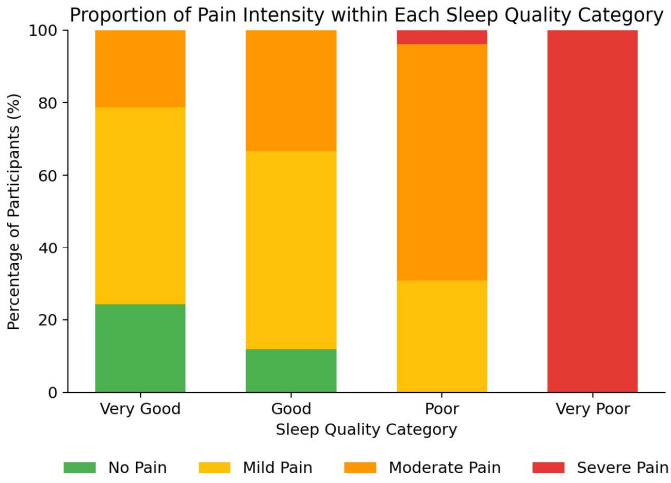


Figure 3: Proportion (%) of pain intensity levels within each sleep quality category.

Table 5: Summary of Statistical Tests

Statistical Test	Value	Df	p-value	Interpretation
Spearman's rho (ρ)	−0.427	—	< 0.001	Moderate negative correlation
Chi-square (χ^2)	19.26	4	< 0.001	Significant association
Cramer's V	0.31	—	—	Moderate effect size

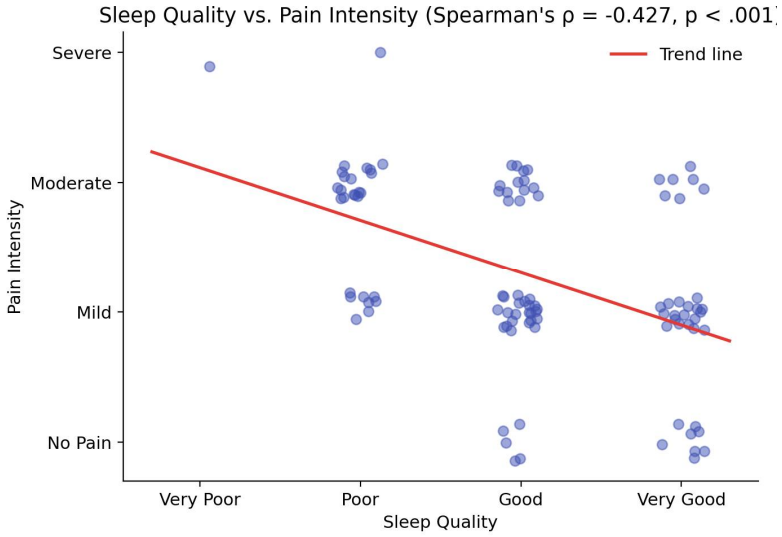


Figure 4: Sleep quality vs. pain intensity for individual participants (jittered for visibility), with a fitted trend line illustrating the negative correlation.

This finding is directly echoed by participants' own subjective accounts, in which 65.7% reported worsened pain following poor sleep. The convergence of an objective correlation statistic with participants' subjective experience, obtained through two independent measurement approaches, strengthens confidence in the observed relationship despite the inherent limitations of a cross-sectional design. These results align with a substantial body of evidence from outside agricultural settings. Sleep quality has been shown to be markedly poorer among individuals with chronic pain compared with the general population [15], and a decade-long prospective study found that sleep disturbance predicted the later development of more severe and more widespread pain, suggesting that impaired sleep may act as a cause of worsening pain rather than merely a consequence of it [14]. Sleep quality has similarly been identified as a mediating pathway through which occupational stressors translate into musculoskeletal discomfort [33], while sleeping less than approximately 6.55 hours nightly has been associated with a materially higher risk of low back pain in adults over 50 [32]. Comparable associations between sleep duration and chronic musculoskeletal pain have been reported in large US adult samples [31], and night-

shift work — a known disruptor of sleep continuity — has been linked to increased musculoskeletal pain and headache frequency among nurses [34], reinforcing that sleep continuity, not merely total duration, is central to this relationship. The mechanisms proposed to underlie this bidirectional relationship include pain-related nocturnal awakenings and difficulty settling on one hand, and, on the other, reduced pain threshold, impaired overnight tissue-repair processes, and heightened inflammatory activity resulting from poor sleep. In farmers specifically, physical exertion, environmental heat exposure, and irregular seasonal working hours may compound both sides of this cycle simultaneously, making it difficult to interrupt without deliberate intervention. Ergonomic tool redesign has been shown to reduce physical strain and discomfort during farming activities [35], suggesting that combined ergonomic and sleep-focused interventions may offer a more effective route to reducing pain burden than either approach alone. Several limitations should be considered when interpreting these findings. The cross-sectional design captures a single point in time and cannot establish the direction of causality between poor sleep and worsening pain. The use of convenience sampling from a single district limits generalizability to farmers in other regions or with different crop and livestock practices. The very small number of participants in the Very Poor sleep category (n = 1) means that estimates involving that subgroup should be interpreted with caution. Finally, self-reported pain and sleep measures, although based on validated instruments, remain subject to recall and reporting bias.

CONCLUSION

Musculoskeletal pain and disrupted sleep are both common among farmers, affecting three in five and roughly one in four participants respectively in this sample, and the two are significantly correlated: farmers with poorer sleep quality reported significantly more intense musculoskeletal pain (Spearman's $\rho = -0.427$; $\chi^2 = 19.26$; both $p < 0.001$). These findings support treating sleep health as a modifiable component of occupational health for farming communities, alongside ergonomic and physiotherapeutic approaches to musculoskeletal pain. Screening for sleep disturbance, promoting sleep hygiene, and addressing the physical strain of farm labor together may offer a more effective route to reducing pain burden and preserving work capacity than addressing either factor alone. Longitudinal research is recommended to clarify the direction of causality and to evaluate whether interventions targeting sleep quality can measurably reduce musculoskeletal pain in this population over time.

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COMPETING INTERESTS

The authors have declared that no competing interest exists.

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