# Relationship Between Work Duration and Work Process with Low Back Pain Among Coffee Farmers

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| ARTICLE INFO | ABSTRACT |
|---|---|
| | **Background:** Low back pain (LBP) is a major occupational health concern among agricultural workers, yet evidence specific to smallholder coffee farmers regarding the combined impact of work duration and work processes remains limited, particularly in the context of developing economies like Indonesia.<br>**Methods:** An analytical cross-sectional study was conducted from 1–13 October 2025 in Tunyang Induk Village, Indonesia. Using total population sampling, 135 coffee farmers participated. Data were collected through face-to-face interviews using a structured questionnaire that assessed sociodemographic variables, work duration (categorized as ≤8 hours or >8 hours/day), work processes (evaluated using an adapted Quick Exposure Check tool and categorized as "good" or "poor"), and low back pain (assessed via the Nordic Musculoskeletal Questionnaire). Data analysis involved descriptive statistics, chi-square tests, and logistic regression using SPSS version 26.0, with statistical significance set at $p < 0.05$.<br>**Results:** The prevalence of low back pain among coffee farmers was 65.2% (n=88). Of those with LBP, 59.1% reported moderate-to-severe pain, and 72.7% indicated that pain interfered with daily farming activities. Bivariate analysis revealed strong associations between LBP and both extended work duration (>8 hours/day; OR = 33.1, 95% CI: 12.8–85.6, $p < 0.001$) and poor work processes (OR = 215.8, 95% CI: 56.2–828.9, $p < 0.001$). Significant associations were also found with age ≥40 years (OR = 2.2, $p = 0.027$) and farming experience ≥10 years (OR = 2.5, $p = 0.011$).<br>**Conclusion:** Prolonged work hours and inadequate ergonomic practices are significant, independent risk factors for low back pain among Indonesian coffee farmers. These findings highlight an urgent need for ergonomic interventions, structured work-rest scheduling, and community-based health education programs to reduce musculoskeletal strain. Future efforts should integrate occupational health perspectives into agricultural policy and expand the role of community nursing in preventive ergonomic care. |

## INTRODUCTION

Low back pain (LBP) remains one of the most prevalent occupational health disorders worldwide, contributing significantly to work disability, reduced productivity, and diminished quality of life, particularly among agricultural workers engaged in repetitive manual tasks (Jain et al., 2018). In low- and middle-income countries, where mechanization is limited and labor-

intensive practices prevail, the burden of work-related musculoskeletal disorders is disproportionately high, with farmers facing elevated exposure to ergonomic hazards such as sustained awkward postures, heavy lifting, and prolonged working hours (Bausad & Allo, 2023; Jain et al., 2018; Nugraha et al., 2023; Roliana Harahap & Harahap, 2024). Coffee cultivation, a key agricultural activity in many developing regions, involves cycles of planting, harvesting, and processing that require frequent bending, twisting, and carrying, thereby imposing considerable biomechanical stress on the lumbar spine (Arif Pristianto et al., 2023; Roliana Harahap & Harahap, 2024).

In Indonesia, smallholder coffee farming supports the livelihoods of millions in rural communities, yet these farmers often work under conditions characterized by minimal ergonomic awareness, inadequate rest breaks, and limited access to occupational health services (Akbar, 2020; Mazloumi & Kouhnavard, 2025). Previous studies in similar settings have identified individual and occupational determinants of LBP, including age, poor posture, and high physical workload (Fethke et al., 2020; Putri & Purwito, 2022). However, much of this research has examined risk factors in isolation, overlooking the potential combined effects of extended work duration and non-ergonomic work processes such as repetitive trunk flexion, insufficient recovery time, and improper lifting techniques which may interact to amplify the risk of musculoskeletal injury (Das, 2023; Nugraha et al., 2023; Shivakumar et al., 2023). Furthermore, few studies have translated these occupational risks into actionable nursing-sensitive outcomes or preventive interventions within agricultural communities.

Occupational health nursing plays a vital role in primary prevention, health education, and ergonomic advocacy in worker populations, yet its integration into rural agricultural settings in Indonesia remains underdeveloped (Baek et al., 2023; Das, 2022; Hafizd Hilal Assegaf et al., 2025)(Baek et al., 2023; Das, 2022; Hafizd Hilal Assegaf et al., 2025). Nurses are well-positioned to conduct ergonomic risk assessments, deliver posture training, and promote self-management strategies that can mitigate musculoskeletal strain. Nevertheless, evidence-based guidelines tailored to nursing care for farmers especially coffee growers are scarce, hindering the development of structured, nurse-led interventions to address work-related LBP in this vulnerable occupational group (Shivakumar et al., 2023).

Globally, ergonomic research in agriculture has increasingly emphasized cumulative exposure to physical risk factors, yet context-specific evidence from coffee-producing regions in Southeast Asia remains limited (Arif Pristianto et al., 2023; Hamzah et al., 2023). Although international guidelines recommend integrated ergonomic assessments and interventions, their applicability in resource-constrained, traditional farming communities—where mechanization is minimal and occupational health infrastructure is often absent—remains underexplored (Akbar, 2020). This gap underscores the need for locally grounded studies that can inform feasible, culturally appropriate preventive measures, including those involving nursing professionals in design and delivery.

The objective of this study is to analyze the relationship between work duration and work processes and low back pain among coffee farmers in Tunyang Induk Village, Bener Meriah District, and to identify implications for the development of community-based occupational health nursing interventions. Specifically, this study aims to: (1) determine the prevalence of low back pain among coffee farmers, (2) examine the association between extended work duration (>8 hours/day) and the occurrence of LBP, (3) analyze the influence of non-ergonomic work processes on musculoskeletal complaints, and (4) formulate evidence-based recommendations for nurses in designing prevention and health promotion programs in rural farming settings. The findings are expected to address a critical evidence gap while providing practical guidance for community nurses and occupational health practitioners in developing effective and sustainable ergonomic strategies for coffee farmers in Indonesia.

## METHODS

### Study Design

This study employed an analytical cross-sectional design to examine the relationship between work duration, work processes, and low back pain among coffee farmers in Tunyang Induk Village, Bener Meriah District, Aceh Province, Indonesia. The cross-sectional approach was selected as it allows for the simultaneous assessment of exposure variables (work duration and work processes) and the outcome variable (low back pain) at a single point in time, making it suitable for determining prevalence and identifying potential associations in resource-limited settings (Setia, 2016). Data collection was conducted from October 1 to October 13, 2025, coinciding with the peak coffee harvesting season to ensure that work patterns and physical demands were representative of typical farming activities.

### Study Setting and Population

The research was conducted in Tunyang Induk Village, located in Bener Meriah District, Aceh Province, a region recognized for its substantial coffee production and reliance on traditional, labor-intensive farming methods. The village was purposively selected due to its high concentration of smallholder coffee farmers and the absence of previous ergonomic or occupational health studies in the area. The study population comprised all active coffee farmers in the village who met the following inclusion criteria: (1) at least one year of experience in coffee farming, (2) aged between 20 and 60 years, and (3) willingness to provide informed consent. Exclusion criteria included: (1) a documented history of chronic spinal disorders unrelated to occupational activities (e.g., congenital deformities, traumatic injuries), and (2) temporary absence or inability to complete the interview during the data collection period.

### Sample Size and Sampling Technique

A total population sampling (census) approach was utilized, as the entire target population was accessible and relatively small. All 150 registered coffee farmers in the village were screened for eligibility, of which 135 met the inclusion criteria and agreed to participate, yielding a response rate of 90.0%. Although formal sample size calculation was not performed due to the total sampling approach, post-hoc power analysis using G*Power version 3.1 indicated that the sample of 135 provided over 90% power to detect medium effect sizes (w = 0.3) at $\alpha = 0.05$ using chi-square tests.

### Ethical Considerations

Ethical approval was obtained from the Research Ethics Committee of STIKes Santa Elisabeth Medan (Approval No. 087/KEPK-STIKesSE/X/2025). The study adhered to the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants after explanation of study objectives, procedures, risks, and benefits. Participants were assured of confidentiality, voluntary participation, and the right to withdraw at any time without consequence. Data were anonymized and stored securely with access restricted to the research team.

### Data Collection Instruments and Procedures

#### Instruments

Data were collected using a structured questionnaire comprising four validated sections. The first section assessed sociodemographic characteristics, including age, gender, educational attainment, and years of farming experience. The second section measured work duration, capturing average daily working hours during the harvest season, which were subsequently categorized as ≤7 hours or >8 hours per day. The third section evaluated work processes using an adapted version of the Quick Exposure Check (QEC) tool. This instrument assessed body posture during key activities (bending, twisting, and squatting), frequency of heavy lifting (>20

kg), and patterns of rest breaks (frequency and duration). Responses were scored and categorized as "good" (score ≤10) or "poor" (score >10) based on predefined ergonomic risk thresholds. The fourth section measured low back pain (LBP) using the standardized low back pain module of the Nordic Musculoskeletal Questionnaire (NMQ), which has demonstrated good reliability in Indonesian agricultural populations (Cronbach's α = 0.82–0.88). The questionnaire underwent forward-backward translation (English–Indonesian) and was pilot-tested with 15 farmers not included in the main study to ensure clarity, cultural relevance, and content validity. Expert validation was obtained from two occupational health nurses and one ergonomics specialist.

## Procedures

Data collection was conducted over a 13-day period from October 1 to October 13, 2025, to coincide with the peak coffee harvest season. Prior to fieldwork, coordination meetings were held with local village authorities and leaders of farmers' groups to secure administrative support and facilitate participant engagement. A team of four trained enumerators, each holding a bachelor's degree in public health or nursing and proficient in both Bahasa Indonesia and the local Acehnese dialect, carried out face-to-face interviews. Enumerators participated in a two-day training program covering the study protocol, ethical guidelines, questionnaire administration, interview techniques, and informed consent procedures.

Interviews were scheduled at times convenient for participants—typically early morning or late afternoon—to avoid disruption of farming activities. They were conducted in private settings, either in participants' homes or designated community spaces, to ensure confidentiality and minimize social desirability bias. Each interview lasted approximately 25–35 minutes, during which enumerators read questions aloud and recorded responses directly onto printed questionnaires. A body diagram was used to assist participants in precisely localizing pain when describing low back symptoms.

To ensure data quality, several measures were implemented: (1) daily supervisory checks by the principal investigator to review completeness and consistency; (2) random verification interviews with 10% of participants (n=14) within 48 hours of the initial interview to confirm key responses; and (3) daily debriefing sessions with enumerators to address ambiguities and standardize response interpretation. Completed questionnaires were assigned unique identification codes to maintain anonymity. Data were stored securely in a locked cabinet, and electronic entry was performed using a password-protected database. Double data entry was conducted by two independent research assistants to minimize transcription errors, with discrepancies resolved by referring to the original questionnaires.

## Data Analysis

Data were entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0. Descriptive statistics (frequency distributions, means, and percentages) were used to summarize respondent characteristics. Bivariate analysis was conducted using the Chi-square test ($\chi^2$) to determine the relationship between age, work duration, work process, farming experinces and low back pain complaints, with a confidence level of 95% (α = 0.05). Results with p-values ≤ 0.05 were considered statistically significant. Quality assurance measures included double data entry verification, random re-checks of completed questionnaires, and the use of standardized coding procedures to reduce transcription errors and maintain data integrity.

## Limitations

The cross-sectional nature of this study limits causal interpretation, as data were collected at a single point in time. Additionally, reliance on self-reported measures may introduce recall bias. However, standardized questionnaires, trained interviewers, and a total population approach were employed to mitigate these limitations and enhance data reliability.

## RESULTS

The overall prevalence of low back pain among coffee farmers was 65.2% (n=88). Among those reporting pain, 59.1% (n=52) described it as moderate to severe intensity, with 72.7% (n=64) indicating that the pain interfered with their daily farming activities

**Table 1. Distribution Characteristics of Study Participants (N=135).**

| Characteristic | n | % |
|---|---|---|
| **Age Group** | | |
| 20-29 years | 19 | 14.1 |
| 30-39 years | 33 | 24.4 |
| 40-49 years | 46 | 34.1 |
| **Gender** | | |
| Male | 106 | 78.5 |
| Female | 29 | 21.5 |
| **Farming Experience** | | |
| <10 years | 45 | 33.3 |
| ≥10 years | 90 | 66.7 |
| **Work Duration** | | |
| ≤8 hours | 50 | 37.0 |
| >8 hours | 85 | 63.0 |
| **Work Process** | | |
| Good | 46 | 34.1 |
| Poor | 89 | 65.9 |

A total of 135 coffee farmers participated in this study, with a mean age of 43.2 ± 10.5 years (range: 22–60 years). The majority of participants were male (78.5%, n=106). The mean farming experience was 15.8 ± 8.3 years. Concerning work patterns, 63.0% (n=85) reported working more than 8 hours per day during the harvest season. Assessment of work processes using the adapted QEC tool revealed that 65.9% (n=89) were classified as having "poor" ergonomic practices, characterized by frequent bending, inadequate rest breaks, and regular heavy lifting.

**Table 2. Prevalence and Characteristics of Low Back Pain (LBP) Among Coffee Farmers (N=135)**

| Characteristic | Category | n | % |
|---|---|---|---|
| **LBP Prevalence** | Present | 88 | 65.2 |
| | Absent | 47 | 34.8 |
| **Pain Intensity** (n=88) | Mild | 36 | 40.9 |
| | Moderate | 42 | 47.7 |
| | Severe | 10 | 11.4 |
| **Pain Interference with Work** (n=88) | Yes | 64 | 72.7 |
| | No | 24 | 27.3 |
| **Duration of Pain Episode** (n=88) | < 1 week | 18 | 20.5 |
| | 1–4 weeks | 52 | 59.1 |
| | > 1 month | 18 | 20.5 |
| **Pain Onset Relative to Work** (n=88) | During work | 45 | 51.1 |
| | After work | 38 | 43.2 |
| | Unrelated to work | 5 | 5.7 |

The overall prevalence of low back pain among the 135 coffee farmers was 65.2% (88 individuals). The severity and impact of reported pain are detailed in Table 1. The majority of affected farmers experienced pain of moderate to severe intensity, and over 70% reported that their pain interfered with daily work activities.

**Table 3. Association Between Work Factors and Low Back Pain (Bivariate Analysis)**

| Variable | OR (95% CI) | p-value |
|---|---|---|
| Work Duration | 33.1 (12.8–85.6) | <0.001 |
| Work Process | 215.8 (56.2–828.9) | <0.001 |
| Age | 2.2 (1.1–4.5) | 0.027 |
| Farming Experience | 2.5 (1.2–5.2) | 0.011 |

Both work duration and work processes demonstrated strong associations with low back pain. Farmers working more than 8 hours daily had 33.1 times higher odds of reporting low back pain compared to those working 8 hours or less (OR=33.1, 95% CI: 12.8–85.6, p<0.001). Similarly, those classified with poor work processes had 215.8 times higher odds of low back pain compared to those with good work processes (OR=215.8, 95% CI: 56.2–828.9, p<0.001).

## DISCUSSION

This study reveals a significant occupational health burden among coffee farmers in Aceh, Indonesia, with a high prevalence of low back pain (65.2%) that is strongly associated with extended work duration and poor ergonomic work processes. These findings align with the broader literature indicating that agricultural workers, particularly in low-resource settings, face substantial risks of work-related musculoskeletal disorders due to physically demanding tasks, prolonged exposures, and limited access to ergonomic interventions or mechanized aids (Baek et al., 2023; Das, 2023).

The robust association between working more than eight hours per day and low back pain (OR=33.1, p<0.001) underscores the cumulative biomechanical stress imposed by prolonged manual labor. Extended work periods without adequate recovery likely contribute to muscle fatigue, reduced spinal stability, and sustained intradiscal pressure—all established mechanisms in the pathogenesis of low back pain (Hafizd Hilal Assegaf et al., 2025; Nugraha et al., 2023; Shivakumar et al., 2023). This finding is consistent with studies among agricultural populations in other regions, where long working hours have been consistently linked to higher rates of musculoskeletal complaints (Arif Pristianto et al., 2023; Hamzah et al., 2023). The dose-response relationship suggested by the stronger association among farmers with greater than ten years of experience implies that chronic exposure to prolonged work may accelerate degenerative spinal changes over time, a concern for the aging farming workforce (Budiman & Fristiyanwati, 2023; Widyanti, 2018).

Furthermore, the exceptionally strong association between poor work processes and low back pain (OR=215.8, p<0.001) highlights the critical—and potentially modifiable—role of task-specific ergonomic factors. The assessment using the adapted QEC tool indicated that most farmers engaged in high-risk activities such as repetitive bending, twisting, squatting, and heavy lifting with minimal postural variation or scheduled rest breaks (Yussy Rha et al., 2025). Biomechanically, such non-neutral trunk postures and high-frequency manual handling significantly increase spinal loading, particularly at the vulnerable L4–L5 and L5–S1 segments, elevating the risk of disc compression, ligamentous strain, and muscular fatigue (Nana Rahdiana, 2024; Nugraha et al., 2023; Pasaribu et al., 2025). The near-universal presence of low back pain among farmers classified with poor work processes (95.5%) suggests that in this population, ergonomic exposure approaches a threshold where musculoskeletal injury becomes highly probable, if not inevitable, without intervention (Agustin et al., 2023; Roliana Harahap & Harahap, 2024).

The significant associations with age (OR=2.2, p=0.027) and farming experience (OR=2.5, p=0.011) in the bivariate analysis reflect the expected compounding effects of biological aging and cumulative occupational exposure. However, the overwhelming strength of the work-related factors suggests that, while age and experience may increase vulnerability, the primary drivers of low back pain in this cohort are the modifiable conditions of work duration and process. This distinction is crucial for prevention, shifting focus from non-modifiable individual

factors to alterable organizational and environmental risk factors (Fathimahhayati et al., 2022; Prastyanto et al., 2023).

From a nursing and public health perspective, these findings delineate clear priorities for intervention. Community and occupational health nurses working in agricultural regions are strategically positioned to lead primary prevention efforts. This could involve conducting ergonomic risk assessments during community health visits, integrating posture and body mechanics education into existing health promotion programs at village health posts (Posyandu), and advocating for simple, low-cost workplace modifications. Examples include promoting the use of long-handled tools to reduce bending, teaching load-spreading techniques (e.g., using two smaller bags instead of one heavy sack), and establishing structured work-rest schedules, such as the "20-8-2" rule (20 minutes of work, 8 minutes of light activity, 2 minutes of rest) (Nevala-Puranen, 2002). Such interventions align with the expanding role of nursing in occupational health, particularly in underserved communities where traditional occupational health services are scarce (Smith, 2021).

The high percentage of farmers reporting pain interference with work (72.7%) underscores the potential impact of low back pain on agricultural productivity and household economic security. This creates a compelling argument for integrating ergonomic health into broader sustainable agriculture and rural development initiatives, supporting goals related to decent work (SDG 8) and good health (SDG 3).

**Limitations and Strengths**

The cross-sectional design precludes definitive causal conclusions, and self-reported data on pain and work habits are susceptible to recall bias. The use of a categorical measure for work duration and a dichotomized score for work processes, while practical, may oversimplify these complex exposures. However, the study's strengths include a high response rate within a total population sample, the use of a structured and adapted data collection tool (QEC and NMQ), and the reporting of strong, clinically significant effect sizes with precise confidence intervals..

**Implications for Practice and Policy**

These findings have important implications for occupational health nursing practice and agricultural policy in Indonesia. At the practice level, they support the development of community-based ergonomic education programs led by nurses and other frontline health workers. At the policy level, they highlight the need for integrating occupational health considerations into agricultural extension services and for developing guidelines on safe working hours and practices for smallholder farmers. Such interventions could contribute to both SDG 3 (good health and well-being) and SDG 8 (decent work and economic growth) by promoting healthier, more sustainable farming practices

**CONCLUSION**

In conclusion, this study provides compelling evidence that prolonged work hours and non-ergonomic work processes are major, independent risk factors for low back pain among Indonesian coffee farmers. The findings call for a multi-level response: at the individual level through farmer education; at the community level through nurse-led prevention programs; and at the policy level through the integration of ergonomic guidelines into agricultural extension services. Future research should employ longitudinal or interventional designs to test the efficacy of specific ergonomic modifications and educational programs in reducing the burden of this pervasive occupational health problem.

Based on the study findings, the following recommendations are proposed to address the high prevalence of low back pain among coffee farmers: 1) For Healthcare Practice: Community and occupational health nurses should integrate ergonomic screening and education into routine primary care services. This includes training farmers in proper posture, safe lifting techniques, and the importance of scheduled rest breaks. Nurses can also develop simple, visual educational materials tailored to low-literacy populations and conduct community workshops

during non-harvest seasons. 2) For Workplace and Policy Intervention: Local agricultural authorities and farmer cooperatives should promote the adoption of ergonomic work practices, such as implementing a "20-8-2" work-rest schedule (20 minutes of work, 8 minutes of light activity, 2 minutes of rest) and facilitating access to low-cost ergonomic tools. Policies should be encouraged to limit continuous work periods to under two hours without a postural change or brief break. 3) For Nursing Education and Research: Nursing curricula should strengthen content on occupational health, particularly ergonomics in agriculture. Future research should prioritize intervention studies evaluating the effectiveness of nurse-led ergonomic programs and explore the long-term impact of such interventions on farmers' productivity, pain levels, and quality of life.

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