Original article

# Musculoskeletal disorders and ergonomic risk in coffee pickers: a cross-sectional study

# Distúrbios musculoesqueléticos e risco ergonômico em colhedores de café: um estudo transversal

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**ABSTRACT | BACKGROUND:** Coffee harvesting is a manual labor activity that occupies a fundamental role in this productive chain. It is generally performed by peasants, who must face occupational risk factors that increase the risk of musculoskeletal disorders. This study aimed to identify correlations between the presence of musculoskeletal disorders attributable to postures and body movements during the harvesting process and the living conditions of those who perform it. **METHODS:** A quantitative, cross-sectional study was developed with a non-probabilistic sampling. Data collection was carried out through a questionnaire that included sociodemographic, health, well-being, and lifestyle variables, the Nordic questionnaire, the IPAQ questionnaire, and the REBA method. The sample consisted of 82 adult coffee pickers from five coffee farms in the department of Huila - Colombia. A descriptive analysis was performed to identify the association, using Fisher's exact test and the chi-square test. The direction and strength of the association were determined with the Odds Ratio (OR) with its respective 95% confidence interval (CI). A logistic regression analysis was performed to identify the factors associated with musculoskeletal disorders; the tests were evaluated at a significance level of 5% (p <0.05). **RESULTS:** The participating coffee pickers work under unfavorable working conditions, mostly men, 61% of whom are at high risk and 39% at very high risk of suffering from musculoskeletal disorders. Likewise, 82.9% have some of them. The findings showed that men are more likely to suffer from musculoskeletal disorders and a high REBA result. **CONCLUSIONS:** Musculoskeletal disorders are common in the coffee-picking population studied, with the upper body area being the most affected.

**KEYWORDS:** Musculoskeletal Diseases. Socioeconomic Factors. Working Conditions. Occupational Health.

**RESUMO | FUNDAMENTOS:** A colheita de café é uma atividade laboral manual geralmente realizada por pessoas camponesas, que devem enfrentar fatores de risco ocupacional, bem como a probabilidade de sofrer distúrbios musculoesqueléticos. O objetivo do estudo foi identificar associações entre a presença de distúrbios musculoesqueléticos atribuíveis às posturas e movimentos corporais durante o processo de colheita e as condições de vida dos coletores de café. **MÉTODOS:** Foi desenvolvido um estudo de abordagem quantitativa, de corte transversal, com amostragem não probabilística. A coleta dos dados foi realizada por meio de um questionário que incluiu variáveis sociodemográficas, de saúde, bem-estar e estilos de vida, o utilizou-se o Nordic Musculoskeletal Questionnaire (NMQ; Questionário Nórdico de Sintomas Musculoesqueléticos), assim como, o questionário International Physical Activity Questionnaire (IPAQ, Questionário Internacional de Atividade Física) e o método Rapid Entire Body Assessment (REBA, Avaliação Rápida do Corpo Inteiro). A amostra foi constituída por 82 adultos trabalhadores da colheita de café manual de cinco fazendas do departamento do Huila – Colômbia (departamento equivalente a estado no Brasil). Realizou-se uma análise descritiva e, para identificar a associação, utilizou-se o teste exato de Fisher e o teste de qui-quadrado; a direção e a força da associação foram determinadas com Odds Ratio (OR, Razão de Chances) e seu respectivo intervalo de confiança (IC) de 95%. Foi realizada uma análise de regressão logística para identificar os fatores associados aos distúrbios musculoesqueléticos, avaliando os testes a um nível de significância de 5% (p<0,05). **RESULTADOS:** Os trabalhadores da colheita de café são expostos a condições laborais pouco favoráveis, sendo, em sua maioria, homens, dos quais 61% apresentam risco alto e 39% risco muito alto de sofrer distúrbios musculoesqueléticos. Além disso, 82,9% apresentam algum desses distúrbios. Os resultados indicaram que ser homem tem maior probabilidade de sofrer distúrbios musculoesqueléticos e obter um resultado de REBA alto. **CONCLUSÕES:** Os distúrbios musculoesqueléticos são comuns na amostra de trabalhadores da colheita de café estudada, sendo o tronco superior a região corporal mais afetada.

**PALAVRAS-CHAVE:** Doenças Musculoesqueléticas. Fatores Socioeconômicos. Condições de Trabalho. Saúde Ocupacional.

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## 1. Introduction

In Colombia, agricultural work is based on coffee production, representing 16% of the agricultural Gross Domestic Product (GDP). It has 553,000 producers, 33% of the Colombian rural population.[1] Coffee growing is an actual engine of development in the rural economy since the value of the harvest, which is $5.2 billion, and is redistributed as income among the more than 550 thousand families that live in 595 municipalities in the country. This being the case, and with this potential, according to studies by the Bank of the Republic, the multiplier effect is a 10% increase in coffee income.[2]

Harvesting marks the beginning of the long journey of coffee until it is consumed. It does not require much material, but it does require a great deal of labor. Those in charge of collecting the beans only carry a basket that, once full, is emptied into a sack.[3]

It is physically hard work, especially when harvesting coffee in plantations that are difficult to access or at high altitudes. Colombian topography means that coffee is mainly planted on hillsides[4], so its harvesting is one of the activities with the greatest biomechanical risk for workers in the agricultural sector, who have a poor record in relation to safety and health at work compared to other occupations, due to precarious conditions, patterns and long work days.[5] In addition to the vulnerable working conditions of coffee pickers, ergonomic risks manifest themselves in high probabilities of musculoskeletal injuries and inadequate living conditions.[6]

Musculoskeletal effects during coffee harvesting are fundamentally similar to other occupational groups and have been related to characteristics of the subjects: age, body mass and sex; characteristics of the work: handling of loads and size of work tools; psychosocial characteristics: stress and depression, and the physical demands of the work.[7] However, very few studies in Colombia have addressed ergonomic risks, the presence of musculoskeletal disorders[6], and their association with demographic and lifestyle conditions of coffee pickers, and even more so, of those who do it in harsh topographic conditions.

The objective of this work was to identify associations between the presence of musculoskeletal disorders [MSDs] attributable to body postures and movements during the harvesting process and the living conditions of coffee pickers on hillsides. The results of this research may serve as a baseline for the biomechanical conditions in which this work is carried out, the demographic aspects that affect it and the living conditions of the subjects that make up this productive sector; in order to generate strategies from physiotherapy and occupational health to improve them.

## 2. Method

This study established the association between the sociodemographic characteristics of 82 coffee pickers from five coffee farms (from the municipalities of Teruel, Gigante, Garzón, Pitalito and San Agustín), located in the department of Huila, Colombia; and the presence of musculoskeletal disorders associated with the work. A quantitative, non-experimental, cross-sectional study was developed. Data collection was carried out during the harvest period, during the months of April 2022 to October 2023.

A non-probabilistic sampling was developed, including as participants in the study people over 18 years of age, whose main job was picking coffee and who were registered with the National Federation of Coffee Growers, Huila Section, an institution through which the invitation was extended to the coffee farms in the region. When visiting each of the five farms that responded to the call, all the pickers present were directly invited and all those who accepted their voluntary participation were included. People with other jobs related to the coffee harvest and who had a diagnosis of pathologies that generate musculoskeletal disorders, especially connective tissue diseases or other autoimmune diseases, were excluded.

In each farm, an area adjacent to the coffee plantations was adapted where the evaluators (five physiotherapists with more than 5 years of professional experience with postgraduate training (Master's in occupational health and safety, Master's in disability, Master's in neurorehabilitation, Master's in administration and planning in education) after obtaining consent from each of the subjects to participate in the study, carried out physical evaluations and applied four instruments: the survey to inquire about some sociodemographic characteristics, health, well-being and lifestyles, the symptoms related to DME were evaluated using the Nordic questionnaire.[8] The level of physical activity using the IPAQ questionnaire[9,10] and postural analysis was performed to estimate the risk of suffering from work-related body disorders using the REBA instrument.[11]

In this study, measures were taken to minimize potential biases inherent to the profile of the study, particularly considering that the participants, coffee pickers, could present a variable level of understanding of the assessment instruments. To mitigate this limitation, strategies such as guided and personalized application of all the questionnaires by trained personnel were employed, ensuring clarity in the explanation of the questions and guaranteeing that the participants understood their purpose and content. In addition, the selected instruments (Nordic Questionnaire, the REBA and the IPAQ) have been validated and culturally adapted, which reduces the risk of misinterpretation. However, it is recognized that the educational or cultural level could influence the perception and response of some items, an aspect intrinsic to this type of study in rural contexts, but which was sought to be controlled through a careful design and methodologies adapted to the context of coffee pickers.

This research has the endorsement of the Ethics Committee of Fundación Universitaria María Cano in session #03 of December 15, 2021, with code number 013008042-2021-311.

The data obtained were systematized and analyzed using the statistical software IBM ® SPSS ® STATINFLUENCIA SOCIALTICS Version 25. Licensed by Fundación Universitaria María Cano. The descriptive analysis of the variables is presented in percentages and absolute frequencies. To identify the association of the qualitative variables, the Fisher Exact Test and the Chi-Square test were used, and the strength of the association was determined with the Odds Ratio (OR) with its respective Confidence Interval (CI) of 95%. The Multivariate analysis with Logistic Regression was performed to identify the factors associated with the [MSDs], and sociodemographic variables. Statistical tests were evaluated at a significance level of 5% ($p < 0.05$).

## 3. Results

### 3.1 Univariate analysis

Of the 82 coffee pickers, 85.4% are male, with an average age of 38.5 ± 1.43 years. Most of the workers are from a low-low socioeconomic stratum, corresponding to 68.3%; 95.1% have a subsidized health regime and 4.9% a contributory regime, only 18.3% have a coffee farm in the region of origin, the majority have experience in coffee picking, standing out more than 20 years with 41.5%; in relation to the REBA analysis, 61% of the subjects present a high risk and 39% a very high risk, likewise 82.9% present some musculoskeletal disorder, 51.2% in the upper body and 31.7% in the lower body, the other characteristics can be seen in table 1.

**Table 1.** Sociodemographic characteristics

| Variable | Category | N | % |
|---|---|---|---|
| Civil status | Single | 35 | 42.7 |
| | Married | 13 | 15.9 |
| | Widower | 1 | 1.2 |
| | Divorced | 3 | 3.7 |
| | Free Union | 30 | 36.6 |
| Socioeconomic level | Stratum 1 Low-low | 56 | 68.3 |
| | Stratum 2 Low | 25 | 30.5 |
| | Stratum 3 Medium-low | 1 | 1.2 |
| Originate from | Neiva City | 4 | 4.9 |
| | Outside of Neiva | 78 | 95.1 |
| Education level | Complete primary | 16 | 19.5 |
| | Incomplete primary | 15 | 18.3 |
| | Completed Secondary | 25 | 30.5 |
| | Incomplete secondary | 14 | 17.1 |
| | Technical- technological | 5 | 6.1 |
| | Bachelor Degree | 3 | 3.7 |
| | None | 4 | 4.9 |
| Ownership of a coffee farm in the region of origin | Si | 15 | 18.3 |
| | No | 67 | 81.7 |
| Type of labor in the region of origin | Various trades | 36 | 43.9 |
| | Farmer | 12 | 14.6 |
| | Laborer | 8 | 9.8 |
| | Collector | 23 | 28.0 |
| | Coffee growing | 3 | 3.7 |
| | None | 4 | 4.9 |
| Probability of employment in the region of origin | Low | 31 | 37.8 |
| | Half | 36 | 43.9 |
| | high | 11 | 13.4 |
| Year of Experience as a collector | Less than or equal to 1 year | 12 | 14.6 |
| | Greater than 1 year and less than or equal to 3 years | 8 | 9.8 |
| | Over 3 years and less than or equal to 5 years | 14 | 17.1 |
| | Greater than 5 years and less than or equal to 10 years | 14 | 17.1 |
| | Over 20 years | 34 | 41.5 |
| Farm selection criterio | Good nutrition | 2 | 2.4 |
| | Good deal | 2 | 2.4 |
| | Good price | 33 | 40.2 |
| | Good production | 21 | 25.6 |
| | Known family | 5 | 6.1 |
| | All of the above | 18 | 22.0 |
| REBA | High risk | 50 | 61% |
| | Very High risk | 32 | 39% |
| Musculoskeletal disorder | Upper body | 50 | 61% |
| | Lower Body | 32 | 39% |

Source: the authors (2025).

Concerning lifestyles, the majority of workers consume a cup of fruit (69.5%) and a cup of vegetables (65.9%) on a typical day, two or more servings of fish a week (74.4%), 91.5% consume 3 or more ounces of whole grains per day, 68.3% drink less than 36 ounces of sugary drinks per week, 59.8% are moderating or reducing salt consumption, 32.9% smoke and 12.2% quit tobacco more than 12 months ago. 14.7% use chewing tobacco.

In the health and well-being survey, 64.6% do not feel safe in their current relationship with their partner, 13.4% report that there is someone from a previous relationship who currently makes them feel insecure, 15.9% were hit or injured in the last year, the other characteristics can be seen in table 2.

**Table 2.** Health and well-being characteristics

| Variable | Category | N | % |
|---|---|---|---|
| Days of vigorous physical activity | 1 to 5 days per week | 29 | 35.4 |
| | 1 to 6 days per week | 28 | 34.1 |
| | 1 to 7 days per week | 18 | 22.0 |
| | No physical activity | 7 | 8.5 |
| Total time spent performing vigorous physical activity. | Hours per day from 1 to 3 | 26 | 31.7 |
| | Hours per day from 3 to 5 | 51 | 62.2 |
| | Don't know/not sure | 0 | 6.1 |
| Days of moderate physical activity | 1 to 6 days per week | 48 | 58.5 |
| | 1 to 7 days per week | 15 | 18.3 |
| | No physical activity | 19 | 23.2 |
| Total, time used to perform moderate physical activity | Hours per day from 1 to 3 | 22 | 26.8 |
| | Hours per day from 3 to 5 | 47 | 57.3 |
| | Don't know/not sure | 13 | 15.9 |
| Walking days of at least 10 minutes | 1 to 6 days per week | 51 | 62.2 |
| | 1 to 7 days per week | 30 | 36.6 |
| | No physical activity | 1 | 1.2 |
| Walking days of at least 10 minutes | Hours per day from 1 to 3 | 56 | 68.3 |
| | Hours per day from 3 to 5 | 25 | 30.5 |
| | Don't know/not sure | 1 | 1.2 |
| Total, time spent walking in a day | Hours per day from 1 to 3 | 67 | 81.7 |
| | Hours per day from 3 to 5 | 13 | 15.9 |
| Time spent sitting on a day in the week | Don't know/not sure | 2 | 2.4 |

Source: the authors (2025).
Note: the total of 6.1% in the "Don't know/not sure" category for vigorous physical activity refers to the sum of cases that did not know or did not answer clearly.

A significant association can be seen between sex ($p < 0.028$) and REBA ($p < 0.033$); in the other variables, no association was found (table 3). An exploratory multivariate logistic regression model was adjusted to identify possible factors associated with presenting DME; for this, the variables age, sex, socioeconomic stratum, health regime, origin, smoking habit, physical activity, and REBA were included. A significant relationship was found between the variable sex and REBA, with men having a greater probability of presenting musculoskeletal disorders than women (OR = 6.395; CI 95%; 1.459-28.022) and high REBA has a greater probability of presenting musculoskeletal disorders than a very high REBA (OR = 4.448; CI 95%; 1.195 -16.55). A goodness-of-fit test was performed to assess how well this model fits the data, and a p-value of 0.279 was obtained in the Hosmer-Lemeshow test, indicating that although not all variables were significant, the model fits well.

**Table 3.** Association between sociodemographic variables, physical activity, REBA, and musculoskeletal disorders

| Variable | | Musculoskeletal disorder | | Valor *p* |
|---|---|---|---|---|
| | | Yes | No | |
| Sex | Male | 61 | 9 | 0.028[A*] |
| | Female | 7 | 5 | |
| Experience as a collector | Under 5 years | 27 | 7 | 0.407[B] |
| | Over 6 years | 41 | 7 | |
| Smoke | Yes | 25 | 2 | 0.128[A] |
| | No | 43 | 12 | |
| Moderate salt consumption | Yes | 42 | 7 | 0.414[B] |
| | No | 26 | 7 | |
| Consumption of sugary drinks | Yes | 48 | 8 | 0.355[A] |
| | No | 2 | 6 | |
| Consumption of alcoholic beverages | Yes | 41 | 9 | 0.780[B] |
| | No | 27 | 5 | |
| Physical activity | Yes | 46 | 9 | 0.807[B] |
| | No | 22 | 5 | |
| REBA | High | 45 | 5 | 0.033[B*] |
| | Very high | 23 | 9 | |

Source: the authors (2025).
[A] Fischer's exact test.
[B] Chi square test.
Observation: *p < 0.05 indicates statistically significant association.

## 4. Discussion

The average age of the collectors who participated in this study was 38 years, which is consistent with the report of the National Federation of Coffee Growers in 2016, which indicates that 53% of the workers were people under 40 years of age[12] as reported in similar works by Garzón et al. (2017) and Ortegón et al. (2019).[6,13] The majority of the collectors were men (85.4%)[6], from low-low socioeconomic strata (68.3%), with a subsidized health regime (95.1%) and low educational level. These results coincide with previous studies[4,14,15] that reported a high percentage of collectors with low economic resources and little schooling.

Regarding health and well-being characteristics, exposure to long work days, repetitive movements, prolonged standing positions, added to weight loads on uneven terrain and different climatic conditions was found to is associated with a high risk of the presence of [MSDs], which is consistent with the results reported by Osorio et al.[16] Handling loads, working in prolonged and/or uncomfortable postures, and repetitive movements are biomechanical risk factors that lead to bone, joint, muscle, tendon, and/or nerve disorders6 in coffee pickers. Back pain is common[17] compared to non-agricultural rural workers. Pain in the shoulders, elbows wrists and hands are also significantly higher compared to other jobs[18], generating a public health problem in the face of health conditions and occupational risks that impact productivity and absenteeism.[19]

In relation to the results of the Nordic questionnaire, it was found that 82.9% of the subjects evaluated presented some [MSDs], of which 51.2% correspond to the upper body (cervical pain, rotator cuff injuries, carpal tunnel) and 31.7% to the lower body (low back pain, knee pain, ankle pain, plantar fasciitis); low back pain being prevalent in harvesters, as reported by Garzón et al.[6,20] In similar studies, Momeni et al.[21] showed that the highest prevalence of symptoms of [MSDs] was related to the lower back, knees, and upper back in agricultural workers in Iran. Jain et al. (2018) found that the highest incidence rate of [MSDs] was in the lower back, followed by fingers, shoulders, and hands/wrists in farmers who worked manually.[22]

Another study by Ncube et al.[23] evaluated the standing posture of agricultural workers where the collection technique is manual and found significant associations in relation to pain in the upper limbs, neck, trunk, and back. These findings are an early warning for companies in the agricultural and related productive sectors for the implementation of preventive strategies for [MSDs] that improve the quality of life of farmers.

According to the REBA postural method, the multivariate analysis identified that the male sex is more likely to present [MSDs] than women, and a high REBA is more likely to present [MSDs] than a very high REBA. This is due to the loads of the container to collect the coffee, which can weigh between 20 to 30 kilos, and each package with the collected material weighs around 120 kilos, which must be transported on foot from the lot to the weighing site. Akbar's study[24] showed that the highest load in coffee transportation was 140 kg in a single lift, and the minimum load recorded was 25 kg per lot; therefore, [MSDs] can arise if the load carried by coffee pickers exceeds 25 kg. This leads to the development of signs and symptoms of musculoskeletal diseases, especially in the upper and lower limbs, cervical, dorsal, and lumbar spine.[15]

36.7% of the workers had significant seniority and presented carpal tunnel syndrome, plantar fasciitis or both.

On the other hand, it was observed that 34.5% of the pickers worked between 5 and 6 days a week, an average of 10 and 12 hours a day, similar results to the study perceptions and interpretations of coffee picker work, where it was found that it is usual for pickers to work up to 60 hours a week.[12]

Within the criteria for selecting farms to carry out their work activity, 40.2% of the pickers mentioned the good price of the grain, followed by 25.6% for good production. On the other hand, Parada-Sanabria[25] says that most of the young pickers said they were not satisfied with their work, so they tended to change their occupation and dedicate themselves to another trade. This is a problem that was found in the municipalities visited, and was a general concern in the face of the difficulty of finding itinerant and local pickers, generating the loan of pickers from farms, according to what was stated by the owners.

Finally, the results of this study establish the opportunity to replicate the assessment strategy of musculoskeletal disorders not only to coffee pickers but to other productive sectors, facilitating the generation of preventive programs that include tools such as booklets, radio programs, ICTs, strengthening the safety and health programs at work in small, medium and large companies that favor the quality of life of workers.

Limitations include the geographical location of the workers, the difficulty of accessing the coffee plantations, and the availability of time for the collectors to apply the instruments and collect the information. At the methodological level, the study presented limitations inherent to the type of study. As it is descriptive with an analytical scope, it does not allow for the establishment of a cause-effect relationship between the variables studied.

## 5. Conclusion

Colombian topography makes coffee be planted mainly on slopes, so its harvesting is one of the activities with the highest risk compared to other agricultural tasks. Musculoskeletal disorders are prevalent in the harvesting population. The presence of these can be facilitated by inadequate postures and repetitive movements that become a direct risk of daily life.

Although this activity is carried out by men and women, it was shown that the male sex is more likely to present musculoskeletal disorders, with the upper body being the most affected area, suggesting in this sense that this population requires preventive and corrective strategies in order to avoid the progression of musculoskeletal disorders.

## Authors contributions

The authors declared that they have made substantial contributions to the work in terms of the conception or design of the research; the acquisition, analysis or interpretation of data for the work; and the writing or critical review for relevant intellectual content. All authors approved the final version to be published and agreed to take public responsibility for all aspects of the study.

## Competing interests

No financial, legal, or political conflicts involving third parties (government, private companies, and foundations, etc.) were declared for any aspect of the submitted work (including but not limited to grants and funding, advisory board participation, study design, manuscript preparation, statistical analysis, etc.).

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