

Identification of Hazards and Assessment of Risks associated with the Harvesting of Coffee

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Objective: To study the factors associated with the occupational risks affecting coffee harvesters from Timbío, Cauca, Colombia.

Methods: This descriptive study assessed workplace conditions, aiming to design a mitigation proposal that would help alleviate the dangers currently facing the studied population. The data were collected through 19 visits to the coffee plantations. A survey to characterize workers and determine the presence of musculoskeletal lesions was applied; in addition, the Colombian Technical Guide (GTC 45, by its initials in Spanish) was consulted.

Results: Coffee harvesting comes with several high priority risks, of which those that are biomechanical stand out. These are the result of strained positions, antigravity postures, repetitive movements, high physical effort, and the manual handling of heavy objects. Additionally, there are psychosocial risks attend the kind of contract, the low wages, the lack of social security, and the lack of affiliation with the occupational risk-management system. During the data collection, 18% of the workers reported having had an occupational accident while harvesting coffee.

Conclusion: The process for identifying danger and assessing risk established, for all the cases, a level 1 risk. According to the rating scale of the GTC 45, such a level is unacceptable. We concluded that it is necessary to take immediate measures to control the identified dangers. To improve the health of the members of the studied sample, we propose the implementation of an epidemiological surveillance system for musculoskeletal injuries. [*PR Health Sci J* 2023;42(1):43-49]

Key words: Coffee farms, Occupational diseases, Biomechanical risks, Psychosocial dangers

According to a report from the International Labour Office (ILO, 2011), approximately 50% of the global labor force works in the agricultural sector, which amounts to 1.3 billion people. Almost 60% of them are in developing countries. The deadly-accident rates in agriculture are above the averages of similar rates for all other industries combined. This situation is compounded by the fact that a great number of workers are not covered by any form of social security (1).

Agricultural labor is physically demanding, and the injury rate in farming is the highest of all occupations. The laborers engaged in agricultural work are commonly affected by injuries of varying degrees of seriousness, such as cuts on the limbs, toes, and fingers; the permanent loss of 1 or more body parts; blisters on the skin; skin abrasions; and different musculoskeletal disorders caused by the repetitive-type work (2). At the same time, workers are generally exposed to several ergonomic risk factors in terms of their respective labors, which factors tend not to be correctly assessed using the principle of monocausality (3). Also, workplace injuries not only provoke ill health, disability, and death but also have several negative economic consequences (4). For these reasons, there is an increased interest in identifying the risks related to agriculture (5).

The setting in the Colombian coffee-related agricultural sector is similar, and in that country, one of the largest employers of agricultural laborers is the coffee-farming industry. This activity is performed informally, i.e., with neither labor stability nor wages that are commensurate with the work (and its inherent conditions) and without any kind of protection against occupational risks. Nevertheless, most coffee workers are beneficiaries of the subsidized health care system (6).

The Colombian Coffee Growers Federation (Federación Nacional de Cafeteros), founded in 1927, directs its policies towards the support of coffee producers. However, our field study has shown that there are no programs that favor the

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workers, who do not own any land and must work in precarious conditions, receiving wages that are below the current minimum wage (in Colombia).

The process of harvesting coffee is, to a large extent, the collecting of ripe fruit. This activity is performed manually and requires care and selectivity because on a single branch can be found both bulbs and flowers as well as fruit at different stages of ripeness, some of which should not be collected from the plant if not yet fully ripe (7).

Cultivating coffee with efficiency depends on factors such as altitude and the distance between trees, as well as the pruning and collection methods being used (8). The coffee harvester carries a basket tied to his/her waist. This basket has a capacity of approximately 10 kilograms (9). The collecting is usually carried out in a standing position, though sometimes the worker must kneel, crouch, or lean forward to reach the lower boughs. Coffee harvesting takes place outdoors, and the people who do it are exposed to the sun's rays, rain, and the bites of diverse kinds of animals; they also must negotiate uneven surfaces, which forces them to adopt prolonged and inadequate postures, with the possibility of suffering accidents or acquiring musculoskeletal lesions. There have been studies on coffee production, those studies exploring technical, agronomic and socioeconomic issues. Few of them, however, have tried to identify the characteristics of the human workload from an ergonomic perspective (10, 11).

According to a study done by the ILO and the Council for Occupational Health of Costa Rica (12) about the labor requirements of coffee growing, the most common risks during the harvesting stage are as follows:

- Biomechanical risks. Because the harvesting of coffee beans is carried out while standing or crouching, with the arms above the shoulders, the worker must adopt strained positions to collect the ripe fruit. In addition, the basket in which the beans are collected hangs from the waist, creating another physical risk for the worker.
- Temperature and humidity. The work is performed outdoors, exposing the worker to weather changes.
- Biological risks. The presence of diverse fauna (e.g., caterpillars, ants, wasps, snakes, rodents) can pose a danger to workers. Stings and bites are common, as are allergies and skin lesions. Even death is a possible outcome.
- Psychosocial risks. Collecting coffee is a monotonous activity, and coffee harvesters have long workdays, low wages, and no labor stability; they lack the devices necessary to prevent occupational risks. All these factors might affect the worker, generating stress, depression, moodiness, anxiety, and/or fatigue.

Occupational accidents can be prevented by implementing measures and methods to reduce the risk factors (13). Identifying and evaluating the dangers and risks associated with the physical process of harvesting coffee would almost certainly lead to the establishing of controls that would result in reducing said dangers and risks (14).

The objective of this study was to identify the dangers and evaluate the risks that affect the coffee pickers of Timbío, Cauca, Colombia, while they harvest ripe coffee. After the identification and evaluation process, the needed intervention measures were formulated. The town of Timbío was chosen because coffee farming is its main economic activity and is done traditionally.

Methods

Over the course of 2 weeks in May 2018, descriptive diagnostic research was carried out through 19 field visits to coffee farms. Direct observations were made of 72 workers. Their working conditions were studied and their perceptions of themselves explored. The identification of dangers and the assessment of risks were made both qualitatively and quantitatively, accomplishing this with the updated (2012) Colombian Technical Guide 45 (GTC 45, by its initials in Spanish), which is published by the Colombian Institute of Technical Standards and Certification (Instituto Colombiano de Normas Técnicas y Certificación). Also, the survey known as the Integral Prevention of Musculoskeletal Lesions (Prevención Integral de Lesiones Osteomusculares) validated by the occupational risk manager for ARL Colpatria in 2010, was applied. These tools helped us to determine the morbidity related to the musculoskeletal system. Additionally, they were used to collect or help in the collection of such data as the number of hours worked, rest periods, medical records, and membership in the system of social security. The methodology was approved by the Research Ethics Committee.

Because of how coffee farming is done, the number of workers assigned to the different fields varies and depends on the stretch of land cultivated, the level of ripeness of the fruit, and the availability of workers in the area. The population analyzed was part of the overall population of coffee harvesters who work on the 553 coffee farms registered by the Coffee Grower's Information System (Sistema de Información Cafetera, 2017). A statistical sampling formula was applied (15). The sample size was 72 workers who were found at 19 fields.

The analysis of data was made in 2 stages:

1. The collection of data via the methodology outlined in and by GTC 45. The results were compared with the interpretive tables which were obtained from the same guide. The data allowed for the establishment of both risk and acceptability levels (14).
2. The implementation of the Integral Prevention of Musculoskeletal Lesions survey. The survey is divided into 4 sections; the first one includes sociodemographic data, seniority in the workplace, rest periods, accidents, and occupational diseases. The second includes both personal and occupational histories. The third corresponds to activities to which the worker dedicates more than 1 hour daily and that take place during non-working times. The fourth identifies musculoskeletal lesions in the upper limbs,

back, and lower limbs. The results of the survey were used to obtain the distribution and percentage concerning each of the considered items.

Results

Coffee crops are determined by the specific geographical zones of the different coffee-growing regions. There are, for each zone, different periods of flowering and harvesting. The Cauca Department, a region in southwestern Colombia known for its coffee production, possesses particular agricultural cycles. The main harvest takes place from April through June; that being the case, coffee workers constitute an itinerant, temporary labor force.

Coffee harvesters have, therefore, characteristics that fit the definition of a seasonal, temporary, or peripheral worker. Such individuals provide transitory services, often, though not exclusively, in the farming sector. (16).

Coffee harvesters' sociodemographic characteristics

The surveyed workers' sociodemographic characteristics showed that most of them were male (68%) and that 67% of the sample was middle aged, while 18% of the sample members belonged to a young age. Fifteen percent of the surveyed workers belonged to the group of older adults. As is common in agricultural workers of this kind, the members of our sample tended to suffer from chronic illnesses and infirmities that are characteristic, such as arthritis, osteoporosis, gout, spinal injury, and hernia. The above-named ailments reduce work capacity and could get worse because of the sufferer's continued exposure to the same work-related dangers. The situation is compounded by the fact that 64% of the participating workers reported having high job seniority (11 years or more), which represents a prolonged period of exposure to the risk factors associated with their profession.

Concerning schooling, 54% of the surveyed workers had a primary education, but 30% of them did not reach that level of completion. In addition, just 12% had finished their secondary education (passing the 11th grade) (Table 1).

Table 1. Coffee harvesters' levels of schooling

Level of schooling	Frequency	Percentage
Illiterate	1	1.4%
Partial primary education	22	30.6%
Primary education	17	23.6%
Partial secondary education	23	31.9%
Secondary education	9	12.5%
Total	72	100.0%

Just 3% of the sample members were enrolled in the contributory health care system, and they did not contribute to the occupational risk-management subsystem (Table 2). This situation has great relevance because generally workers are not protected in case of an occupational illness or accident.

Table 2. Enrolled in social security

Type of enrollment	Frequency	Percentage
Subsidized	69	96%
Contributive	2	3%
Not enrolled	1	1%
Total	72	100%

This kind of work, which is associated with the seasonal cycle of coffee farming, is linked to informal working conditions, low wages, work instability, and social security problems. These factors and the others that compound them might affect the health and welfare of workers, and they are considered to be psychosocial risk factors, as well (17, 18). It has been established that these factors are often associated with work accidents, low productivity, the existence of a negative work environment, and workers' health problems, including physiological and psychological ones (19).

Results of the survey on the prevention of musculoskeletal lesions

The results of the survey taken by the 72 workers are shown in Figures 1, 2, 3, and 4.

Thirteen workers, 18% of the sample, reported having had an occupational accident while harvesting coffee. Seven had some kind of musculoskeletal lesion, and 6 suffered some kind of worm bite (Figure 1). None of these cases was reported as an occupational accident because none of the workers who suffered an accident were affiliated with an ARL member institution.

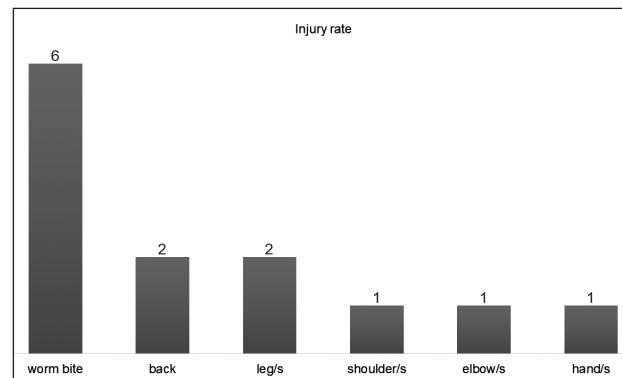


Figure 1. Injury rate

Six of the workers had medical records indicating, among them, several diagnoses, which included arthritis, carpal tunnel syndrome, inguinal hernia, diabetes, and back injury (Figure 2).

There was also an inquiry about the activities coffee harvesters carried out daily for at least an hour, and that took place outside of their working hours. It was found that 56% of the sample group engaged in such activities (Figure 3). Within this percentage, there were 22 women, i.e., 95% of the sample's female population, who had to take care of household chores

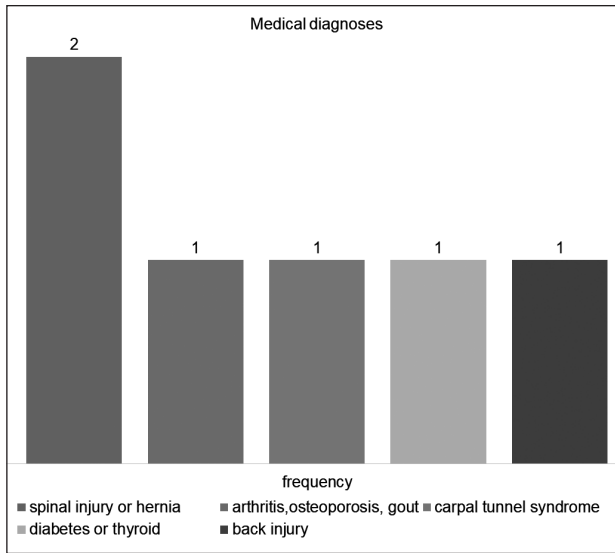


Figure 2. Frequency of medical diagnoses

after work. Twenty percent of the surveyed workers engaged in activities related to farming or gardening when not working.

As can be seen in Figure 4, the musculoskeletal-related pains and discomforts that were found in the workers were divided into the following categories:

- Pains/discomfort in the upper limbs. Nineteen workers reported having had occasional pain (resembling that induced by burns) in their hands, and the symptom had evolved for more than a year. Nine workers presented occasional pain in one or both of their elbows, which pain had endured more than a year, and another 7 reported occasional pain in one or both of their shoulders, which had been evolving for more than a year.
- Back pain. Fifty percent (36) of the surveyed workers asserted they had occasional back pain, especially in the lumbar region, for more than a year. Figure 4 shows that the musculoskeletal issues reported most frequently by the harvesters had to do with the back. Some coffee harvesters

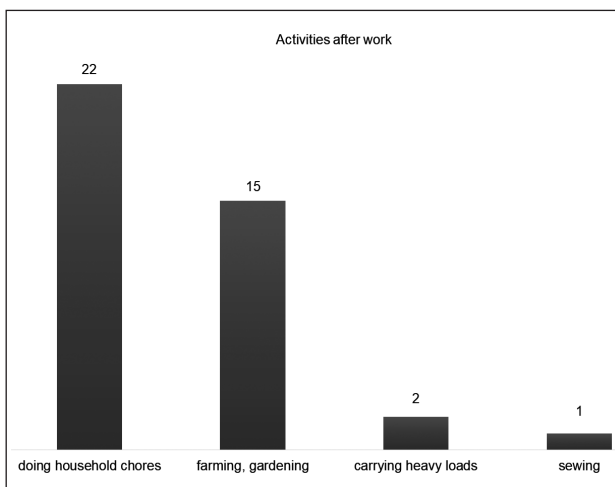


Figure 3. Frequency of non-work-related activities

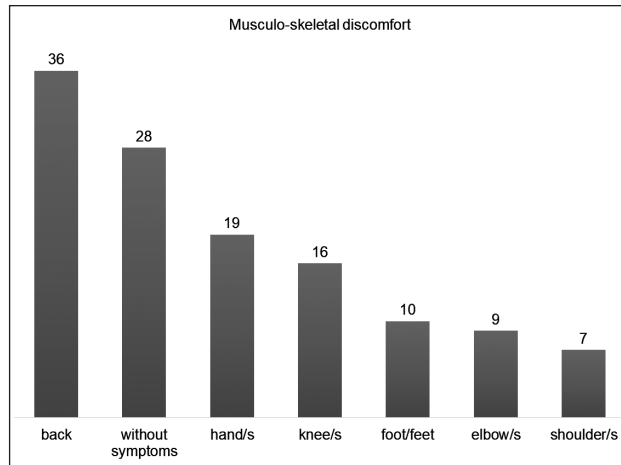


Figure 4. Frequency of musculoskeletal discomfort

affirmed they had suffered pain in several parts of their bodies. These results concur with those that appear in a report from Timbio Hospital, which report indicated that non-specific lumbago and joint pain were among the 10 main causes of morbidity (20).

- Knee issues. Sixteen workers reported suffering from occasional knee pain, which had evolved for more than a year.
- Foot issues. Ten workers affirmed they had occasional pain in one or both of their feet for more than a year.

According to the symptomatology, the diagnoses associated with the upper limbs were carpal tunnel syndrome, epicondylitis, and shoulder pain. Additional complaints included scoliosis, lumbago, and cervical pain. These results show that musculoskeletal disorders were the most common of all the reported nonfatal farming-related occupational injuries and illnesses. Musculoskeletal disorders tend to be observed to a greater degree in farmers whose work is particularly labor intensive; a finding that has been confirmed by other studies (21, 22).

Given the above, it is necessary to consider previous studies about the influence on workers of different training programs concerning the handling of burdens, repetitive movements, and postural hygiene (23, 24, 25). Such programs have implemented measures to prevent the long exposure of laborers to unrelenting activity. These studies coincide in pointing out that, after working with and modifying those variables, there are considerable increases in performance and production, as a result of which, the quality of life of the workers improves. Additionally, the labor absenteeism, accident, and occupational illness rates decrease.

Identification of dangers and assessment of risks

For all the cases, a risk level of 1 was established after the identification of the dangers and the assessment of risks. According to the rating scale of the GTC 45, such a level is unacceptable. It was concluded then that it was necessary to take immediate measures to control the identified dangers.

The most common danger was the biomechanical danger to the musculoskeletal system, which resulted from both having to assume strained and/or antigravity postures, on the one hand, and the manual handling of heavy objects, on the other.

Biological danger was also found to be a priority because the laborers are constantly exposed to bites from animals, especially worms. These bites may produce swelling, pain, burns, and, in hypersensitive people, edema, queasiness, abdominal pain, and shock. Generally, one of the consequences of one of these bites is the inability to work for about 3 days.

The identified psychosocial dangers are linked to occupational instability, low wages, and poor working conditions characterized by a high level of physical demand.

Discussion

Several high priority occupational risks associated with coffee harvesting were found, with those of a biomechanical nature standing out. These risks were found to be linked to strained positions, antigravity postures, repetitive movements, high physical effort, and the manual handling of heavy objects. Additionally, psychosocial dangers related to the contractual agreements, which featured low wages, lack of social security, and the lack of affiliation with the occupational risk-management subsystem, were found.

In conclusion, it is necessary to take immediate measures concerning the control of the identified risks, all of which were placed at the priority 1 (unacceptable) level, according to the scale of assessment of the GTC 45.

Farming-related stakeholders at the town level, agriculture administrations at the local and national levels, policymakers, and researchers could use the findings of this study to design further studies. These studies should aim to identify interventions to decrease the risks and injuries of coffee-farm workers and address the occupational health needs of seasonal farm workers in Colombia. To this end, labor inspectors (established through the Colombian occupational-risk system) would play an important role within the coffee-farming sector. Also, these studies suggest that there is a need to reduce labor informality. Moreover, it is necessary to promote the development of healthier work environments throughout the coffee-farming community.

Hazard mitigation proposal

The study proposes that certain activities should be undertaken to protect the musculoskeletal health of coffee pickers in Colombia. Actions should include pauses and recovery, warming up, and pre- and post-work stretching periods, as well as training concerning adequate postures and the use of personal protective equipment (PPE) that might lessen the impact of the exposure to the different risk sources. Examples of this equipment are wedges and knee pads for crouching and kneeling, as well as mechanical aids for the handling of heavy objects (1). It has been suggested that an advisory program

concerned with the design and implementation of the previously mentioned epidemiological surveillance program dealing with musculoskeletal disorders be established. This program should use the data collected by the present study to accomplish this end. In terms of the intervention measures for the workers in the sample, various of them (e.g., elimination and substitution) were found to be difficult to implement according to the legal norms of Colombia and the guidelines suggested by the ISO 45001 (26). The elements of PPE are fundamental, and the employer must provide the relevant staff with the adequate protective equipment, both in sufficient quantity and that complies with the international norms. The employer must also guarantee that employees will be trained in the correct use, storage, replacement, and maintenance of this equipment, which must include protective gear for the face, eyes, and upper and lower limbs.

Coffee harvesters do not consider the use of PPE to be important, that, coupled with their lack of knowledge about this form of protection, makes it vital to promote a cultural change regarding the compulsory use of protective gear.

The workers must be informed about the risks to which they are exposed while performing their labor. It has been proposed that such information should be part of an employee's induction and that individual's training about occupational risk prevention during the harvesting of coffee. This process must be established, in the form of a training course or program of induction, as a prerequisite concerning the actual task of harvesting coffee. Such a measure must be recommended by the Colombian Coffee Growers Federation, the National Training Service (Servicio Nacional de Aprendizaje), or the universities located in the coffee-farming regions.

It is proposed that the training program have a booklet informing the new employee of the risks that are specific to coffee harvesting. This booklet might be similar to the ones the Colombian Coffee Growers Federation published years ago about coffee-plant diseases.

There are also proposals concerning training programs organized by the employers and supported by the authorities. The core topics of these programs should be protection measures and self-care, as well as employers' rights and responsibilities with reference to occupational risks.

This study aimed to identify the dangers and assess the risks that are associated with the process of harvesting coffee. It is now proposed that the research be continued through other epidemiological studies. These should include the analysis of data related to the safety and health of the coffee-harvesting population at work. These studies might also focus on the following:

1. Making a medical diagnosis from occupational medical exams.
2. The accident rate of the studied population.
3. Work absenteeism.
4. Documented occupational illnesses.
5. Epidemiological surveillance programs.

Resumen

Objetivo: Estudiar los factores asociados al riesgo laboral en cosechadores de café del municipio de Timbío, Cauca, Colombia. **Métodos:** Este estudio de tipo descriptivo se orientó a la evaluación de las condiciones de trabajo, y el diseño de una propuesta de mitigación de los peligros que se identificaron como prioritarios en la población estudiada. Los datos fueron recolectados mediante 19 visitas a los cultivos de café, aplicándose una encuesta para caracterizar a los trabajadores y determinar la presencia de lesiones osteomusculares, además se consultó la Guía Técnica Colombiana (GTC 45). **Resultados:** Se encontraron varios riesgos laborales de nivel prioritario asociados a las actividades de recolección de café, destacándose los riesgos biomecánicos. Estos son el resultado de posturas corporales forzadas, posturas antigravitacionales, movimientos repetitivos, alto esfuerzo físico y manipulación de objetos pesados. Adicionalmente, existen riesgos psicosociales debidos al tipo de contratación, los bajos salarios, la falta de seguridad social y la falta de afiliación al sistema de gestión de riesgos laborales. Se encontró que el 18% de la muestra, manifestó haber tenido un accidente laboral desempeñando el oficio de cosechador de café. **Conclusiones:** Según la identificación de peligros y valoración de los riesgos, se concluye que es necesario tomar medidas inmediatas para el control de los peligros detectados, clasificados en nivel de riesgo I, el cual no es aceptable según la escala de valoración de la GTC 45. Para mejorar la salud de la muestra estudiada, se propone la implementación de un programa de vigilancia epidemiológica en desórdenes musculoesqueléticos.

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