Sociodemographic and labor conditions and the presence of musculoskeletal symptoms in workers in a market in a Colombian municipality

Condiciones sociodemográficas, laborales y presencia de síntomas musculoesqueléticos en trabajadores de un mercado de un municipio colombiano

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ABSTRACT | Introduction: Although informal employment is increasing, there is still little evidence of musculoskeletal symptoms in workers with precarious jobs in marketplaces and of how these symptoms are related to their labor conditions and risks. Objective: To identify sociodemographic and labor conditions and ergonomic risks associated with musculoskeletal symptoms in workers from a marketplace in a Colombian municipality in 2017. Methods: Cross-sectional study of a 2017 census of 194 workers. A survey was applied, and labor and environmental records were collected. Univariate, bivariate and multivariate analyses were performed, with statistical tests with 95% confidence level. Results: Women (56.7%) and workers older than 30 years (75.4%) predominated; 90.7% of participants worked 8 hours a day or more; 52.8% worked from 1 to 5 days a week; and 33.9% had been working in the profession for > 20 years. Moreover, 86.6% had semi-stationary sales position; 43.8% were overweight, and 18.8% obese. Also, 60.6% presented with some type of musculoskeletal symptom, the most prevalent of which was joint pain (37.7%). Selling meat (PR A = 2.36), merchandise/pots (PR A = 1.40), harvest/perishable products (PR A = 1.26), and working from 8 to 11 hours a day (PR A = 1.76) explained higher prevalence of musculoskeletal symptoms. Conversely, moving (PA A = 0.5) and lifting (PR A = 0.75) heavy objects explained lower prevalence of these symptoms. Conclusions: Greater musculoskeletal symptoms were related to older age, lower schooling, fewer days of work, working from 8 to 11 hours, and selling meat, merchandise/pots, and harvest/perishable products. These conditions, once identified, will facilitate promotion and prevention actions to improve the living and health conditions of marketplace workers.

Keywords: vulnerable populations; musculoskeletal pain; working conditions; occupational health; occupational risks.

RESUMEN | Introducción: Aunque el empleo informal va en aumento, aun es escasa la evidencia de la sintomatología osteomuscular en trabajadores con empleos precarios en plazas de mercado y de cómo esta se relaciona con sus condiciones y riesgos laborales. Objetivo: Identificar condiciones sociodemográficas y laborales y riesgos ergonómicos asociados a la presencia de sintomatología osteomuscular en trabajadores de una plaza de mercado de un municipio colombiano en 2017. Métodos: Estudio transversal de un censo de 194 trabajadores en 2017. Se aplicó encuesta y se recogió la ficha médico laboral y ambiental. Se realizaron análisis univariados, bivariados y multivariados, además de pruebas estadísticas con 95% de confianza. Resultados: Predominaron las mujeres (56,7%) y los mayores de 30 años (75,4%); el 90,7% laboraba 8 o más horas diariamente; el 52,8% solía trabajar entre 1 y 5 días por semana; y el 33,9% tenía > 20 años en su labor. El 86,6% tenía puesto de trabajo estacionario. El 43,8% presentó sobrepeso y el 18,8% obesidad. El 60,6% tenía algún tipo de sintomatología osteomuscular, siendo más prevalente el dolor articular (37,7%). Vender carne (PR A = 2,36), mercancía y cacharro (PR A = 1,40), productos de cosecha y perecederos (PR A = 1,26), y trabajar entre 8 y 11 horas diarias (PR A = 1,76) explicaron mayor prevalencia de sintomatología osteomuscular. Por su parte, desplazar (PR A = 0,5) y levantar (PR A = 0,75) objetos pesados explicaron menor prevalencia de esta sintomatología. Conclusiones: Mayor sintomatología osteomuscular estuvo relacionada con mayor edad y menor escolaridad, menos días de trabajo, trabajar entre 8 y 11 horas, y vender carnes, mercancía/cacharro y cosecha/perecederos. Estas condiciones, una vez identificadas, facilitarán adelantar acciones de promoción y prevención para mejorar las condiciones de vida y salud de los trabajadores de las plazas de mercado.

Palabras clave: poblaciones vulnerables; dolor musculoesquelético; condiciones de trabajo; salud laboral; riesgos laborales.
INTRODUCTION

Health and labor conditions are object of special interest worldwide, although some working populations have still little evidence on these conditions and how they affect the health of these populations. Among these workers, informal marketplace workers are of particular concern, since they could be immersed in a situation of labor vulnerability, which affects social health determinants and leads to a greater impairment of physical and mental health. As described by the International Labor Organization (ILO), this population is underpaid and experience labor conditions that may affect their health and quality of life. In Latin America, for the year 2012, there were 103 million people working in the informal sector of economy; Colombia is one of the countries with the higher proportion of informal workers, due to the reduced economic capacity to absorb the labor force, a factor that led to the rapid growth of the informal sector, which increased from 25% to 31% between 1980 and 1989, and is currently higher than 50% in some locations.

This population shows a significant prevalence of overweight, obesity, extensive hours of work, and little physical activity. Furthermore, studies identified risks related to lifting heavy loads, inappropriate postures, and repetitive work. These conditions are more prevalent in women than in men of the informal sector.

In the municipality of Ciudad Bolívar, Antioquia, Colombia, there was a predominance of labor informality, with no characterization of labor conditions nor estimation of the number of people working in the informal sector. Therefore, ergonomic risks and the most prevalent musculoskeletal disorders (MSD) in this population remain unknown, which hampers the implementation of health promotion and disease prevention actions according to workers’ peculiarities, as proposed by the Ten-Year Public Health Plan 2012-2021.

MSD are one of the main causes of absenteeism and a frequent reason for consultation. According to the 5th Colombia National Pain Survey, at least 60% of the population have already experienced musculoskeletal pain, and work activity may contribute to the onset of pain. MSD include muscle, tendon, joint, and neurovascular diseases. In Colombia, an increase was reported increased occurrence of the following occupational diseases from 2001 to 2004: carpal tunnel syndrome, low back pain, rotator cuff, among others; therefore, it is extremely important that people's workplace is appropriate to their characteristics so as to ensure a comfortable environment that prevents work-related accidents and morbidities.

In view of the foregoing, it is possible to observe that informal work compromises the right to health and to a dignified work; hence, it is important to provide scientific evidence that allows understanding labor conditions and how they affect workers’ health, in order to promote actions based on the reality observed. Therefore, the aim of the present study was to identify sociodemographic, labor, health, environmental conditions and ergonomic risks associated with the presence of musculoskeletal symptoms in marketplace workers from a municipality in Colombia in the second semester of 2017.

MATERIALS AND METHODS

DESIGN

This is a cross-sectional descriptive, analytical study on primary sources of information that assessed a population of 194 marketplace workers from a municipality in Southwestern Antioquia, Colombia, in December 2017. We collected labor and environmental medical records of participating workers, after signature of informed consent. The study and all its activities were arranged with the marketplace administration, the workers, the Municipal Department of Health, and the School of Medicine of Universidad CES.

The study included workers older than 14 years, with at least one year working in the marketplace, who were familiar with the study activities and agreed to participate. Workers who answered less than 50% of the survey, who did not sign the consent, and who were under the effect of psychoactive substances. The study was conducted in accordance with the ethical standards of the Declaration of Helsinki and Resolution 8340 of 1993 of Colombia. The study was approved by the institutional Ethics Committee of Universidad CES under protocol 123.
VARIABLES
The outcome variable was musculoskeletal symptoms (Yes/No), re-categorized according to the presence or not of symptoms such as: joint pain, inflammation or stiffness, low or upper back pain, muscle weakness, and difficulty walking. Independent or explicative variables included sociodemographic characteristics such as age, sex, marital status, and educational level in years, in addition to labor conditions and occupational risk factors: hours of work per day and days of work per week, time working in the profession, type of sales position, type of product sold, forced postures, repetitive movements, lifting or moving heavy objects, physical characteristics, risks, order and hygiene in the workplace, tools used to perform the work, and personal protective equipment. Anthropometric measures were taken to calculate the body mass index (BMI) so that to identify overweight/obesity in workers, according to standards for nutritional use: BMI<18.5, underweight; BMI ≥ 18.5 ≤ 24.9, normal weight; BMI > 24.9 ≤ 29.9, overweight; BMI ≥ 30 obesity.

Medical evaluation was performed by three physicians, professors at the School of Medicine, and fourth and fifth-year medical students. Information was collected by two professors, by medical students of Universidad CES, by students of Health Information System Management of Universidad de Antioquia, and by a group of assistants from the health department and the municipal hospital. Data were collected in participants’ workplaces and on the second floor of the marketplace. Selection bias was controlled by performing a census, and information bias by awareness of the workers’ population, investigators, and field work assistants. Furthermore, a pilot test was conducted with three workers located in surrounding areas, in order to make adjustments to the instrument and enhance the data collection process.

ANALYSIS
Descriptive analysis was performed by calculating frequency and percentage distributions for qualitative variables: sex, marital status, type of sales position, type of product sold, body mass index, occupational risk factors, and musculoskeletal symptoms. Measures of central tendency, position and dispersion were calculated for quantitative variables, which were assessed using the Kolmogorov-Smirnov test to examine data distribution normality and determine what bivariate tests should be performed. Age, time working in the profession, hours of work per day, and days of work per week were reclassified for bivariate analysis.

A bivariate analysis was performed with non-causative characteristics and conditions that were associated with a higher prevalence of musculoskeletal symptoms in the workers. Statistical association was verified using the chi-square test, and median differences were calculated using the Mann–Whitney U test. Prevalence ratios (PR) were calculated to establish the association between the prevalence of musculoskeletal symptoms and the other characteristics of the study. An explanatory multivariate analysis with multiple logistic regression was performed, including the variables that complied Hosmer-Lemeshow criteria (p < 0.25), in order to adjust and identify the sociodemographic and work-related variables and occupational risk factors that explained higher or lower prevalence of musculoskeletal symptoms. Analysis of information was performed on Excel, Epidat 3.1 and 4.2, and SPSS software licensed to Universidad CES. All statistical tests were performed with a 95% confidence level and a 5% margin of error.

RESULTS

SOCIODEMOGRAPHIC CHARACTERISTICS
Overall, 75.4% of workers were older than 30 years and 56.7% were women. With regard to marital status, more than 50% had a partner, including 31.3% (61) who were married and 25.1% (49) who were in a consensual union, and 43.3% without partner. Furthermore, 46.2% had from 6 to 11 years of schooling; 34.4%, from 1 to 5 years; 10.3%, more than 11 years; and 9.2% had no schooling (Table 1).

LABOR CONDITIONS
It was found that 45.1% of participants worked from 8 to 11 hours a day; 45.6%, 12 hours or more; and 9.2% (18), less than 8 hours. Most of the sample worked from 1 to 5 days a week (52.8%). Furthermore, 33.88% (66)
had been working in the profession for more than 20 years, and 25.6% (50) for 1 to 5 years (Table 1).

Overall, 86.6% of workers sold their products always at the same place, i.e., had the so-called “stationary” sales position, 10.8% had a semi-stationary sales position, and 2.6% had a non-stationary sales position. With regard of the type of product sold, merchandize/pots, meat, harvest/perishable products presented

Table 1. Proportional distribution of sociodemographic and work-related characteristics, overweight/obesity status, and musculoskeletal symptoms in marketplace workers from a municipality in Southwestern Antioquia, Colombia, 2017 (n = 194)

| Characteristic or condition | n   | (%) |
|----------------------------|-----|-----|
| **Sociodemographic characteristics** |     |     |
| Age (years)                |     |     |
| 14-17                      | 14  | 7.2 |
| 18-29                      | 34  | 17.4|
| 30-44                      | 54  | 27.7|
| 45-59                      | 60  | 30.8|
| 60 or older                | 33  | 16.9|
| Sex                        |     |     |
| Male                       | 84  | 43.3|
| Female                     | 110 | 56.7|
| Marital status             |     |     |
| With a partner             | 110 | 56.7|
| Without a partner          | 84  | 43.3|
| Schooling                  |     |     |
| From 1 to 5 years          | 67  | 34.4|
| From 6 to 11 years         | 90  | 46.2|
| More than 11 years         | 20  | 10.3|
| Labor conditions           |     |     |
| Hours of work per day      |     |     |
| From 8 to 11               | 88  | 45.1|
| 12 or more                 | 89  | 45.6|
| Less than 8 hours          | 18  | 9.2 |
| Days of work per week      |     |     |
| From 1 to 5                | 103 | 52.8|
| 6 or 7                     | 92  | 47.2|
| Time working in the profession (years) |     |     |
| From 1 to 5                | 50  | 25.6|
| From 6 to 10               | 41  | 21.0|
| From 11 to 20              | 38  | 19.5|
| More than 20               | 66  | 33.8|
| Type of sales position     |     |     |
| Non-stationary/semi-station| 26  | 13.4|
| Stationary                 | 168 | 86.6|
| Type of product sold       |     |     |
| Merchandise/pots           | 52  | 26.9|
| Meat                       | 45  | 23.3|
| Harvest and perishable products | 42  | 21.8|

| Characteristic or condition | n   | (%) |
|----------------------------|-----|-----|
| **Overweight/obesity status** |     |     |
| BMI (n = 160) category      |     |     |
| Underweight                | 3   | 18  |
| Normal                      | 57  | 356 |
| Overweight                  | 70  | 438 |
| Class 1 obesity             | 19  | 119 |
| Class 2 obesity             | 5   | 31  |
| Class 3 obesity             | 6   | 38  |
| **Reclassified BMI**        |     |     |
| Underweight/normal          | 60  | 374 |
| Overweight/obesity          | 100 | 626 |
| **Musculoskeletal symptoms (n = 138)** |     |     |
| Yes                        | 86  | 606 |
| No                         | 54  | 394 |
| Joint pain                  |     |     |
| Yes                        | 52  | 377 |
| No                         | 85  | 616 |
| Joint inflammation          |     |     |
| Yes                        | 10  | 80  |
| No                         | 127 | 920 |
| Joint stiffness             |     |     |
| Yes                        | 13  | 9.5 |
| No                         | 124 | 905 |
| Low back pain               |     |     |
| Yes                        | 36  | 265 |
| No                         | 100 | 735 |
| Upper back pain             |     |     |
| Yes                        | 19  | 141 |
| No                         | 116 | 859 |
| Muscle weakness             |     |     |
| Yes                        | 7   | 51  |
| No                         | 130 | 949 |
| Difficulty walking          |     |     |
| Yes                        | 7   | 51  |
| No                         | 130 | 949 |

BMI = body mass index.
showed similar proportions (26.9%, 23.3% and 21.8%, respectively), and a lower prevalence was observed for fast food (11.9%), other type of products (10.9%), and beverages, appetizers/dessert (5.2%) (Table 1).

**OVERWEIGHT/OBESITY STATUS**

According to BMI reclassification (BMI), 37.4% of workers were underweight or had normal weight, whereas 62.6% were overweight/obese (Table 1).

**MUSCULOSKELETAL SYMPTOMS**

With regard to the outcome of interest for the present study, 60.6% (86) of workers were found to have some type of musculoskeletal symptoms, the most common of which were joint pain (37.7%), low back pain (26.5%), and upper back pain (14.1%), and the least prevalent of which were muscle weakness and difficulty walking (5.1% each) (Table 1).

**OCCUPATIONAL RISK FACTORS**

An equal proportion of workers reported that their work required forced postures, repetitive movements, and bending frequently (63.4%). Moreover, 36.1% (70) said that their work required lifting heavy objects and 31.1% (60), moving this type of object. Only 4.6% (8) reported wearing a belt on the waist or on the back, and 83.9% (162) considered that they performed their work safely (Table 2).

With regard to chemicals, 6.7% of workers used them, or felt that they were used somewhere nearby, causing malaise in 6.8% of participants. Furthermore, 37.6% (65) considered that they could get infected with some type of microbe in their workplace or in its surroundings (Table 2).

Conversely, it is noteworthy that more than 70.0% of workers did not wear gloves, masks, protective gown to handle meat products, googles, boots, and apron. Additionally, 28.4% of them considered that their workplace and its surroundings had deteriorated floors, walls, and areas. In turn, most of them reported that their workplace was well-ventilated (97.9%), well-illuminated (96.8%), tidy and clean (94.3%), and had enough space to move around (87.0%). Only 49.7% reported being able to respond to the start of a fire, and 8.3% (160) were able to exit in case of emergency (Table 2).

Finally, 82.7% (134) of workers reported that their work tools were in good conditions, and only 7.8% (15) said that their workplace or its surroundings presented stripped power cables, overloaded outlets, or defective connections.

**SOCIODEMOGRAPHIC AND LABOR CONDITIONS ASSOCIATED WITH MUSCULOSKELETAL SYMPTOMS**

**Sociodemographic conditions**

With regard to age, although no statistically significant association was observed, the following findings stood out: for every worker aged from 14 to 17 years who had musculoskeletal symptoms, there was 1.12 aged from 18 to 29 years, 1.38 from 30 to 44 years, and 1.55 from 45 to 59 years. The presence of musculoskeletal symptoms was similar for men and women, and in relation to marital status. Despite not being a statistically significant association, it bears nothing that the prevalence of musculoskeletal symptoms was 84.0% higher (PR = 1.84) in workers who reported having a partner (Table 3).

A statistically significant association (p < 0.05) was observed between musculoskeletal symptoms and years of schooling, in which the presence of these symptoms was 43.0% higher in workers with 5 years of schooling or less compared to those with 6 years of schooling or more (PR 1.43, CI: 1.09-1.88) (Table 3).

**Labor conditions**

An analysis of the number of hours of work per day showed that individuals who worked 12 hours or more and who worked from 8 to 11 hours a day showed a 1.3- and 0.95-times higher prevalence of musculoskeletal symptoms than those who worked less than 8 hours a day, with the prevalence of musculoskeletal symptoms increasing as the number of hours of work increased. A statistically significant association was found (p < 0.05) between days of work per week and musculoskeletal symptoms, in which for every individual that worked 6 or 7 days a week and presented musculoskeletal symptoms, there was 1.32 individual who worked from
### Table 2. Proportional distribution of occupational risk factors to which workers from a marketplace are exposed in a municipality of Southwestern Antioquia, Colombia, 2017 (n = 194)

| Risk factor                                      | n   | (%) |
|--------------------------------------------------|-----|-----|
| Work requires forced postures                    |     |     |
| Yes                                              | 123 | 63.4|
| No                                               | 71  | 36.6|
| Work requires repetitive movements                |     |     |
| Yes                                              | 123 | 63.4|
| No                                               | 71  | 36.6|
| Work requires lifting heavy objects               |     |     |
| Yes                                              | 70  | 36.1|
| No                                               | 124 | 63.9|
| Work requires moving heavy objects                |     |     |
| Yes                                              | 60  | 31.1|
| No                                               | 133 | 68.9|
| Wear a belt on the waist or on the back           |     |     |
| Yes                                              | 8   | 4.6 |
| No                                               | 164 | 85.4|
| Work requires bending frequently                  |     |     |
| Yes                                              | 123 | 63.4|
| No                                               | 71  | 36.6|
| Performs work safely                              |     |     |
| Yes                                              | 162 | 83.9|
| No                                               | 31  | 16  |
| Use of chemicals at the workplace                 |     |     |
| Yes                                              | 11  | 6.7 |
| No                                               | 153 | 93.3|
| Smell of chemicals in the surrounding environment |     |     |
| Yes                                              | 10  | 6.8 |
| No                                               | 152 | 93.2|
| Could get infected with some microorganism        |     |     |
| Yes                                              | 65  | 37.6|
| No                                               | 108 | 62.4|
| Wears gloves at work                              |     |     |
| Yes                                              | 32  | 21.9|
| No                                               | 114 | 78.1|
| Wears a mask                                      |     |     |
| Yes                                              | 14  | 9.6 |
| No                                               | 132 | 90.4|
| Wear a protective gown to handle meat products    |     |     |
| Yes                                              | 28  | 23.3|
| No                                               | 92  | 76.7|

| Risk factor                                      | n   | (%) |
|--------------------------------------------------|-----|-----|
| Wears eye protection (googles)                   |     |     |
| Yes                                              | 8   | 60  |
| No                                               | 125 | 94  |
| Deteriorated floor, walls, areas at the workplace|     |     |
| Yes                                              | 54  | 28.4|
| No                                               | 136 | 71.6|
| Well-ventilated workplace                        |     |     |
| Yes                                              | 188 | 97.9|
| No                                               | 4   | 2.1 |
| Well-illuminated workplace                       |     |     |
| Yes                                              | 186 | 96.8|
| No                                               | 6   | 3.2 |
| Tidy and clean workplace                         |     |     |
| Yes                                              | 182 | 94.3|
| No                                               | 11  | 5.7 |
| Enough space to move around                      |     |     |
| Yes                                              | 168 | 87.0|
| No                                               | 25  | 13.0|
| Able to respond to the start of a fire           |     |     |
| Yes                                              | 95  | 49.7|
| No                                               | 96  | 50.3|
| Able to evacuate or exit in case of emergency    |     |     |
| Yes                                              | 160 | 83.3|
| No                                               | 32  | 16.7|
| Work tools in good conditions                    |     |     |
| Yes                                              | 134 | 82.7|
| No                                               | 28  | 17.3|
| Defective cables and connections                 |     |     |
| Yes                                              | 15  | 7.8 |
| No                                               | 177 | 91.2|
| Excess heat or cold in the workplace             |     |     |
| Yes                                              | 57  | 29.5|
| No                                               | 136 | 70.5|
| Such a loud noise that requires shouting          |     |     |
| Yes                                              | 94  | 48.7|
| No                                               | 99  | 51.3|
| Feels satisfied with work                        |     |     |
| Yes                                              | 181 | 93.3|
| No                                               | 13  | 6.7 |
| Wears protective boots and apron                  |     |     |
| Yes                                              | 60  | 42.5|
| No                                               | 81  | 57.5|
Table 3. Sociodemographic and labor conditions associated with musculoskeletal symptoms in workers from a marketplace in municipality of Southwestern Antioquia, Colombia, 2017 (n = 137)

| Characteristic                        | Musculoskeletal symptoms |          | Chi-square (p-value) | PR (95%CI) |
|---------------------------------------|--------------------------|----------|----------------------|------------|
|                                       | Yes (n/%) | No (n/%) | Total                |            |
| **Sociodemographic characteristics** |           |          |                      |            |
| Age (years) (n = 137)                 |           |          |                      |            |
| 14-17                                 | 4 (44.4)  | 5 (55.6) | 9                    | 3.26 (0.514)| 10         |
| 18-29                                 | 11 (50.0) | 11 (50.0)| 22                   | 1.12 (0.48-2.61) | 102 (0.48-2.61) |
| 30-44                                 | 24 (64.9) | 13 (35.1)| 37                   | 1.38 (0.64-2.99) | 155 (0.73-3.31) |
| 45-59                                 | 29 (65.9) | 15 (34.1)| 44                   | 1.55 (0.73-3.31) | 135 (0.61-2.91) |
| 60 or older                           | 15 (60.0) | 10 (40.0)| 25                   | 1.35 (0.61-2.91) | 10         |
| **Sex**                               |           |          |                      |            |
| Male                                  | 28 (47.5) | 46 (47.4)| 74                   | 0.00 (0.99) | 100 (0.67-149) |
| Female                                | 31 (52.5) | 51 (52.6)| 82                   | 1.0        |
| **Marital status (n = 137)**          |           |          |                      |            |
| With a partner                        | 31 (54.4) | 26 (45.6)| 57                   | 1.57 (0.210) | 0.84 (0.63-114) |
| Without a partner                     | 52 (65.0) | 28 (35.0)| 80                   | 1.0        |
| **Schooling (years) (n = 137)**       |           |          |                      |            |
| 5 or less                             | 45 (72.6) | 17 (27.4)| 62                   | 6.82 (0.009) | 143 (1.09-188) |
| 6 or more                             | 38 (50.7) | 37 (49.3)| 75                   | 1.0        |
| **Labor conditions**                  |           |          |                      |            |
| **Hours of work per day**             |           |          |                      |            |
| Less than 8                           | 7 (53.8)  | 6 (46.2) | 11                   | 4.74 (0.093) | 10         |
| From 8 to 11                          | 31 (51.7) | 29 (48.3)| 60                   | 0.95 (0.55-1.68) | 102 (0.48-2.61) |
| 12 or more                            | 45 (70.3) | 19 (29.7)| 64                   | 1.30 (0.77-2.21) | 10         |
| **Days of work per week**             |           |          |                      |            |
| From 1 to 5                           | 47 (69.1) | 21 (30.9)| 68                   | 4.11 (0.042) | 132 (1.00-175) |
| 6 or 7                                | 36 (52.2) | 33 (47.8)| 69                   | 1.0        |
| **Time working in the profession (years) (n = 137)** |           |          |                      |            |
| From 1 to 5                           | 17 (53.1) | 15 (46.9)| 32                   | 1.39 (0.706) | 10         |
| From 6 to 10                          | 18 (58.1) | 13 (41.9)| 31                   | 1.06 (0.70-170) | 106 (0.70-170) |
| From 11 to 20                         | 16 (64.0) | 9 (36.0)| 25                   | 1.20 (0.78-187) | 120 (0.78-187) |
| More than 20                          | 32 (65.3) | 17 (34.7)| 49                   | 1.23 (0.84-180) | 123 (0.84-180) |
| **Type of sales position (n = 137)**  |           |          |                      |            |
| Non-stationary                        | 11 (55.0) | 9 (45.0)| 20                   | 0.30 (0.580) | 10         |
| Semi-stationary or stationary         | 72 (615)  | 45 (38.5)| 117                  | 0.89 (0.59-136) | 10         |
| **Type of product sold**              |           |          |                      |            |
| Meat                                  | 16 (44.4) | 20 (55.6)| 34                   | 6.08 (0.0192) | 10         |
| Merchandise/pots                      | 20 (64.5) | 11 (35.5)| 31                   | 1.45 (0.73-2.27) | 145 (0.73-2.27) |
| Harvest/perishable products           | 12 (75.0) | 4 (25.0)| 16                   | 169 (1.06-268) | 169 (1.06-268) |
| Fast food                             | 20 (66.7) | 10 (33.3)| 30                   | 1.50 (0.96-2.34) | 150 (0.96-2.34) |
| Beverages, appetizers/ dessert        | 15 (62.5) | 9 (37.5)| 24                   | 1.41 (0.87-2.27) | 141 (0.87-2.27) |

Bold indicates statistically significant association when p < 0.05
1 to 5 days week and presented these symptoms (PR 1.32, CI: 1.00-1.75) (Table 3).

It was observed that the greater the time working in the profession, the higher the prevalence of musculoskeletal symptoms, with no significant association. With regard to type of sales position, musculoskeletal symptoms were 89.0% (PR = 1.89) more prevalent in workers who had a semi-stationary or a stationary sales position. Workers who sold meat had fewer musculoskeletal symptoms than those who sold other types of products (Table 3).

### OCCUPATIONAL RISK FACTORS ASSOCIATED WITH MUSCULOSKELETAL SYMPTOMS

No statistically significant association was observed between musculoskeletal symptoms and the fact that workers considered that their work required performing forced postures or repetitive movements, lifting heavy objects, or bending frequently. However, there was a significant association (p < 0.05) between musculoskeletal symptoms and moving heavy objects, in the prevalence of these symptoms was 37% higher in workers who moved heavy objects than in those who did not (PR 1.37, 95%CI: 1.06-1.77) (Table 4).

#### Table 4. Ergonomic occupational risk factors associated with musculoskeletal symptoms in workers from a marketplace in a municipality of Southwestern Antioquia, Colombia, 2017 (n = 137)

| Occupational risk factor - characteristic | Musculoskeletal symptoms | Total | Chi-square (p-value) | PR (95%CI) |
|-------------------------------------------|--------------------------|-------|----------------------|------------|
| Work requires forced postures (n = 137)   |                          |       |                      |            |
| Yes                                       | 24 (66.7)                | 12 (33.3) | 36 | 0.76 (0.384) | 1.14 (0.56-1.51) |
| No                                        | 59 (58.4)                | 42 (41.6) | 101 |               | 1.0           |
| Work requires repetitive movements (n = 137)|                          |       |                      |            |
| Yes                                       | 58 (63.7)                | 33 (36.3) | 91 | 1.23 (0.288) | 1.17 (0.86-1.59) |
| No                                        | 25 (54.3)                | 21 (45.7) | 46 |               | 1.0           |
| Work requires lifting heavy objects (n = 137)|                          |       |                      |            |
| Yes                                       | 38 (70.4)                | 16 (29.6) | 54 | 3.57 (0.058) | 1.30 (0.99-1.69) |
| No                                        | 45 (54.2)                | 38 (45.8) | 83 |               | 1.0           |
| Work requires moving heavy objects (n = 137)|                          |       |                      |            |
| Yes                                       | 34 (73.9)                | 12 (26.1) | 46 | 5.15 (0.023) | 1.37 (1.06-1.77) |
| No                                        | 49 (53.8)                | 42 (46.2) | 91 |               | 1.0           |
| Work requires frequently (n = 137)        |                          |       |                      |            |
| Yes                                       | 56 (62.9)                | 33 (37.1) | 89 | 0.58 (0.445) | 1.12 (0.83-1.50) |
| No                                        | 27 (56.3)                | 21 (43.8) | 48 |               | 1.0           |
| Wears a belt on the waist or on the back (n = 120)|                          |       |                      |            |
| Yes                                       | 4 (66.7)                 | 2 (33.3) | 6  | 0.50 (0.828) | 1.07 (0.60-1.92) |
| No                                        | 71 (62.3)                | 43 (37.7) | 114 |               | 10           |
| Has enough space to move around in the workplace (n = 136)|                          |       |                      |            |
| Yes                                       | 73 (59.8)                | 49 (40.2) | 122 | 0.30 (0.580) | 0.84 (0.58-1.20) |
| No                                        | 10 (71.4)                | 4 (28.6) | 14 |               | 1.0           |
| Performs work safely (n = 137)             |                          |       |                      |            |
| Yes                                       | 70 (59.8)                | 47 (40.2) | 117 | 0.19 (0.661) | 0.92 (0.64-1.31) |
| No                                        | 13 (65.0)                | 7 (35.0) | 20 |               | 10           |
| Feels satisfied with work (n = 137)        |                          |       |                      |            |
| Yes                                       | 76 (59.8)                | 51 (40.2) | 127 | 0.08 (0.766) | 0.85 (0.56-1.31) |
| No                                        | 7 (700)                  | 3 (30.0) | 10 |               | 10           |

Bold indicates statistically significant association when p < 0.05
Finally, it is noteworthy that workers who reported having enough space to move around, performing their work safely, and feeling satisfied with their work presented a higher prevalence of musculoskeletal symptoms (84.0%, 92.0% and 85.0% respectively) than those who did not consider so (Table 4).

**SOCIODEMOGRAPHIC CHARACTERISTICS, LABOR CONDITIONS, AND OCCUPATIONAL RISK FACTORS THAT EXPLAIN MUSCULOSKELETAL SYMPTOMS**

When adjusting all variables that presented \( p < 0.25 \), according to Hosmer-Lemeshow criteria, such as: marital status, schooling, type of product sold, hours of work per day, days of work per week, lifting and moving heavy objects, it was found that the only variables that significantly explained lower prevalence of musculoskeletal symptoms \( (p < 0.05) \) were working from 1 to 5 days a week and having less than 5 years of schooling. Therefore, for each individual who worked 6 or 7 days a week and presented musculoskeletal symptoms, there was 0.27 individual who worked 5 days or less and presented these symptoms \( (PR_C = 1.32, 95\% CI = 1.00-1.75. PR_A = 0.27, 95\% CI = 0.11-0.67) \), all when adjusted for the remaining variables. Having 5 years of schooling or less explained a prevalence 0.32 times lower of musculoskeletal symptoms, in comparison to having 6 years of schooling or more \( (PR_C = 1.43, 95\% CI = 1.09-1.88. PR_A = 0.32, 95\% CI = 0.14-0.75) \).

It bears nothing that, initially, both variables were significantly associated with a higher prevalence of musculoskeletal symptoms, they remained statistically significant after adjustment, but there was a change in the direction of associations, and these characteristics had a reversal in the direction of association, allowing to determine that they explain lower prevalence of symptoms in the study (Table 5).

With regard to type of product sold, it was found that selling meat went from being a factor associated

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**Table 5. Sociodemographic and labor conditions that explain musculoskeletal symptoms in marketplace workers, December 2017 \( (n = 194) \)**

| Condition - characteristic | Crude PR | 95%CI | Adjusted PR | 95%CI |
|----------------------------|---------|-------|-------------|-------|
|                            | LT | UT   | LT | UT |
| Type of product sold. Appetizer and dessert (RC)* | | | | |
| Meat | 0.71 | 0.44 | 1.15 | 2.36 |
| Merchandise/pots | 1.03 | 0.69 | 1.55 | 1.40 |
| Harvest/perishable products | 1.20 | 0.79 | 1.82 | 1.26 |
| Fast food | 1.07 | 0.71 | 1.59 | 1.05 |
| Hours of work per day. Less than 8 hours (RC)* | | | | |
| From 8 to 11 hours | 0.95 | 0.55 | 1.68 | 1.76 |
| 12 hours or more | 1.30 | 0.77 | 2.21 | 0.59 |
| Days of work per week 6 and 7 days (RC)* | | | | |
| From 1 to 5 days | 1.32 | 1.00 | 1.75 | 0.27 |
| Marital status. Without partner (RC)* | | | | |
| With partner | 0.84 | 0.63 | 1.14 | 0.68 |
| Years of schooling. More than 6 (RC)* | | | | |
| 5 or less | 1.43 | 1.09 | 1.88 | 0.32 |
| Work requires lifting heavy objects. No (RC)* | | | | |
| Yes | 1.30 | 1.00 | 1.69 | 0.75 |
| Work requires moving heavy objects. No (RC)* | | | | |
| Yes | 1.37 | 1.06 | 1.77 | 0.50 |

* (RC) = Reference category for comparison. Results are presented for the categories with which this category is compared.
with fewer musculoskeletal symptoms ($PR_c = 0.71$) to explaining greater musculoskeletal symptoms ($PR_A = 2.36$), selling merchandise and pots went from showing a $3.0\%$ ($PR_c = 1.03$) higher prevalence to a $40.0\%$ ($PR_A = 1.40$) higher prevalence, and selling harvest and perishable products went from showing a $20.0\%$ ($PR_c = 1.20$) higher prevalence to a $26.0\%$ ($PR_A = 1.26$) higher prevalence when adjusted for the remaining variables (Table 5).

There was a change in the direction of association for hours of work per day, in which working from 8 to 11 hours went from being associated with fewer musculoskeletal symptoms ($PR_c = 0.95$) to explaining more symptoms ($PR_A = 1.76$) when adjusted for the remaining variables; conversely, working 12 hours or more a day went from being associated with greater musculoskeletal symptoms ($PR_c = 1.30$) to being associated with fewer symptoms ($PR_A = 0.14$) (Table 5).

Finally, having a work that required moving heavy objects, a characteristic that was significantly associated with a higher prevalence of musculoskeletal symptoms in the bivariate analyses, lost its statistical significance, and became a factor associated with fewer musculoskeletal symptoms ($PR_A = 1.37$, 95%CI = 1.06-1.77. $PR_A = 0.50$, 95%CI = 0.18-1.38); as well as lifting heavy objects ($PR_c = 1.30$, 95%CI = 0.99-1.69. $PR_A = 0.75$, 95%CI = 0.28-2.00) (Table 5).

**DISCUSSION**

The present study evidenced, at least in part, the sociodemographic characteristics, labor conditions, and occupational risk factors of the 194 participating workers, and their association with some musculoskeletal symptoms.

It was observed that most workers were older than 30 years, which is consistent with findings reported by two Colombian studies that investigated the working conditions of informal vendors.\(^2\),\(^{16}\) Furthermore, older workers were found to have more have greater musculoskeletal symptoms, which was also observed in coffee collectors and sewer maintenance workers assessed for ergonomic risk and MSD in Colombia.\(^{16}\),\(^{17}\)

The majority of workers were women, a result that coincides with data reported in a study with a population of street vendors.\(^18\) However, the presence of musculoskeletal symptoms was similar for men and women in the present study, a situation different from that observed by other authors, who found a higher prevalence of musculoskeletal pain and other MSD in women ($p < 0.05$).\(^{17},\(^{19}\)

The present study identified a statistically significant association ($p < 0.05$) between musculoskeletal symptoms and years of schooling, showing a lower prevalence of these symptoms in workers with $\leq 5$ years of schooling, a situation different from that reported in a study that assessed coffee collectors, in which less educated individuals had a higher prevalence of MSD.\(^{17}\)

In general, workers in this study worked more than 8 hours a day, in line with findings from other studies with populations working in the informal sector both in the streets and in marketplaces,\(^2\),\(^{20}\) which reported an average 10 hours of work per day and, in the case of marketplace vendors in Cartagena, a significant percentage of them worker 12 hours a day or more,\(^2\) fundamentally 6 days a week, similarly to workers from Medellin,\(^2\),\(^{20},\(^{21}\) whereas the workers included in the present study worked mainly from 1 to 5 days a week.\(^2\) Working from 8 to 11 hours a day was associated with greater musculoskeletal symptoms, whereas working 12 hours or more was associated with fewer symptoms. Conversely, those who worked from 1 to 5 days a week had a lower prevalence of musculoskeletal symptoms, showing a statistically significant association. However, when days of work per week were adjusted for the other variables that were included in the multivariate model, working from 1 to 5 days a week were found to significantly explain lower prevalence of musculoskeletal symptoms.

Although most workers had $\geq 20$ years working in the profession, those with fewer years of experience showed a lower prevalence of musculoskeletal symptoms, results consistent with those observed in coffee collectors from a municipality in Southwestern Antioquia.\(^{17}\) Also, a higher prevalence of these symptoms were found in those who sell meat in the marketplace, in line with a study that assessed women working in the fishing industry, which showed that...
this group have a worse health-related quality of life compared to the general population, mainly reporting bodily pain.\textsuperscript{22}

The workers participating in this study found a higher prevalence of overweight and obesity (62.6%), values lower than those reported in informal workers from downtown Medellín\textsuperscript{21} and similar to those observed in workers from José María Villa marketplace, located in the same city.\textsuperscript{20}

The presence of musculoskeletal symptoms was 60.6\% (86), the most common of which were joint pain (37.7\%), lower back pain (26.5\%), and upper back pain (14.1\%). Similarly, the fifth Colombia National Pain Survey reported that “at least 60.0\% of the population had musculoskeletal pain, of which 27.0\% suffered from back pain.”\textsuperscript{11}

The present study found that 63.4\% of participants performed repetitive movements at work, and the same percentage reported that their work requires forced postures; both variables were not significantly associated with the prevalence of musculoskeletal symptoms. The only variable with a statistically significant association with musculoskeletal symptoms was moving heavy objects, similar to a study of female street vendors, in which more than a half of women carried loads and almost a half perceived their posture as uncomfortable.\textsuperscript{18} When performing multivariate analysis, there was a decrease in $PR_A$ for moving and lifting heavy objects.

In another study, prolonged postures and physical effort were reported as some of the elements related to labor fatigue.\textsuperscript{18} Back pain can be related to inadequate postures or to lifting heavy loads;\textsuperscript{2} and upper limb pain is more prevalent in those whose work involved performing repetitive movements.\textsuperscript{16,17,19} In the present study, musculoskeletal symptoms were more prevalent in workers who considered that their work required performing forced postures, repetitive movements, or bending frequently, but these were not statistically significant associations.

A great proportion of workers participating in this study reported not working in a place with deteriorated floors, walls, and areas, and most of them stated that their workplace was well-ventilated and well-illuminated, as well as tidy, clean, with enough space to move around, and with known routes of evacuation in case of emergency; furthermore, few workers reported feeling excess heat or cold, or hearing loud noise in their workplace. These findings differed from those reported in a study in Cartagena that assessed the work and health conditions of informal vendors and found precarious labor conditions.\textsuperscript{2} A study conducted in Catalonia stated that precarious employment was associated with worse health in the working population, putting into question what was reported by the workers surveyed in our article, since those who said that they had enough space to move, performed their work in a safe manner, and felt satisfied with their work presented a higher prevalence of musculoskeletal symptoms.\textsuperscript{23}

With regard to the limitations of this study, it is worth noting that it was not possible to apply instruments to assess movements, postures, ways of moving and carrying load, neither the Kuorinka Nordic questionnaire and the OWAS method were used to evaluate ergonomic risk and disorder, which is why only symptoms were addressed. Thus, it is important to perform future trivariate analyses.

One of the strengths of the present study was the participation of an anatomist physician, who evaluated and reviewed the variables related to musculoskeletal symptoms, thus refining these variables. Furthermore, selection bias was controlled by performing a census of all individuals working in the marketplace.

**CONCLUSION**

This disease is explained by modifiable factors that may be controlled or prevented with health promotion and disease prevention, with the active participation of workers, their families, and municipal health authorities, especially considering that musculoskeletal symptoms for the working population is a topic of interest for occupational health in the continent. Furthermore, the case of workers with precarious and subsistence job in marketplaces has been little explored with regard to their sociodemographic and labor conditions and of their occupational risk factors.
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Author contributions
MOGD was responsible for conceptualization, investigation, formal analysis, data curation, writing – original draft and review & editing, and validation. MCBV participated in investigation, formal analysis, writing - review & editing, and validation. JATR participated in conceptualization, writing - review & editing, and validation. IA participated in formal analysis, investigation, writing - review & editing, and validation. All authors approved the final version submitted and take public responsibility for all aspects of the work.

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