

## DOR LOMBAR: RELAÇÃO COM A MASSA E FORÇA MUSCULAR EM TRABALHADORES RURAIS

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**Resumo:** O trabalho rural requer muito esforço físico, movimentos repetitivos, posturas incorretas, aumentando as possibilidades de apresentarem dores no corpo, e uma das regiões mais afetadas é a lombar. A dor lombar pode levar a redução do esforço físico e consequentemente a redução das atividades físicas, ocasionando perda de força da musculatura lombar, fragilizando ainda mais essa musculatura e agravando o quadro clínico. O objetivo deste estudo foi investigar a relação da DL com a massa muscular e a capacidade de produção de força dos músculos extensores de tronco de trabalhadores rurais. A amostra contou com 31 trabalhadores rurais, de ambos os sexos, com idades de 35 a 55 anos. Os participantes foram divididos em dois grupos de acordo com a presença ou ausência de dor lombar. Os indivíduos tiveram sua composição corporal avaliada por bioimpedância, posteriormente foram obtidos dados de perda muscular. O teste de contração isométrica voluntária máxima da musculatura extensora do tronco foi realizado para identificar a capacidade de produção de força da musculatura lombar. Em relação a força muscular, o grupo sem dor apresentou níveis de força de 31,19 ( $\pm 18,35$ ) kgf versus 17,02 ( $\pm 11,33$ ) kgf do grupo com dor. Em relação ao índice musculoesquelético, o grupo com dor obteve valores de 34,68 ( $\pm 11,33$ ) % versus 44,84 ( $\pm 18,35$ ) % do grupo sem dor, sendo essas diferenças significativas. Conclusão: Trabalhadores rurais com sintomas de dor lombar apresentam menor massa muscular e menor capacidade de produção de força da musculatura extensora de tronco em relação aos trabalhadores sem dor lombar.

**Palavras-chave:** dor lombar; força muscular; doenças dos trabalhadores agrícolas; agricultor

Afiliação

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## LOW BACK PAIN: RELATIONSHIP WITH MUSCLE MASS AND FORCE IN RURAL WORKERS

**Abstract:** Rural work requires a lot of physical effort, repetitive movements, incorrect postures, causing increased chances of presenting body pain, in which one of the most affected regions is the lumbar region. Lumbar pain reduces physical effort and consequently reduces physical activity, resulting in loss of strength of lumbar muscles, weakening the lumbar muscles and worsening the clinical picture. The aim of this study was identify the relationship of low back pain with loss of muscle mass and strength production of the extensor muscles of the trunk in rural workers. The sample consisted of 31 rural workers of both sex with ages ranging from 35 to 55 years. The subjects were divided into two groups according to the presence of pain in the lumbar region (symptomatic and asymptomatic). The subjects performed an evaluation of body composition through bioimpedance, where data regarding muscle loss were obtained. The subjects underwent the maximal voluntary isometric contraction test of the trunk extensor muscles to identify the capacity of lumbar muscle strength. As for muscle loss, the asymptomatic group had strength levels of 31.19 ( $\pm$  18.35) kgf versus 17.02 ( $\pm$  11.33) kgf of the symptomatic group. Regarding the musculoskeletal index, the symptomatic group had values of 34.68 ( $\pm$  11.33) % versus 44.84 ( $\pm$  18.35) % of the asymptomatic group. Rural workers with symptoms of low back pain demonstrate a greater loss of muscle mass and a lower capacity of strength production of the extensor muscles of the trunk in relation to the asymptomatic workers.

**Key words:** low back pain; muscle strength; rural workers' diseases; farmer

## Introduction

Approximately 16 million workers are active in rural areas out of a total of 90 million workers<sup>1</sup>. This work activity presents physical and physiological demands that requires observation and monitoring of ergonomic and psychosocial risks, as a way to avoid possible damages to these workers<sup>2</sup>. Rural work sometimes requires high physical effort, which can lead to work disabilities, discomfort, pain, postural disorders and even skeletal muscle injuries<sup>3</sup>.

The most frequent causes of these pains in rural workers (RW) are related to low back pain (LBP)<sup>4</sup>, the complaints of LBP in this population are frequent<sup>5</sup>. It is estimated that 60% to 80% of the population will have LBP at some point of their life, occurring more commonly between 25 and 60 years of age<sup>6</sup>. These manifestations occur in the posterior region of the body, from the inferior margin of the twelfth rib to the inferior gluteal folds<sup>7</sup>.

LBP occurs due to stress on structures that surround the lumbar spine, such as intervertebral discs, intervertebral joints, ligaments, nerves and lumbar muscles<sup>8</sup>. There are several factors associated with the development of LBP, such as changes in muscle activity, spinal stability<sup>9-10</sup>, and reductions in muscle volume and strength<sup>9-11</sup>. Individuals with LBP may have lumbar muscles with a smaller cross-sectional area<sup>12</sup> and low capacity of isometric and isokinetic force production on trunk extensor muscles<sup>9</sup>.

Changes in body composition can be observed throughout life, such as the loss of skeletal muscle mass<sup>13</sup>. Muscle mass loss (MML) occurs mainly with age, and may approach 1% to 2% per year from the age of 50<sup>14</sup>. The reduction in muscle mass of the multifidus, spine erector and lumbar square muscles are associated with the occurrence of LBP<sup>8,12</sup>. Thus, the presence of LBP can lead to a reduction in physical activity<sup>14</sup>, a fact that further aggravates the condition of LBP and interferes with the productivity of RW<sup>15</sup>.

Given that MML is a natural degenerative process<sup>16-17</sup>, low back pain (whether chronic or acute) could be associated<sup>18</sup> with MML and lumbar musculature's capacity to produce strength. The aim of the present study was to investigate the relationship between LBP and muscle mass and the capacity to produce strength of trunk extensor muscles of rural workers.

## Materials and Methods

This is a comparative cross-sectional study based on secondary data extracted from the project database “Screening for overweight risk factors in agribusiness workers using new health information and analytical technologies - Phase III” of the University of Santa Cruz do Sul, approved by the Research Ethics Committee CAAE: 78889317.1.0000.5343 of the University of Santa Cruz do Sul (UNISC).

### *Participants*

Fifty-five rural workers were evaluated in the research, and thirty-one were included in this study considering the inclusion criteria, 14 male, from the municipalities that make up the Southern Microregion of the Rio Pardo Valley Regional Development Council (COREDE-VRP), aged 35 to 55, who attended the following inclusion criteria: a) be a rural producer and participated in the previous three phases of the “master project” and b) present conditions for carrying out the tests proposed by the project. We excluded: a) those individuals who had already performed some type of surgical procedure in the spine and b) those who presented acute symptoms of LBP in the moments prior to and during the tests.

### *Procedures*

For data collection, we used the lifestyle questionnaire<sup>19</sup>, which investigated sociodemographic variables, and the Visual Analog Scale (VAS) to identify the presence of LBP. VAS consists of a subjective pain scale with values from one to ten, where pain is rated 1-3 as "mild", 4-7 "moderate" and 8-10 "severe". According to the presence or absence of DL symptoms, workers were divided into two groups: the group without LBP (NLBP) and group with LBP (LBP).

### *Anthropometric assessment*

To characterize the sample, anthropometric evaluations were performed using the following variables: body mass (Kg) and height (m) using an anthropometric scale with coupled stadiometer (Welmy SA, Santa Bárbara do Oeste, SP, Brazil), after that the body mass index (BMI) was calculated. Through bioimpedance analysis (BIA) it was possible to obtain skeletal muscle mass (SMM), body mass (BM) and body fat percentage (% Fat).

The BIA was performed with the InBody 720 equipment (Biospace, Seoul, South Korea), consisting of an octapolar multi-frequency analyzer (8 electrodes positioned in pairs, in contact with the palm, thumbs and front and back of each foot) following the manufacturer's

recommendations<sup>20-21</sup>. For this test workers received the following recommendations: 1) do not eat moments before the test; 2) go to the bathroom before the test starts; 3) wear soft clothes; 4) remove accessories and metallic objects; 5) do not perform physical activity before the test; 6) do not shower before the test; 7) keep in an orthostatic position for five minutes before the start of the test; 8) Avoid performing the test in case of ingestion of diuretic substances.

#### *Muscle mass assessment*

This assessment is performed automatically by the BIA as a result of the equation “[ $(\text{height}^2 / \text{BIA resistance} \times 0.401) + (\text{gender} \times 3.825) + (\text{age} \times -0.071)$ ] + 5.102”, validated by Janssen et al<sup>22</sup>. From this equation, where the resistance of the BIA is expressed in Ohms; gender: male = 1 and female = 0; and age in years, the percentage of skeletal muscle mass (SMM) is obtained. With these data we obtain the skeletal muscle index (SMI) which consists of the ratio of the percentage of SMM to the subject’s percentage of body mass (BM) [SMM / BMx100 (%)].

#### *Lumbar strength*

The strength of the trunk extensor muscles were evaluated to quantify the lumbar region strength production capacity, and a maximal voluntary isometric contraction (MVIC) was performed by means of a load cell coupled to the digital dynamometer EMG800C-432 (EMG System do Brasil, Curitiba, PR, Brazil) four-channel, sampling rate 2000 Hz, with data filtered through the Butterworth filter. The workers were positioned prone on a table from a position where the lumbar spine was at 0° of flexion (i.e. trunk in neutral position). Subjects were fixed with velcro straps at the hips, popliteal fossa and legs. A vest attached to the chest at shoulder blade level was adopted to secure the load cell by chains attached to the xiphoid process of the sternum bone and the ground. During the execution of the MVIC, all workers received verbal stimulus during trunk extension seeking to reach the maximum strength of each participant. Load cell distraction was considered as a representative measure of the strength capacity of the trunk extensor muscles. Three MVIC attempts (kgf) were performed with a duration of five seconds of contraction each, with a two-minute interval between repetitions. For data analysis, the highest force values among the three trials were considered.

#### *Statistical analysis*

Data were analyzed by SPSS v. 23.0 (IBM Corporation, Armonk, NY, USA) using

descriptive statistics of mean and standard deviation, to numeric variables, and absolute and relative frequency, to categorical variables. After verifying the normality of the data through the Shapiro-Wilk test, we used comparison tests of means between groups: Student's t test for independent samples for variables with normal distribution, and the Mann-Whitney U test for variables with non-normal distribution. For categorical variables analysis the Qui-Square test were performed. A significance level of  $\alpha = 0.05$  was considered.

## Results

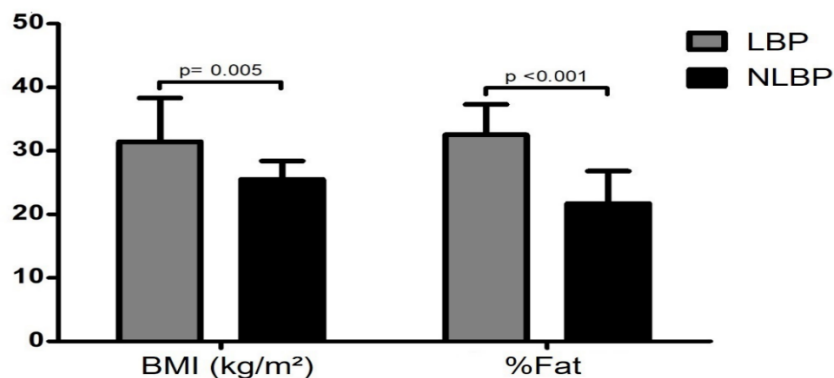
Table 1 compares NLBP and LBP groups, in which the female gender presented LBP more often. Another significant data was related to age in which LBP group was older compared to NLBP group. Marital status, socioeconomic classification, working time, working hours per day, housework, children, predominant posture and physical activity did not show significant differences.

**Table 1** - Sample characterization

| Variable                      | LBP<br>(n=14) | NLBP<br>(n=17) | p      |
|-------------------------------|---------------|----------------|--------|
| Sex*                          |               |                |        |
| Female                        | 13 (76.5)     | 4 (23.5)       | <0.001 |
| Male                          | 1 (7.1)       | 13 (92.9)      |        |
| Age**                         | 48,8 (4.7)    | 44.3 (5.9)     | 0.028  |
| Marital status*               |               |                |        |
| Single                        | -             | 2 (100)        | 0.330  |
| Married                       | 12 (46.2)     | 14 (53.8)      |        |
| Divorced                      | 2 (66.7)      | 1 (33.3)       |        |
| Socioeconomic Classification* |               |                |        |
| B                             | 6 (40.0)      | 9 (60.0)       | 0.576  |
| C                             | 8 (50.0)      | 8 (50.0)       |        |
| Working Time**                | 23.9 (12.1)   | 25.4 (13.3)    | 0.891  |
| Working Hours per day**       | 9.9 (2.8)     | 9.5 (1.9)      | 0.625  |
| Domestic journey*             |               |                |        |
| Less than 2h                  | 8 (36.4)      | 14 (63.6)      | 0.233  |
| More than 2h                  | 6 (66.7)      | 3 (33.3)       |        |
| Children*                     |               |                |        |
| Yes                           | 14 (50.0)     | 14 (50.0)      | 0.232  |
| No                            | -             | 3 (100)        |        |
| Predominant posture*          |               |                |        |
| Standing                      | 12 (52.2)     | 11 (47.8)      | 0.240  |
| Seated/alternating            | 2 (25.0)      | 6 (75.0)       |        |
| Physical activity*            |               |                |        |
| Yes                           | 2 (50.0)      | 2 (50.0)       | 1.000  |
| No                            | 12 (41.4)     | 15 (55.6)      |        |

n: number of subjects; \*: absolute frequency (relative frequency); \*\*: mean (standard deviation).

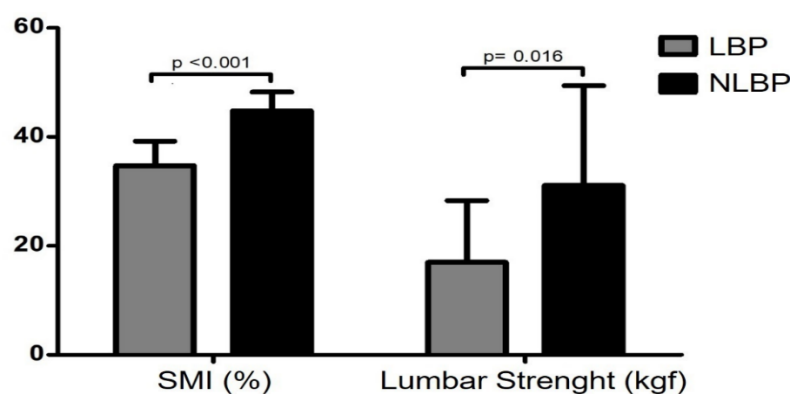
The sample characterization data are presented in Figure 1. Differences between groups were observed in the BMI ( $p = 0.005$ ) and % fat ( $p < 0.001$ ) variables.



**Figure 1** - Anthropometric parameters.

Values described as mean and standard deviation ( $\pm$ ); Age in years; BMI = body mass index ( $\text{kg} / \text{m}^2$ ); Fat = body fat percentage (%); \* Statistically significant differences ( $p \leq 0.05$ ).

Regarding MML and trunk extensor muscle strength production, NLBP presented higher percentages of SMI ( $p < 0.001$ ), and higher strength levels ( $p = 0.016$ ) (**Figure 2**).



**Figure 2** - Strength production parameters of trunk extensor muscles and skeletal muscle index.

Figure caption: Values described as mean and standard deviation ( $\pm$ ). SMI: skeletal muscle index (%); Lumbar strength (kgf); \* Statistically significant differences ( $p \leq 0.05$ ).

## Discussion

The aim of this study was to investigate the relationship between LBP and MML and the lumbar muscle strength production capacity in RW. It can be observed that the NLBP group presented higher SMI and greater capacity of force production. In this sense, the results observed in our study may indicate that a lower MML and a greater capacity to produce force on the trunk extensor muscles are related to the absence of LBP. On the other hand, the presence of these symptoms in RW may be a consequence of the lack of health information, especially regarding care with posture and physical exercise<sup>23</sup>.

The relationship between the presence of LBP and the lowest SMI was evidenced in the present study, demonstrating that individuals with lower back pain had lower SMI, which may

be related to lower capacity to produce muscle strength. However, it is important to consider the age factor, since LBP group had a higher mean age. According to Yamada et al.<sup>24</sup>, MML starts around the age of 40 and becomes more pronounced at age of 50. Therefore, MML is directly associated with increasing age. However, there are other influencing factors, such as diet, physical activity and especially the practice of strength training<sup>25</sup>, fundamental aspects for maintaining muscle mass. Decreased muscle volume can lead to physical disability and poor quality of life<sup>26</sup>.

Arab et al.<sup>27</sup> analyzed the relationship between the strength of the lumbar and hip extensor muscles in men and women with and without LBP, and their results found that the strength of the trunk extensor muscles in men is associated with LBP, similar result to the findings of our study, indicating that the reduction in trunk extensor muscle strength is a contributing factor to the onset of LBP. Nava et al.<sup>28</sup> found similar results in women with LBP as they presented reduced muscle resistance in this musculature, confirming the hypothesis.

In a study conducted with coal miners<sup>29</sup>, there was a high prevalence of lumbar muscle weakness with low functional impairment. However, this result may be associated with the fact that the sample had a high degree of weakness of the lumbar musculature (77.5%). Another study<sup>30</sup> analyzed the relationship between the clinical classification of LBP with dorsal and lower limb muscle strength. The findings of this study indicated that the reduction in dorsal muscle strength is associated with LBP, a result similar to that observed in present study. Thus, it is of fundamental importance to implement guidelines on care with posture at work, as well as care with diet and the inclusion of exercise programs of different modalities<sup>25,31</sup>.

In our study, the LBP group presented lower levels of the trunk extensor muscles strength, evidencing a relationship between low lumbar muscle force production capacity and the presence of pain. Agreeing with our results, studies<sup>9-10</sup> reported lower maximal isometric strength production in individuals with LBP compared to individuals without LBP. In contrast to these findings, Renkawitz et al.<sup>32</sup>, in a study conducted with athletes, there were no differences in muscle strength of individuals with and without LBP, these results, according to the authors, resulted from the achievement of maximum strength by the subjects, without avoidance behavior or fear of pain. Although it is a complex multifactorial symptom, it is possible to support the hypothesis that the deconditioning of the trunk extensor musculature is directly linked to the LBP<sup>10</sup>. On the other hand, the initial cause of the symptom is still unknown, and the presence of LBP may contribute to the reduction of muscle use, as well as a low capacity to produce force could be one of the causes of symptom's development.

Our findings demonstrate that individuals with LBP have lower SMI and reduced ability to produce trunk extension force, similarly, presented older age, and higher BMI and fat percentage. These data may indicate that these individuals with LBP symptoms may be less physically active, as the development of LBP may be due to the higher mean age of this group, and other factors such as physical inactivity<sup>9</sup>, advanced age (i.e. degenerative changes in the spine)<sup>9,33</sup>, and overweight<sup>9,34</sup>.

This study has limitations. Some potential confounders were not considered: the control of hormonal factors that may have different repercussions on female subjects, the different tasks in the work activities, the volume and intensity of the physical effort during the work activity and rural working time<sup>15</sup>. However, this study identified the association of LBP with lower SMI and lower back muscle production capacity. For further investigations, it is suggested a longitudinal follow-up of this population, as well as the control of daily physical activities. Muscle stiffness of lower back muscles could be included in future analysis, as increased muscle stiffness of lower back muscles may be related to the occurrence of LBP<sup>8</sup>.

Preventive and awareness strategies through health information could promote better health care for this population. The practice of training through resistance exercises can favor the maintenance of muscle mass and increase the physical performance of the individual, making them able to have a more independent life and reduce the risk of falls and physical disability<sup>13,25</sup>. In this sense, the search for strategies through training programs involving strength exercises and the strengthening of the trunk extensor musculature may be some alternatives for the treatment and prevention of LBP symptoms, since LBP is related to intense physical work, frequent movements of trunk rotation or flexion<sup>8</sup>, which are present in the daily tasks of the RW. It is noteworthy that the population investigated is distributed in large territory, making it difficult to access health care and information<sup>19</sup>. Thus, awareness through health information could also promote better health care for this population.

## Conclusion

Rural workers with low back pain present lower musculoskeletal index and lower capacity of force production on trunk extensor muscles, suggesting that these factors may be contributing to the development of pain.

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