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Is low back pain related to the body composition, flexibility, and postural deviations in rural workers?

A dor lombar está relacionada à composição corporal, flexibilidade e desvios posturais em trabalhadores rurais?

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Is low back pain related to the body composition, flexibility, and postural deviations in rural workers?

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Abstract

Introduction: Hard work in the countryside can lead to the onset of pain conditions, which in turn trigger different degrees of labor reduction and musculoskeletal disorders. Low back pain (LBP) is one of the most common disorders that lead to inactivity, and obesity seems to be associated with the development of low back pain symptoms, since abdominal fat causes mechanical demands in this region due to excessive load. **Objectives:** To analyze low back pain and its relationship with body composition, flexibility, and posture in rural workers. **Methods:** Rural workers (n = 55) were grouped according to the presence (LBPG), or symptoms' absence (NLBP) of low back pain. Body composition, flexibility, and posture were assessed and compared between groups. A principal component analysis was used to group variables to identify possible associations among variables and low back pain. **Results:** LBPG presented greater obesity rates than NLBP. Regarding the low back pain prevalence, most of the participants had pain symptoms and showed postural deviations. Principal components analysis showed that NLBP was mainly related to the amount of muscle tissue, while the LBPG was to the adipose tissue. **Conclusions:** Low back pain appears to be associated with body composition and postural deviations, while musculoskeletal and adipose tissues are protective and risk factors for low back pain, respectively, in rural workers.

Keywords: rural health; occupational health; back pain; body composition; posture.

Resumo

Introdução: O trabalho árduo no campo pode levar ao aparecimento de quadros de dor, que desencadeiam diferentes graus de redução do trabalho e distúrbios musculoesqueléticos. A dor lombar é um dos principais distúrbios que levam a inatividade. A obesidade parece estar associada a dor lombar, pois a gordura abdominal provoca demandas mecânicas nessa região devido à carga excessiva. **Objetivos:** Analisar a dor lombar e sua relação com a composição corporal, flexibilidade e postura em trabalhadores rurais. **Métodos:** Trabalhadores rurais (n = 55) foram agrupados de acordo com a presença (LBPG) ou ausência de sintomas (NLBP). A composição corporal, flexibilidade e postura foram avaliadas. Uma análise de componentes principais foi utilizada para identificar possíveis associações entre as variáveis e a dor lombar. **Resultados:** O grupo LBPG apresentou maiores taxas de obesidade do que o NLBP. Em relação à prevalência de dor lombar, a maioria dos participantes apresentava dor e desvios posturais. A análise de componentes principais mostrou que o grupo NLBP estava relacionado à quantidade de tecido muscular, enquanto o grupo LBPG estava ao tecido adiposo. **Conclusões:** A dor lombar parece estar associada à composição corporal e desvios posturais, enquanto os tecidos musculoesquelético e adiposo são fatores protetores e de risco para dor lombar, respectivamente, em trabalhadores rurais.

Palavras-chave: saúde rural; saúde ocupacional; dor lombar; composição corporal; postura.

INTRODUCTION

In Brazil, approximately 18% of the workers work in the countryside.[1] Rural workers' health status is directly or indirectly influenced by factors that include working conditions, lifestyle, diet, and social relationships.[2] Also, behavioral factors of the rural population are correlated with lower income and education levels.[3] In agriculture, care for the work environment and its optimization is little observed due to the fragmented nature of this activity, the reduced possibilities of this population's collective organization, and it is also related to the large territory in which the production units are located.[4]

Hard work in the countryside can lead to the onset of pain conditions, which in turn trigger different degrees of labor reduction and musculoskeletal disorders.[5] Low back pain (LBP) (i.e., acute or chronic pain in the lumbar or sacral regions) is one of the most common musculoskeletal disorders that lead to inactivity, postural disorders, and muscle dysfunctions, which can result in disability, reduced quality of life and loss of productivity at work.[6] In rural workers, LBP is the most commonly reported complaint, having significant consequences on both the clinical and economic status of these individuals.[7]

There is an increasing prevalence of LBP in Brazil, which has shown a 79% increase in the total number of years lived with disability since 1990.[8] In rural workers, the annual prevalence of LBP reaches 74% in Nigeria,[9] 58% in Canada,[7] and 56% in Thai,[10] however, in Brazilian workers the evidence is scarce. When compared to workers from other economic sectors, rural workers demonstrate greater exposure to LBP's risk factors,[7] and have a longer time off work due to LBP,[8] since work in the countryside consists of strenuous tasks and many manual demands,[11] such as exposure to vibrations; trunk flexion and rotational movements performed repeatedly; and lifting/carrying high loads at heights above the shoulder joint.[6,10]

The presence of LBP contributes to physical inactivity and decreased muscle mass and strength.[12] The lack of physical activities contributes to the development of obesity, which is considered public health trouble.[12,13] Previous evidences[12,14] suggested that individuals with increased body fat levels tended to have an increased risk of LBP development. Thus, obesity seems to be associated with the development of LBP,[13] since abdominal fat causes mechanical demands in this region due to excessive load, generating structural changes and painful conditions.[15] Due to its multifactorial character, obesity may be related to chronic diseases, postural inadequacies related to the work environment, inactivity, and biomechanical issues.[16]

Thus, knowing the role and relationship of these factors can help to develop strategies to reduce the emergence of LBP and time off work in rural workers.

Considering the aspects addressed, the limited number of available studies in the rural workers' health area, and understanding the importance of musculoskeletal disorders in this population,[11] this study aimed to analyze the presence of LBP and its relationship with body composition, flexibility, and postural deviations in rural workers.

MATERIALS AND METHODS

Participants

To participate in the study, the subjects should meet the following inclusion criteria: a) rural producers; b) age equal to or older than 18 years old; c) present the necessary physical conditions to perform the proposed tests. The following exclusion criteria were considered: a) presented any pathology that could make it impossible to perform the tests. Fifty-five rural workers (25 men and 30 women) from the cities in the southern microregion of the Vale do Rio Pardo Regional Development Council (composed of 23 municipalities in the central-west region of the state of Rio Grande do Sul – Brazil) participated in this study. All participants met the inclusion criteria, were informed about the study, and gave written consent to participate. This study was approved by the institutional Research and Ethics Committee (Number 1.337.659; CAAE 50617815.6.0000.5343).

Study design

From the lifestyle questionnaire,[17] sociodemographic variables and the presence of LBP were investigated, with workers being dichotomized and grouped according to the presence (LBPG), or symptoms' absence (NLBP). To assess pain perception, the Visual Analog Pain Scale (VAS) was used, which consists of levels stratified from 0-10, with zero was no pain and ten corresponds the maximum of pain perception experienced by the participants, which is self-reported and classified as: 1-3 as "mild", 4-7 "moderate", and 8-10 as "intense".[18] Soon after, assessments of body composition (anthropometry and bioimpedance analysis), lumbar region's flexibility (sit and reach test), and posture (New York test) were performed with each participant.

Body composition's assessment

In the anthropometric assessment, the following variables were used: body mass and height, estimating the body mass index (BMI), as well as bone mass (BM), lean body mass (LBM), and muscle mass (MM). The body composition assessment was also performed using a bioimpedance device (In-Body 720; Biospace, Seoul, South Korea) considering the variables of body fat mass (BIA_{BFM}), skeletal muscle mass (BIA_{SMM}), percentage of body fat (BIA_{BF}), and visceral fat area (VFA).

Functional parameters' assessment

The lumbar region's flexibility was assessed from the sit and reach test (SST), using the Wells bench in which the total distance reached represents the final score, with three reaching attempts performed. The highest result among the three attempts was considered for the analyses. The results of performance on the SST were stratified according to the participants' gender, and classified by the following categories: below average; average; and above average.[19]

Postural deviations were identified by photogrammetry, from the New York Test (NYT).[20] For this purpose, Nikon digital camera model D3000 was used, with a VIVITAR-series "63.7" tripod. The camera was positioned on the tripod and placed at a distance of 3m, with a height of 1.1m, recording the participant in the posterior and lateral views. Considered an objective method for postural assessment, six segments in the posterior plane (head, shoulders, spine, hip, feet, and plantar arch) and seven segments in the lateral plane (neck, chest, shoulders, thoracic spine, trunk, and pelvis, lumbosacral spine, and abdomen).

The scores determined to classify the deviations observed during the NYT were: scores of 5.0 points for the normal pattern; 3.0 points for moderate postural deviation; and 1.0 point for severe postural deviation in each segment. The postural classification was obtained by summing the items and considered "normal posture" as scores between 56-65 points; "moderate deviation" between 40-55 points; and "severe postural deviation" up to 39 points.[21]

Statistical analysis

Data processing and statistical analysis were performed using SPSS 23.0 (IBM Corporation, Armonk, NY, USA). Descriptive analysis was performed using frequencies and percentages, mean and standard deviation. To test the data's normality, the Shapiro-Wilk test was used. To compare the body composition parameters and the values obtained in the SST and NYT between groups, Student's t-test was used for independent samples for parametric variables, and the Mann-Whitney's U test for non-parametric variables, considering a significance level of $\alpha \leq 0.05$. To compare the grouping of variables, principal components analysis was used, in which the method used for the analysis was the Varimax rotation, with self-scaling per variable, Kaiser-Meyer-Olkin (KMO) normalization test per sample, in that values obtained between 0.5 and 1.0 indicate that the factor analysis is adequate, and ≤ 0.05 in Bartlett's sphericity test so that we can perform the principal components analysis.

Models were created considering the NLBP and LBPG (KMO = 0.554; KMO = 0.528 respectively and Barlett's sphericity test < 0.001 for both) taking into account a factor loading ≤ 0.40 for the grouping of variables, in which each component (factor) has an explained variation of LBP and the greater the explained variation, higher is the association between the variables and outcomes.

RESULTS

In the evaluated rural workers, it was observed that most of these are between socioeconomic classes C1 and B2 (92.7%). Concerning the classification by length of work, 40% of the participants have less than 20 years of work and 60% over 20 years in this business. Regarding the BMI, LBPG presents 29.7% of obese participants versus 5.6% of the NLBP. The VFA is high in 54.1% of LBPG and 33.3% in NLBP. The prevalence of LBP was 67.2% in rural workers, and of these, most (91.9%) had moderate pain. Regarding flexibility, when the classifications of "average" and "above average" were analyzed together, the results are similar in both groups. In addition, 94.6% of the participants in the LBPG present postural deviations (Table 1).

Table 1. Demographic and general information of the included rural workers

Variables		NLBP n (%)	LBPG n (%)	Total n (%)
Sex	Male	8 (44.4)	17 (45.9)	25 (45.5)
	Female	10 (55.6)	20 (54.1)	30 (54.5)
Socioeconomic class	C2	2 (11.1)	2 (5.4)	4 (7.3)
	C1	13 (72.2)	14 (37.8)	27 (49.1)
	B2	3 (16.7)	21 (56.8)	24 (43.6)
Working time	<20 years	8 (44.4)	14 (37.8)	22 (40.0)
	>20 years	10 (55.6)	23 (62.2)	33 (60.0)
Age group	<40	4 (22.5)	8 (21.6)	12 (21.8)
	40-49	5 (27.8)	13 (35.1)	18 (32.7)
	50-60	6 (33.3)	8 (21.6)	14 (25.5)
	>60	3 (16.7)	8 (21.6)	11 (20.0)
BMI	Recommended	7 (38.9)	12 (32.4)	19 (34.5)
	Overweight	10 (55.6)	14 (37.8)	24 (43.6)
	Obesity	1 (5.6)	11 (29.7)	12 (21.8)
VFA*	Normal	12 (66.7)	16 (43.2)	28 (50.9)
	High	6 (33.3)	20 (54.1)	26 (47.3)
AVS	Painless	18 (100.0)	-	18 (32.7)
	Light	-	1 (2.7)	1 (1.8)
	Moderate	-	34 (91.9)	34 (61.8)
	Intense	-	2 (5.4)	2 (3.6)
SST	Above average	13 (72.2)	19 (51.3)	32 (58.2)
	Average	1 (5.6)	10 (27.0)	11 (20.0)
	Below average	4 (22.2)	8 (21.6)	12 (21.8)
NYT	Normal	4 (22.2)	2 (5.4)	6 (10.9)
	Moderate deviations	10 (56.6)	28 (75.7)	38 (69.1)
	Severe deviations	4 (22.2)	7 (18.9)	11 (20.0)
	Total	18 (100.0)	37 (100.0)	55 (100.0)

AVS: analogic visual scale; BMI: body mass index; NYT: New York test; SST: sit and reach test; VFA: visceral fat area; *1 female missing.

Table 2 shows the results related to the comparison in body composition, flexibility levels, and postural deviation between the LBPG and NLBP. No differences were found between groups in all parameters evaluated ($p > 0.05$).

Table 2. Comparison of body composition parameters, flexibility levels and postural deviations between NLBP and LBPG

Variables	NLBP	LBPG	p
BM (Kg)	10.35±1.99	11.11±1.66	0.127
LBM (Kg)	54.89±10.79	58.84±10.59	0.857
MM (Kg)	26.89±6.78	28.20±6.41	0.477
BFM (Kg)	18.34±4.45	22.20±8.35	0.197
BIA_{SMM} (Kg)	29.92±7.06	31.55±6.80	0.579
BIA_{BFM} (Kg)	19.61±6.78	24.67±12.04	0.233
BIA_{BF} (%)	26.98±8.86	30.02±10.77	0.244
VFA (cm²)	86.91±29.15	107.83±44.23	0.090
SST (cm)	28.09±7.83	25.30±8.89	0.351
NYT (score)	48.22±7.39	45.94±6.21	0.238

Data expressed as mean ± standard deviation. BFM: body fat mass; BIA_{BF}: bioimpedance body fat percentage; BIA_{BFM}: bioimpedance body fat mass; BIA_{SMM}: bioimpedance skeletal muscle mass; BM: bone mass; LBM: lean body mass; MM: muscle mass; NYT: New York test; SST: sit and reach test; VFA: visceral fat area. cm: centimeters; cm²: square centimeters; Kg: kilogram; *significance difference p ≤ 0.05.

Considering the greater number of obese participants in the LBPG, the principal components analysis was performed (Table 3).

Table 3. Analysis of principal components of body composition parameters, levels of flexibility and postural deviations of NLBP and LBPG

Variables	NLBP		LBPG		
	Factor-1	**Factor-2**	**Factor-1**	**Factor-2**	**Factor-3**
BM (Kg)	**0,878**	0,115	-0,053	**0,909**	-0,153
LBM (Kg)	**0,981**	0,033	0,188	**0,975**	-0,021
MM (Kg)	**0,928**	-0,132	-0,05	**0,961**	0,050
BFM (Kg)	-0,011	**0,87**	**0,956**	0,081	-0,115
BIA_{MME} (Kg)	**0,950**	-0,224	-0,185	**0,949**	-0,045
BIA_{BFM} (Kg)	-0,077	**0,984**	**0,99**	0,021	-0,060
BIA_{BF} (%)	**-0,47**	**0,872**	**0,926**	-0,337	-0,047
VFA (cm²)	0,044	**0,982**	**0,949**	0,042	-0,063
SST (cm)	**-0,413**	0,081	0,024	-0,3	**0,759**
NYT (score)	0,034	**-0,594**	-0,209	0,17	**0,81**
Explained variation (%)	46,02	31,87	41,52	36,35	11,86
Accumulated variation (%)	46,02	77,89	41,52	77,87	89,73

BFM: body fat mass; BIA_{BF}: bioimpedance body fat percentage; BIA_{BFM}: bioimpedance body fat mass; BIA_{SMM}: bioimpedance skeletal muscle mass; BM: bone mass; LBM: lean body mass; MM: muscle mass; NYT: New York test; SST: sit and reach test; VFA: visceral fat area. cm: centimeters; cm²: square centimeters; Kg: kilogram. Principal component analysis; Varimax rotation method with Kaiser normalization; Numbers in bold represent variables with factor loading >0.4.

The principal components analysis formed different groups of variables, grouping the NLBP into two factors representing 77.89% of the model, containing the variables BM, LBM, MM, and SMM, with a positive relationship and the BIA_{BF} with a negative relationship in factor-1; the variables BFM, BIA_{BFM}, and VFA were related to factor-2, in which the BIA_{BF} appears again with a positive association; lumbar region's flexibility and postural deviations were negatively related to 1 and 2 factors (respectively). While in the LBPG, the grouping occurred in three factors representing 89.73% of the model. In this, the variables were grouped differently when compared to the NLBP, because in factor-1 the grouping was: BFM, BIA_{BFM}, BIA_{BF}, and VFA; while in factor-2: BM, LBM, MM, and SSM; and factor-3: lumbar region's flexibility and postural deviations. In the principal component analysis' diagrams (Figure 1), the groups' information can be observed.

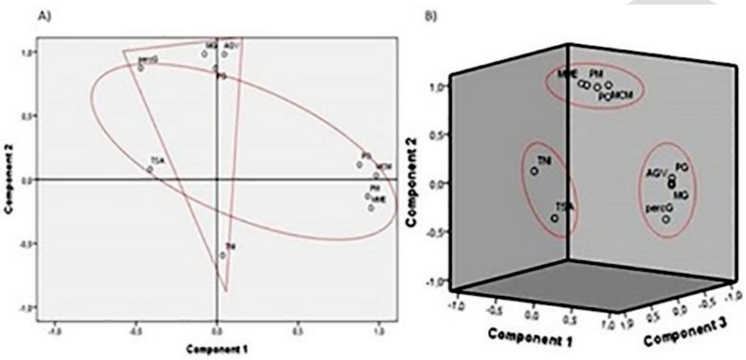

Figure 1. Principal component analysis' diagrams with the groups' information.

DISCUSSION

This study aimed to investigate the relationships between LBP symptoms and the body composition, flexibility, and postural deviations in rural workers. Regarding body composition, LBPG presented greater obesity rates and VFA values than the NLBP group. About the prevalence of LBP in rural workers, most of the participants had pain symptoms and showed postural deviations. Principal components analysis showed that NLBP was mainly related to the amount of muscle tissue, while the LBPG was to the adipose tissue.

Association between obesity and pain has already been discussed, as in the study by Deere et al.,[22] in which is essential that obesity can represent an important risk factor for the occurrence and persistence of musculoskeletal pain in young adults. Stone & Broderick[23] found a relationship between level III obesity and pain reported by individuals. In the same direction, Shiri et al.[24] found that obese and physically inactive individuals would be more likely to develop LBP. A recent systematic review[14] suggests that excess body fat mass is the essence of the process to develop symptoms of LBP, regardless of whether the BMI is considered normal. Furthermore, with increasing body fat mass, the risk of developing LBP increases by approximately 20%.[14]

The increase in fat mass, especially the fat located in the abdominal region, would increase the gravitational load on the spine, and the constant stress can induce structural changes in the intervertebral discs, resulting in local pain in the lower back.[14,15] In addition to the biomechanical point of view, it is possible that adipose tissues, which are metabolically active, may release a large number of pro-inflammatory cytokines and substances related to metabolism, which may lead to LBP from the nerve ingrowth or neovascularization.[14]

Regarding the prevalence of LBP in rural workers, we observed that more than half of the evaluated participants had pain. These results are close to those found by Tella et al.,[9] in which the rate obtained was 74% in Nigerian workers. Other studies obtained lower values, such as those by McMillan et al.[7] and Udom et al.[10] who found an annual prevalence of 58% in Canada, and 56% in Thai rural workers, respectively. Although exposure to factors related to physical work can contribute to the development of LBP, there seems to be no consensus on the body's mechanical and physiological responses to the various types of agricultural tasks found in the routine of these workers, but is possible that high or low levels of capacity could influence the development of pain symptoms.[7]

Another highlight of our study is that most participants had pain symptoms and had postural deviations. Considering that different degrees of functional incapacity can occur due to musculoskeletal disorders, which can cause illness and the worker's withdrawal from their work activities. Since several musculoskeletal disorders can be detected, analysis of static posture is one of the steps in preparing exercise-based interventions to correct postural dysfunctions.[25] Thus, our findings demonstrate the importance of identifying dysfunctions through postural assessment.

Our principal components analysis allowed us to observe that the grouping of variables was different between the two groups, as for the NLBP, in factor-1, the variables BM, LBM, MM, and SSM were positively related, demonstrating that a better musculoskeletal condition may be associated with the absence of LBP. This fact may be associated with the balance of body structures, maintained by the musculoskeletal system during a specific activity,[26] and correct posture, which are important factors in preventing injuries caused by improperly performed activities.[27] Trunk muscles, for example, play a very important role in supporting the spinal column, therefore, lower levels of muscle mass in the trunk region could increase the risk of developing LBP due to a possible sagittal imbalance of the spine.[28]

Our analyzes also showed a negative relationship between the BIA_{BF} and the lumbar region's flexibility, suggesting that the decreases in fat mass can be a protective factor for pain in the lumbar spine, once, as mentioned earlier, when located in the region abdominal, the fat mass can cause additional structural overload in the lower back.[14,15] About flexibility, most individuals presented above average rating levels,[19] which could be a positive factor against LBP symptoms, once restricted flexibility of posterior chain muscles (e.g., lower back and hamstring muscles) has been linked to reduced lumbar lordosis, which in turn is associated with increased risk of developing LBP.[29]

Factor-2 grouped positively the variables referring to adipose tissue (i.e., BFM, BIA_{BFM}, BIA_{BF}, and VFA), and negatively the postural deviations, suggesting that posture influences the presence of pain symptoms. The two components formed for this model explain 77.89% of this association.

The variables of the LBPG were grouped differently, with the formation of three components explaining 89.73% of the model, and these were grouped as follows: in factor-1, body composition parameters referring to the adipose tissue (i.e., BFM, BIA_{BFM}, BIA_{BF}, and VFA); factor-2, variables related to the musculoskeletal system (i.e., BM, LBM, MM, and SSM); and finally, factor-3 grouped the lumbar region's flexibility and postural deviations.

In summary, the groups were similar regarding the assessed parameters, however, the principal components analysis allowed us to observe that the variables related to adipose tissue were found in factor-1, presenting a possible association with the presence of LBP in the rural workers. Our findings bring new information about the health of rural workers, reinforcing that obesity, as well as pain conditions and their characteristics, must be constantly focused themes, in the search for preventive measures together to this population.[30] Thus, this study contributes so that professionals who deal with this symptomatology can broaden their approach, focusing on aspects related to the work process, as well as the rural workers' health and lifestyle. New studies of high methodological quality are needed to establish new relationships since both LBP and obesity are considered public health problems.

CONCLUSIONS

The LBP appears to be associated with body composition and postural deviations in rural workers. A high percentage of rural workers with LBP have some level of obesity, accompanied by postural dysfunctions, while flexibility was not associated with the presence of the symptoms. In addition, the evaluated parameters' grouping indicated that musculoskeletal tissue volume may be a protective factor for LBP symptoms, while excess adipose tissue seems to increase exposure to these symptoms.

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