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Original Article

Efficacy of Bioelectrical Impedance Analysis for the Evaluation of Physical Impairment in Chronic Low Back Pain. Results from a Cohort Study

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Abstract

Introduction: Determining the effect of body composition on chronic low back pain seems to have the potential to improve our understanding of its mechanism and to develop novel preventive and therapeutic approaches.

Aim: The purpose of the present study was to assess by electrical impedance the composition of lower extremities of individuals with chronic low back pain.

Materials and methods: One hundred and twenty-one adult participants with diagnosed chronic low back pain were recruited in this study. The study activities were divided into three phases: phase 1 – self-administered questionnaires, phase 2 – biomedical examination (including anthropometric measurements and physical function performance tests), and phase 3 – bioimpedance analysis.

Results: Our results showed that chronic low back pain differentiates the circumference of thigh and calf of the symptomatic leg. Besides, patients experience pain also in hip, thigh, and calf, which act as a barrier to patient's personal, professional, social, and recreational activities. Furthermore, patients appear with 'unstable' walking, reduced balance, and reduced general physical condition that affect all of the neuromuscular structures of the locomotor system. Interestingly, patients seem to be characterized by a tendency to deposit fat and to decrease muscle mass in the symptomatic limb regardless of the gender.

Conclusions: In the present study, we determine the profile of a patient with chronic low back pain through a variety of measurements. Chronic low back pain causes several structural changes to the symptomatic leg of the patients leading to 'unstable' walking, reduced balance, and reduced general physical condition. It is clear that further studies using bioimpedance analysis are needed to address the concerns raised by investigating a multifactorial condition such as chronic low back pain.

Keywords

bioimpedance analysis, body composition, low back pain

INTRODUCTION

Chronic back pain is one of the major challenging health problems in Western societies[1] and the leading cause of disability and productivity loss worldwide with a lifetime prevalence of up to 84% for the adult patient population.[2] Due to its high prevalence, lower back pain has a major impact on the health care system; annually, the total cost of back pain worldwide is estimated at about billions of dollars.[3] In addition to pain and disability, high muscle tension, low self-efficacy, and depression are common side effects of chronic back pain.[4] Hence, it appears essential to identify effective and economical prevention options and treatments for chronic back pain and associated impairments.

Bioelectrical impedance analysis (BIA) is an easy and non-invasive method for assessing body composition, in particular fat-free mass, body fat, body cell mass, total body water, extracellular water, and intracellular water from electrical resistance.[5] BIA assesses the different body composition parameters by assessing the difference of impedance of each component of the body[5] in a relatively inexpensive way. BIA is reported as a favourable alternative to dual energy X-ray absorptiometry as a screening tool for sarcopenia and osteoporosis among patients with low back pain.[6] Also, in a recent study, BIA was found to be beneficial for measuring trunk muscle mass in patients with low back pain.[7]

Changes in body composition, especially in muscle and fat mass have been associated with several health problems. It is well known that there are negative effects of excess adiposity on movement patterns and on body structure.[8] On the contrary, increased fat mass is associated with high levels of low back pain intensity and disability.[9] Similarly, greater fat mass and attenuated muscle mass as body composition factors were associated with chronic low back pain.[10] Recently, in a large cohort of participants with low back pain, it has been reported that fat mass and distribution are associated with low back pain intensity and disability, suggesting that systemic metabolic factors associated with adiposity play a significant role in the pathogenesis of low back pain.[11]

Determining the effect of body composition on chronic low back pain seems to have the potential to improve our understanding of its mechanism and consequently, clarifying such mechanisms, will facilitate the developing of novel preventive and therapeutic approaches.

AIM

The main aim of the present study was to assess by electrical impedance the composition of lower extremities of individuals with chronic low back pain, in relation to anthropometric measurements, clinical examination and physical function performance tests.

MATERIALS AND METHODS

Ethical statement

This research was approved by the IRB of the authors' affiliated institutions. Each participant provided his/her verbal and written informed consents to participate in this study. Each informed consent was ensured through the appropriate information about the purpose and nature of the study as well as its consequences, benefits, and possible risks.

Study subjects

One hundred and twenty-one adult participants (40 males and 81 females), with diagnosed chronic low back pain (with an average of 3-year symptoms) were recruited in this study. The study occurred over a 12-month period between March 2017 and March 2018. The inclusion criterion was patients with persisting low back pain for at least 3 months; the exclusion criteria were: (1) patients diagnosed with large lumbar disc herniation or lumbar spinal stenosis confirmed by magnetic resonance imaging (MRI); (2) patients with difficulty standing upright because of pain, paralysis, or spinal kyphosis; (3) patients with cardiac pacemaker; and (4) patients undergone spine surgery and with artificial joints/spinal implants in the limbs and trunk.

The study activities were divided into three phases: phase 1 – the self-administered questionnaires, phase 2 – the biomedical examination, and phase 3 – the bioimpedance analysis.

Self-administered questionnaires

Demographic data including age (date of birth) and gender were collected by interview, whereas height, weight, and BMI were measured. Afterwards, patients completed two self-administered pain questionnaires. Firstly, a Body Pain Chart **(Fig. 1)** similar to the McGill pain questionnaire[12] (Questionnaire 1a) was used to determine the site of pain. Specifically, an outline of the human body on both sides with numerical labels for all the body parts was administered to patients. Secondly, a Pain Quality Questionnaire (Questionnaire 1b) was administered to patients. This questionnaire included 6 categories of questions regarding pain quality, deteriorating factors, relieving factors, 24-h pain behaviour, other symptoms and other musculoskeletal problems. Lastly, the Greek FES-I questionnaire[13] (Questionnaire 2) which measures the quality of life in daily activities was used. This questionnaire included 16 questions about the quality of life of a patient with chronic low back pain, such as his reflection on his daily activities and his behavior in motor activities.

Although the questionnaires were basically in a self-administered mode, a trained physiotherapist and a biologist were present to ensure standardization during the process.

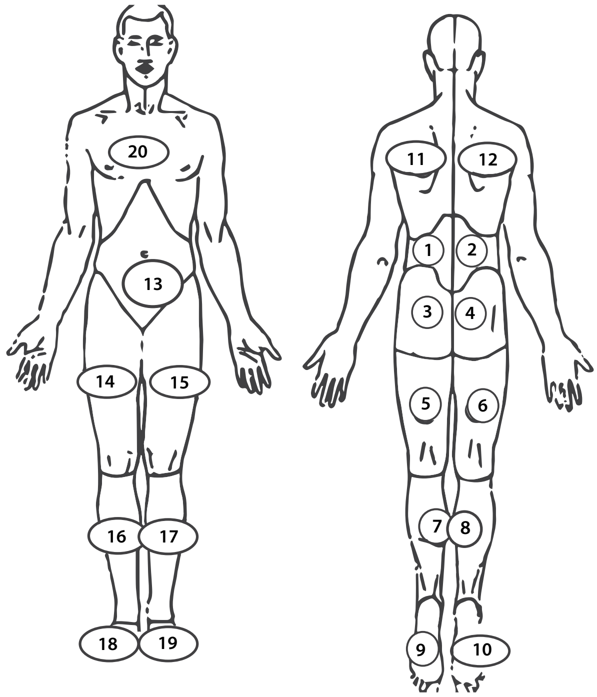

Figure 1. Body Pain Chart used in the study.

Biomedical examination

Biomedical examination included anthropometric measurements, clinical examination and physical function performance tests.

All anthropometric measurements were taken by a trained physiotherapist following standard techniques.[14] Height was measured without shoes using a digital mobile stadiometer (Seca, Hamburg, Germany). Weight was measured without shoes and in light clothing using an electronic scale (Kern&Sohn, Balingen, Germany). BMI was calculated using the standard formula: weight in kilograms divided by height in meters squared. Waist, thigh and calf circumference, and pelvic width were measured using a standard measuring tape.

Clinical examination determined the standing position, type of walking, and the pain provoking movements of the patients. In specific, posture deformities were evaluated and the standing position was characterized as normal, scoliotic, lordotic, or kyphotic. Also, movement testing included forward flexion, extension, and side flexion of the lumbar spine. Walking was determined as normal or unstable. Moreover, ability of walking on heels and on tiptoe was examined.

Furthermore, three physical function performance tests were chosen to assess the functional capacity of participants: a) the 30-second sit-to-stand test[15], b) the single limb stance test[16], and c) the timed up and go (TUG) test[17]. In the 30-second sit-to-stand test the participant was seated with his back straight with one foot slightly in front of the other to help maintain balance. If he had to use his arms to complete the test, he was scored 0. The participant was encouraged to complete as many full stands as possible within 30 seconds. The single limb stance test assesses the ability to stand on one leg as long as possible, as it is important to have a good balance to avoid a fall due to the symptomatic leg. This test is performed for both legs. The TUG test is a simple, easy-to-use functional test that can depict the mobility of patients with chronic low back pain and leg symptoms. All clinical examination and physical function performance tests were performed by trained orthopedics.

Bioimpedance analysis

The Bodystat1500 analyzer (Bodystat Ltd, British Isles) using bioelectrical impedance analysis, assessed body composition parameters, following manufacturer recommendations. Bodystat 1500 complies with all the European and US Medical Device Directives (CE Medical Devices Directive [CE 120], FDA).The subjects stood on the platform, body composition parameters were automatically calculated by flowing weak currents at 50 kHz frequency using 2 electrodes for each side, one for the sole and one for the grip in standing barefoot position, and determining the difference in electric resistance. The analysis time is less than 20 seconds. Body composition parameters including fat mass (FM), fat free mass (FFM), total body muscle mass (kg), total body fat mass (kg), total body water (kg) and basal metabolic rate (BMR) were directly calculated by Bodystat. The body weight was also measured by this device to the closest 100 g and a maximum weight of 300 kg. All measurements were taken in accordance with the recommended guidelines.

Statistical analysis

T-test for paired samples was used to evaluate the difference in characteristics between symptomatic and asymptomatic legs. All continuous variables were expressed as mean±SD and categorical variables were shown as absolute and relative (percentage) frequencies. For all tests performed, statistical significance was set at two-sided p value <0.05. Statistical analysis was carried out with the SPSS version 21.0 statistical software package for Windows (IBM – SPSS Inc., USA).

RESULTS

Forty male and eighty-one female patients (mean age 56±17 years) with diagnosed chronic low back pain participated in our study. Of the 81 female patients, 65.4% had the left leg as symptomatic and of the 40 male patients, 90% had the left leg as symptomatic. A statistically significant increase in the circumference of the symptomatic leg's thigh was observed in relation to the asymptomatic (symptomatic thigh 0.52±0.06 cm vs. asymptomatic thigh: 0.51±0.06 cm, p<0.001). Furthermore, a statistically significant increase in the circumference of the symptomatic leg's calf was observed in relation to the asymptomatic (symptomatic calf 0.37±0.03 cm vs. asymptomatic calf 0.36±0.03 cm, $p<0.001$).

During clinical examination, the standing position, the walking and the pain reproduction in active lumbar spine movements were also evaluated. Regarding the standing position, 47.1% of patients presented with lordosis, 66.9% – with scoliosis, and 13.2% – with kyphosis. All patients' walking was found to be 'unstable' in a way. 93.4% of patients experienced difficulty to walk on heels and 100.0% to walk on tiptoes. Furthermore, as far as movement testing is concerned, 93.4% of patients were feeling pain during flexion, 52.9% in extension, 73.6% in left lateral flexion, and 33.1% in right lateral flexion.

The majority of patients pointed that pain in lumbar spine was the primary cause of their pain symptoms **(Table 1)**. In specific, they developed persistent pain on the side where the cause initially began. The hip, thigh, calf, and toes of the symptomatic leg were found to be prolonged pain points of the disease but with different rates of symptoms in the general set of patients. Also, it was found that in other areas beyond the main symptomatology of the disease such as the upper body parts (neck, shoulders, chest, and abdomen) the pain was absent.

Regarding the quality of pain, the majority of patients characterized their pain as intense or deep **(Table 2)**. The most deteriorating factors for low back pain were found to be the walking and the standing. Whereas, the vast majority of patients felt relieved from low back pain when lying down. Regarding other musculoskeletal problems, it was found that deformations such as scoliosis, lordosis or kyphosis were present in 73.6% of patients.

The main finding of Questionnaire 2 is that pain and the related severe symptoms in both the lumbar spine and the symptomatic leg act as a barrier to the various personal, professional, social and leisure activities of the patients **(Table 3)**.

Limb stance test was applied to both symptomatic and asymptomatic legs. Analysis of the time measurements showed a statistically significant decrease in symptomatic leg's time in relation to the asymptomatic leg (24.07±11.37 and 30.43±11.72 seconds, respectively, $p<0.001$). TUG revealed that patients with chronic low back pain had a statistically significant increase in their running time (18.00±4.71 s) compared to the suggested time scale of the test itself (7-10 s) ($p<0.001$). In the 30-second sit-to-stand test, the majority of patients (56.2%) achieved 6 or more successful repeats. Following, 27.3% of patients achieved 5 repeats and 16.5% achieved 4 repeats. It is also interesting that none of the patients achieved less than three repeats.

Analysis of bioelectric impedance results showed statistically significant changes in body composition between the symptomatic and asymptomatic leg **(Table 4)**. In specific, the mean percent of fat in the symptomatic leg was 29.85±9.51% and in asymptomatic leg 28.73±9.21%,

Table 1. Questionnaire 1a: Body Pain Chart results

Body sites	N	Men (n=40)	Women (n=81)	*p*-value
Site 1: Left lumbar spine	89 (73.6)	36 (90.0)	53 (65.4)	0.004
Site 2: Right lumbar spine	44 (36.4)	4 (10)	40 (49.4)	<0.001
Site 3: Left hip	81 (66.9)	32 (80.0)	49 (60.5)	0.032
Site 4: Right hip	28 (23.1)	4 (10.0)	24 (29.6)	0.016
Site 5: Left posterior thigh	45 (37.2)	8 (20.0)	37 (45.7)	0.006
Site 6: Right posterior thigh	16 (13.2)	4 (10.0)	12 (14.8)	0.462
Site 7: Left calf	49 (40.5)	16 (40.0)	33 (40.7)	0.938
Site 8: Right calf	20 (16.5)	0 (0.0)	20 (24.7)	0.001
Site 9: Left foot	17 (14.0)	8 (20.0)	9 (11.1)	0.186
Site 10: Right foot	4 (3.3)	4 (10.0)	0 (0.0)	0.004
Site 11: Left shoulder	0 (0.0)	0 (0.0)	0 (0.0)	-
Site 12: Right shoulder	0 (0.0)	0 (0.0)	0 (0.0)	-
Site 13: Abdomen	0 (0.0)	0 (0.0)	0 (0.0)	-
Site 14: Left quadriceps	4 (3.3)	0 (0.0)	4 (4.9)	0.153
Site 15: Right quadriceps	28 (23.1)	4 (10.0)	14 (29.6)	0.016
Site 16: Left anterior tibialis	24 (19.8)	8 (20.0)	16 (19.8)	0.974
Site 17: Right anterior tibialis	13 (10.7)	4 (10.0)	9 (11.1)	0.853
Site 18: Left foot fingers (toes)	16 (13.2)	8 (20.0)	8 (9.9)	0.122
Site 19: Right foot fingers (toes)	16 (13.2)	8 (20.0)	8 (9.9)	0.122
Site 20: Chest, thorax	0 (0.0)	0 (0.0)	0 (0.0)	-

Table 2. Questionnaire 1b: Pain Quality Questionnaire results

	Answers	Results (n=121)
Question 1 Quality of pain **A.** How do you describe your pain in lumbar spine?	Hazy	0 (0.0)
	Intense	44 (36.4)
	Superficial	0 (0.0)
	Deep	65 (53.7)
	Sharp	12 (9.9)
	Diffuse	0 (0.0)
	Located	0 (0.0)
B. How do you describe your pain in symptomatic leg?	Burning	8 (6.6)
	Numb	53 (43.8)
	Sharp	0 (0.0)
	Shooting	0 (0.0)
	Pulsing	0 (0.0)
	As electrical current	60 (49.6)
Question 2 Deteriorating factors What aggravates your pain?	Bending	12 (9.9)
	Raising	0 (0.0)
	Sitting	0 (0.0)
	Standing	45 (37.2)
	Walking	64 (52.9)
	Lying	0 (0.0)
	Immobility	0 (0.0)
	Movement	0 (0.0)
Question 3 Relieving factors What relieves your pain?	Bending	0 (0.0)
	Raising	0 (0.0)
	Sitting	0 (0.0)
	Standing	0 (0.0)
	Walking	0 (0.0)
	Lying	113 (93.4)
	Immobility	8 (6.6)
	Movement	0 (0.0)
Question 4 24-h behavior of pain When do you feel intense pain?	Wakes me up at night	32 (26.4)
	When falling asleep	45 (37.2)
	Worst in the morning	40 (33.1)
	Worst at night	4 (3.3)
Question 5 Other symptoms	Stiffness / Spasms	77 (63.6)
	Cramps / Crawling Legs	44 (36.4)
Question 6 Other musculoskeletal problems	Deformation (Scoliosis/Lordosis/Kyphosis)	89 (73.6)
	Neck pain	24 (19.8)
	Leg discrepancy	8 (6.6)

respectively ($p<0.001$). The mean fat mass of the symptomatic leg was 22.13±7.89 kg and of the asymptomatic leg was 21.31±7.62 kg. ($p<0.001$). The mean percent of water on the symptomatic leg was 54.15±6.86% while on the asymptomatic leg 55.17±6.53% ($p<0.001$). Finally, bioelectric impedance conductivity of the symptomatic leg was found to be 499.11±90.96 S, while on the asymptomatic leg it was 478.22±93.26 S ($p<0.001$).

DISCUSSION

In the present study, an attempt was made to map the symptoms of chronic low back pain but also to photograph the status of the patient with the changes of this chronic disease. For this reason, we conducted questionnaires for recording the progress of the pain and the patient's quality of life, clinical assessment, physical function performance tests, and the measurement of biochemical changes in body composition by electrical bioimpedance analysis. To our knowledge, this is the first study to assess all the above-mentioned parameters together.

The most common symptom of low back pain is pain in the lumbar spine, which extends to the hip, buttocks, and along the symptomatic leg.[18] Our results from the body chart (Questionnaire 1a) showed that the vast

Table 3. Questionnaire 2: The Greek FES-I questionnaire results

How much chronic back pain bothers you…					
Question 1 When doing the housework?	Not at all	0 (0.0)	**Question 9** When trying to reach something high?	Not at all	0 (0.0)
	A little	4 (3.3)		A little	20 (16.5)
	Quite a lot	20 (16.5)		Quite a lot	48 (39.7)
	A lot	97 (80.2)		A lot	53 (43.8)
Question 2 When dressing or undressing?	Not at all	0 (0.0)	**Question 10** When going to answer the phone?	Not at all	0 (0.0)
	A little	24 (19.8)		A little	28 (23.1)
	Quite a lot	48 (39.7)		Quite a lot	60 (49.6)
	A lot	49 (40.5)		A lot	33 (27.3)
Question 3 When preparing food?	Not at all	0 (0.0)	**Question 11** When walking on a slippery surface?	Not at all	0 (0.0)
	A little	52 (43.0)		A little	0 (0.0)
	Quite a lot	65 (53.7)		Quite a lot	12 (9.9)
	A lot	4 (3.3)		A lot	109 (90.1)
Question 4 When taking a bath or shower?	Not at all	8 (6.6)	**Question 12** When visiting a friend?	Not at all	4 (3.3)
	A little	44 (36.4)		A little	20 (16.5)
	Quite a lot	61 (50.4)		Quite a lot	85 (70.2)
	A lot	8 (6.6)		A lot	12 (9.9)
Question 5 When going shopping every day?	Not at all	0 (0.0)	**Question 13** When walking in a crowded place?	Not at all	0 (0.0)
	A little	8 (6.6)		A little	4 (3.3)
	Quite a lot	60 (49.6)		Quite a lot	32 (26.4)
	A lot	53 (43.8)		A lot	85 (70.2)
Question 6 When sitting or raising from a chair?	Not at all	0 (0.0)	**Question 14** When walking on a rough road?	Not at all	0 (0.0)
	A little	20 (16.5)		A little	0 (0.0)
	Quite a lot	48 (39.7)		Quite a lot	4 (3.3)
	A lot	53 (43.8)		A lot	117 (96.7)
Question 7 When going up or down stairs?	Not at all	0 (0.0)	**Question 15** When walking uphill or downhill?	Not at all	0 (0.0)
	A little	0 (0.0)		A little	0 (0.0)
	Quite a lot	40 (33.1)		Quite a lot	0 (0.0)
	A lot	81 (66.9)		A lot	121 (100.0)
Question 8 When walking in the neighbourhood?	Not at all	4 (3.3)	**Question 16** When going to a social event (e.g. Church)?	Not at all	0 (0.0)
	A little	32 (26.4)		A little	12 (9.9)
	Quite a lot	77 (63.6)		Quite a lot	73 (60.3)
	A lot	8 (6.6)		A lot	36 (29.8)

Table 4. Bioimpedance analysis results in all patients

Parameter	Symptomatic leg	Asymptomatic leg	*p*-value
Percent of fat (%)	29.85±9.51	28.73±9.21	<0.001
Fat mass (kg)	22.13±7.89	21.31±7.62	<0.001
Fat free mass (kg)	53.07±13.90	53.61±12.95	<0.001
Dry lean mass (kg)	12.65±4.97	12.42±4.85	0.092
Water (%)	54.15±6.86	55.17±6.53	<0.001
Water (L)	40.50±10.06	41.70±9.90	<0.001
Net muscle mass (kg)	26.26±3.46	26.41±3.44	<0.001
Calories resting (cal)	1634.96±352.48	1652.52±346.37	<0.001
Daily calories need (cal)	2660.76±694.82	2688.0±686.05	<0.001
BMR	21.94±2.86	22.14±2.86	<0.001
Conductivity (S)	499.11±90.96	478.22±93.26	<0.001

BMR: basal metabolic rate

majority of patients felt low back pain in the left side. Also, patients experienced pain not only in the lumbar spine but also mainly in hip, thigh, and calf, while in areas other than the symptomatology of the disease such as the upper body parts (neck, shoulders, chest, and abdomen) pain was absent. These results are consistent with the common symptomatology of low back pain disease.[18,19] According to Questionnaire 1b, our results show that chronic pain and/or neurologic stress, both in the lumbar spine and the sciatic nerve, produced symptoms and each time the mechanical loading was above the limits of tissue strength (in ligaments, muscles, spine joints, etc.) the neurological symptoms (numbness, electricity, etc.) arose as described elsewhere.[19] Questionnaire 2 showed that the symptoms of low back pain determine the pace, intensity and duration of everyday activities. All in all, our results depict that chronic low back pain is a disabling disease which restricts quality of life. Psychological factors may have a larger impact on disability and quality of life than pain itself in accordance with the suggestions of Scolich et al.[4]

The main purpose of clinical examination is to identify the cause of pain, and to check the functionality of the lumbar spine and the symptoms to the lower extremities.[20] Our results revealed that the left, mainly non-dominant, leg is the most frequent symptomatic leg, indicating that as our activities are performed in a specific way, that seems to create the appropriate circumstances for the onset and development of chronic low back pain.

In general, the three physical functional performance tests determined that patients with chronic low back pain have limited mobility in their daily activities, so as reduced balance and strength which appear different between symptomatic and asymptomatic legs. These results depict the feeling of pain whenever the patient attempts to walk even in his daily activities. Patients also reported that the pain and numbness that reaches the toe of the symptomatic leg increases during walking. Our results in TUG test indicated that patients with chronic low back pain have in general impaired physical condition. It was evident that pain restricted their running ability, which forced them to perform slowly and pay greater attention to their lifting and sitting in order to avoid experiencing more pain as it is reported elsewhere.[21] We therefore confirm that the determinant factor of decreased mobility in patients with chronic low back pain is the pain itself and its severity. Results of the 30-second sit-to-stand test revealed that the age, the duration of low back pain and the severe symptoms predetermined the frequency of the repeats achieved in the test. In general, all patients displayed limited mobility of the spine and hips, but it was observed that the majority of them employed various strategies to compensate for it. Consequently, patients with chronic low back pain appear with impaired balance due to the attenuation of the symptomatic leg, to be sluggish due to pain and with reduced general fitness due to the chronic symptoms affecting all the neuromuscular structures of the motor system.[22] Furthermore, patients with chronic low back pain accumulate fat, have reduced muscle mass and lose fluids (body water) on the symptomatic leg. These results are in agreement with previous studies[9,11] suggesting that fat mass and distribution are associated with low back pain intensity and disability, indicating that systemic metabolic factors associated with adiposity play a major role in the pathogenesis of low back pain.

CONCLUSIONS

Chronic low back pain differentiates the circumference of the thigh and the calf of the symptomatic leg with an increased tendency for depositing fat in the symptomatic side (i.e. leg) and for decreasing muscle mass. Patients with chronic low back pain experience pain not only in the lumbar spine but also in hip, thigh, and calf, which act as a barrier to patient's various personal, professional, social, and recreational activities. Chronic low back pain causes several structural changes to the symptomatic leg of the patients leading to 'unstable' walking, reduced balance, and reduced general physical condition. It is clear that further studies using bioimpedance analysis are needed to address the concerns raised by investigating a multifactorial condition such as the chronic low back pain.

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Эффективность анализа биоэлектрического импеданса для оценки физических нарушений при хронической боли в пояснице. Результаты когортного исследования.

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Резюме

Введение: Определение влияния состава тела на хроническую боль в пояснице, по-видимому, может улучшить наше понимание её механизма и разработать новые профилактические и терапевтические подходы.

Цель: Целью настоящего исследования было оценить с помощью электрического импеданса состав нижних конечностей людей с хронической болью в пояснице.

Материалы и методы: В это исследование был отобран 121 взрослый участник с диагностированной хронической болью в пояснице. Исследования были разделены на три фазы: фаза 1 - анкеты для самостоятельного заполнения, фаза 2 - биомедицинское обследование (включая антропометрические измерения и тесты на эффективность физических функций) и фаза 3 - анализ биоимпеданса.

Результаты: Наши результаты показали, что хроническая боль в пояснице различается по окружности бедра и голени симптомной ноги. Кроме того, пациенты также испытывают боль в бедре, бедре и икре, которая препятствует личной, профессиональной, социальной и досуговой деятельности пациента. Кроме того, у пациентов наблюдается нестабильная походка, нарушение равновесия и общее физическое состояние, что влияет на все нервно-мышечные структуры опорно-двигательного аппарата. Интересно отметить, что пациенты имеют тенденцию к накоплению жировой ткани и уменьшению мышечной массы симптоматической конечности независимо от пола.

Заключение: В настоящем исследовании мы построили профиль пациента с хронической болью в пояснице с помощью различных измерений. Хроническая боль в пояснице вызывает несколько структурных изменений симптоматических конечностей пациентов, что приводит к нестабильной походке, ухудшению равновесия и ухудшению общего физического состояния. Очевидно, что необходимы дальнейшие исследования с анализом биоимпеданса для решения проблем, вызванных многофакторным заболеванием, таким как хроническая боль в пояснице.

Ключевые слова

биоимпедансный анализ, состав тела, боль в пояснице