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Effect of strength training and physiotherapy on the morphophysiological aspects and life quality of patients from the Public Healthcare System

Efeito do treinamento de força e fisioterapia sobre parâmetros morfofuncionais e qualidade de vida de pacientes com dor lombar crônica inespecífica do Sistema Único de Saúde (SUS)

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ABSTRACT: *Introduction:* Currently, low back pain is considered one of the main chronic non-communicable diseases that affect society. *Objective:* To analyze the effects of strength training and physiotherapy on the morphophysiological aspects and quality of life of UHS patients with chronic non-specific low back pain. *Methods:* In total, 15 patients of both sexes participated, over the age of 40, attended by the UHS. The volunteers were submitted to an interview and evaluation to identify chronic non-specific low back pain and functional capacity, quality of life, local pain, anthropometry, and strength measurements. Subsequently, the volunteers were allocated to the strength training (8) and physiotherapy (7) groups. *Results:* There was an increase in strength in the lumbar region ($p = 0.006$) and lower limbs (LL) ($p = 0.018$), decreased local pain ($p = 0.009$), improved functional capacity ($p = 0.023$), and reduced limitations due to physical aspects ($p = 0.036$) and due to emotional aspects ($p = 0.015$), in both modalities. *Discussion:* There was a large corroboration between the chosen age group and the age of greatest involvement according to the literature. Regarding the interventions, we identified several morphofunctional benefits, similar to the studies already published. *Conclusion:* Both strength training and conventional physiotherapy provided improvement in chronic low back pain in adult patients treated by the UHS, as well as increasing strength and some domains of quality of life.

Keywords: Low back pain; Physiotherapy; Resistance training.

RESUMO: *Introdução:* Nos últimos anos, a dor lombar é considerada uma das principais doenças crônicas não transmissíveis que acometem a sociedade. *Objetivo:* Analisar os efeitos do treinamento de força e fisioterapia nos aspectos morfofisiológicos e qualidade de vida dos pacientes atendidos pelo Sistema Único de Saúde (UHS) que apresentam dor lombar crônica inespecífica. *Métodos:* Participaram 15 pacientes de ambos em sexos com idade superior a 40 anos, atendidos pelo UHS. Os voluntários foram submetidos a entrevista e avaliação para identificação da dor lombar inespecífica como crônica, capacidade funcional, qualidade de vida, dor local, antropometria e mensuração da força. Posteriormente foram alocados nos grupos de treinamento de força (n=8) e fisioterapia (n=7). *Resultado:* Observou-se aumento de força na região da lombar (p=0,006) e membros inferiores (MMII) (p=0,018), diminuição da dor local (p=0,009), melhora da capacidade funcional (p=0,023), redução das limitações por aspectos físicos (p=0,036) e limitações por aspectos emocionais (p=0,015), em ambas modalidades. *Discussão:* Houve corroboração entre a faixa etária escolhida com a idade de maior acometimento, segundo a literatura. Com relação as intervenções, identificou-se diversos benefícios morfofuncionais, assemelhando-se aos estudos já publicados. *Conclusão:* Sendo assim, tanto o treinamento de força, quanto a fisioterapia convencional, proporcionaram melhora da dor lombar crônica em pacientes adultos atendidos pelo UHS, bem como aumento da qualidade de vida em alguns domínios da qualidade de vida e ganho de força nos MMII e lombar.

Palavras-chave: Dor lombar; Fisioterapia; Treinamento de resistência.

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INTRODUCTION

Various technological and medical advances, among others have brought about greater longevity, with subsequent worldwide population growth. The decrease in the mortality rate has led to the development of greater social vulnerability, associated with the appearance of several non-communicable diseases, with the lumbar region demonstrating the highest prevalence[1].

Low back pain is characterized as a disabling disease, often developed through musculoskeletal disorders, and it usually has a non-specific etiology, making treatment even more difficult and exponentially increasing the ineptitude of the population[2,3].

In western countries, low back pain is considered the main cause of disability and has a worldwide prevalence of 0.5 billion[4]. There has been a 20% increase in the prevalence of low back pain in the last 10 years[5].

According to research, this disorder significantly interferes with the health of the world population, generating alarming values of commitment in countries like Germany, Turkey, France, and the United States, corresponding to 59%, 51%, 55.4%, and 50%, respectively[6-9].

Thus, low back pain is considered to be a major disorder, which interferes with social well-being and represents the main reason for disability in the world. Due to severe discomfort in the affected region, affected individuals subsequently develop a sedentary lifestyle or a drastic decrease in their physical activity routine[10-13].

Epidemiological studies report that factors such as sex, overweight, age, smoking, sleep, and work conditions directly influence the development of this disease and approximately 70-85% of the world population will present low back pain in at least one moment in life[10,14,15].

In parallel, Brazilian studies involving populations with a specific age group, showed that 25% of cases affect the lumbar region of older people over the age of 60 years, characterizing this complication in one in four older people[16].

Based on these statements, the importance of collaborative efforts associated with health is verified, to implement efficient solutions aimed at combating the disability developed by low back pain[17].

In this context, a meta-analysis composed of 76.9% of studies with physical exercise, found positive results when compared to the control group in the treatment of chronic low back pain, demonstrating the benefits of the behavioral factor[18]. Still addressing the benefits of exercise, another meta-analysis composed of 89 studies involving physical exercise as an intervention in patients with chronic low back pain, identified improvement in local pain, physical function, muscle strength, and mental health of the affected individuals[19].

In short, aiming to detail the biomechanical aspects of physical exercise, it was observed that the erector spinae muscles can be worked in an isometric and dynamic way, together with those located in the abdominal region (rectus abdominis, transversus, obliquus internus, and externus), enabling a better quality of life for the affected individuals[15,20,21].

Among the main options, strength training (ST) stands out, as it efficiently works the deep and stabilizing muscles of the trunk[22], improving mental aspects, enhancing local strength, and increasing general functionality[19].

Considering non-pharmacological tools, positive results are also identified in the treatment of low back pain through physiotherapy, demonstrating apparent efficacy even in short periods of intervention [23-25]. In view of this, among the main alterations, the decline in pain associated with physical disability stands out[26].

Therefore, verifying the main institution responsible for dealing with this public is essential. Thus, the Unified Health System (UHS) stands out, since 75% of the population (approximately 157 million people) are served exclusively by the Brazilian public system[27]

Thus, the aim of the present study was to analyze the effects of strength training and physiotherapy on the morphofunctional aspects and quality of life of patients treated by the UHS who have chronic non-specific low back pain.

METHODS

Study location and sample

The current study was approved by the Research Ethics Committee of the Faculty of Health Sciences - (CAAE 08027319.0.0000.5515), adhering to the recommendations in force in the resolution of the National Health Council (CNS). After approval, the volunteers signed an informed consent form.

Regarding the sample number, 15 volunteers participated, of both sexes, who were attended at the sports activities center (CAE) of a university located in the interior of the state of São Paulo, allocated into two modalities (strength training (ST) and conventional physiotherapy) based on their preference, presenting eight and seven patients, respectively. Two weekly interventions were applied, for four weeks, totaling eight interventions.

For the first contact with the sample, one of the researchers involved visited the Basic Health Unit (BHU) closest to the university, where he detailed all the procedures and ethical aspects of the study for the responsible physiotherapist, who provided a list of patients on the waiting list. Subsequently, contact was made through a phone call and, an explanation of all experimental procedures was again provided. All volunteers who agreed to participate came to the agreed place (CAE) to carry out the evaluation and interview.

Inclusion criteria:
- Voluntary participation;
- Aged over 40 years;
- Being a patient of the UHS.

Exclusion criteria:
- Not agreeing with the study procedures;
- Not reaching a minimum attendance frequency of 80% in the sessions.

Data collection instruments

Low Back Pain (*face-to-face*)

The face-to-face questionnaire[28], previously validated for the Portuguese language[29,30], was designed to evaluate musculoskeletal symptoms (pain, tingling or numbness) in different regions of the body (neck, shoulder, upper back, elbows, wrists/hands, lower back, hips/thighs, knees, and ankles/feet). However, in the current study, only the lower back was used as an observation tool. Regarding the functioning of the questionnaire, each body region has four dichotomous questions (yes or no) regarding: (i) presence of skeletal muscle disorders in the previous 12 months; (ii) impairment of daily activities in the previous 12 months due to these disorders; (iii) consultation with a health professional due to these disorders; (iv) feeling these disturbances in the last week before the interview. Chronic low back pain was then considered the positive answer to all questions.

Functional capacity

The Roland-Morris questionnaire was used in the form of an interview, which has 24 questions (maximum 24 points); the higher the score, the greater the disability resulting from chronic low back pain[31].

Pain

The patients' subjective perception of pain was evaluated with the aid of the Visual Analog Scale (VAS). The scale resembles a ruler. All patients who report a score of 0 are classified as pain free and a score of 10 as presenting maximum pain[32].

Quality of life

The Sf-36 questionnaire was used to assess quality of life and, subsequently, subdivided into eight domains (functional capacity, limitations due to physical aspects, pain, general health, vitality, social aspects, limitation due to emotional aspects, and mental health))[33].

Evaluation protocols

Anthropometry

Personal data (name, age, sex) and anthropometric data (abdominal circumference; waist circumference, hip circumference, body mass [kg] using a Filizola scale, and height [m] using a wooden stadiometer) were collected. For the calculation of the body mass index [kg/m^2]), data on the individual body mass and height of each patient were used. Blood pressure was also measured (indirect method with the aid of a stethoscope and sphygmomanometer) and skin folds were collected using an adipometer (Harpenden), based on the Guedes protocol[34] which uses the subscapular, suprailiac, and medial thigh folds for women and tricipital, suprailiac, and abdominal folds for men. All folds were collected three times in a row in the same region to calculate the mean between attempts.

Flexibility

To determine flexibility, the WELLS bank was used. This protocol indicates that the individuals are seated without shoes and align the third finger of both hands, thus trying to reach the greatest possible amplitude with the knees extended. All participants were allowed three attempts, and the highest value among them was used[35].

Strength

With regard to contractile aspects, static strength was measured with trunk (lumbar) and lower limb (lower limb) dynamometers, both tests using 120 degrees of flexion. Each patient made three attempts using each device, with a three-minute interval, and the mean of the attempts was calculated[36].

Determination of training load

First, patients performed a warm-up with 15 repetitions using moderate load and rested for 1 minute. Next, they were allowed 5 attempts to perform 10 maximum repetitions in perfect biomechanics in all exercises reported below, with intervals of 3 to 5 minutes. The test was repeated after between 48 and 72 hours to confirm the load found in the first collection. If the load difference between the days exceeded 5%, a third evaluation day would be necessary. In this way, the largest load found between days was used in training[37].

Six-minute walk test

Initially, a 25-meter course was established and patients were instructed to walk for six minutes at maximum speed, along the marked path, going back and forth repeatedly during the defined time. A timer was used as an aid to start and end the test accurately, where patients started and stopped the movement at the moment they heard the previously established sound signal. At the end of the test, the total number of laps performed was counted and the distance travelled in the last unfinished lap was measured using a tape measure, thus accounting for the total distance covered[38].

Waist/hip ratio

To collect the respective circumferences, a standard anthropometric tape was used, with the patient

in an anatomical position, where the tape was positioned between the iliac crest and the last rib to collect the waist circumference and, over the largest apparent portion of the gluteus for hip circumference. Subsequently, the values were divided according to the order discussed above[39].

Intervention protocol

Strength training (ST)

Three sets of 10 repetitions of the following exercises were performed: bench press, front puller, extension chair, flexing table, barbell curl, and triceps pulley. In all training sessions, there was a warm-up on an athletics track with a moderate 10-minute walk, followed by 15 repetitions with 50% of the training load. The ST session lasted 40 minutes and ended with abdominal exercises associated with stretching.

The load progression was carried out with care, using the feedback of patients with relation to pain in other regions of the body, due to the various orthopedic alterations reported at the beginning of the study.

Physiotherapy

With the help of the students in the final year of physiotherapy at the university and under the supervision of the responsible professor, conventional physiotherapy was applied without the interference of the researchers. The protocol used consisted of lumbar stabilization with two weekly sessions and a duration of 45 minutes. Initially, the patients performed a five-minute warm-up (walking on a treadmill) and then performed the main part (three sets with 15 repetitions and 10 seconds of contraction for 10 seconds of deep muscle relaxation: transversus abdominis and multifidus. Regarding the superficial musculature: rectus abdominis, erector spinae, obliquus internus, and externus, 35 minutes of contractile training was applied). At the end, patients performed global stretches with the help of the students.

Procedures for data analysis

Initially, the Shapiro Wilk test was applied to analyze the normality of the data. Subsequently, the absolute and relative frequency analysis was used for sample description and analysis of variance (ANOVA) for repeated measures, followed by the Tukey post-test to compare the variables in the pre and post-training periods. All analyses adopted a significance of 5% ($p<0.05$) and were performed in the program *Statistical Package for the Social Sciences* (SPSS), version 25.0.

RESULTS

After obtaining the data, the general characteristics of the sample were illustrated in absolute and percentage frequency, highlighting the predominance of female volunteers and also the large percentage of the sample with high levels of overweight (Table 1).

Table 1 – Patient characteristics

	Physiotherapy Frequency (n=7)		ST Frequency (n=8)	
	Absolute (n)	Relative (%)	Absolute (n)	Relative (%)
Sex				
Female	5	33.33	7	46.67
Male	2	13.33	1	6.67
BMI				
Normal	2	13.33	1	6.67
Overweight	2	13.33	2	13.33
Obese	3	20	5	33.33
Age				
<60	2	13.33	6	40
≥60	5	33.33	2	13.33

BMI = Body Mass Index; ST = Strength training.

A decrease in body mass, increased flexibility, and potentiation of strength were observed in both modalities. These findings are considered the main non-pharmacological aspects of protection against low back pain, so much so that a lower level of pain was identified in the treated region. In addition, there was also an increase in aerobic capacity, as shown in Table 2.

There was a significant decrease in the functional capacity score, due to physical aspects and pain. Therefore, this association positively influenced the limitations due to the patients' emotional aspects, thus enhancing the possibilities for a better social life (Table 3).

Table 2 – Anthropometric and kinanthropometric tests.

Variables	Modality	Pre	Post	ANOVA for repeated measurements		
		Mean±SD	Mean±SD	*p-value "Time"*	*p-value "Group"*	*p-value "Time/ Group"*
Body mass	Physiotherapy	75.68 ± 4.5	73.47 ± 4.5	**0.013**	0.672	0.660
	ST	78.31 ± 5.5	76.68 ± 5.6			
Flexibility	Physiotherapy	17.28 ± 2.0	19.78 ± 2.4	**0.002**	0.310	0.607
	ST	20.71 ± 2.6	24.71 ± 2.6			
Dynamometry LL	Physiotherapy	61.28 ± 6.7	81.85 ± 17.1	**0.018**	0.958	0.735
	ST	62.71 ± 17.8	77.57 ± 20.2			
Lumbar Dynamometry	Physiotherapy	51.28 ± 6.1	58.00 ± 7.5	**0.006**	0.728	0.228
	ST	55.14 ± 14.5	67.71 ± 15.6			
6MWT	Physiotherapy	518.99 ± 26.6	538.31 ± 24.2	**0.008**	0.574	0.774
	ST	495.14 ± 29.7	523.90 ± 21.5			
RCQ	Physiotherapy	0.83 ± 0.04	0.89 ± 0.02	0.224	0.827	0.362
	ST	0.85 ± 0.03	0.86 ± 0.03			
Abdominal Circumference	Physiotherapy	98.50 ± 3.7	95.81 ± 4.5	0.056	0.899	0.309
	ST	97.92 ± 4.1	97.75 ± 3.9			
VAS	Physiotherapy	51.42 ± 6.3	35.71 ± 6.8	**0.009**	**0.043**	0.802
	ST	73.57 ± 7.4	55.00 ± 7.9			
Functional capacity	Physiotherapy	14.71 ± 3.4	6.71 ± 1.6	**0.002**	**0.026**	0.875
	ST	20.71 ± 1.2	13.57 ± 2.2			
SBP (mmHg)	Physiotherapy	127.71 ± 7.0	129.71 ± 7.6	0.282	0.709	0.666
	ST	128.42 ± 6.2	135.85 ± 9.2			
DBP (mmHg)	Physiotherapy	76.14 ± 1.6	73.85 ± 2.3	0.191	0.101	0.230
	ST	81.71 ± 2.9	81.42 ± 2.7			
BF (%)	Physiotherapy	32.19 ± 3.4	31.91 ± 2.5	0.582	0.323	0.832
	ST	33.97 ± 3.9	33.44 ± 3.7			

6MWT: Six-minute walk test; WHR: waist/hip ratio; VAS: visual analogue scale; SBP: systolic blood pressure; DBP: diastolic blood pressure; BF: body fat; LL: lower limbs; SD: standard deviation; ST = strength training; Analysis of variance (ANOVA) with repeated measures and post Tukey test with an error of 5% ($p<0.05$).

Table 3 - Presentation of mean values for the domains of quality of life in the modalities analyzed

Domains	Modalities	Pre	Post	ANOVA for repeated measurements		
		Mean±SD	Mean±SD	*p-value "Time"*	*p-value "Group"*	*p-value "Time/Group"*
Functional capacity	Physiotherapy	74.28 ± 16.4	64.28 ± 14.5	**0.023**	**0.046**	**0.017**
	ST	36.42 ± 19.9	57.14 ± 22.7			
Limitation by physical aspects	Physiotherapy	50.00 ± 47.8	75.00 ± 35.3	**0.036**	0.056	0.267
	ST	3.57 ± 9.4	53.57 ± 39.3			
Pain	Physiotherapy	57.14 ± 9.9	51.28 ± 11.8	0.177	0.095	**0.027**
	ST	27.57 ± 18.5	44.14 ± 21.7			
General health status	Physiotherapy	51.00 ± 22.2	51.71 ± 15.8	0.054	0.687	0.101
	ST	39.14 ± 14.0	54.71 ± 21.4			
Vitality	Physiotherapy	65.71 ± 14.2	75.00 ± 12.5	0.076	0.444	0.752
	ST	56.42 ± 29.8	61.42 ± 36.1			
Social aspects	Physiotherapy	87.50 ± 19.0	83.92 ± 20.0	0.322	0.196	0.268
	ST	53.57 ± 35.1	69.64 ± 34.5			
Emotional aspects limitation	Physiotherapy	47.60 ± 46.5	100.00 ± 0.0	**0.015**	0.081	0.376
	ST	38.07 ± 35.6	57.14 ± 53.4			
Mental health	Physiotherapy	72.00 ± 14.9	78.28 ± 8.2	0.080	0.083	0.499
	ST	43,42 ± 33,3	60,57 ± 25,9			

ST = Strength Training. Analysis of variance (ANOVA) with repeated measures and post Tukey test with an error of 5% ($p<0.05$).

DISCUSSION

Initially, there was great similarity between the benefits of strength training and physiotherapy in the intervention of patients with chronic low back pain. These values corroborate with studies that point out the respective modalities to be effective tools in the intervention of this specific public[15,40,41].

In general, one of the main associations for improving low back pain is gains in flexibility and strength. In view of this, these variables can be considered determining factors for reducing pain, as shown in Table 2 by means of the VAS and in the pain domain, present in the SF36 quality of life questionnaire, reported in table 3.

Strengthening this assertion, a meta-analysis with the central objective of identifying the main training options for improving low back pain, found great benefits from the use of exercises that facilitate increases in strength and flexibility, because the increase in strength enables improvement in joint functions, increases in stability and reductions in mechanical friction. Thus, these benefits minimize the pain situation[42]. When considering flexibility, alignment and balance of the lumbar spine is essential, avoiding unnecessary tension and compensating energy expenditure that fatigues the postural muscles[18,20].

Another important aspect that deserves attention is related to the improvement in cardiovascular fitness demonstrated in the 6MWT, observed in Table 2, since this improvement has a mediating factor in the local reduction in pain, and corroborates with other research in the area. Among the benefits involved in the respective training, there is improvement in blood perfusion to the muscle tissue, favoring metabolic activity and reducing the fatigue of the stabilizing muscles. For this reason, the American physiotherapy society recommends the insertion of aerobic exercises to treat low back pain[15,42].

Regarding the chosen age group and the general public of the sample, a direct association with the literature was observed, as a higher prevalence of involvement was identified among women and also in individuals aged between 45 and 60 years[19]. In addition, the higher prevalence of females usually occurs due to their greater concern with health when compared to men, thus more frequently seeking the care provided by the UHS [20,43,44,15].

In view of the concentrations of adipose tissue, it was observed that 53.33% and 26.67% of the patients presented, respectively, obesity and overweight. This information confirms the excess of body fat as a risk factor for the appearance of low back pain [46]. Thus, based on the information presented, a possible explanation would be the joint overload and changes in the gravitational axis due to the increase in body weight[45-47].

Directing the benefits to the intrinsic issues, it was seen that individuals affected by chronic low back pain report high rates of depression and less cerebral blood flow, drastically interfering in the patient's quality of life and well-being[48]. As a result, significant results on improvement in local pain (visual analogue scale), functional capacity, and limitations due to emotional aspects, allow improvement in these variables.

Thus, when investigating the risk factors for such a disease, together with the harm caused, there is again a great corroboration of the present study with other results found in the literature, since approximately 73.3% of affected patients suffer from depression, anxiety, fear of performing daily activities, stress and high socioeconomic problems. In addition, older age, female sex, and overweight, are well established as strong risk factors[20,47,49].

Focusing now on low back pain from economic perspectives, a direct influence on the cost burden is identified, since low back pain leads the ranking of the main causes of inability to work in the world. For this reason, it is of utmost importance that studies address the present subject, seeking to identify low-cost tools to assist in the treatment of the disorders involved. Therefore, a strong commitment to physical exercise is easily identified in the literature as a treatment option for low back pain. However, there is no specific global consensus that best serves this population[50-53].

Associating the findings with cardiovascular complications, values between 121/139 mmHg for systolic blood pressure (SBP) and 81/89 mmHg for diastolic blood pressure (DBP) are considered prehypertensive[54]. The blood pressure (BP) data of the present study fall into this category. However, non-significant results were found in both modalities in this aspect, even though it was evidenced that strength exercises are efficient in decreasing blood pressure values in pre-hypertensive patients. It is possible this occurred due to the short intervention period, as well as which there is evidence that aerobic training is more efficient in this particularity[54].

It is worth mentioning that all sessions in both modalities were held in a properly air-conditioned place, providing maximum comfort to patients. All personnel involved in the study were appropriately trained to assist in the practical and theoretical procedures.

As a limitation, the short intervention period is identified, as, in the case of chronic diseases, a longer time horizon would be more appropriate. Therefore, it is important to develop new studies to further strengthen the evidence in this area.

CONCLUSION

It is concluded that both strength training and conventional physiotherapy provided improvement in chronic low back pain in adult patients treated by the UHS, as well as improving some domains of quality of life, and increasing flexibility, aerobic capacity, and strength in the lower limbs and lumbar region of patients.

Author´s participation: *Rafael Pereira da Silva*: Wrote the manuscript, applied the questionnaires, and corrected according to the reviewers' notes. *Henrique Izaias Marcelo*: Applied the questionnaires, assisted in writing the manuscript, and corrected according to the reviewers' notes. *Robson Chacon Castoldi*: Guided throughout the study and assisted in the statistical analysis. *Everton Alex Carvalho Zanuto*: Guided throughout the study and assisted in the statistical analysis.

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