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Physical Activity Care for Chronic Low Back Pain in Out-Patient Practice

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Abstract

The aim of this study was to demonstrate the impact, on chronic low back pain workers, of a short physical activity reconditioning program, outside the conventional health care structure. This prospective study was performed on 68 chronic low back pain patients divided into two groups by their usual doctor. The first group received a multidisciplinary care in a rehabilitation center for 114 h spread over four weeks. The other group received a reconditioning program composed of six hours of physical activity spread over two weeks. Our result suggested that both care programs resulted in improved physical and psychological parameters, and reduced pain intensity ($p<0.001$). Thus, a physical activity reconditioning program outside the conventional health care structure can reduce pain and disability as well as increase physical capacities as shown by better muscle endurance and flexibility.

Introduction

A large number of people worldwide are affected by low back pain. Indeed, epidemiological studies have shown that globally the number of people with low back pain in 1990 was 377.5 million, and it increased to 577.0 million in 2017 [1]. Thus, it is a very common health problem and a major cause of disability. This disability comes from the multifactorial nature of low back pain, including physical, functional, psychological, occupational and social factors [2]. That is why there are numerous reports in the scientific literature that Chronic Low Back Pain (CLBP) patients suffer from a syndrome of physical and psychological deconditioning linked to pain [3-5], making the management complex.

Because of this complexity, interdisciplinary rehabilitation programs appear to be one of the most effective care regimens to improve back pain and decrease disability [6,7]. These programs include at least one physical component (physical activity or ergonomics exercises) and one other element of mental approach (psychological, social and/or educational). The length of these programs, usually 4 to 6 weeks at the rate of 5 days a week, 7 h a day, requires inpatient or outpatient hospitalization [8,9]. Despite the differences between all these interdisciplinary programs, their objectives remain the same, namely to restore functional, physical and psychological capacities of CLBP patients in order to facilitate their return to work [10]. But these programs are not suitable for subjects who are still employed. Indeed, this treatment requires hospitalization, so CLBP workers must take sick leave during the time of the care, inducing direct costs (loss of wage, medical costs, etc.) and indirect costs (loss of production for the enterprises, etc.) [11]. That is why many authors recommended these programs as a second-line treatment due to the resources allocated [12,13]. Thus, according to the literature [13], it is recommended to propose multidisciplinary rehabilitation only for CLBP patients at a therapeutic impasse, associated with social and/or professional exclusion.

Other programs based on physical activity, such as non-medical treatment to counteract disability in CLBP patients [14,15], seem to be a good alternative to multidisciplinary programs for CLBP workers because they do not require hospitalization and can be provided outside conventional health care structures. Thus, the CLBP workers can maintain their work during the care. However, although the impacts of aerobic exercise interventions alone, muscle strength training alone or flexibility training alone on CLBP patients are known, the benefits of a general exercise program which combines the three interventions has not yet been demonstrated [14]. However, as concluded

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by Gordon and Bloxham, a specific intervention program focusing on one area of fitness for CLBP may not be appropriate because CLBP is multifactorial and affects all areas of fitness [14]. That is why these authors recommended the implementation of a general exercise program to cover all areas of fitness [14].

The objective of this current study was to demonstrate the impact, on CLBP workers, of a short physical activity reconditioning program including general exercises, outside the conventional health care structure, on the evolution of physical and psychological parameters.

Materials and Methods

Study design

This was a prospective study of two groups undergoing different care regimens. The first group of low back pain patients (G1) included patients who followed a multidisciplinary care program in a rehabilitation center for 4 weeks, 5 days per week, 7 h per day. The second group of low back pain patients (G2) comprised patients who underwent a physical activity reconditioning program outside the conventional health care structure over 2 weeks, 3 times a week, for 1 h per session. The G1 served as a reference group since the effectiveness of intensive multidisciplinary care is no longer to be demonstrated [6].

The inclusion criteria were that the patients were more than 18 years old and had low back pain for at least 3 months, demonstrating the chronicity of the disease [16]. The exclusion criteria were specific low back pain (e.g., infection, fracture and malignancy), severe psychiatric or psychological disorders, and cardiac disease restricting physical activity. The patients were directed to either the rehabilitation center or the non-conventional health care structure by their usual doctor. Patients were directed to a rehabilitation center if they presented a therapeutic impasse and often had to miss work. The other patients who did not have these characteristics were directed to the non-conventional health care structure. Therefore, the constitution of the groups did not allow randomization, but it should be noted that the patients in the rehabilitation center serve as a reference group without comparison with the non-institutionalized group.

Before study enrolment, the design was explained to each patient, after which they signed a written consent form, specifying the purpose and risks of the study. The study protocol was approved by the Ethics Committee N° 2019-380-S77.

A total of 68 CLBP patients (35 males, 33 females) were included in this study. The G1 had 38 patients (22 males and 16 females) aged 41.5 ± 10.0 years old, and the G2 comprised 30 patients (13 males and 17 females) aged 42.5 ± 15.7 years old. Their characteristics are summarized in Table 1. At the beginning of the study, G2 was composed of 36 patients, but six patients were excluded from the study because they did not meet the inclusion criteria, three because of the time commitment, two for personal reasons, and one for secondary low back pain.

Program content

Multidisciplinary care program (G1): The G1 program included a multidisciplinary team composed of physicians, physiotherapists, occupational therapists, psychotherapists, sports therapists and social workers. Patients in this program had to tolerate some temporary discomfort, such as detoxifying from habit-forming narcotic medication. This program was intensive because the patients were present in the rehabilitation center 5 days a week, 7 h a day over 4 weeks, representing 114 h of care for each patient.

Over a week, patients received:

- 7½ h of individual physiotherapy, including global muscle strengthening using body weight for 45 min a day, with a physiotherapist, and stretching, focusing on quadriceps, hamstring, pyramidal and spinal muscles for 45 min a day.

- 5 h of balneotherapy, composed of lower limb muscle strengthening exercises, stretching and relaxation.

- 5 h of occupational therapy, including training in weight-bearing techniques and rules for a healthy spine.

- 10 h of physical activity, with training in techniques for warming up, muscle strengthening (spine and lower limbs) and cardiovascular endurance, as well as soft gymnastic exercises, Scandinavian walking, badminton and outdoor biking. In addition, every morning for 45 min, patients underwent muscle waking, from mild to moderate intensity.

- a 1-h theoretical class, given by a doctor of physical medicine and rehabilitation, regarding the anatomy of the spine, mechanisms of pain, and available non-medical treatment like physical activity in order to deconstruct false fear-avoidance beliefs.

The patients could also meet with a psychologist and/or a social worker, depending on their needs.

Physical activity reconditioning program (G2): Patients received a physical activity reconditioning program for 6 h, spread over 2 weeks (three sessions of 1 hour a week), including an individual session of muscle and cardiorespiratory endurance, an individual low-impact gym session, and a group aquatic gym session. During the entire care, G2 patients had to stop narcotic treatments like patients in the G1 group.

The individual session of muscle and cardiorespiratory endurance consisted of the following:

- 15 min of cardiorespiratory warm-up on a cycle ergometer or an elliptical bike, at 65% of target heart rate, as determined by the Karvonen formula [17].

- 30 min of stato-dynamic muscle strengthening activities using body weight or a resistance band. This activity included strengthening of the lumbar and dorsal region, and also the lower limb muscles.

- 15 min of stretching of the spine and lower limb muscles.

An individual low-impact gym session consisted of:

- 10 min of warm-up, including all articulations of the body.

- 30 min of proprioception and balance using Swiss exercise balls, a Bosu balance trainer and walking trails for balance and coordination.

- 20 min of muscle relaxation exercises, including stretching and respiratory exercises.

A group aquatic gym session was made up of:

- Warm-up, consisting of swimming freestyle for 150 to 200 meters.

- Lower limb training for 20 min by, for example, swimming

three lengths of a 25-meter pool by forward kicking, backstroke kicking and vertical kicking motions. Training on the upper limbs for 20 min by, for example, three lengths of breaststroke with alternate lengths of front crawl. These exercises included muscle strengthening and cardiorespiratory endurance, and used pool noodles, bodyboards and swimming fins. These sessions were of moderate intensity.

- Recovery, which consisted of swimming 100 meters freestyle between each 20-min session.

- The end of session, which consisted of relaxing for 5 min. The patients could choose either stretching exercises in the small pool or lying on their backs, on a pool noodle, letting the water rock them.

Physical and psychological measurements

For the G1, all the assessments were made in the rehabilitation center, the first before the care was started (T0) and the last one after 4 weeks (T4 weeks). The G2 was assessed in a non-conventional health care structure before the beginning of the first session (T0) and after the sixth session (T6). Each assessment for both groups was realized by the same evaluator, and each patient completed the same assessment in the same way.

For each patient, age, body mass, height, gender, duration of complaint and disability were recorded (Table 1).

Psychological measurements: Each evaluation began with pain measurement by the Analogue Visual Scale (VAS) [18], which is a 0 mm to 100 mm scale (low scores indicate less severe pain); then assessment of psychological parameters was done by three questionnaires. The Dallas questionnaire [19] assessed the repercussions of pain in four areas: Daily Activities (DA), Work and Leisure activities (W/L), Anxiety and Depression (A/D) and Social Interest (SI) (scale 0% to 100%; high scores indicated a severe repercussion of pain). The Tampa Scale for kinesiophobia questionnaire [20] determined the level of kinesiophobia in patients (scale 17 to 68; high scores indicated severe kinesiophobia). Finally, the Roland Morris disability questionnaire [21] measured back pain disability (scale 0 to 24; low scores indicated less severe disability).

Physical measurements: All the patients for the two groups began physical measurements with a 10-min warm-up on a cycle ergometer, at 65% of their target heart rate, as determined by the Karvonen formula [17]. After the warm-up, the patients underwent muscle endurance and then flexibility tests.

The physical measurements included: 1) tests where the finger-to-floor distance was used to estimate posterior chain flexibility [22] and heel-to-buttock distance was used to estimate anterior chain flexibility [23]; and 2) two additional tests: the Ito-Shirado test to assess abdominal endurance [24] and the Biering-Sorensen test to determine spinal endurance [25].

Statistical analysis

Statistical analysis was performed with Sigma Stat version 3.5 software. All values were expressed as means ± Standard Deviation (mean ± SD). For each parameter, data normality was tested with the Shapiro-Wilk test. The comparison of the initial demographic characteristics between the two groups was made using an unpaired t test. The intra-group comparisons between initial training and the end of training were made by paired t test. The significance level was set at the 0.05 level for all performed tests.

Results

Baseline evaluations of the two groups

There was no difference between groups in terms of age, body mass index and the duration of pain before study enrolment (Table 1). Only work status differed between groups. For G1, nine subjects were still at work (23.7%), 20 were on sick leave (52.6%), six were unemployed (15.8%) and three were retired (7.9%), while the 30 CLBP patients in G2 were still at work (100%); Table 1.

Patients of G2 presented significant differences in comparison with the patients of G1 for disability (p=0.002, Rolland Morris questionnaire; Table 2), pain repercussion (p=0.039 for the item DA; p=0.003 for the item W/L; p=0.014 for the global score of Dallas questionnaire; Figure 1). In the same way, some significant differences appeared between the two groups for flexibility of the posterior muscle chain (finger-to-floor distance), with a difference of 6.0 ± 11.5 cm (p=0.024), and the holding time of the Ito-Shirado test, with a difference of 20.8 ± 41.2 sec. (p=0.045); Table 3.

Post-treatment evaluation

Multidisciplinary care program (G1): The 4 weeks of the multidisciplinary care program allowed a significant improvement in all the parameters measured. The pain intensity decreased by 22.6

Table 1: Characteristics of the patients.

	G1		G2	
	(n=38 patients)		(n=30 patients)	
	Mean ± SD or %	Min - Max	Mean ± SD or %	Min - Max
Age (years)	41.5 ± 10.1	26-60	42.6 ± 15.7	30-60
Body mass (kg)	80.9 ± 13.6	53-116	73.9 ± 17.4	47-114
Height (cm)	172.3 ± 8.0	158-188	169.0 ± 7.9	156-187
BMI (kg/m^2)	26.9 ± 4.2	16.2-37.2	25.9 ± 5.8	16.7-40.9
Length of pain (months)	25.3 ± 8.2	9-48	19.9 ± 9.3	6-32
Work situation				
Work (%)	23.7		100	
Sick leave (%)	52.6		-	
Unemployment (%)	15.8		-	
Retired (%)	7.9		-	

G1: Multidisciplinary care program; G2: Physical activity reconditioning program; SD: Standard Deviation; %: Percentage; Min: Minimum value; Max: Maximum value; kg: Kilogram; cm: centimeter; BMI: Body Mass Index

Table 2: Summary of pain parameters and their repercussions on daily life at the beginning and the end of care.

		G1	G2
		Mean ± SD	Mean ± SD
Pain-related parameters	**Pain VAS (mm)**		
	Baseline	50.8 ± 16.1	56.7 ± 11.6
	End of care	28.2 ± 21.8 ***	25.7 ± 12.5 ***
	TSK (a.u.)		
	Baseline	40.3 ± 8.2	39.2 ± 7.3
	End of care	36.4 ± 9.6 ***	30.7 ± 7.7 ***
	Roland Morris (a.u.)		
	Baseline	9.9 ± 4.0	6.7 ± 4.3 $$$
	End of care	5.8 ± 4.6 ***	2.7 ± 2.8 ***

Data are presented by means ± SD; G1: Multidisciplinary care program; G2: Physical activity reconditioning program; SD: Standard Deviation; mm: millimeter; a.u.: arbitrary unit; VAS: Analog Visual Scale; TSK: Tampa Scale Kinesiophobia; Significant difference intra-group between baseline and the end of care: * p<0.05; ** p<0.01; *** p<0.001; Baseline difference inter-group: $$$ p<0.001

Table 3: Summary of physical parameters at the beginning and at the end of care.

		G1	G2
		Mean ± SD	Mean ± SD
Flexibility	**Finger to floor distance (cm)**		
	Baseline	13.6 ± 10.5	7.6 ± 12.6 $
	End of care	4.5 ± 8.9 ***	0.3 ± 11.4 **
	Left heel-to-buttock distance (cm)		
	Baseline	6.1 ± 6.2	4.7 ± 5.2
	End of care	1.1 ± 2.7 ***	0.8 ± 1.2 ***
	Right heel-to-buttock distance (cm)		
	Baseline	6.8 ± 4.3	5.2 ± 4.1
	End of care	1.2 ± 3.4 ***	1.2 ± 2.2 ***
Muscle endurance	**Abdominal endurance (sec.)**		
	Baseline	71.5 ± 46.4	92.3 ± 61.7 $
	End of care	123.2 ± 66.1 ***	128.2 ± 69.7 *
	Lumbar endurance (sec.)		
	Baseline	75.5 ± 46.3	66.2± 36.2
	End of care	113.9 ± 51.8 ***	118.3 ± 61.5 ***

Data are presented by means ± SD; G1: Multidisciplinary care program; G2: Physical activity reconditioning program; SD: Standard Deviation; cm: centimeter; sec.: second; Significant difference intra-group between baseline and the end of care: * p<0.05; ** p<0.01; *** p<0.001; Baseline difference inter-group: $ p<0.05

± 18.9 mm (p<0.001) and the score of kinesiophobia decreased by 3.9 ± 8.9 a.u (p<0.001); the score of Rolland Morris questionnaire of disability was reduced from 9.9 ± 4.0 a.u to 5.8 ± 4.6 a.u (p<0.001); Table 2. Last, the global score of the Dallas questionnaire was significantly improved (p<0.001), and three of the four items of this questionnaire were also improved by a decrease of DA: -20.2 ± 19.3%, p<0.001; W/L: -15.4 ± 23.0%, p<0.001; A/D: -7.8 ± 24.5%, p=0.014 (Figure 1).

Concerning the physical parameters, the finger-to-floor distance significantly improved (p<0.001), as did the heel-to-buttock distance (p<0.001 for both sides). The holding time of muscle endurance tests was significantly increased by 51.7 ± 56.2 sec on the Ito-Shirado test (p<0.001) and by 38.4 ± 49.1 sec on the Biering-Sorensen test (p<0.001); Table 3.

Physical activity reconditioning program (G2): Pain intensity (p<0.001, Table 2), kinesiophobia (p<0.001, Table 2) and disability (p<0.001, Table 2) significantly decreased respectively by 31.0 ± 12.1 mm, 8.5 ± 7.5 a.u and 4.0 ± 3.5 a.u. The Dallas questionnaire presented a significant improvement for all items (DA: -26.0 ± 19.1%, p<0.001; W/L: -23.2 ± 21.9%, p<0.001; A/D: -17.4 ± 18.9%, p<0.001; SI: -11.8 ± 17.6%, p=0.008). The global score of the Dallas questionnaire significantly decreased (p<0.001, Figure 1).

The flexibility significantly improved by 7.3 ± 12.0 cm in the finger-to-floor distance test (p=0.006, Table 3) and by 3.9 ± 3.2 cm in the left side and 4.0 ± 3.1 cm in the right side of the heel-to-buttock distance test (p<0.001, for both sides, Table 3). The muscle endurance holding time significantly improved by 35.9 ± 65.7 seconds on the Ito-Shirado test (p=0.041, Table 3) and by 52.1 ± 48.9 sec on the Biering-Sorensen test (p<0.001, Table 3).

Discussion

A physical activity reconditioning program proposed to CLBP workers outside the conventional health care structure over a short period has highlighted the possibility to break the vicious deconditioning psychological and physical circle by significant improvements in the feeling of pain, disability, physical capacities (muscle endurance and flexibility), repercussions of pain on daily life and a decrease of kinesiophobia. As expected, these same results occurred in the multidisciplinary care program.

The interest in offering several types of physical activities supervised to patients was to provide them with positive experiences in a safe environment to demonstrate that movement is not necessarily associated with the occurrence of pain or increased pain [26]. This method, named graded exposure to physical activity [27], notably reduces kinesiophobia and increases self-efficacy in low back pain patients [28]. Ogston et al. stated that the decrease in kinesiophobia would come from an awareness of the possibility of safely engaging in physical activity [29]. Thus, the reduction in kinesiophobia in our study could explain the significant improvement in other pain-related parameters. Indeed, kinesiophobia is one of the mediators of disability in this population [30]. Moreover, the decrease in kinesiophobia seems to be the cause of the improvement in physical parameters as well. Indeed, in order to improve physical abilities, it is necessary to offer a longer training period than the one we tested in our study. In this sense, Häkkinen et al. showed that in order to obtain physiological improvement in muscle function such as muscle hypertrophy, it was necessary to follow a period of muscle strengthening longer than 10 weeks [31]. To improve neuromuscular parameters, the literature has also demonstrated the need for a training period longer than 2 weeks [32-34].

In the current study, at baseline, G2 presented significant differences regarding repercussion of pain and disability in comparison with G1. In the literature, scores on the Dallas questionnaire are close to those of our G1, with scores for the daily activities and the work and leisure activities items generally between 50% and 60%, and for the anxiety-depression and the social interest items between 30% and 40% [35,36]. This statement also applies for the Roland Morris disability questionnaire, for which the mean score for CLBP patients in the literature is usually around 12 a.u [37,38]. With regard to the impact of the pain, the differences encountered in our study between the two groups could be explained by the fact that the patients in

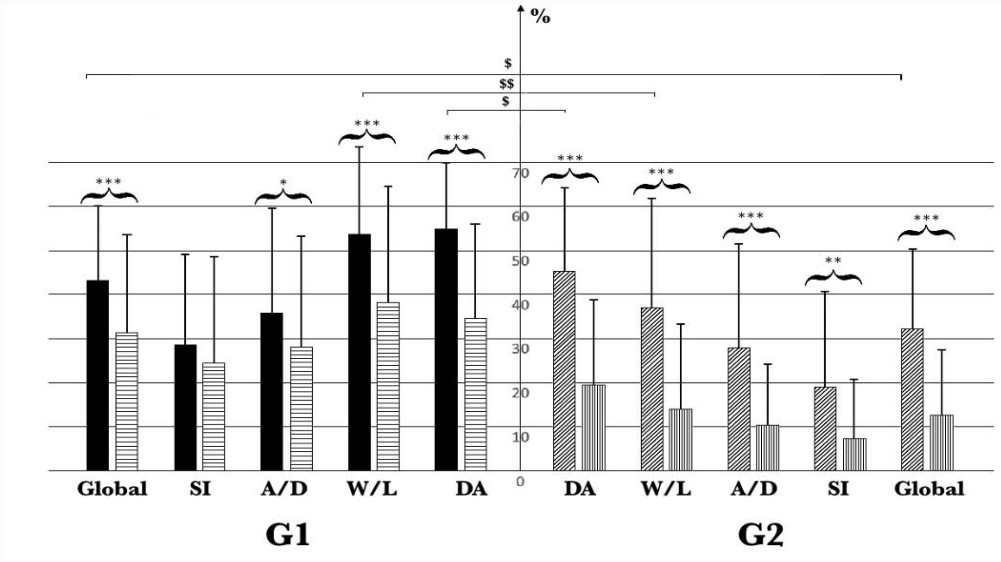

Figure 1: Evolution of Dallas questionnaire scores at the beginning and at the end of care.

G2 were still in professional activity. Indeed, workers with CLBP should maintain at least a sufficient level of physical activity to meet the physical demands of their jobs [39]. This result was recently confirmed by the study of Davergne et al., which demonstrated that CLBP patients who were still at work presented better performance in endurance and flexibility tests [40] than CLBP patients who were benefiting from a multidisciplinary rehabilitation program [41,42]. This result was evidenced equally in our study, with a significant difference in favor of G2 compared to G1 for the physical parameters at baseline. That is why it is necessary to propose early management to CLBP workers in order to avoid, in particular, a progression of kinesiophobia, which would limit physical activities [43].

There are a few limitations of the present study. First, the participants were not randomized because the choice of the care depended on participants' work status and therapeutic impasse. However, the main objective of this study was not to compare the two forms of treatment, but to determine the possibility and the impact of a physical activity reconditioning program outside the conventional health care structure over a short period for CLBP workers.

Conclusion

This study demonstrated that a short physical activity reconditioning program outside the conventional health care structure is possible, and it can reduce pain and disability as well as increase physical capacities as shown by better muscle endurance and flexibility. In the same way, this program allows, through gradual exposure to physical activity, for the provision of positive experiences to patients, thus leading to a decrease in kinesiophobia and an increase in their physical aptitudes. The promising results of this study show that a short physical activity reconditioning program outside the conventional health care structure is a good alternative to multidisciplinary care for chronic low back pain patients still at work.

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