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Effectiveness of Back School program versus hydrotherapy in elderly patients with chronic non-specific low back pain: a randomized clinical trial

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Abstract. *Background and aim of the work:* Chronic low back pain (CLBP) is a major cause of disability, for which clinical practice guidelines suggest exercise programs, such as Back School program (stretching and selective muscle reinforcement techniques) and Hydrotherapy technique, as an effective treatment to reduce pain intensity and disability. *Methods:* We enrolled 56 elderly individuals, affected by non-specific CLBP, whose pain had worsened in the last three months, which were randomly allocated to Back School (group A) or to Hydrotherapy program (group B). Each group underwent two one-hour-treatment sessions per week, over a 12-week period. Each patient was evaluated using the Roland Morris Disability Questionnaire (RMDQ) and the 36-Item Short Form Health Survey (SF-36) V2.0 at the beginning (T0), at the end of treatment (T1) and at the 3-month follow-up (T2). *Results:* At T1 and T2 we observed a highly significant statistical difference in the values measured in both groups: at T1 in group A RMDQ improvement of 3.26±1.02 ($p<0.001$) and SF-36 of 13.30±1.44 ($p<0.001$); in group B RMDQ improvement of 4.96±0.71 ($p<0.001$) and SF-36 of 14.19±1.98 ($p<0.001$). We have also evaluated the difference in effectiveness of the two programs and no significant statistical differences were found between the two groups. *Conclusions:* Back School program and Hydrotherapy could be valid treatment options in the rehabilitation of non-specific CLBP in elderly people. Both therapies proved to be effective and can be used in association with other rehabilitation programs. We believe that Back School program should be favored for its simplicity and the small number of resources required. (www.actabiomedica.it)

Key words: low back pain, chronic non-specific low back pain, elderly patients, physiotherapy, Back School program, hydrotherapy

Introduction

Musculoskeletal pain syndromes are widely recognized as being a common health problem. Among these disorders, low back pain has a high incidence and prevalence (1). Episodes of low back pain are demonstrated in 60–80% of adults, typically occurring between 35 and 55 years of age (2).

A recent systematic review (3) showed that 39% of adults have suffered at least one episode of low back pain throughout their lives. According to the Global Burden of the Disease Study data (4), low back pain is one of the four most common diseases among 291 health conditions. It can be regarded as the pathology that affects most people in the world in terms of years lived with disability.

Chronic low back pain (CLBP) is a major cause of disability, which differentiates acute low back pain episodes based on the duration of pain, that is, pain persisting for more than 3 months. CLBP affects 5% of people suffering from lower back pain, i.e. about 4% of the whole population (5).

In the most painful phase, pain is nociceptive; whereas chronic low back pain appears to be associated with a number of different factors: alteration in peripheral inhibitory mechanism, reverberating nociceptive activity, abnormal cortical feedback caused by cognitive or affective disorders which alter the intensity of pain signal (6), psychological and social factors (7), decreased strength of lumbar extensors and dysfunction of the trunk muscles (8, 9). Moreover, a reduction in quality of life is a known consequence (10, 11).

Most patients affected by CLBP show a deconditioning syndrome, as the reduction of daily physical activity could lead to decreased joint mobility, loss of strength, endurance and muscular coordination (12). Physical deconditioning contributes to worsening of pain and has a negative effect on subjects' postures and physical compensations assumed to avoid pain (13).

Exercise programs are suggested by clinical practice guidelines (14, 15) as an effective treatment to reduce pain intensity and short, medium, and long-term disability in these patients (16).

Most interventional studies published examined the efficacy of single intervention strategies, thus failing to account for the multifactorial aetiology of the syndrome. As opposed to these therapeutic approaches, the European Guidelines for the management of chronic non-specific low back pain recommend the inclusion of cognitive behavioral therapy and a short educational intervention (14, 17).

Prevention and treatment of CLBP also feature stretching and selective muscle strengthening techniques, such as the "Back School" program, which proved to be an effective and lasting method when compared to other treatments like manipulation, myofascial therapy, pharmacological therapy and placebo (18-20).

Back School is an educational program that provides individuals with practical information about back care, posture, body mechanics, back exercises, and how to prevent long-term back problems.

Modern Back School originates from the synthesis of several rehabilitative physical therapies; the traditional rehabilitation methods developed by Williams, Cailliet e Charrière are enriched by modern kinesitherapy techniques. Modern Back School does not employ just one method, instead it selects it according to the goal it wants to reach or the needs of the individual. The method does not come first, as this approach centers on the patient's well-being: the individual's ability to manage pain with a confident attitude and a personal commitment, thanks to the psychophysical preparation acquired.

Hydrotherapy could be considered another effective therapeutic instrument in preventing and treating CLBP. In water it is possible to perform actions and movements which cannot be performed in an environment which is governed by the law of physics, reducing muscle tension and the weight of the individual (21-23). Hydrotherapy, also called aquatic physiotherapy or balneotherapy, is a broad range of approaches and therapeutic methods completed entirely in water in a purpose built hydrotherapy pool. The aim of hydrotherapy is to decrease pain, increase range of movement and flexibility as well as develop muscle strength and general fitness.

Aim of this randomized clinical trial is to compare the short and middle-term effectiveness of Back School program and hydrotherapy in treating non-specific CLBP in elderly people.

Materials and Methods

This randomized, parallel group clinical trial enrolled sixty-four consecutive patients affected by chronic non-specific low back pain, whose pain worsened in the previous three months.

The patients were to be between 65 and 80 years of age, able of carrying out the rehabilitation program and signing the consent form. The participants were informed in detail on the scope and procedures of the study and were then asked to take part in a clinical trial. They underwent a progressive CLBP rehabilitation program in which they were randomly allocated to receive either physiotherapy treatment (Back School program) or hydrotherapy. The institutional local Ethic Review Board approved the study and all individuals provided written, informed consent to participate in this randomized controlled clinical study, in accordance with the National Health Council Resolution No. 196/96 and with the Helsinki Declaration of 1975, as revised in 2000.

Inclusion criteria were:

- participants aged between 65 and 80 years;
- diagnosis of chronic non-specific low back pain;
- algic low back pain recurrence in the last three months.

Whereas exclusion criteria were:

- presence of musculoskeletal disorders, severe heart failure or internal medicine pathologies that could interfere with moderate physical activity;
- fever or infectious disease;
- systemic inflammatory or rheumatologic diseases;
- previous spinal surgery or a history of vertebral traumas/fractures;
- instrumental physical therapies or physiotherapeutic therapies in the previous three months.

Out of 64 individuals assessed to the first evaluation, 8 were excluded: two individuals did not meet the inclusion criteria, three presented disabling musculoskeletal disease, one was excluded for undergoing physiotherapeutic treatments a few weeks earlier and two patients declined to participate in the rehabilitation program.

Each group underwent two treatment sessions per week, each lasting one hour, over a 12-week period.

In the first session of the Back School program (Group A), individuals were informed about the anatomy of spinal column, its functioning and ergonomic position and the basis of the pain-inducing mechanism, psychological aspects and stress management, whereas in the following sessions they performed stretching and muscular strengthening, associated with proper breathing. The program scheduled global bilateral exercises associated with slow and prolonged inhaling, according to the following model (Figure 1):

- Diaphragmatic breathing: Seated, inhale slowly and deeply through the nose, elevating the abdomen. Breathe air out through the mouth. 10 repetitions.
- Stretching of iliopsoas muscle ("single knee to chest"): in supine position, bend both knees; hold one leg at the thigh behind the knee and pull it to the chest for 20 seconds, repeat five times on each side.

Figure 1. Back School programme exercise

- Stretching of hamstring muscle: in supine position, hold one leg behind the thigh; slowly straighten the knee until a stretch is felt in the posterior region of the thigh. Hold 20 seconds, repeat five times on each side.
- Stretching of gastrocnemius muscle: place hands on a wall, stand with one leg in front of the other, both feet pointed forward; keep back knee straight, heel pressed to the floor. Hold 20 seconds, repeat three times on each side.
- Stretching of quadriceps femoris muscle: place one hand on a wall, stand with one leg bent up behind; hold the foot for 20 seconds, repeat three times on each side.
- Stretching of hip flexor muscles: kneeling, one knee on the floor and the other foot in front with the knee bent; hips pushed forwards and back upright. Hold 20 seconds, repeat three times on each side.
- Stretching of erector spinae muscles: on hands and knees, head and back parallel to the floor;

slowly slide glutes toward the ankles, maintaining the natural curve of the spine. Hold 20 seconds, repeat five times.

- Strengthening of rectus abdominis ("partial curl"): in supine position, knees bent, feet flat on the floor, hand behind the neck; raise head, shoulders and upper back off the floor while exhaling; then go back to the starting position while inhaling. Two sets of 10 repetitions.
- Strengthening of external and internal oblique abdominis muscles ("oblique curl"): in supine position, knees bent, feet flat on the floor, hand behind the neck; raise head and shoulders off the floor while exhaling, bring the elbow towards the contralateral knee; then go back to the starting position while inhaling. One set of 10 repetitions on each side.
- Strengthening of erector spinae muscles: in supine position, extended limbs; raise one arm and the contralateral leg. One set of 10 repetitions on each side.
- Strengthening of gluteal muscles: in supine position, extended lower limbs; bring both knees to the chest, hold for 5 seconds; then place the feet flat on the floor and raise the glutes, hold for 10 seconds. Two sets of 10 repetitions.
- Strengthening of quadriceps femoris muscle ("wall squats"): stand with feet about hip-width apart and 30 cm from a wall. Lean with the back against the wall and slowly slide down until knees are bent about 30 degrees while exhaling; then slowly return to the starting position while inhaling. Two sets of 10 repetitions.
- Exercise for trunk flexion/extension ("Cat and Camel"): on hands and knees, head parallel to the floor, keep arms and legs straight; flex the back while exhaling, then let it slowly sag toward the floor while inhaling. Two sets of 10 repetitions.
- Exercise for pelvic tilt: in supine position with a small cushion under the head, knees bent, feet flat on the floor, upper body relaxed and chin gently tucked in; slowly flatten low back into the floor and contract stomach muscles, then tilt pelvis towards heels until feeling a small arch in lower back, feeling back muscles contracting and return to the starting position. Two sets of 10 repetitions, tilting pelvis back and forwards in a slow swinging motion.

In Hydrotherapy program (group B), participants at first performed walking exercises to adapt to the pool conditions, afterwards they performed bilateral stretching and selective muscle strengthening exercises according to the following water therapy exercise program (Figure 2):

- Stretching of iliopsoas muscle and contralateral hip flexor muscles: standing on one leg slightly bent, hold the other leg at the knee and pull it to the chest for 20 seconds. Repeat five times on each side.
- Stretching of gastrocnemius muscle, hamstrings and posterior muscle chain: place hands on the handrail, stand with feet parallel, both feet pointed forward; keep back knee straight, heel pressed to the floor. Hold 20 seconds, repeat three times. Then place one leg in front of the other. Hold 20 seconds, repeat three times on each side.
- Strengthening of abdominal muscles: place hands on the handrail, both feet off the pool floor; perform a rhythmic pedaling motion. Practice for 20 seconds, repeat three times on each rotation direction.
- Strengthening of lower abdominal muscles and lumbar erector spinae muscles: stand with feet parallel. Lean with the back against the wall and

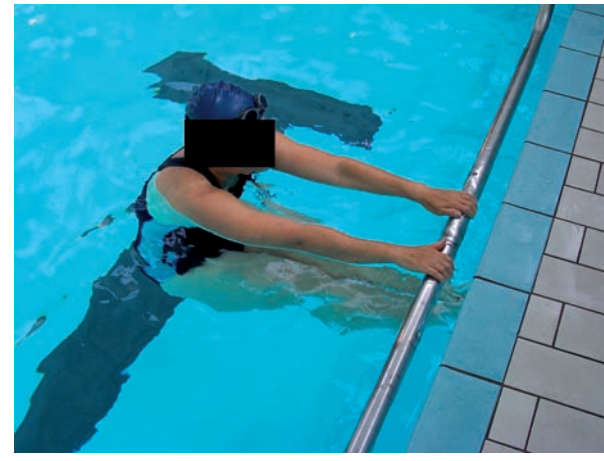

Figure 2. Hydrotherapy program exercise

slowly slide down until knees and hips are bent about 40 degrees while exhaling; then slowly return to the starting position while inhaling. Two sets of 10 repetitions.

- Strengthening of abductor/adductor muscles of the hip and posterior muscle chain: place hands on the handrail, stand with feet parallel; perform a rhythmic abduction/adduction movement of the hip with back knee kept straight. Practice for 20 seconds, repeat three times on each side.
- Strengthening of abdominal muscles: place hands on the handrail, stand with feet parallel; bring the legs up together flexing the hips and knees about 90 degrees while exhaling; then slowly return to the starting position while inhaling. Two sets of 10 repetitions.
- Active rotation mobilization of the thoracic/lumbar spine with strengthening of external and internal oblique abdominis muscles: place hands on the handrail, stand with feet parallel; bring the legs up together flexing the hips and knees about 90 degrees and rotating the thoracic/lumbar spine while exhaling; then slowly return to the starting position while inhaling. One set of 10 repetitions on each side.
- Active mobilization of the lower limbs with strengthening of abdominal muscles and lumbar erector spinae muscles: place hands on the handrail, both feet off the pool floor, legs, knees and ankles joined together; perform a rhythmic motion in abduction/adduction of the hips, in internal and external rotation of the hips and in flexion/extension of the knees. One set of 10 repetitions on each motion.

Treatments were carried out by the same professional physiotherapist and the same physician performed all the assessments.

Each patient was evaluated using the Roland Morris Disability Questionnaire (RMDQ) (24-26) and the 36-Item Short Form Health Survey (SF-36) Version 2.0 (27,28) at the beginning (T0), at the end of treatment (T1, 12 weeks) and at the 3-month follow-up (T2, 26 weeks).

The RMDQ is a questionnaire that measures low back pain in which the individual checks the actions hindered by pain. The RMDQ is a self-administered outcome measure of disability where greater levels are reflected by higher numbers on a 24-point scale. Whereas the SF-36 is a multi-purpose, short-form health survey with 36 questions. It yields an 8-scale profile of functional health and well-being scores as well as psychometrically-based physical and mental health summary measures and a preference-based health utility index.

The purpose of this study was to evaluate the short-term and middle-term effects of Back School program and hydrotherapy in improving the recovery of lumbar region mobility and in term of pain reduction in a group of elderly patients with chronic non-specific low back pain. The primary outcome was defined as the difference in the short-term improvement of RMDQ and SF-36 values measured at the beginning (T0) and the end of the 12-week treatment protocol (T1). The first secondary outcome was defined as the difference in improvement in the values of the questionnaires at T1 and T2 between the two groups. Lastly, the second secondary outcome was defined as the difference in the middle-term improvement in the values measured at the beginning (T0) and the 3-month follow-up (T2).

The sample size calculation is based on the primary outcome. The participants were randomly allocated using computer randomization software (RANDI2 software version 0.6.1) to the Back School program (group A) or to the Hydrotherapy program (group B), 28 patients per group.

The characteristics of the patients were described using the average and the standard deviation for continuous variables and by percentage for categorical variables. The analysis of the difference in the short-term (T0-T1) and middle-term (T0-T2) improvement of questionnaire values was performed using the Student's t-test for paired data (repeated measures), while the difference between the groups improvements at baseline, T1 and T2 evaluation was analyzed using the Student's t-test for independent samples.

All analyses were performed on the basis of the principle of the intention to treat. A p-value < 0.05 was considered significant. The confidence interval (CI) at 95% was also calculated. All statistic analyses were performed with SPSS software for Windows (version 20.0).

Results

We enrolled 56 elderly patients that would meet our inclusion and exclusion criteria.

In our study we noticed that both rehabilitation programs had no side effects nor complications and we also had a high patients' compliance.

One participant in both treatment groups was lost after the beginning of the treatment, for not having entirely carried out the rehabilitation program: the patient in group A had family problems, while the patient in group B had to stop treatment for intercurrent health problems. On the basis of the intention-to-treat, the data for the 54 remaining patients (27 for each group, 30 males and 24 females, mean age 73.46 ± 3.43 years, range from 66 to 78 years) were included in our analysis. (Figure 3)

The baseline demographic characteristics of group A and group B patients were comparable, no significant differences between the groups were found with

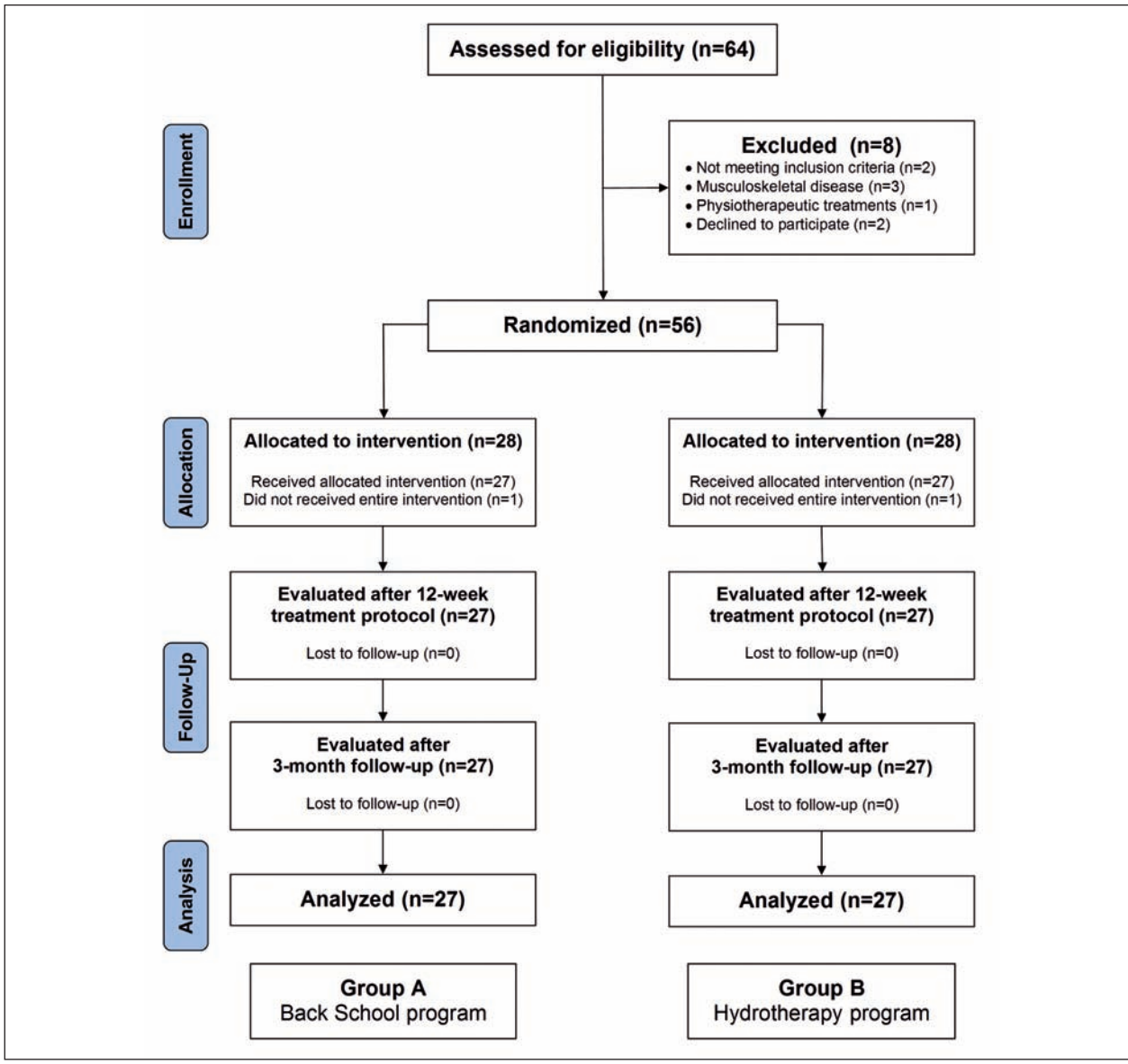

Figure 3. CONSORT participant flow diagram

respect to age, sex, weight, body mass index (BMI) and symptoms duration as shown in Table 1. In addition, RMDQ and SF-36 values were analyzed at T0, confirming the baseline homogeneity of the sample (Table 1).

In Table 2 are shown the average scores measured with RMDQ and SF-36 in Back School group (group A) and Hydrotherapy group (group B).

At the end of the treatment (T1) we observed a highly significant statistical difference in the values measured with both questionnaires in both groups: in group A an RMDQ improvement of 3.26 ± 1.02 ($p < 0.001$) and at SF-36 of 13.30 ± 1.44 ($p < 0.001$); whereas in group B the RMDQ improvement was 4.96 ± 0.71 ($p < 0.001$) and in SF-36 was 14.19 ± 1.98 ($p < 0.001$), reaching the primary outcome (Table 3).

Concerning the first secondary outcome, we evaluated whether the difference in effectiveness of the two programs was statistically significant (Table 4):

- the difference at T1 in the RMDQ average values between Back School group and Hydrotherapy group was not significant ($p = 0.096$);
- the difference at T1 in the SF-36 average values between the two groups was not significant ($p = 0.925$);
- the difference at T2 in the RMDQ ($p = 0.202$) and SF-36 ($p = 0.885$) average values between the two groups was not significant.

Therefore, no significant statistical differences were found between the two groups.

Finally, we evaluated the improvement in the parameters taken into consideration at the middle-term follow-up (T2). Both groups showed a highly significant statistical difference in the questionnaire scores: in group A an RMDQ improvement of 3.48 ± 1.28 ($p < 0.001$) and at SF-36 of 13.07 ± 2.27 ($p < 0.001$); whereas in group B the RMDQ improvement was 4.85 ± 1.10 ($p < 0.001$) and in SF-36 was 13.70 ± 2.84 ($p < 0.001$) as shown in Table 3.

Table 1. Baseline (T0) demographic characteristics and questionnaires values, Student's t-test for independent samples

	Student's t-test for independent samples								
	Group A (Mean ± SD)	Group B (Mean ± SD)	Mean difference between groups	Std. Error Difference	95% CI Lower	95% CI Upper	t	df	Sig. (2-tailed)
Gender (Male/Female)	51.8%/48.2%	59.3%/40.7%	7.5%	0.137	0.202	0.350	0.539	52	0.592
Age (years)	73.63 ± 3.36	73.30 ± 3.55	0.333	0.941	-1.555	2.222	0.354	52	0.725
Weight (kg)	69.15 ± 7.66	67.93 ± 8.94	1.222	2.266	-3.324	5.768	0.539	52	0.608
BMI	24.86 ± 2.18	24.72 ± 3.21	0.138	0.747	-1.361	1.638	0.186	52	0.854
Symptoms duration (months)	22.81 ± 7.01	23.96 ± 7.67	1.148	2.000	-5.161	2.864	-0.574	52	0.568
RMDQ values	9.59 ± 3.08	10.22 ± 2.50	0.630	0.763	-2.162	0.902	-0.825	52	0.413
SF-36 values	52.96 ± 5.52	52.19 ± 4.38	0.778	1.355	-1.941	3.497	0.574	52	0.568

SD, standard deviation; Std., standard; CI, Confidence Interval of the Difference; df, degrees of freedom; Sig., significance; BMI, Body Mass Index

Table 2. Questionnaires average scores measured in both groups

	RMDQ T0 (Mean ± SD)	RMDQ T1 (Mean ± SD)	RMDQ T2 (Mean ± SD)	SF-36 T0 (Mean ± SD)	SF-36 T1 (Mean ± SD)	SF-36 T2 (Mean ± SD)
Group A Back School program	9.59 ± 3.08	6.33 ± 2.48	6.11 ± 2.36	52.96 ± 5.52	66.26 ± 4.90	66.04 ± 4.26
Group B Hydrotherapy technique	10.22 ± 2.50	5.26 ± 2.16	5.37 ± 1.82	52.19 ± 4.38	66.37 ± 3.66	65.89 ± 3.19

SD, standard deviation

Table 3. Statistic analysis in the short-term (T0-T1) and middle-term (T0-T2) improvement of measured questionnaires values, Student's t-test for paired samples

Student's t-test for paired samples									
T0 - T1	T0 (Mean ± SD)	T1 (Mean ± SD)	Mean difference	Std. Error Difference	95% CI Lower	95% CI Upper	t	df	Sig. (2-tailed)
Group A									
RMDQ	9.59 ± 3.08	6.33 ± 2.48	3.259 ± 1.023	0.197	2.855	3.664	16.562	26	< 0.001
SF-36	52.96 ± 5.52	66.26 ± 4.90	-13.296 ± 1.436	0.276	-13.864	-12.728	-48.106	26	< 0.001
Group B									
RMDQ	10.22 ± 2.50	5.26 ± 2.16	4.963 ± 0.706	0.136	4.684	5.242	36.522	26	< 0.001
SF-36	52.19 ± 4.38	66.37 ± 3.66	-14.185 ± 1.981	0.381	-14.969	-13.401	-37.200	26	< 0.001
T0 - T2	T0 (Mean ± SD)	T2 (Mean ± SD)	Mean difference	Std. Error Difference	95% CI Lower	95% CI Upper	t	df	Sig. (2-tailed)
Group A									
RMDQ	9.59 ± 3.08	6.11 ± 2.36	3.481 ± 1.282	0.247	2.974	3.989	14.109	26	< 0.001
SF-36	52.96 ± 5.52	66.04 ± 4.26	-13.074 ± 2.269	0.437	-13.972	-12.177	-29.941	26	< 0.001
Group B									
RMDQ	10.22 ± 2.50	5.37 ± 1.82	4.852 ± 1.099	0.212	4.417	5.287	22.938	26	< 0.001
SF-36	52.19 ± 4.38	65.89 ± 3.19	-13.704 ± 2.839	0.546	-14.827	-12.580	-25.077	26	< 0.001

SD, standard deviation; Std., standard; CI, Confidence Interval of the Difference; df, degrees of freedom; Sig., significance

Table 4. Statistic analysis between the groups at T1 and T2 questionnaires values, Student's t-test for independent samples

Student's t-test for independent samples									
	Group (Mean ± SD)	Group (Mean ± SD)	Mean difference beetween group	Std. Error Difference	95% CI Lower	95% CI Upper	t	df	Sig. (2-tailed)
RMDQ (T1)	6.33 ± 2.48	5.26 ± 2.16	1.074	0.633	-0.196	2.344	1.697	52	0.096
SF-36 (T1)	66.26 ± 4.90	66.37 ± 3.66	-0.111	1.176	-2.472	2.249	-0.094	52	0.925
RMDQ (T2)	6.11 ± 2.36	5.37 ± 1.82	0.741	0.574	-0.410	1.892	1.291	52	0.202
SF-36 (T2)	66.04 ± 4.26	65.89 ± 3.19	0.148	1.024	-1.906	2.202	0.145	52	0.885

SD, standard deviation; Std., standard; CI, Confidence Interval of the Difference; df, degrees of freedom; Sig., significance

Discussion

Many studies concerning the effectiveness of Back School program and hydrotherapy in patients affected by chronic non-specific low back pain can be found in literature (5-12).

Back School program is as effective as manual treatments for relieving low back pain (29) and many studies have shown a short and long-term effectiveness of this program in reducing pain and improving mobility (2, 3, 7-10, 30); whereas some authors considered hydrotherapy an effective therapeutic option in treating CLBP especially in the short-term (5, 6, 12).

The data collected at T0 showed no significant statistical differences between the two groups in the values measured with the two evaluation questionnaires. Therefore, the two groups were homogeneous as far as age, symptoms duration and pain were concerned.

The statistical analysis of data at T1 and T2 (3-month follow-up) measured with the two questionnaires confirmed the effectiveness of both programs ($p < 0.001$).

Moreover, the lack of significant difference between the two programs highlighted by the data proved that both therapeutic options could be equally effective in treating CLPB in elderly people.

Therefore, due to the lack of international guidelines and the comparable effectiveness of both therapies, it could be appropriate for the physician to see each single patient affected by CLBP in order to select and design a customized program, which best adapts to each single patient.

From this point of view, costs rationalization and therapeutic options, Back School program is surely the easiest to execute, as it does not require specific devices, a single physiotherapist can deal with a small group of patients and it does not demand a fully equipped pool, therefore lower operating costs.

The present results should be evaluated considering several limitations that should be acknowledged. First, we think that our results are encouraging as patients' pain symptomatology and general well-being improved, even though our sample is small. Therefore we suggest that future studies should have a larger sample size (adults, young adults and elderly, sportive and sedentary people) to confirm our results.

Finally, given the chronic relapsing course of non-specific low back pain, it could be advisable to perform a long-term follow-up and a structured cyclic program to evaluate whether the reached benefits can last.

Conclusions

The present study suggests that Back School program and Hydrotherapy technique could be valid treatment options in the rehabilitation of chronic non-specific low back pain in elderly people.

Both therapies proved to be effective and can be used in association with other rehabilitation programs: we believe that Back School program should be favored, given its simplicity and the small number of resources required.

Moreover, it could be interesting to implement future studies with a larger sample, including young, adults and elderly patients with long-term follow-ups, in order to evaluate the role these simple and effective therapies can play for the general population.

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