

## Research Paper



# Is Online Exercise at Home More Effective Than Hydrotherapy and Physiotherapy in Patients With Non-specific Chronic Low Back Pain? A Randomized Clinical Trial

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## ABSTRACT

**Purpose:** Many non-pharmaceutical methods have been proposed for the treatment of non-specific chronic low back pain (NCLBP), including online exercise at home (OEH), hydrotherapy, and physiotherapy approaches that have shown significant effects. Nevertheless, there are ambiguities in choosing the best option. Therefore, the present study was designed to compare these methods.

**Methods:** This randomized clinical trial included 60 patients with NCLBP (25–45 yrs). After selection, they were randomly divided into three groups (20 patients in each) of OEH (including core stability exercises and education), hydrotherapy, and physiotherapy (including hot pack, ultrasound, and TENS), and then, received interventions for 12 weeks. The Visual Analog Scale (VAS) was used to evaluate pain before and after treatment. The ANOCOVA and paired t-test were used to analyze the data and a significant level of  $P < 0.05$ .

**Results:** The results showed that all three treatments used in this study had a significant effect ( $P < 0.05$ ) on reducing the pain intensity of the patients after the intervention. There was no significant difference between the three treatments in reducing pain; however, the OEH method could reduce the pain to a greater extent (32.79%).

**Conclusion:** Although the present study reaffirms the effectiveness of all three treatment approaches, no significant differences were found in the selection of the best option. However, depending on the patient's condition, one of these methods can be selected. Therefore, we introduce hydrotherapy, and physiotherapy methods for the elderly, severe pain and disability, and OEH as an available method to save money, and time and, most importantly, prevent the COVID-19.

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## Highlights

- All three treatment approaches are significantly effective in reducing pain.
- OEH, hydrotherapy, and physiotherapy were effective in reducing the VAS score, respectively; however, this difference was not significant.
- Saving economic costs and time as well as ease of execution are the advantages of home exercise over physiotherapy and hydrotherapy.
- OEH is an available and safe option to prevent COVID-19 in patients with NCLBP.

## Plain Language Summary

Physiotherapy and exercise therapy in water and land have always been the most popular and common non-pharmacological strategies for the treatment of non-specific low back pain. The high cost of treatment as well as spending a lot of time going to medical centers for a long time and most importantly the emergence of COVID-19 in the world have created many problems for these patients. These factors have even caused frustration and discouragement for many of these patients from pursuing treatment processes as well as improving low back pain. Therefore, we decided to compare home exercise with online monitoring against the two popular approaches of physiotherapy and hydrotherapy. Our results showed that all three methods are effective and almost equal in reducing pain intensity. However, online exercise at home was more prominent and covered all the problems mentioned above.

### 1. Introduction

Low back pain (LBP) after a cold is the second most common reason for seeing a doctor in the world [1] and is one of the most well-known musculoskeletal problems that usually affect everyone during their lifetime and has become a major socio-economic problem [2]. Also, literature shows that one of the most important causes of disability is LBP, and despite its high prevalence, in many cases, the source of pain has not been proven, and therefore, the term nonspecific LBP has been used for it [3]. Nonspecific chronic low back pain (NCLBP) is pain minimum for three months, located above the inferior gluteal folds and below the costal margin without leg pain [4]. NCLBP is a major public health problem in industrialized societies, with a 60 to 80% prevalence [5, 6]. Different methods can be applied for the treatment and management of NCLBP, including pharmaceutical and non-pharmaceutical [7].

However, long-term use of the drug has side effects and after the cessation of treatment due to the lack of muscle imbalances, there is also the possibility of recurrence of pain [8]. Many non-pharmacological methods have been proposed, among which exercise therapy [9], hydrotherapy [7], and physiotherapy [10] are the most popular strategies among recent researchers and thera-

piasts, and their positive effects in improving pain have been proven. In a systematic review and meta-analysis, the efficiency of various exercises, including Pilates, stability/motor control, resistance, and aerobics training, were investigated and reported they are effective in treating NCLBP [11]. Moreover, Bai et al., in a review and meta-analysis study, pointed to the positive benefits of water exercise [7]. In another review article, Haile et al. reported that physiotherapy methods also effectively reduce LBP [12].

Although exercise therapy is the most common type of treatment [13, 14], recent studies have pointed to stability exercises as one of the best training approaches [1, 15, 16]. In a recent systematic review, this approach was introduced as the best solution among other exercises in LBP treatment [1]. The San Francisco Spine Institute is one of the first institutions to recommend dynamic back stabilization as a more effective treatment [17, 18]. This exercise has shown tremendous effects, relying on the major strengthening of the multifidus, paraspinal, pelvic floor, diaphragm, abdominal, and gluteal muscles [1, 19].

In contrast, medical experience has shown that water-based exercise has beneficial results for musculoskeletal disorders, especially for patients with severe pain [20]. Three important properties of water, including buoyancy, resistance, and water flow, have made hydrotherapy

effective in reducing pain. Research shows that hydrotherapy can positively affect pain, strength, muscle flexibility, performance, self-confidence, fitness, and stress reduction in disorders, such as LBP [10]. Furthermore, physiotherapy methods, including using ultrasound devices [12], Transcutaneous Electrical Nerve Stimulation (TENS) [21], and hot water packs [22], have been old and very common applications in reducing patients' back pain. Ultrasound and TENS devices, through surface waves and electrical stimulation with the help of a hot water bag, increase blood circulation in muscles and soft tissues, which is quite effective in improving the healing process and reducing the transmission of pain nerve commands [12, 21].

Nowadays, due to the availability of online communication networks and on the other hand, there are some urban problems such as traffic, limited access to physiotherapy and exercise therapy clinics, lack of time, and most importantly, the emergence of COVID-19 and its potential risks, which highlights online exercises at home (OEH) [23]. Although studies have found the patient's presence with a specialist more effective [24], the above reasons led us first to identify one of the best exercise methods recommended by researchers (stability exercise) [1, 15], and then try to implement this style of practice at home, and secondly, compare it with the two popular methods of physiotherapy and hydrotherapy. It should be noted that to cover the weaknesses of the absence of the specialist as much as possible, we decided to control the patients' exercises at home through video and face-to-face networks.

Generally, in the field of home exercise, especially after the onset of COVID-19, little research has been done to help patients with NCLBP. However, there is insufficient evidence of the effectiveness of this type of exercise in particular and its superiority over other popular methods (physiotherapy and hydrotherapy) in general [5, 20, 25]. Recently, researchers in the reviews and meta-analyses also have emphasized the need to conduct research comparing different training methods in order to more accurately identify the effects of each [11, 24].

Therefore, the importance of exercise at home, given the current situation, specially COVID-19, and since to our knowledge to date, no study has compared these three treatments, made it necessary for us to conduct the present study. Hence, the present study was designed to compare the effects of three different treatment approaches (namely physiotherapy, hydrotherapy, and OEH) among patients with NCLBP. We hypothesized that the OEH is more effective than other methods.

## 2. Methods

The current study was a single-blind (therapist and specialist) randomized clinical trial of 60 patients with NCLBP with a mean age of 25-45 years. The participants were selected by convenience sampling method. In addition, an independent research coordinator from a local physiotherapy and corrective exercises clinic in Tehran, Iran recruited them. All participants filled out written informed consent forms before inclusion, and a local ethics committee approved the study. All subjects were examined by a physician and referred to the clinic to treat LBP. The study was registered on the UMIN\_RCT website, and the unique trial number is UMIN000046358.

The inclusion criteria were a history of pain for at least three months, a minimum score of two on the visual analog scale (VAS), willingness to participate in any randomly selected treatment groups, and receiving full doses of the COVID-19 vaccine. The exclusion criteria were the presence of the lumbar disc herniation, acute stage of lumbar disc protrusion, systematic diseases (such as cardiovascular), or any condition, which contraindicated. Spinal surgery, fractures or inflammatory diseases of the spine, or any pathophysiological disorder, body mass index (BMI) more than normal level, having any intervention in the last two months, taking medical drugs, and failure to participate in the treatment sessions [22].

### Outcome measure

VAS was used to measure pain intensity. It is a 10 cm ruler with zero (no pain) and 10 (most severe pain). Subjects are asked to select a point according to their pain level. Finally, patients' pain scores were recorded before and after treatment interventions. Validity of 0.70 and reliability of 0.97 have been reported for this scale [26].

### Treatment groups

Participants were randomized followed by a concealed allocation ratio of 1:1 by unlocking an opaque and sealed envelope, and a card inside demonstrated the group, to which the subjects were randomly allocated: OEH (n=20), hydrotherapy (n=20), and physiotherapy (n=20). Before starting the project, all participants were asked to complete the written consent form, and they were informed about the 12 weeks of clinical interventions and study procedure.

### Online Exercise at Home

The first group performed OEH. They were given five exercises (Table 1). In addition, they received a manual guideline containing exercises and training on LBP, how

to create it, and correct postural daily positions, including the proper technique of movement patterns, such as lifting objects off the ground, sitting, sleeping, walking as well as ergonomic methods at work and home [27]. They were asked to read this manual and follow it daily. The exercise was performed three times a week for 12 weeks. Each 20-30-minute exercise session included 5 minutes of cool-down and warm-up and the main program [28]. Further, the exercises were monitored online so that whenever the subjects were ready, they communicated with the experts using a computer or mobile phone through the videoconferencing software (<https://meet.jit.si/>) [29].

### Hydrotherapy exercises

The second group performed their hydrotherapy (five exercises) in a pool (with a normal water temperature range of 30-32° C and 120-cm deep) under the supervision of a specialist (Table 2). This group had 40-50 minute exercise sessions three times a week for 12 weeks, including 15 minutes of warm-up (walking exercises to adapt to the pool conditions), cool down (bilateral and general stretching), and about 25 minutes of the main

program. Water exercises were performed in groups of 6 to 7 participants per session due to the closer supervision of hydrotherapy specialists and the pool's small size. Moreover, the number of repetitions and sets were designed based on the amount of pain and the ability of patients from the first week to the last week based on the principles of overload [20].

### Physiotherapy methods

The third group was treated in a physiotherapy clinic under the supervision of a physiotherapist. All supervised intervention programs were applied for 50 to 60 minutes a day, three times per week, for 12 weeks. The heating surface is applied with hot packages for 20 minutes in the low back region. The patients also used ultrasound devices (Chattanooga, Tennessee, USA) for 10 minutes, which operated at a frequency of 1 MHz and an intensity of 1.5 W/cm, and a converter head with an area of 5, BNR 1:5, and an ERA of 4 cm. Slow circular movements were applied to the paravertebral lumbar region

**Table 1.** Method of Online Core Stability Exercises at Home

Compositions	Methods
Curl up 	Train the abdominal (rectus and obliques) muscles and control the movement of the pelvis. The person is placed with 90° knee flexion, then the hands are placed crosswise on the chest, and the upper torso is raised to 30° and returns to the first position. 4 sets × 10 rep.
Side Bridge 	Train the oblique muscles and the quadratus lumborum, as critical muscles in the spine's stability. The person tries to keep his body along a straight line so that only the forearm and the outer ankle of the foot are in contact with the ground. 4 set×15 sec.
Bird dog 	Strengthen the posterior and anterior lumbar muscles, especially the transverse abdominis. The person is placed in a dog position and at the same time keeps the opposite arm and leg in full extension along the ground. 4 set×10 rep
Bridging 	Strengthen the muscles of the rectus spine and gluteal. The person is placed on the mattress with full knee flexion, then lifts the body off the ground, maintains this position for 3 sec, and returns to the first position. 4 set×15 rep.
Pelvic tilt 	Strengthen the anterior abdominal and gluteal muscles. The person sleeps in the supine position and puts the knee in flexion, then with the contraction of the relevant muscles, he/she places the back completely flat on the ground so that the arch of the lumbar region disappears and maintains this position. 4 set×15 sec.

by the head of the transducer. Finally, TENS; 30–40 Hz was applied for 20 min [22].

**Statistical analysis**

Statistical analysis was performed using IBM SPSS version 20 for Windows (SPSS Inc., Chicago, IL, USA); all variables were reported using the descriptive statistic (Mean, Standard Deviation). The analysis of variance (ANOVA) was used to compare individual characteristics between groups. One-way analysis of the covariance (ANCOVA) and the post hoc test were used to compare groups, both at baseline (pre-test) and follow-up (post-test). In these models, the outcome variable (pain intensity in post-test) was entered as dependent variables, the group was used as a fixed factor, while the pre-test was used as covariates. Assumptions of ANOCOVA were considered: normal distribution of residues and homogeneity of variances in groups.

In addition, paired t-test was used to compare pain intensity in pre and post-test in every group separately. The significance level was set at  $P < 0.05$ .

**3. Results**

Individual characteristics were compared between groups using the ANOVA test for scale data (e.g., age and height) and no significant difference was observed between the groups ( $P > 0.05$ ), which is shown in Table 3.

In Table 4, the ANCOVA showed no significant differences between groups in VAS ( $F(2, 56) = 1.39, P = 0.258, \eta^2 = 0.14$ ). Comparisons of mean pain intensity are shown in Figure 1. A significant reduction in pain intensity was observed after therapy intervention as follows: OEH (32.79%,  $P < 0.001$ ), HT (29.58%,  $P = 0.006$ ), and HT (22.01%,  $P = 0.012$ ).

**Table 2.** Method of Hydrotherapy Exercise

Compositions	Methods
Waking (forward, backward and side) 	Counteract the dynamic resistance, strength, and stretching of the iliopsoas muscle and contralateral hip flexor muscles. The person walks to forwards, backward, right, and left. (Each direction for about 2 to 3 minutes).
Bring knee to chest 	Strengthen and stretch the muscles of the hip flexors and extensors and strengthen the rectus abdominis. In the supine position, the person grabs the handrail, floats in the water, extends the hip and knee joint, and returns to the first position (Return the knee to the chest). 3 set×20-30 rep.
Twisting side to side 	Active rotation exercise is to mobilize the hip joint and thoracic/lumbar spine and strengthen and stretch the external and internal oblique abdominis muscles. Place hands on the handrail, then place the knee and thigh joint at an angle of about 90° and rotate it to the right and left sides. 3 set×20-30 rep.
Top elbow to knee 	Strengthen the abdominal muscles, especially the inside and outside, and hip flexors and mobilization of the hip joint and spine. Place the legs on the floor of the pool, then, with flexion of the hip and upper extremities, bring one hand to the knee of the opposite side, and then do the opposite side. 3 set×20-30 rep.
Leg kicks 	To counteract the dynamic resistance and strengthen the hamstring and quadriceps muscles. The person leans against rails or walls and kicks in a way that exerts a force similar to the movement of a bicycle. 4 set×20-30 rep.
Posterior pelvic tilt 	Strengthens the abdominal and gluteal muscles and stretches the iliopsoas and quadratus muscles of the lumbar spine. The person leans back against the pool wall and tries to smooth the arch of the lumbar spine with the wall with an isometric contraction. 4 set×15 sec.

**Table 3.** Individual characteristics in three treatment groups

Variables	Mean±SD			P
	Online Exercise at Home (n=20)	Hydrotherapy (n=20)	Physiotherapy (n=20)	
Age (y)	38.5±12.68	35.1±15.12	37.3±13.11	0.125
Height, cm	171.5±20.77	167.8±24.14	173.1±20.20	0.078
Weight, kg	68.7±8.14	70.2±7.10	69.8±9.44	0.455
Body mass index, kg/m <sup>2</sup>	23.4±1.81	24.9±1.50	23.3±1.41	0.314

PHYSICAL TREATMENTS

**Table 4.** Results of analysis of covariance for pain intensity

Source	Sum of Squares	df	Mean Square	F	P	η <sup>2</sup> <sub>2</sub>
pre	8.625	1	8.625	2.452	0.001	0.42
groups	9.755	2	4.877	1.386	0.258	0.14
Error	196.999	56	3.518			

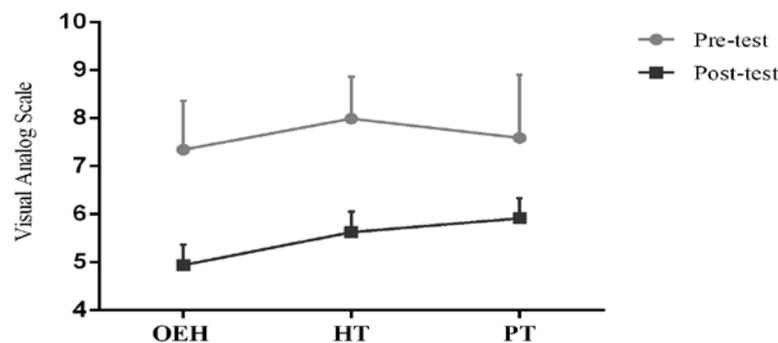
PHYSICAL TREATMENTS

### 4. Discussion

To our knowledge, this is the first study to compare OEH, hydrotherapy exercise, and physiotherapy in patients aged 25-45 years with NCLBP. The results showed that the pain intensity decreased significantly after the implementation of all three different treatment approaches. Although there was no significant difference between the groups, the outcome of the online core stability exercise at home was more prominent.

In the first hypothesis, our results are consistent with some studies in terms of reducing patients' pain through exercise at home [22, 24, 30]. On the other hand, some studies are inconsistent in terms of relative superiority over other approaches. Bronfort et al. compared the three methods of supervised exercise, spinal manipulation, and home exercise for 12 weeks and reported that exercise

under the supervision of specialists, manipulation, and home exercise, respectively, were more effective in reducing pain in these patients [27]. In another study, Schulz et al. compared home exercise program supervised exercise plus home exercise program, or spinal manipulative therapy at 12 weeks, and stated that pain intensity was decreased (30% to 40%) after treatment in all three methods with the largest difference (8%) favoring manipulative therapy and home exercise over home exercise alone [31]. Torstensen et al. evaluated the effect of three progressive therapies, physiotherapy, and personal exercises on the pain of these patients [10]. This agreement might be related to the similarity in the use of Williams exercises combined with lumbar stabilizers training that could effectively match the results of the two studies. In general, there are fundamental differences in the kinetics and kinematics of our movement pattern exercises with them. In most previous studies, home exercises have been



**Figure 1.** Comparison of mean pain intensity in pre-test and post-test  
OEH: Online Exercise at Home; HT: Hydrotherapy; PT: Physiotherapy.

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performed without online supervision, and this principle has been observed in our study as the first approach. On the other hand, due to the acceptable results of stability exercise [1, 16], we focused only on these exercises aimed at strengthening the lumbopelvic muscles isometrically and isotonicity as a second approach, which is less seen in other studies. Furthermore, the term positions and performing the correct techniques of daily activities is a very important third approach that we have considered. Sahrman et al. also confirmed this issue and stated that the main musculoskeletal disorders, such as CLBP are due to the implementation of incorrect daily movement techniques and their repetition over time [32].

However, hydrotherapy is the second effective and significant hypothesis in improving patients' symptoms after the home exercise approach from the numerical point of view, which does not show significant results between the three methods. From the inconsistent results, we can mention the study by Dundar et al. They showed that aquatic exercise interventions have more significant effects than home-based exercise, which is in stark contrast to our results [20]. The most important possible reason for the superiority of water training can be attributed to the lack of direct supervision of specialists in the land training group. Because in the follow-ups, patients shared their problems and physical condition with the therapists only once a week by phone [20]. Similar findings were repeated by Bello et al. after six weeks of training. However, in their study, the land-based exercise group was performed in the presence of a specialist [33]. The type of exercise protocol can be used to justify this finding; these researchers designed the type, dose, and movement patterns in water and land exercises are quite similar. On the other hand, Sami et al. could not find a significant difference in comparison between hydrotherapy, relaxation, and McKenzie exercise methods, while in their study, all three methods had significant effects on improving pain symptoms [18]. Our results are consistent with the reports of these researchers in terms of hydrotherapy effects [34].

The third hypothesis of the present study shows that physiotherapy is not superior but an effective method after home and water exercises in reducing patients' pain. Several researchers have repeated this finding in the past and are consistent with their reports [35, 36]. Cecchi et al. compared the three methods of spinal manipulation, trunk training, and physiotherapy. Their results showed that spinal manipulation exercises were better than the other two groups [35]. Noori et al. found that both exercise therapy and physiotherapy positively reduced the

subjects' pain; however, no significant differences were observed between the two methods [36].

Nonetheless, in our study, the physiotherapy approach was numerically placed after exercise at home and hydrotherapy. However, this situation was not statistically significant, inconsistent with the study of Kumar et al. They tested physiotherapy modalities (ultrasound, short-wave diathermy) and exercise (lumbar strengthening) against dynamic stability exercises on hockey players with moderate pain. After four weeks, although the physiotherapy group received the usual exercises, the stability exercises group became more efficacious [37]. From this point of view, one of the possible reasons can be attributed to doing stability group exercises in the clinic, and on the other hand, not using TENS in the physiotherapy group is another possible reason.

Hence, in general, all three approaches we consider are effective in improving these patients' pain, but with an overview of the benefits and harms of each of these methods, the best option can be selected, which we will mention the most important ones below. If we pay attention to the research process, we will find that the time spent performing exercises at home was about 20 to 30 minutes. This time in physiotherapy and hydrotherapy is about 45 to 60 minutes, in addition to the time that a person goes to the clinic or pool also adds to the disadvantages of these two methods, which can even increase the pain and prolong the treatment process for the patient. On the other hand, the cost of treatment for treating patients in physiotherapy and swimming pools is much higher than practicing at home, which adds to the disadvantages of both approaches. It is necessary to mention that there is no set time for performing exercises at home and the persons can do these exercises according to their free time, and more importantly, after the epidemic of the COVID-19, the home environment is the safest place against public treatment places and swimming pools [24]. In contrast, doing stability exercise may not be possible for patients with severe pain, whereas physiotherapy and hydrotherapy will be preferred, respectively [22]. However, in order to minimize the recurrence of pain and the possibility of skeletal injury, we designed exercises in a closed movement chain.

In conclusion, the present study reaffirms the hypothesis of the effectiveness of all three methods (physiotherapy, hydrotherapy, and OEH) in treating these patients [7, 11, 12], and the superiority of one of these approaches could not provide significant results. However, due to the advantages and disadvantages mentioned above and, on the other hand, improved pain scores numerically on the

VAS scale, OEH is introduced as the best option for the treatment of NCLBP.

This study has two weaknesses. First, minimal access to research that has done home exercises under online supervision has made it difficult to discuss our findings with this type of research. Second, the lack of a control group to more accurately diagnose the effects of each intervention over time is one of the most important weaknesses of our study because it is possible that patients' pain would have worsened without the use of treatment and management methods or vice versa.

In contrast, our study has strengths in several respects: 1) covering the most important weakness of exercise at home, despite the many benefits reported in previous studies, monitoring patients online [23, 24, 27, 30], 2) the use of stability exercises is one of the best therapeutic approaches globally for the home exercise group [1, 11, 38]; 3) comparing the most popular and effective non-invasive strategies [11, 22, 33, 34] in a research design to help more accurately identify the effects of each for researchers, especially future review and meta-analysis; 4) blinding therapists or specialists in order to achieve more reliable results, and 5) using online exercises for the first time compared to physiotherapy and hydrotherapy methods. We suggest that future researchers use exercise-supervised online therapy to evaluate other side effects of LBP pain alongside the double-blind control group (patients and therapists).

## 5. Conclusion

The present study results indicated the effectiveness of all three approaches in reducing chronic pain in these patients. Although numerically, home exercises, hydrotherapy, and physiotherapy were ranked first to third, respectively, no significant difference was observed in the superiority of one of these methods. However, some important points could convince us to choose exercise at home.

## Ethical Considerations

### Compliance with ethical guidelines

All participants in this study have read and signed the consent form. Participants were informed of the process and purpose of the study and had the right to withdraw from the study at any time if they were not satisfied. In addition, if they wanted to know the results of this research, the information obtained was easily provided to them. The local ethics committee approved the whole research process.

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## Authors' contributions

Data analysis and manuscript writing: Arash Khaledi; Data collection and manuscript correction: Mohammad Bayattork; Investigation, Mohammad Bayattork, and Arash Khaledi.

## Conflict of interest

The authors declared no conflict of interest.

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