Therapeutic Exercise Programming for Nonspecific Low Back Pain

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Abstract

Nonspecific low back pain is a prevalent cause of injury and disability in the world today. However, most people with this condition continue to live in discomfort because they do not know how reduce their pain. Exercise is one of the many ways that those with lumbar pain can find relief. By combining a wide variety of exercises that have been shown to reduce pain while increasing strength, range of motion, activity, and functionality, this thesis attempts to create an evidence-based generalized therapeutic exercise program that those with nonspecific low back pain can utilize to live an active and healthy lifestyle while also improving their symptoms related to lower back pain.

Disabilities and Nonspecific Lumbar Pain

According to the Centers for Disease Control (CDC), a disability is "any condition of the body or mind (impairment) that makes it more difficult for the person with the condition to do certain activities (activity limitation) and interact with the world around them (participation restrictions)" (Centers for Disease Control and Prevention, 2020, para. 1). By this definition, nonspecific low back pain (NSLBP) is considered a disability. While there is a spectrum of NSLBP that ranges from mild discomfort to severe limitations, it is a prevalent issue in all of its forms. In fact, "low back pain is one of the most prevalent and costly musculoskeletal disorders in the United States" (Haladay et al., 2013, p. 1). One in three adults during their lifetime will experience back pain lasting for at least three months and is the chief complaint in about 2.5% of all office visits to a physician (Durstine et al., 2016).

Importance of Exercising with NSLBP

Exercising with disabilities, especially NSLBP, is important for several reasons. First, exercising can benefit the participant physically. Exercising can improve overall health, reduce risks for diseases, and decrease disability rating (Bloxham et al., 2020; Katz et al., 2020; Nikolajsen et al., 2021; Schmid et al., 2019). Additionally, physical exercise can improve mental health, both through the activity itself and by decreasing the disability that is causing mental distress (Bloxham et al., 2020; Katz et al., 2020; Nikolajsen et al., 2021; Schmid et al., 2019).

Obstacles to Exercising with Disabilities

However, it is difficult for many people with disabilities to exercise for several reasons. There are numerous barriers to exercising including health concerns, transportation barriers, exercise program costs, lack of energy and motivation, lack of understanding of how to adapt exercises for their specific disability, social pressures from non-disabled individuals, and often

unwelcoming atmospheres in public gyms (Nikolajsen et al., 2021; Manaf et al., 2021). While these barriers depend on the level of disability the person is experiencing, it is something to be considered with clients at any level.

Methods of Exercising with Disabilities

Knowing that exercising with physical disabilities is important but difficult, the next step is to understand how to exercise. There are several different methods of exercising with differing disability levels, and they all have benefits and disadvantages.

Regular Gyms

One option is to work out in a gym with non-disabled individuals. Some gyms have adapted their facilities and workout equipment to accommodate for those with disabilities, which is a step in the right direction. However, a disadvantage to using regular gyms for those with physical restrictions is perceived judgement from non-disabled individuals (Nikolajsen et al., 2021).

Disability-Specific Gyms

Another option growing in popularity is gyms specifically for disabled individuals. An example of this type of fitness center is the SPIRIT Club (Ciner, 2021).. This program is a 3,000 square foot facility designed to be 100% accessible to those with disabilities. Since COVID, they have developed online exercise programs with four levels of difficulty for every video allowing people of different levels of ability and strength to participate. Their goal is to provide services to people with and without disabilities where they can work out together (Ciner, 2021). Another example is AccesSurf. This nonprofit empowers people with disabilities to perform adaptive swimming and surfing (Schmid et al., 2019). Both of these options allow people with disabilities to exercise in a location specifically designed for them and provides them the unique opportunity to exercise to their exact ability level with others who have similar conditions.

Exercising at Home

For convenience and financial reasons, some individuals choose to exercise at home. Whether it is through instructional videos online or prescribed programs from a physical therapist or a doctor, working out at home is a choice to consider. It takes away the stigma and social pressure of working out in public and allows individuals to personalize their exercises as needed. One study investigated the effects of at home exercise program in those with back pain and found that these exercises decreased disability rating by 19% (Bloxham et al., 2020). However, there are some drawbacks to consider with at-home exercise. Firstly, there is no supervision from professionals so exercises might not be performed with correct form and technique which can lead to problems in the future. Additionally, some at-home exercises require specific equipment which can be costly. There are several benefits and drawbacks with home exercise programs that should be considered before deciding which option is best for the individual.

Measuring Progress: Outcomes

Regardless of which exercising method is used, monitoring progress to ensure proper treatment is crucial. Progress can be measured by monitoring patient-oriented outcome measures or clinician-oriented outcome measures. Patient-oriented outcomes measures are more subjective and include things such as disability rating, pain scale, and mental health that the patient reports themselves. Clinician-oriented measures are more objective and include measurements such as weight, range of motion, blood pressure, and any other measurable value that demonstrates overall physical health improvements (Banks et al., 1980; Manniche et al., 1994; Riley et al., 2019).

Patient-Oriented Outcomes

Disability Rating

The first way to measure progress in those with disabilities is using disability rating. Disability rating can be modified depending on the type of pain present and what information the researcher desires to know. One option specifically for low back pain is the Oswestry Low Back Pain Disability Questionnaire (Fairbank & Pynest, 2000). This questionnaire includes measurements of pain intensity, disability, and physical impairment. Since it was designed to monitor the results of low back pain treatment, it is a useful way to measure the effectiveness of treatment. For questions involved in Oswestry Low Back Pain Disability Questionnaire, see Table 1-3.

Table 1

Example questions for disability rating

Section 1 – Pain intensity

- ☐ I have no pain at the moment
- ☐ The pain is very mild at the moment
- ☐ The pain is moderate at the moment
- ☐ The pain is fairly severe at the moment
- ☐ The pain is very severe at the moment
- ☐ The pain is the worst imaginable at the moment

Section 2 – Personal care (washing, dressing etc)

- ☐ I can look after myself normally without causing extra pain
- ☐ I can look after myself normally but it causes extra pain
- ☐ It is painful to look after myself and I am slow and careful
- ☐ I need some help but manage most of my personal care
- ☐ I need help every day in most aspects of self-care
- ☐ I do not get dressed, I wash with difficulty and stay in bed

Section 3 – Lifting

- ☐ I can lift heavy weights without extra pain
- ☐ I can lift heavy weights but it gives extra pain
- ☐ Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently placed eg. on a table
- ☐ Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned
- ☐ I can lift very light weights
- ☐ I cannot lift or carry anything at all

Section 4 – Walking*

- ☐ Pain does not prevent me walking any distance
- ☐ Pain prevents me from walking more than 1 mile
- ☐ Pain prevents me from walking more than 1/2 mile
- ☐ Pain prevents me from walking more than 100 yards
- ☐ I can only walk using a stick or crutches
- ☐ I am in bed most of the time

Table 2

Example questions for disability rating

Section 5 – Sitting

- ☐ I can sit in any chair as long as I like
- ☐ I can only sit in my favourite chair as long as I like
- ☐ Pain prevents me sitting more than one hour
- ☐ Pain prevents me from sitting more than 30 minutes
- ☐ Pain prevents me from sitting more than 10 minutes
- ☐ Pain prevents me from sitting at all

Section 6 – Standing

- ☐ I can stand as long as I want without extra pain
- ☐ I can stand as long as I want but it gives me extra pain
- ☐ Pain prevents me from standing for more than 1 hour
- ☐ Pain prevents me from standing for more than 30 minutes
- ☐ Pain prevents me from standing for more than 10 minutes
- ☐ Pain prevents me from standing at all

Section 8 – Sex life (if applicable)

- ☐ My sex life is normal and causes no extra pain
- ☐ My sex life is normal but causes some extra pain
- ☐ My sex life is nearly normal but is very painful
- ☐ My sex life is severely restricted by pain
- ☐ My sex life is nearly absent because of pain
- ☐ Pain prevents any sex life at all

Section 9 – Social life

- ☐ My social life is normal and gives me no extra pain
- ☐ My social life is normal but increases the degree of pain
- ☐ Pain has no significant effect on my social life apart from limiting my more energetic interests eg, sport
- ☐ Pain has restricted my social life and I do not go out as often
- ☐ Pain has restricted my social life to my home
- ☐ I have no social life because of pain

Table 3

Example questions for disability rating

Section 7 – Sleeping

- ☐ My sleep is never disturbed by pain
- ☐ My sleep is occasionally disturbed by pain
- ☐ Because of pain I have less than 6 hours sleep
- ☐ Because of pain I have less than 4 hours sleep
- ☐ Because of pain I have less than 2 hours sleep
- ☐ Pain prevents me from sleeping at all

Section 10 – Travelling

- ☐ I can travel anywhere without pain
- ☐ I can travel anywhere but it gives me extra pain
- ☐ Pain is bad but I manage journeys over two hours
- ☐ Pain restricts me to journeys of less than one hour
- ☐ Pain restricts me to short necessary journeys under 30 minutes
- ☐ Pain prevents me from travelling except to receive treatment

For each section the total possible score is five. If the first statement is marked, the section score is zero; if the last statement is marked, it is five. The score is added up and divided by the 50

total questions, and then multiplied by 100 to get a percentage. The Oswestry Low Back Pain Disability Questionnaire rates the different possible scored percentages as follows:

> 0-20%: The patient can cope with most living activities. Usually, no treatment is indicated apart from advice on lifting sitting and exercise. 21-40%: The patient experiences more pain and difficulty with sitting, lifting and standing. Travel and social life are more difficult, and they may be disabled from work. Personal care, sexual activity and sleeping are not grossly affected, and the patient can usually be managed by conservative means. 41-60%: Pain remains the main problem in this group, but activities of daily living are affected. These patients require a detailed investigation. 61-80%: Back pain impinges on all aspects of the patient's life. Positive intervention is required. 81-100%: These patients are either bed-bound or exaggerating their symptoms. (Fairbank & Pynest, 2000, pp. 2940-2953)

This disability rating index is just one option of those that can be used to subjectively monitor disabilities. Questionnaires such as this one allow both the patient and the practitioner to see how the patient is progressing throughout the program and if there are any necessary changes to decrease pain levels and increase mobility or the ability to perform desired activities.

Decreased Pain Rating

However, the patient not only desires to be healthier but also desires to be in less pain. Those with disabilities are unique in that the goal of care is not just overall health but also the amount of pain that the client feels. The Numeric Pain Rating Scale (NPRS) is an eleven-point ordinal system that allows the patient to describe the level of pain that they are experiencing. Zero represents no pain, and ten represents the worst that pain can be (Riley et al., 2019). This

scale can be used to keep track of progress and make sure that the goals and needs of the patient are being addressed properly.

Mental Health

Researchers have also evaluated mental health as a method to monitor the efficacy of an exercise program. While the main goal of physical activity is to help improve physical health, mental health is also an important factor, especially in those with disabilities. Subjective self-report forms can be used where the client reports their mental health before, during, and after the program. One such form is the GHQ-12, where the client answers twelve questions about their mental state recently (Banks et al., 1980). If an exercise program is effective, the answers to these sorts of questions should improve over time.

Clinician-Oriented Outcomes

Overall Physical Health

Overall physical health is another way to monitor progress of an exercise program. While this does not directly show the extent to which the program is affecting their disability, it does show if the exercises are helping the patient to become an overall healthier individual. This should be one of the main goals of exercising, even in those with disabilities. This can be measured numerically using values such as weight, blood pressure, muscular strength, heart rate, aerobic fitness, body mass index, endurance, flexibility, body composition, and range of motion. These measurements will allow practitioners to see the overall health of the individual and whether or not the program that is being used is positively impacting the client. Patients should leave an exercise program healthier than they entered it.

What Can Be Done

An exercise program that can help those with disabilities, especially NSLBP, is one option of treatment. Of course, there are limitations to exercise programs for NSLBP due to the wide range of causes and disability levels within those who have NSLBP. An individualized program by a physical therapist or personal trainer would be the most beneficial for patients who have access to these resources and know the cause of their NSLBP so that their specific abilities, limitations, and desires can be taken into account. However, the pathophysiology of low back pain is difficult to pinpoint, because so many possible sources of pain exist, ranging from discs to nerve roots to facet joints to bone to musculotendinous and connective tissues. Isolating the source or sources of pain is uncommon, so sometimes a more generalized approach is better for the patient (Durstine et al., 2016). While not as effective as a specific exercise program, general exercises that have been shown to improve general NSLBP will be included in an attempt to help those without access to such personalized resources. Individuals should take into account what exercises they can and cannot perform, and in what environments, so that they can benefit from this information and see personal improvements in the aforementioned areas.

Therapeutic Exercise Intervention

Generally, in those with NSLBP, the “hamstrings, iliopsoas, piriformis, and tensor fasciae latae are overactive due to weak hip abductor, extensor, and core muscles” (Kim & Yim, 2020, p. 1). Therefore, an exercise program that emphasizes core stability and hip stretches would be beneficial (Durstine et al., 2016; Kim & Yim, 2020). Other exercises that have been shown to significantly reduce back pain include aerobic exercises, postural education, home exercises, and yoga (Cavalcanti et al., 2020; Durstine et al., 2016; Lalkate et al., 2020; Tekin et al., 2020; Zhu et al., 2020).

Interventions for Enhancing Core Stability

In order to strengthen the core and transfer the brunt of the force and stress of movement away from your spine and through your muscles instead, there are several different exercises one can perform. Planks, side planks, bridge, abdominal hollowing, straight leg raise from prone, alternate arm and leg raise from quadruped, contraction of transverse abdominal and pelvic floor muscles, and prone bridge are just a few examples of core exercises that have been shown to help reduce nonspecific low back pain (Kim & Yim, 2020; Kline et al., 2013; Sengul et al., 2021).

Exercises for Hip Musculature

For hip abductors, exercises can include side-lying abduction with internal rotation and prone heel squeeze (Kim & Yim, 2020). In order to stretch hip extensors, quadruped hip extension in a four-point kneeling position and standing gluteal squeeze would be beneficial in reducing low back pain. Hip flexors are also major contributors to lumbar spine stability. If the hip flexors are stiff, pain in the lumbar spine may occur (Konrad et al., 2021). Therefore, some exercises to target the hip flexors include “standing hip flexor stretch and a modified kneeling lunge stretch” (Mettler et al., 2019, p. 3341). In addition to these exercises, some general hip stretches that are beneficial include the hamstring stretch, iliopsoas stretch, piriformis stretch, and tensor fasciae latae stretch (Irshad et al., 2016; Kim & Yim, 2020).

Aerobic Exercise

If patients would like to attempt aerobic exercises to reduce pain and disability, working out on a treadmill is one option. The treadmill should start at 60% of their maximum heart rate and increase by 5% each week up to 85% of their maximum heart rate (Tekin et al., 2020). Another option is postural education, in which the person is taught how to sit and stand in such a

way that it decreases the pain caused by incorrect posture, especially in youth (Calcalcanti et al., 2020). Finally, some simple home exercises that can be performed from the comfort of the home include pelvic tilt, waist or hip muscles stretches, cat-camel exercises, abdominal strengthening exercises, lumbar flexion exercises, hip flexion and extension, abduction exercises, range of motion, and stretching and strengthening (Tekin et al., 2020).

Yoga

One last option for decreasing nonspecific low back pain is yoga (Lalkate et al., 2020; Zhu et al., 2020). It has been shown to reduce pain and disability rating, as well as increasing lumbar flexion range. Some examples of postures include Padmasana, Ardh Matsyendrasana, Yog Mudra, Paschimotanansana, Bhujangasana, Naukasana, ArdhaChakrasana, and Trikonasana (Lalkate et al., 2020).

Preparing the Program

In order to create an exercise program, it is crucial to understand the prevalence of NSLBP today, the importance of exercising to reduce disability, the difficulties and challenges facing those with disabilities, and what exercises can specifically combat NSLBP. This knowledge can provide the ability to create a unique exercise program that can help those with NSLBP to live lives with less pain, more mobility, less disability, and more overall health.

Method

Due to the benefits of exercising with disabilities and the lack of general knowledge of how to exercise with disabilities, an exercise plan was created for those with disabilities. Specifically, due to the prevalence of NSLBP, the exercise program created can hopefully help reduce pain and increase physical activity in those with NSLBP (Amorim et al., 2019; Haladay et

al., 2013). The generalized program for NSLBP follows the CDC4 guidelines for those with chronic conditions as seen in table 4 (Durstine et al., 2016).

Table 4

Generalized exercise program recommendations for NSLBP

Mode	Frequency	Duration	Intensity	Progression
Aerobic • Large-muscle easily accessible activities such as walking as the basic program • Aquatics recommended for those with musculoskeletal problems during weight-bearing activity • Other fun-to-do large-muscle activities such as cycling or gardening are alternatives	4-5 days/ week	Start at any duration, as tolerated Goal of 40 min/session 20 min if a combined session with strength training exercises	Start at self-selected walking speed, at an intensity meeting the talk test Gradually increase to an RPE of 3-5/10	From self-selected pace, over 4 weeks gradually increase time to 40 min each session, increasing intensity as tolerated. Persons interested in higher-intensity exercise should obtain guidance before doing it.
Strength • Functional gravity-based exercises recommended as the basic program • Weight training an alternative for those who are interested and motivated to do it	2-3 days/ week	For body weight exercises: Functional exercises (see chapter 4), one set during TV commercials For weights: 1 set of 8-12 reps to fatigue	• Sit to stand: 8 reps • Alternative: stair steps (standard is 10 steps) • Arm curls: 8 reps with ~4 kg (can use plastic milk jug filled with water) • 50-70% of 1RM	Build gradually to as many sets a day as tolerated. For curls and weight training: Increase to 2 sets over ~8 weeks.
Flexibility Hips, knees, shoulders, and neck	3 days/ week	20 s/stretch	Maintain stretch below discomfort point	Discomfort point should occur at a ROM that does not cause instability. This discomfort point will vary between people and with different joints in each person.
Warm-up and cool-down	Before and after each session	10-15 min	Easy RPE <3/10	Should be maintained as transition phase, especially for those doing higher-intensity physical activity.

Potential Exercises for NSLBP with Instructions

Upper Body:

- Dumbbell lateral raises
    - Can be performed at home, in a regular gym, or disability specific gym. Stand straight, with arms down at sides holding dumbbells, palms facing inwards. Lift arms a few inches and pause for a second to ensure proper muscle activation. Then lift arms straight out to the sides until the weights reach shoulder height.

Pause for a moment with the weights at shoulder height, then lower the arms slowly to the initial position. Repeat. Inhale as the weights are lifted and exhale as the weights are lowered back down to the starting position. Do not use too heavy weights, use momentum, or drop your chin to your chest. MODIFICATION: bend elbows at 90 degrees and perform the same movement, or don't use weights. For more challenging modifications, use kettlebells instead of dumbbells.

- Assisted pull up
    - Can be performed at home if a chair and pullup bar are present, but usually performed in a gym.
    - With chair (at home or in gym without assisted pullup machine): Place a chair underneath the pullup bar. Grip the bar in an overhand grasp a little wider than shoulder width. Lift body as high as possible using just your arms. When you can't lift yourself any further, press off the chair with one leg, only using as much strength from your leg as is necessary to get your chin slightly above the bar. Lower back down into the starting position, and then do the same exercise, but using the other leg for help this time.
    - With machine (gym only)- stand in front of the assisted pull up machine, grip the bar in an overhand grasp a little wider than shoulder width, and step up onto the foot bar. Lift yourself until your chin is slightly above the bar. Lower back down into the starting position.
- Lat pull downs
    - Can be performed in regular gyms and disability specific gyms. Using the lat pull down machine, place the pad so it sits securely on the thighs. Hold the bar with a

wide grip, keeping the eyes forward and the upper body upright. “Retract your shoulder blades and pull the bar down in front of you to your upper chest. Squeeze your lats at the bottom of the move (Rider, 2021, para. 5).” DO NOT lean back to aid the movement, and when grip starts to loosen, reduce the amount of weight for safety.

- Bench press
    - Can be performed in either type of gym. Can also be done at home with proper equipment. On the bench, recline into a supine position with the back flat. Grasp the bar at approximately shoulder-width or slightly wider. Lift the bar out of the rack with elbows fully extended above the chest. Lower the bar slowly to chest at approximately nipple level while breathing in. Push up and breathe out, keeping the wrists stiff and watching a spot on the ceiling to ensure the bar moves along the same path every time the action is performed.

Core

- Bird dogs
    - Can be performed in any location. Yoga mat may be desired for the comfort of knees but is not required. Starting in a quadruped position (on your hands and knees), lift opposite arm and leg parallel to floor, then lower back to quadruped. Switch sides and repeat the motion.
- Glute bridge
    - Can be performed in any location. Yoga mat may be desired for comfort but is not required. Lie on back, hands at sides, knees bent, feet flat on floor hip width apart. Squeeze glutes and abs, push through heels, and lift hips a few inches. Form a

straight line from shoulders to knees (DO NOT hyperextend lower back). Hold position, then lower back down to the floor.

- Tabletop leg press
    - Can be performed in any location. Yoga mat may be desired for comfort but is not required. Lay on back, knees bent 90 degrees and stacked over hips. Contract abs and press low back into ground. Put hands on quads and push quads towards your hands while pushing your hands toward your quads. This is an isometric exercise meaning that there should be no movement during the action. Hold, release, and repeat.
- Dead bug
    - Can be performed in any location. Yoga mat may be desired for comfort but is not required. Lie on back with knees bent 90 degrees. Lower the right arm and the left leg or vice versa to the floor. Slowly bring them back up to the original position with the knees bent and the arms extended. Do other side and repeat for ten repetitions.

- Pelvic Tilt
    - Can be performed in any location. Yoga mat may be desired for comfort but is not required. Lie on the back with the knees bent and the feet flat on the mat. Press the back against the mat by tightening the abs and tilting the pelvis up slightly. Hold for approximately 10 seconds.

Lower Body

- Reverse lunge

  - Can be performed in any location. Yoga mat may be desired for comfort but is not required. Place feet shoulder width apart, with hands on hips or behind the head. Step back about two feet with one foot, landing on ball of foot (keep heel off of the ground). Bend both knees, creating 90-degree angles with both. Place the shoulders above the hips, chest upright, and the shin of the front foot perpendicular to the floor with knee stacked above ankle. Butt and core should be engaged. Push through heel of front foot to return to standing. Repeat on same side, then switch to other side.

- Forward lunge
  - Can be performed in any location. Yoga mat may be desired for comfort but is not required. Is NOT recommended for those with knee problems. Instead, reverse lunges are better for those with knee problems. Place feet shoulder width apart, put hands on hips or behind the head, step forward approximately two feet with a foot, and plant it firmly on ground. Bend both knees to 90-degree angles. Shoulders should be above the hips, chests ought to be upright, and the shin of the front leg will be erect with the knee stacked above the ankle. Butt and core should be engaged. Push through front foot to return to standing. Repeat, then perform on other side.

- Leg press
  - Must be performed on a leg press machine, so this exercise is usually performed at a gym. Sit on the leg press machine with back and head resting on the padded support. Place feet on the footplate about hip-width apart and make sure that heels are flat. Bottom should be flat against the seat, knees should be at about 90

degrees, and knees should be in line with feet and bowed in or out. Grasp the assist handles, stabilize the core, and drive the platform away with feet. Make sure heels stay flat to ensure that the front of the foot is never exclusively pushing the plate. Exhale and extend your legs, keeping your head flat against the seat. Extend with slow control, being careful not to perform the motion too quickly. Pause at the top of the movement. Do NOT lock or knees or let them bow in or out. Inhale and bring the footplate back down to starting position by bending knees. Keep feet and back flat throughout the entire movement. Start with 3 sets of 10 reps, and advance as you build up strength.

- Squats
    - May be performed at home or in either type of gym. Some variations require a bar/weights, others simply require body weight. Make sure to lift no more than you can handle and use a rack or a spotter for assistance if needed for safety.
    - With bar: Take bar off of rack and rest the bar on rear shoulder muscles NOT the neck. Take two steps back, and stand with feet about shoulder-width apart, toes pointing forward and slightly out. Look at a spot on the floor about two meters ahead of you to help keep your spine alignment neutral. “Sit” back as if aiming for a chair and descend until hip crease is below the knee. Keep weight on heels and drive back up to standing. Make sure that feet stay flat on the floor for the entire exercise, don’t drop the chin, keep the chest up, and keep knees in line with the toes, not letting them collapse inward.
    - Without bar: stand with feet slightly wider than hip width with the toes facing forward. Drive hips back, bending at knees and ankles and pressing knees slightly

open while “sitting” into squat position. Be sure to keep the heels and toes on the floor throughout the entirety of the squat and keep chest and shoulders up and back. Attempt to reach the level at which the thighs are parallel with the floor. Press into the heels to and extend the hips and knees to return to standing. Repeat (Warner, 2020).

Yoga

- All yoga exercises can be performed in any location. Yoga mat may be desired for comfort but is not required.
- Padmasana
    - Sit on the floor with legs extended. Bend one knee out to the side and hold that knee and foot in hands. Rotate leg from the hip, making sure not to rotate from the knee, and bring foot to the opposite hip crease. Do the same thing on the other side, bringing the foot over the other and into the opposite hip crease. Rest feet on upper thighs and release knees to the floor (beginners may need a block or towel roll under the knees if they cannot reach the floor). Sit up tall, straighten spine, and lift chest. Do not round the spine. Take slow deep breaths and hold the pose for as long as comfortable. This stretch is a good hip opener.
- Ardha Matsyendrasana
    - Sit up straight with legs out in front. Place feet together and keep spine neutral. Bend right leg so that the heel of that foot is next to the opposite hip. Then take left leg and put it next to the right knee, going over the top of it to the other side. Twist waist, neck, and shoulders toward the right side of the body. Set your gaze over the right shoulder. Keep spine upright. Place the right hand on the ground

behind you, and the left hand on your left knee. Hold pose for 30-60 seconds with deep breaths. Repeat on other side.

- Paschimottanasana
    - Sit up straight with legs in front and toes up toward the ceiling. Stretch arms up above the head, elongating the spine. Fold at the hips and reach for the toes, keeping neck and back straight while bending forward. Do not hunch the back. Can use a strap for modification if needed.

- Bhujangasana
    - Lie flat on stomach, with toes flat and forehead resting on the mat. Have legs together with feet and heels touching. Place hands palm down under the shoulders, keeping elbows parallel and close to chest. With a deep breath in, lift head, chest, and abdomen off the floor, keeping belly button on the floor. Then pull back torso with the support of the hands. Slowly curve back and straighten arms if possible (don't strain the shoulders, bend elbows if needed). Tilt head back and look up. Hold.

- Naukasana
    - Lie on back on the mat with feet together and arms down by the sides. "Take a deep breath in and as you exhale, lift your chest and feet off the ground, stretching your arms towards your feet (World Peace Yoga School, 2016)." Hold, exhale, and slowly lower back to ground. 3 reps

- Ardha Chakrasana

    - Standing, raise hands above the head or on the hips. Bend backwards and hold. Exhale while coming back to standing. 4 reps

- Trikonasana
    - Stand with feet wide. Pivot left foot while turning the other foot 90 degrees. Press into the outer heel of the left foot. Extend the right hand down to the floor and reach the left hand up toward the ceiling. Press the inside of the right foot into the floor and turn that thigh out toward the side. Reach the arms apart. Turn chest upwards and gaze as top thumb. Repeat on other side (Garden, 2020).

- Savasana
    - Lie on the back with legs straight or bent at the knee and arms relaxed by the sides with the palms facing up toward the ceiling. Close your eyes and remember to breathe organically. Permit the body to feel heavy, almost as if it is sinking into the ground. Relax each part of the body one at a time. Relax here for as long as desired. Then slowly begin to wiggle the fingers and toes and bring movement back into the body before slowly coming up to seated.

Aquatic:

- All aquatic exercises require the use of a pool with a firm wall. It is recommended to perform these exercises at a gym pool, but private or neighborhood pools can also be functional for those who do not have regular access to a gym with a pool.
- Pool pushups
    - “Start in the shallow end of the pool facing the wall and your feet on the floor. Place your hands on the pool edge. Press your body weight through the hands and lower yourself towards the wall as your arms bend at the elbow. Hold for three

seconds and then push off the wall to return to your starting position (Alliance Spine and Pain Centers, 2021)."

- Pool planks
    - Pool noodle needed for this exercise. Holding the noodle out in front, lean forward in the water while keeping the back straight. Push down on the noodle while going forward into a semi-plank. Lock elbows and keep feet on the floor. Hold the plank for up to 60 seconds.
- Knee stretch
    - In the shallow end of the pool, plant feet and relax arms at your side. March in place, lifting knee closer to the chest each time while maintaining balance.
- Pelvic stretch
    - Stand with feet on the bottom of the pool and the back towards the wall. Tuck tailbone and pelvis until back is rounded. Back should feel parallel to the wall and this is achieved by tightening abs and pushing hips forward. Hold, release, repeat.
- Flutter kicking
    - Holding onto the side of the pool, gently scissor kick legs with body parallel to the bottom of the pool.
- Regular Swimming
    - Regular swimming can be a healthy way to exercise without hurting the lower back. However, avoid strokes that involve twisting the body, as this can cause more pain.

Stretches:

- All of these stretches can be performed anywhere. Some of them may require a chair, wall/couch, or yoga mat.
- Knee to chest stretch
    - Gently pull one knee up to the chest until a stretch is felt in the lower back. Bring the knee as close to the chest as is possible without causing discomfort. Keep the opposite leg relaxed noting that this knee can be bent or extended for this pose. Hold for about 30 seconds. Repeat on the other side.
- Clamshell
    - Lie on one side with knees bent and with one leg stacked on top of the other. Keep the feet together and lift the knee that is on top until it is in line with the hip. Lower the top knee back to the starting position. Repeat, then switch sides.
- Hip opener/glute stretch
    - This stretch requires a chair. Sit in chair, place one foot on the floor, create a 90-degree angle with your knee making sure the knee and ankle are in a straight line. Place opposite ankle on top of the knee of the leg that is on the floor. Keep spine long and extended while folding at the hips over the shin of the top leg while exhaling. Hold position for 5 deep breaths, then come back up. Switch which leg is on the ground and which is on top, and repeat.
- Hamstring stretch
    - This hamstring stretch requires either a wall or a couch to perform. Lay on the floor next to the wall or couch. Straighten one leg as much as you comfortably can and place it on the wall or couch. The other leg can either be flat on the floor

or bent. Start holding for 10 seconds but work up to holding for 30 seconds. Repeat on other side.

- Downward dog
    - This yoga stretch may be more comfortable with a yoga mat, but it is not required. Start on the hands and knees with the hands a little in front of shoulders and knees below the hips. Spread palms and tuck the toes under. Exhale and lift knees from the floor. Lengthen tailbone away from the back of the pelvis and lift the sitting bones toward the ceiling. Inhale, and on the exhalation, push the top of the thighs back and reach the heels toward the floor. Straighten the knees but be sure not to lock them out. The shoulder blades should be retracted and depressed. Keep the head between the arms. “Stay in the pose for 10 or more breaths, then bend the knees as you breathe out and lower down into Child’s Pose (YJ Editors, 2022, para. 15).”

Exercise Program for Those with NSLBP

Table 5

Weekly Exercise Program Suggestion

Day of the Week	Warm Up	Upper Body	Core	Lower Body	Aerobic	Aquatic	Yoga	Stretches	Cool Down	RPE and Duration
Monday	10 Minute Warm Up in pool	N/a	N/a	N/a	N/a	•Flutter Kick. 2 sets, 10 reps. •Pelvis Stretch. Hold for 10 seconds, 10 reps. •Knee Stretch. 2 sets, 10 reps. •Pool Planks. 2 sets, 5 reps. •Pool Pushups. 2 sets, 10 reps.	N/a	Knee to Chest Stretch	10 minute Cool Down in pool	40 minutes total, RPE between 3-5
Tuesday	10 minute Warm Up	•Dumbbell lateral raises. 1 set, 8-12 reps to fatigue. •Assisted pull up. 1 set, 8-12 reps to fatigue	• Bird dogs. 1 set, 10 reps. • Glute bridge. 1 set, 10 reps.	•Reverse lunge. 1 set, 8-12 reps to fatigue. Can hold weights to make exercise more difficult or perform without weights. • Leg press. 3 sets of 10 reps, and advance as you build up strength. 50% of 1RM (one repetition maximum) for amount of weight.	N/a	N/a	N/a	Clamshell. 1 set, 20 reps on each side	10 minute Cool Down	See sets and reps for each exercise
Wednesday	10 minute Warm Up	N/a	N/a	N/a	40 minutes of cycling, flat terrain and proper posture (can start with 20 minutes of cycling if 40 minutes is too intense	N/a	N/a	Hip opener/glute stretch. Hold for 5 seconds, 1 set of 5 reps on each side.	10 minute Cool Down	40 minutes total, RPE between 3-5
Thursday	10 minute Warm Up	• Lat pull downs. 1 set, 8-12 reps to fatigue. 50% of 1RM for weight. • Bench press. 1 set, 8-12 reps to fatigue. 50% of 1RM for weight.	•Tabletop leg press. 1 set, 10 reps. •Dead bug. 1 set, 10 reps on each side.	•Squats. 1 set, 8-12 reps. Body weight or 50% of 1RM weight if using bar/weights. •Forward lunge (or reverse again if knee problems). 1 set, 8-12 reps to fatigue. Can hold weights to make exercise or challenging or just use body weight.	N/a	N/a	N/a	Back press ups (cobra). Hold for 20 seconds, 5 reps	10 minute Cool Down	See sets and reps for each exercise
Friday	10 minute Warm Up	N/a	N/a	N/a	Walk, 20 minutes, once in the morning and once in the evening	N/a	N/a	•Hamstring stretch. Hold for 20 seconds, 5 reps. •Downward dog. Hold for 10 seconds, 5 reps. •Pelvic Tilt. Hold for 10 seconds, 5 reps.	10 minute Cool Down	40 minutes total, RPE between 3-5
Saturday	10 minute Warm Up	N/a	N/a	N/a	N/a	N/a	•Yoga breathing exercises •Padmasana •Ardha Matsyendrasana •Paschimottanasana •Bhujangasana •Naukasana •Ardha Chakrasana •Trikonasana •Shavasana	N/a	10 minute Cool Down	See sets and reps for each exercise
Sunday	Day of rest	Day of rest	Day of rest	Day of rest	Day of rest	Day of rest	Day of rest	Day of rest	Day of rest	Day of rest

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