

A photograph of three people exercising in a gym. On the left, a man in a yellow polo shirt and white shorts is stepping on a grey aerobic step while holding a green dumbbell. In the center, a woman in a light blue t-shirt and grey leggings is also stepping on a grey aerobic step while holding a blue dumbbell. On the right, a man in a light blue polo shirt and grey shorts is stepping on a grey aerobic step while holding a red dumbbell. They are all smiling and looking towards the right. The gym has large windows in the background showing a parking lot with cars. The text "NSCA Guidelines for Training Specialist Population Groups" is overlaid in the center of the image in a bold, black font with a blue outline.

NSCA Guidelines for Training Specialist Population Groups

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Table of Contents

SIMPLE MECHANICAL BACK PAIN.....	6
EXERCISE RECOMMENDATIONS FOR CLIENTS WITH LOW BACK PAIN	6
OSTEOPOROSIS.....	8
EXERCISE RECOMMENDATIONS FOR CLIENTS WITH OSTEOPOROSIS	8
OSTEOARTHRITIS	10
EXERCISE RECOMMENDATIONS FOR CLIENTS WITH OSTEOARTHRITIS	10
JOINT REPLACEMENT.....	11
EXERCISE RECOMMENDATIONS FOR CLIENTS WITH JOINT REPLACEMENTS.....	11
RHEUMATOID ARTHRITIS.....	13
EXERCISE RECOMMENDATIONS FOR CLIENTS WITH RHEUMATOID ARTHRITIS.....	13
ASTHMA	15
EXERCISE RECOMMENDATIONS FOR CLIENTS WITH ASTHMA AND EIB	15
CHRONIC OBSTRUCTIVE PULMONARY DISEASE	17
EXERCISE RECOMMENDATIONS FOR CLIENTS WITH COPD.....	17
TYPE 2 DIABETES MELLITUS	18
EXERCISE MODIFICATIONS, PRECAUTIONS, AND CONTRAINDICATIONS FOR CLIENTS WITH TYPE 2 DIABETES.....	18
TYPE 1 DIABETES MELLITUS	21
EXERCISE RECOMMENDATIONS FOR CLIENTS WITH TYPE 1 DIABETES.....	21
EXERCISE MODIFICATIONS, PRECAUTIONS, AND CONTRAINDICATIONS	21
ANGINA	23
EXERCISE RECOMMENDATIONS FOR CLIENTS WITH ANGINA.....	23
EXERCISE RECOMMENDATIONS FOR CLIENTS WITH HYPERTENSION	25

General Exercise Guidelines for Clients Who Are Obese

Parameter	Guideline
Exercise intensity	40-85% heart rate reserve
Weekly exercise duration (to prevent weight gain)	150-300 min
Weekly exercise duration (to prevent regain)	300+ min per week
Weekly caloric expenditure for weight loss	1,200-2,000 kcal
Weekly caloric expenditure to prevent regain	2,000+ kcal
Exercise frequency	5 or more days per week, preferably 7 days per week
Minimum exercise duration per session	10 min (for very deconditioned clients)
Exercise duration goal per session	30 min (minimum)
Optimal exercise duration for weight loss	45-60 min per day
Optimal exercise duration to prevent regain	60-90 min per day
Modality	Aerobic activity is a priority, weight bearing preferred; resistance training should be incorporated to promote lean body mass preservation and contribute to health benefits and maintenance of resting metabolism; ideally, a combination is preferred.

Exercise Modifications, Precautions, and Contraindications for Clients with Obesity

There are several precautions that the exercise professional needs to consider and be aware of when working with clients with obesity. Importantly, clients with obesity are likely to have one or more metabolic disorders such as hypertension, dyslipidaemia, type 2 diabetes, or cardiovascular disease (CVD). Medical clearance is essential before starting an exercise program for most of these clients.

- Clients with obesity are prone to musculoskeletal injuries and diseases, particularly osteoarthritis and hip, low back, neck, and knee pain. Thus, a carefully graded progression is critical. Also, it may be helpful to emphasize that joint pain usually improves, sometimes dramatically, following weight loss of as little as 5% to 10% of body weight. Low-impact aerobic exercise may be prudent, such as cycle ergometry or moderately paced walking.
- Both aerobic and resistance training may need to initially be performed intermittently in multiple bouts (5-15 minutes) per day.
- The exercise professional should focus on increasing duration and frequency before increasing intensity.

- Some machines may not be usable by clients who are obese and thus adaptive equipment such as a larger seat on a bicycle ergometer may be required.
- The exercise professional should be sensitive to the physical and emotional difficulties that the client with obesity may experience when exercising in a facility or a group. The exercise professional should encourage a client with obesity to increase daily NEPA and obtain a pedometer and initially determine his average daily steps. With this baseline measure, the client should increase daily steps by around 250 per day per week, to reach 11,000 to 14,000 steps. This goal would include structured exercise and may take several months to achieve.
- The exercise professional should recognize that weight loss is most effectively induced with a low-calorie diet and increased physical activity. Thus, the client with obesity should be encouraged to adhere to a low-calorie, high-fibre diet that is limited in saturated and trans-fat and processed carbohydrates. Clients with obesity must become accustomed to exercise, as exercise minimizes the loss of fat-free mass and is a key predictor of long-term weight loss maintenance.
- Due to the high risk for metabolic disorders, per cent fat, weight, blood pressure, fasting blood glucose, and lipids should be assessed every three to six months.
- For safety and as a potential motivational tool, blood pressure should be periodically assessed before, during, and after exercise to ensure safe levels and to demonstrate the post-exercise hypotension that commonly occurs after an exercise bout with enhanced conditioning and weight loss.
- The exercise professional must encourage adequate fluid intake in clients with obesity and be attentive to maintaining a thermoneutral environment (66-72°F [19-22°C]), as persons with obesity are prone to hyperthermia.

Simple Mechanical Back Pain

Type of exercise	Frequency	Intensity	Volume
Resistance training			
	Begin with one or two sessions per week	Begin with light to moderate intensity (40-80% one repetition maximum [1RM]), using multijoint exercises to engage all major muscle groups	Start with 1 set per exercise of 8-12 reps
	Increase to two or more sessions per week as tolerated	Progress to moderate to high intensity with 1-2 min rest between sets	Increase to 2-4 sets per exercise as appropriate
Aerobic training			
Modes: walking, jogging, running, swimming, other aquatic exercise	Begin with at least three sessions per week	Begin with light to moderate intensity (30% to <60% $\dot{V}O_2$ or heart rate reserve or 55% to <75% maximal heart rate [MHR], or RPE of 9-13 on Borg 6- to 20-point scale)	Begin with at least 10 min per session three or more times per day
	Progress to four or more sessions a week	Moderate intensity (40% to <60% $\dot{V}O_2$ or heart rate reserve or 65% to <75% MHR, or RPE of 12-13 on Borg 6- to 20-point scale)	300 min per week
	OR Three or more sessions a week	Vigorous intensity ($\geq 60\%$ $\dot{V}O_2$ or heart rate reserve or $\geq 75\%$ MHR, or RPE of ≥ 14 on Borg 6- to 20-point scale)	150 min per week

Exercise Recommendations for Clients with Low Back Pain

Testing and assessment for trunk strength, muscular endurance, and mobility, as well as general aerobic capacity, may be considered before initiating a training program. In conjunction, medical clearance should be required before testing to ensure there are no structural limitations to exercise.

Program design guidelines for clients with LBP are summarized in the above table. The recommendations for a resistance training program to improve overall muscular strength and endurance, and abdominal and lumbar extensor strength, are two to four sets (one set if the client is sedentary or low in conditioning) of 8 to 12 repetitions per exercise at an initial light to moderate intensity, one or two times per week. Flexibility training should aim to increase trunk, hip flexor, and extensor mobility via three repetitions of 10-second static hold for each exercise. Recommendations for aerobic exercise (e.g., brisk walking) are to engage large muscle groups at an initial light to moderate intensity for at least 10 minutes three or more times per day on three or more days per week, progressing to at least 300 minutes of moderate or 150

minutes of vigorous (or an equivalent combination of both intensities) per week. Exercise should cease immediately if there is an increase in lower back pain, with possible referral to a physician or other health care professional depending on the severity and duration of the increased pain.

Osteoporosis

Type of exercise	Frequency	Intensity	Volume
Resistance training			
Modes: weight training machines or free weights or both, body weight, elastic tubing	Two or three sessions per week	Moderate intensity (60-80% 1RM), using multijoint exercises to engage all major muscle groups	2-3 sets per exercise of 8-10 repetitions and 2-5 min rest between sets
Aerobic training			
Mild to moderate osteoporosis (T-score <3)	3-5 days/week	Light to moderate (40-70% HRpeak), weight-bearing, large muscle mass activities such as running or walking	30-60 min per session (150 min per week)
Severe osteoporosis	3-5 days/week	Light to moderate (40-50% HRpeak), low- or no-impact weight-bearing, large muscle mass activities such as walking or swimming	30-60 min per session (150 min per week)
Flexibility training			
	5-7 days/week	Stretches should be held at the point of mild discomfort (i.e., not painful)	Three stretches per muscle group; hold each stretch for 15-30 s

Exercise Recommendations for Clients with Osteoporosis

As part of the pre-exercise screening process for those with osteoporosis, it is important to be aware of (1) any exercise limitations due to previous fractures (e.g., reduced locomotion capacity due to hip fracture), (2) muscle weaknesses or imbalances, (3) balance or proprioceptive issues, (4) the presence of other chronic diseases (e.g., cardiovascular disease, osteoarthritis), and (5) associated medications. The severity and location of osteoporosis are also important, as severely osteoporotic clients should avoid high-impact weight-bearing activity, despite the evidence of its efficacy, due to their increased risk of fracture.

Exercise testing can be undertaken with those who have osteoporosis to establish baseline values and determine exercise tolerance to assist in prescription; however, a physician or other health care professional's clearance should be obtained before testing and fall mitigation procedures should be implemented and always maintained. The validity of such tests may be compromised in clients with a fear of falling, so appropriate education about the mitigation procedures may improve test results. Program design guidelines for clients with osteoporosis are summarized in the

above table. Clients with osteoporosis are likely to be deconditioned, and thus initial use of light-intensity training is recommended.

- Aerobic exercise for those with mild to moderate osteoporosis (T-score <3) should include weight-bearing, large muscle mass activities such as running or walking at light to moderate intensity, 30 to 60 minutes per session, three to five days per week (i.e., ≥150 minutes per week).
- Aerobic exercise in clients with severe osteoporosis, which may be represented as multiple fractures in recent years or noticeable spinal changes (e.g., kyphosis), should follow the same guidelines for duration and frequency but use light-intensity and low-impact exercises such as walking or swimming in the exercise program.
- Resistance training of two or three sets of 8 to 10 repetitions at 60% to 80% 1RM, two or three days per week, is also recommended. Using free weights with clients who are conditioned to do so safely will increase proprioceptive and balance demands. Again, for those with severe osteoporosis, a more conservative approach should be taken to reduce or avoid high impact, twisting, and any activity resulting in bone or joint pain.
- Also recommended is flexibility training to increase mobility and range of motion, particularly at the hip, knee, and pectoral girdle, consisting of three stretches per muscle group, holding each stretch for up to 30 seconds, at a frequency of five to seven days per week. Avoid excessive twisting, flexion, and extension of the spine for anyone diagnosed as severely osteoporotic or with a history of fractures.
- Functional training that specifically aims to increase balance and proprioception is recommended two to five days per week.

To achieve the frequency of prescription, it may be necessary to complete more than one training modality in a single session, for example, flexibility exercises before and after resistance training.

Osteoarthritis

Type of exercise	Frequency	Intensity	Volume
Resistance training			
Modes: weight training machines, free weights or both, body weight, elastic tubing	Two or three sessions per week	Moderate intensity (60-80% 1RM), using multijoint exercises to engage all major muscle groups	2-3 sets per exercise of 6-8 repetitions and 2-3 min rest between sets
Aerobic training			
	3-5 days/week	Light to moderate (55-75% MHR), RPE 9-13) weight-bearing, large muscle mass activities such as swimming, cycling, or walking	20-30 min per session (goal of at least 150 min per week)
Flexibility training			
	3-7 days/week	Stretches should be held at the point of mild discomfort (i.e., not painful)	3 sets of one to five stretches per muscle group; hold each stretch for 5-30 s

Exercise Recommendations for Clients with Osteoarthritis

Program design guidelines for individuals with OA are summarized in the table above. The American College of Rheumatology recommends that clients with OA engage in a range of motion, resistance, and aerobic exercise.

- Aerobic exercise that uses large muscle mass such as swimming, cycling, or walking should be undertaken three to five days per week at a light to moderate intensity (i.e., 55 to <75% maximal heart rate [MHR] or an RPE of 9 to 13) for 20 to 30 minutes.
- Resistance training, two or three times per week at a moderate intensity for six to eight repetitions and two or three sets per exercise, in a progressive overload manner is also recommended.
- Exercise to increase flexibility and mobility should be initiated three to seven days per week, with three sets of one to five repetitions per muscle group, and held for 5 to 30 seconds, according to initial flexibility and comfort levels.

Joint Replacement

Type of exercise	Frequency	Intensity	Volume
Resistance training			
Modes: weight training machines, free weights, or both; body weight, elastic tubing	Begin with one or two sessions per week	Initial light to moderate intensity (40-80% 1RM), using multijoint exercises to engage all major muscle groups	Start with 1 set per exercise of 8-12 reps
	Increase to at least two sessions per week as tolerated	Progress to moderate to high intensity (after 6 months) with 1-2 min rest between sets	Increase to 2-4 sets per exercise as appropriate
Aerobic training			
Modes: walking, jogging, running, swimming, cycling	3-7 days per week	Begin with light to moderate intensity (30% to <60% $\dot{V}O_2$ or heart rate reserve or 55% to <75% MHR, or RPE of 9-13 on Borg 6- to 20-point scale)	Begin with at least 10 min 3 or more times per day
		Moderate intensity (40% to <60% $\dot{V}O_2$ or heart rate reserve or 65% to <75% MHR, or RPE of 12-13 on Borg 6- to 20-point scale)	300 min per week
		Vigorous intensity ($\geq 60\%$ $\dot{V}O_2$ or heart rate reserve or $\geq 75\%$ MHR, or RPE of ≥ 14 on Borg 6- to 20-point scale)	150 min per week
Flexibility training			
	3-7 times per week	Stretches should be held at the point of mild discomfort (i.e., not painful)	Each stretch held for 15-30 s

Exercise Recommendations for Clients with Joint Replacements

Recovery and rehabilitation following joint replacement are highly individualized, as the healing and pain associated with the surgery can last weeks to months, as can the adjustment to the new joint and its movement. During this period of reduced activity, loss of muscle strength will accrue and should be considered and addressed. Initially the client's physician and physical therapist direct the exercise prescription to restore normal and healthy movement patterns and strengthen the joint and associated structures and musculature.

Due to the invasive nature of the surgery, the various types of joint replacement (i.e., partial, or total), individualized responses to recovery and rehabilitation, and inconsistencies in the literature, specific exercise prescriptions are highly individualized. Following the initial recovery and rehabilitation phase, evidence of functionally stable and painless movement patterns of the affected joint is necessary

before the client begins a strength and conditioning program. General guidelines for such a program include the following:

- A period of six months is recommended before engaging in vigorous exercise.
- An initial period of low-impact aerobic exercises (i.e., those that combine cyclic low limb movement patterns with low rotational and minimal impact forces) is highly recommended. This includes cycling, swimming, walking, low-impact aerobics, weight training, and cross-country skiing.
- High-impact activities and contact sports should be avoided.
- Exercise and physical activity that includes frequent jumping or plyometrics is contraindicated in most cases but should be evaluated individually.

Rheumatoid Arthritis

Type of exercise	Frequency	Intensity
Resistance training		
Multijoint movements a. Bodyweight resistance b. May use resistance bands, suspension training, and manual resistance c. Basic weight training such as resistance machines and free weights Mode of resistance training can vary based on how well exercise is tolerated.	Frequency will vary based on postexertion symptomatology. Strive for two or three sessions per week.	Avoid exercises with impact unless tolerated. Choose 8-10 exercises using a full-body approach. Slowly progress over time to 2-3 sets of 10-15 repetitions. Use light to moderate intensity, 40-80% 1RM. If doing multiple sets, consider 1-2 min between sets to start; be prepared to adjust as needed.
Aerobic training		
Aerobic exercise mode should be low impact and well tolerated. Water aerobics, water walking or running, swimming, and biking are good suggestions. Mode of aerobic training can vary based on how well exercise is tolerated. Consider combination of intermittent aerobic activities and resistance training.	Begin conservatively, working up to two to five sessions per week. If tolerated, sessions can be increased slowly over time. Sessions can be performed most, if not all, days of the week.	Using 55-85% MHR, begin with 3- to 10-min bouts as tolerated, progressing to 2- to 15-min bouts. Strive for 20-60 min of continuous exercise. Tolerance may vary widely between clients.
Flexibility training		
Full-body flexibility exercises, starting with static stretching Also consider range of motion, functional activities, yoga, tai chi, and stretching.	1-3 days per week	8-10 static stretches, held 5-10 s initially, progressing to 20 s as tolerated

Note: MHR, maximal heart rate.

Exercise Recommendations for Clients with Rheumatoid Arthritis

Program design guidelines for clients with RA are summarized in the above table. Exercise professionals should consider the client's interests, fitness levels, classification of RA, current and acute pain levels, and goals when prescribing exercise. A warm-up should consist of dynamic activity, performed at light to moderate intensity. For those with a high rheumatism classification or those experiencing inflammation or pain, no-impact to low-impact large-muscle activities should be encouraged, such as walking, swimming, biking, elliptical or rowing machines, or water activities (e.g., water aerobics and water walking or running). Persons with RA should start at a light to moderate level of exercise but progress to moderate- to high-intensity aerobic activities. Running and sport (if tolerated) should be conducted two to five days per week with a goal of most, if not all, days per week, at an intensity of 55% to 85% maximum predicted heart rate. Clients should be encouraged to do resistance training to strengthen all major muscle groups at 40% to 80% 1RM two or three days per week,

progressing from one or two sets initially to three or four sets of 10 to 15 reps. A combination of intermittent aerobic activities and resistance training at an intensity that is tolerated can be recommended. Exercise professionals should consider the primary joints affected by the RA and modify activities accordingly. Balance and range of motion from other types of training such as yoga, tai chi, and stretching should be encouraged as well. It's important to monitor the client's pain levels and adjust exercise accordingly. The cooldown should consist of 5 to 10 minutes of light-intensity aerobic activity and static stretching.

Asthma

Table - General Aerobic Exercise Guidelines for Clients with Asthma

Parameter	Guideline
Frequency	3-5 sessions per week
Intensity	40% to <60% $\dot{V}O_2$ or heart rate reserve
Mode	Large muscle mass activities (e.g., walking)
Duration	20-60 min of continuous activity

Table - General Resistance Exercise Guidelines for Clients with Asthma

Parameter	Guideline
Frequency	2-3 sessions per week
Intensity	Moderate (60-80% 1RM)
Repetitions	6-12
Sets	2-4

Exercise Recommendations for Clients with Asthma and EIB

The prevalence of asthma and EIB in clients and athletes who compete in environments that are known to trigger asthma and EIB attacks (e.g., cold, and dry) supports the fact that exercise is possible for clients with these conditions. Exercise prescription recommendations for clients with asthma and EIB should be based on the results of exercise testing and assessment, including a bronchial challenge test, so the exercise professional is aware of the client's threshold and response to exercise intensity, duration, mode, and, when possible, environmental stimuli.

Clients with asthma and EIB need to have adequate control of their symptoms and condition before initiating an exercise program. Commonly, aerobic exercise is paired with pharmaceutical therapy as a method to improve BHR, exercise capacity, and quality of life in clients with moderate or severe asthma. The exercise professional should be aware that clients with asthma or EIB typically use a pre-exercise (15 minutes) medication such as a SABA, a mast cell stabilizing agent, or an inhaled anticholinergic agent. In conjunction, clients with asthma or EIB often take a daily controller medication that may include an ICS or leukotriene receptor antagonist. Although this comprehensive strategy greatly reduces the risk of the exercise session

causing an adverse event, it is still recommended that the client and exercise professional, with input and approval from the client's physician or other health care professional, determine an individualized action plan before starting a program in case of an exacerbation of symptoms.

Exercise guidelines for clients with asthma or EIB include several specific recommendations. First, a 10- to 15-minute pre-workout warm-up is highly recommended. An effective warm-up—especially using variable or interval high-intensity exercise, as opposed to continuous high- or light-intensity exercise—may produce a refractory period of up to 2 hours that reduces a client's propensity to develop EIB.

The intensity and duration of an aerobic workout need to begin at a lower level and gradually progress so for example to not cause an exacerbation of symptoms. As a client's fitness level improves, the exercise professional should strive to assign an intensity of 40% to <60% V.O₂ or heart rate reserve for 20 to 60 minutes three to five times a week using an exercise mode that involves rhythmic and continuous movement of large muscle groups. For example, a client with asthma or EIB can start with walking, then progress to a walk-jog program, then a run-only program. When clients can handle vigorous-intensity sessions of ≥60% to 90% V.O₂ or heart rate reserve without an exacerbation of symptoms, they can do interval training workouts of 10 to 30 seconds of high-intensity exercise followed by 30 to 90 seconds of rest.

For clients with asthma or EIB, the design of an initial resistance training program is like common guidelines for beginning, untrained individuals (two or three sessions a week of two to four sets using moderate loads). The two tables above show a summary of the aerobic and resistance training guidelines for clients with asthma and EIB.

Chronic Obstructive Pulmonary Disease

Table - General Aerobic Exercise Guidelines for Clients with COPD.

Parameter	Guideline
Frequency	3-5 days per week
Intensity	30-80% of peak work rate*
Mode	Walking or cycling
Duration	20-60 min/session*

*Intensity and duration of exercise should be individualized to reflect the severity of symptoms.

Table - General Resistance Exercise Guidelines for Clients with COPD.

Parameter	Guideline
Frequency	2-3 days per week
Intensity	Light to moderate; 40-80% 1RM
Repetitions	8-12
Sets	1-4
Rest periods between sets	2-3 min
Exercises	8-12 mostly large muscle groups and multijoint

Exercise Recommendations for Clients With COPD

Although several studies have shown improvement in peripheral muscle strength, gas exchange, and aerobic endurance capacity with exercise interventions, there is no consensus on the optimal exercise program, as intensity and duration should be individualized to reflect the severity of symptoms (see tables above). The addition of resistance training to aerobic training in clients with COPD (see tables above) is associated with significantly greater increases in muscle strength and mass but does not provide additional improvement in exercise capacity, dyspnoea, or quality of life. However, the addition of resistance training to an aerobic endurance program seems a reasonable strategy since muscle weakness is one of the extrapulmonary manifestations of COPD.

Resistance training, aerobic endurance training, and a combination resistance and aerobic endurance training program have similar efficacy for clients with COPD. As such, the program can be designed around the client's preference to maximize compliance. Improvements in exercise tolerance and an increase in muscle strength are indicative of a successful rehabilitation program.

Type 2 Diabetes Mellitus

Parameter	Guideline
Aerobic exercise frequency	Sedentary clients should start with two or three 10-min bouts of aerobic activity per day and progress to 30 min of continuous aerobic activity on 5 to 7 days per week
Aerobic exercise intensity	50-85% heart rate reserve; 12-16 rating of perceived exertion (RPE); talk test ^a is applicable for most clients
Aerobic exercise duration	Minimum of 10 min per session (even lower with peripheral neuropathy or peripheral vascular disease) with a minimum goal of 30 min per session; if weight loss needed, gradually progress to 60 min per session or per day; minimum goal is 150 min per week, up to 300 min or more if weight loss and prevention of weight regain needed
Aerobic exercise modes	Rhythmic, continuous; emphasize large muscle groups as with walking, biking, and swimming
Aerobic exercise caloric expenditure	Goal of 300+ per session and >2,000 per week
Resistance training frequency	2-3 days per week or, ideally, every other day or 48 h apart
Resistance training duration	30-60 min per session using 8-12 repetitions, 2-3 sets, 10-12 large-muscle multijoint exercises
Resistance training intensity	If just beginning a program, use 50-70% 1RM and gradually progress such that by 3-6 months the program consists of a nonlinear plan of 50-65% 1RM with high reps for one session, 65-80% 1RM with moderate reps for one session, and 80-95% 1RM for one session each week (occasionally may test the 1RM)
Resistance training exercise types	Large variety of possibilities depending upon the goals, interests, capabilities, and clinical status of the client (e.g., resistance bands; pneumatic, hydraulic, plate-loaded, or selectorized machines; free weights); goal is to primarily use free weights
Flexibility training ^b	Stretch all major muscle groups every other day, 1-2 static stretches per major muscle groups, hold stretches for 10-30 s each, 20-25 min total duration

^aThe talk test is a test of how comfortably a person can talk during exercise. The intensity at which a person can “just barely respond in conversation” is considered to be safe and appropriate for aerobic endurance improvement (165).

^bFlexibility exercise is very important in persons with type 2 diabetes due to the association of poor range of motion with this disease.

Exercise Modifications, Precautions, and Contraindications for Clients with Type 2 Diabetes

There are several guidelines that the exercise professional needs to consider and be aware of when working with clients who have type 2 diabetes:

- Individuals with type 2 diabetes need to be medically cleared before starting a vigorous exercise program and should undergo a thorough medical evaluation, particularly if they have any cardiovascular, kidney, nervous, renal, or visual complications or have $\geq 10\%$ risk of a cardiac event over 10 years.
- Individuals with type 2 diabetes who have a greater than 10% risk of a cardiac event over the next 10 years should undergo a medically supervised maximal clinical exercise test before starting an exercise program.

- Individuals with type 2 diabetes are prone to silent ischemia (insufficient blood flow to the heart without clinical signs or symptoms). They may need to have a clinical exercise test with radionuclide injection that allows for the detection of ischemic areas of the heart.
- Hypoglycaemia is the most common abnormal response to exercise. Hypoglycaemia is clinically defined as a blood glucose of <70 mg/dl and is particularly common in individuals with type 2 diabetes on insulin or multiple oral hypoglycaemic agents.
- Exercise should not occur when exogenous insulin action is peaking. Thus, the exercise professional must be familiar with hypoglycaemic oral agents and insulin preparations.
- Blood glucose monitoring should be performed before and after an exercise session and when starting or progressing an exercise program (36).
- If pre-exercise blood glucose is <100mg/dl, it is prudent to have the client ingest 20 to 30 g of carbohydrate before starting exercise (recheck glucose 10 minutes after ingestion).
- Avoid injecting insulin into exercising limbs; it is best to use an abdominal site if a type 2 diabetes client presents with blood glucose above 200 mg/dl, and it is also prudent to check ketone bodies in urine (reagent sticks are available at most pharmacies). If no ketone bodies are present, light to moderate exercise is possible (30% to <60% V.O₂ or heart rate reserve), but vigorous exercise (≥60%-90% V. O₂ or heart rate reserve) should be avoided.
- Be aware of possible dehydration, particularly if the client is hyperglycaemic.
- For clients with retinopathy, avoid vigorous-intensity exercise and excessive elevations in blood pressure. Individuals with autonomic neuropathy (pathology of the autonomic nervous system) may have a blunted blood pressure and heart rate response to exercise. These clients should be referred to a medically supervised program.

- Individuals with type 2 diabetes who have kidney disease, peripheral artery disease, or peripheral neuropathy also should be referred to a medically supervised program.
- Be particularly cautious with vigorous exercise in all individuals with type 2 diabetes, as a high percentage of them have undiagnosed atherosclerosis of the coronary and peripheral arteries. Seventy-five per cent of individuals with type 2 diabetes will die from CVD.

Type 1 Diabetes Mellitus

Component	Type	Frequency	Intensity	Volume
Aerobic exercise training	Large muscle groups and rhythmical movements (e.g., walking, jogging, biking, swimming, stair stepping)	3-7 days per week (with ≤2 days between training days)	Moderate (40% to <60% VO ₂ or heart rate reserve) to vigorous (≥60%-90% VO ₂ or heart rate reserve)	≥10 min (per session); goal is ≥150 min (per week)
Resistance training	All types of exercises qualify; an emphasis on larger muscle groups is ideal	2-3 nonconsecutive days per week	At least 8-10 exercises; 1-3 sets; 6-15 RM loads	20-30 min (depending on the number of exercises and sets)
Flexibility training	Static and dynamic stretching; yoga	2-3 days per week	To the point of tightness; repeat 2-4 times	Hold a static stretch for 10-30 s; repeat a dynamic stretch for 10-30 s
Balance training	Single-leg stands; tai chi; yoga	2-3 days per week	Light to moderate	Any duration

Exercise Recommendations for Clients with Type 1 Diabetes

The guidelines for designing an exercise program for a client with type 2 diabetes who is taking insulin are also appropriate for a client with type 1 diabetes. The goal is 150 minutes a week of moderate- to vigorous-intensity aerobic exercise attained via three or more weekly sessions, two or three non-consecutive days a week of resistance training, and two or three days a week of flexibility and balance training. See the table above for general exercise guidelines that are specific to type 1 diabetes.

Exercise Modifications, Precautions, and Contraindications

One of the goals regarding exercise and type 1 diabetes is to effectively balance the amount and timing of insulin administration with pre-exercise food (carbohydrate) intake and the type, duration, and intensity of the exercise session. During- or postexercise hypoglycaemia can be avoided or mediated by increasing the time between the pre-exercise insulin administration and the beginning of the exercise session, reducing the amount of pre-exercise insulin, increasing the amount of carbohydrate consumed before exercising, lowering the amount of postexercise insulin, or a combination of these tactics.

The decision about how much (if any) carbohydrate to eat before exercise is based on pre-exercise blood glucose levels and the parameters of the upcoming session:

- If pre-exercise glucose levels are under 100 mg/dl, consume 15 to 30 g of carbohydrate unless the duration of the session will be less than 30 minutes or at a very high intensity (no extra carbohydrate is needed) or if the session will be long (consume 0.5-1 g of carbohydrate per kilogram of body weight per hour).
- Pre-exercise glucose levels between 90 and 150 mg/dl commonly necessitate carbohydrates to be ingested from the beginning of the session and throughout the session at a rate of 0.5 to 1 g of carbohydrate per kilogram of body weight per hour.
- If pre-exercise glucose levels are between 90 and 150 mg/dl, delay consuming carbohydrates until levels fall under 150 mg/dl.
- Pre-exercise glucose levels between 250 and 350 mg/dl require a ketone test; if moderate to large amounts exist, exercise should not be performed. If ketones are low, light-to-moderate-intensity exercise is acceptable but wait until levels are under 250 mg/dl before performing high-intensity exercise.
- If pre-exercise glucose levels are over 350 mg/dl, measure ketones and delay the session if they are moderate to high. If ketones are negative or at trace levels, administer an appropriate insulin correction per the orders of the client's health care professional. If ketones are in an acceptable range, mild- to moderate-intensity exercise can begin, but the intensity should not be high until glucose levels are under 250 mg/dl.

In addition to checking blood glucose levels before exercise, it is also important to frequently check levels during the exercise session and consume carbohydrates and adjust insulin administration as needed. Further, if the client is taking certain medications in addition to insulin, it may be necessary to adjust the type, timing, and amount of insulin considering an upcoming exercise session, as some of those medications can increase the incidence of exercise-induced hypoglycaemia.

Angina

Table. Aerobic Exercise Guidelines for Clients with Angina.

Parameter	Guideline
Frequency	4-7 days per week (preferably every day)
Intensity	10-15 beats · min ⁻¹ below ischemic threshold
Mode	Activities that engage large muscle groups such as walking, jogging, cycling
Duration	20-60 min per day of continuous or accumulated activity

Table. Resistance Exercise Guidelines for Clients with Angina.

Parameter	Guideline
Frequency	2-3 days per week
Intensity	Light; 40-60% 1RM*
Repetitions	8-12
Sets	1-2 sets each for upper and lower body
Rest periods between sets	60 s or longer if needed
Exercises	Initially one per large muscle group and multijoint

*Intensity determined by angina symptoms if onset is less than 40% 1RM.

Exercise Recommendations for Clients with Angina

For those with angina, a medically supervised graded exercise test should be undertaken, and a medical release to exercise independently must be obtained before an exercise program is initiated. Apart from safety reasons, the results of the graded exercise test may be used to assist the exercise professional in developing exercise programming recommendations.

- With knowledge of the intensity and duration of exercise that elicits symptoms of angina, the aerobic exercise recommendations include the use of large muscle group activities including walking, jogging, stepping, or cycling as the preferred mode of exercise. Aerobic exercise can be performed four to seven days per week (preferably seven) for 20 to 60 minutes of continuous or accumulated activity at an intensity of 10 to 15 beats/min below the ischemic threshold, in addition to an increase in activities of daily living.

- Light-intensity resistance training can be performed two or three days per week at 40% to 60% 1RM of 15 to 20 minutes per session to improve functional capacity. As with all clients with cardiovascular conditions, a longer warm-up and cooldown may be necessary, and the medications may cause postural hypotension. Higher intensities and HIIT may be performed for those clients with higher exercise capacities and those who have been appropriately screened for this type of activity.

The most crucial consideration for the exercise professional when working with this population is to be aware of the symptoms that clients experience with their angina and what they need to do to relieve the pain. Usually slowing down or stopping exercise is all that is needed. If the pain does not subside, then the client may need to take a nitro-glycerine tablet that he has brought with him for any exercise he may perform. If nitro-glycerine is not effective, then the client should be immediately transported to the emergency room for further treatment. The exercise professional and client should discuss this symptom mitigation plan before any exercise, including the location of all medicines. The tables above summarize guidelines for aerobic exercise and resistance training for clients with angina.

Exercise Recommendations for Clients with Hypertension

Exercise programming recommendations for clients with HTN should be based on the results of exercise testing and assessment such that the exercise professional is aware of the blood pressure response to exercise intensity and duration. In general, however, exercise recommendations for clients with HTN include the following:

- The mode for aerobic training should be large muscle group activities such as walking, jogging, or cycling with a frequency of most, if not all, days of the week and 30 minutes or more of either continuous or accumulated exercise throughout the day. Intensity should be moderate (i.e., 40% to <60% V.O₂ or heart rate reserve or a rating of perceived exertion [RPE] of a 12 to 13 out of 20 on the Borg scale).
- Since post-exercise is associated with reduced blood pressure for up to 4 hours, repeated bouts of exercise or performance of activities of daily living that include higher levels of energy expenditure should be encouraged throughout the day to enhance the positive exercise effects on blood pressure and fitness gains. These benefits include increased caloric expenditure, which may also be important because obesity is often comorbidity for clients with HTN.
- Resistance training is recommended at a moderate level of 8 to 12 repetitions at 60% to 80% of one-repetition maximum (1RM) using total body exercises for most clients; however, some may benefit from lighter intensity (40% to 60% 1RM) and higher volume (up to 15 repetitions). A circuit weight training format may be most appropriate and is time efficient.