

Supplementary appendix 2: RT prescription in included studies.

Author	Guidelines related to principles of training
Ahmed ²⁴	<p>For the upper body, participants started with no weight or half-pound wrist weights for each exercise. If there were no lymphedema-related symptoms by the next session, the weight was increased by the smallest available increment for each exercise. For the lower body, participants lifted the most weight they could lift in each exercise, eight to 10 times for each set of repetitions. Participants increased to three sets for each exercise over the first 2 to 3 weeks of exercise. Women were taught stretching exercises to increase range of motion. Sessions lasted approximately 60 minutes.</p>
Brown et al ^{52,53}	<p>Weightlifting sessions lasted 90 minutes and included upper and lower body exercises. Participants started with two sets of 10 repetitions of each exercise and increased to three sets of 10 repetitions over 5 weeks. Prior to each weightlifting session, all participants engaged in at least 10 minutes of aerobic activity (usually treadmill walking), static stretching of the upper and lower body, and abdominal strengthening exercises. For each exercise, if there were no changes in arm symptoms after two exercise sessions at a given weight, the load was increased by the smallest possible increment (typically 1 pound). All weightlifting exercises were symptom limited, such that if a participant reported pain or discomfort with a specific exercise, that exercise was modified or substituted appropriately by the health-fitness professional (e.g., straight leg lifts were substituted for those with knee pain while doing leg extensions until the knee pain resolved). There was no upper limit on the maximal weight lifted over 1 year. After 3 months of supervised weightlifting, participants continued unsupervised twice-weekly weightlifting for 9 months. If a participant with lymphedema arrived to exercise without her compression garment, she was asked to do all the exercises except</p>

	for the upper body weightlifting for that session.
Cormie ⁵⁴	The intensity of the resistance exercise sessions was moderate to high for both groups (i.e. target rating of perceived exertion [RPE] of 12–16 on the Borg scale [37]). The only component of the exercise program that differed between the high-load and low-load groups was the load and number of repetitions completed. For the high-load resistance exercise group, the load of the exercises was manipulated from 75–85 % of 1RM using 10–6 repetition maximum (RM; i.e. the maximal weight that can be lifted 10–6 times) for one to four sets per exercise. For the low-load resistance exercise group, load was manipulated from 55–65 % of 1RM using 20–15 RM (i.e. the maximal weight that can be lifted 20–15 times) for one to four sets per exercise. To ensure the progressive nature of the training program, the resistance was increased in 5–10 % increments for the next set and/or training session if participants were able to perform more repetitions than the RM's specified during a set and reported no increase in arm symptoms.
Dolan ⁵⁶	The RET group did two sets of 8 to 12 repetitions of nine different exercises at 60% to 70% of their estimated 1 repetition maximum (1RM) with prespecified weight progression.
Hagstrom ^{22,57}	Loads were initially prescribed based on individualised eight-repetition maximums which were measured during the first training session for each programme. A repetition maximum is defined as the maximum amount of times a load can be lifted prior to muscular failure (Feigenbaum & Pollock 1999). Loads were adjusted each time an individual had adapted to achieve the ability to complete 10 repetitions prior to muscular failure. The exercise prescription was split into two 8-week programmes progressing from an introductory machine-based prescription to a more advanced free weight-style prescription.

<p>Alberga⁷²</p>	<p>Resistance training participants exercised three times per week, performing one set of 8–12 repetitions for weeks 1–2 and increasing to two sets for the remainder of the training program. They performed 10 different exercises [22] (leg extension, leg curl, seated chest fly, latissimus pulldown, overhead press, triceps extension, biceps curls, calf raises, low back extension, and modified curl-ups) at 60–70% of their estimated 1-RM. Resistance was increased by 5 lb when participants completed more than 12 repetitions.</p>
<p>Capozzi⁷¹</p>	<p>Basic exercise prescription included: 8-10 repetitions at 8-10 Repetition Maximum (RM), for 2-3 sets, rest: 60 seconds between sets. Participants were told to use the Borg Rated Perceived Exertion Scale (0-10) to monitor intensity. All participants were told to work within the moderate to hard range, 3-5/10. Progression was applied at 4, 6, and 9 weeks, as appropriate, with patients advancing to 3 sets of 8 repetitions at 8 RM.</p>
<p>Christensen^{69,70}</p>	<p>For the initial five sessions, participants performed three sets of 15 repetitions on 15-repetition maximum (RM) load. From session 6 and onward, participants performed four sets of 10 repetitions on a 10- to 12-RM load. Individual supervision ensured that training load was continuously and progressively increased, and training load for each set and the number of training sessions were continuously recorded.</p>
<p>Courneya⁵⁵</p>	<p>The RET group were asked to exercise three times per week performing two sets of eight to 12 repetitions of nine different exercises at 60% to 70% of their estimated one- repetition maximum.⁹ The exercises were leg extension, leg curl, leg press, calf raises, chest press, seated row, triceps extension, biceps curls, and modified curl-ups. Resistance was increased by 10% when participants completed more than 12 repetitions.</p>
<p>Musanti⁸⁰</p>	<p>The women in the resistance group were prescribed a Thera-Band (Hygenic Corporation, Akron, OH) that produced an</p>

	<p>RPE of 3–5 on a scale of 0–10. Women started with one set of 10–12 repetitions of the following exercises: shoulder flexion, shoulder press, latissimus pulldown, seated row, chest press, elbow press (triceps), elbow curl (biceps), hip flexion, hip extension, abdominal crunches, leg press, and squat. They performed these exercises three times per week and were progressed through more resistive bands so that their RPE rose to around seven to eight at the completion of 12 repetitions. After this initial progression, transition to new bands occurred when their RPE fell to three or lower</p>
<p>Ohira²⁶</p>	<p>These small training groups met twice-weekly for 13 weeks, so that the trainers could teach the participants the safe and effective execution of all exercises in the protocol. After the first 13 weeks the participants continued to train on their own for an additional 13 weeks. Participants were encouraged to train with other survivors to foster friendships. Nine common weight-training exercises were performed using variable resistance machines and free weights (for muscles of the chest, back, shoulders, and arms, as well as the buttocks, hips, and thighs). In addition, participants were taught stretching exercises to perform before and after each weight-training session.</p>
<p>Schmidt⁵⁸</p>	<p>In order to define the individual resistance for each exercise, the therapist carried out the hypothetic one-repetition maximum (h1RM) according to the Brzycki method (26) in the first training session of the RT group. The h1RM is a dynamic maximum force test and was performed according to the repetition method. Thereby, the therapist chose the weight so that the patient could not carry out more than 20 repeats (27). The h1RM test took place on all workout machines. At the beginning, patients of the RT group completed one training set of 20 repetitions, with a hypothetical 50% of the maximum weight. The training took place on the following devices: squat, chest press, leg curl,</p>

	rowing, leg extension, upper arm curl, upper arm extensors, shoulder press, abdominal bench and <i>latissimus</i> pull down. Any further increase in intensity was based on the Borg scale (18, 19).
Schmidt ⁵⁹	Therefore, on the basis of h1RM measurement, a training plan for every participant was developed, where at the very beginning of the gentle strength training programme the intensity of h1RM was set at 50%, with 20 repetitions during one training set per device. Any further increase in intensity was based on the Borg scale.
Schmidt ⁵	EX comprised 8 different machine-based progressive resistance exercises (three sets, 8–12 repetitions at 60–80% of one repetition maximum) without any specific aerobic exercise.
Schmitz ²¹	For the upper body, participants started with no weight or 0.5 lb wrist weights for each exercise and progressed as symptoms allowed. If there was any worsening/onset of symptoms, the exercise associated with the symptoms was skipped, or a lighter weight was used, until the symptoms cleared up. For the lower body, a standard progressive weight-training approach was used in which participants lifted the most weight they could lift in each exercise 8 to 10 times in each set of repetitions. Participants built up to three sets per exercise over the first 2 to 3 weeks of exercise. For the first 3 months, the protocol for increasing weight on each lower body exercise was as follows: after two sessions during which a participant lifted the same weight 10 times during each completed set, the weight was increased by the smallest increment available for the exercise. For the remaining months of weight training, participants increased the weight after four sessions during which they lifted the same weight for 10, 10, and 12 repetitions for sets 1, 2, and 3, respectively. Once the women had learned all of the exercises, each exercise session lasted ~60 minutes.
Schmitz ^{60,61}	During the first 5 weeks, participants

	<p>increased their number of sets of each exercise per session from two to three, with 10 repetitions per set. If no changes in symptoms were noted for a particular exercise after two sessions at a given weight, the resistance was increased by the smallest possible increment. If fatigue prevented the completion of a third set of 10 repetitions of a given exercise with proper biomechanical form, resistance for that exercise would remain the same at the next session. After two sessions at which three sets of 10 repetitions could be performed with proper form at a given level of resistance, without changes in arm and hand symptoms, the trainer guided the participant to increase the resistance by the smallest possible increment at the next session. No upper limit was placed on the weight to which women could progress in any exercise. During lymphedema exacerbations, women continued all exercises except the upper-body exercises, which were resumed only after approval of their lymphedema therapist, with resistance reset to the lowest possible level and then increased again as described above.</p>
<p>Simonavice⁶²</p>	<p>On 2 nonconsecutive days each week, the participants performed 2 sets of 8–12 repetitions of 10 resistance exercises for the upper and lower body. Exercise intensities for the chest press and leg extension were calculated as a representation of upper body and lower body intensity, respectively. When assessing the intensity (percentage of 1RM) for a particular 4-week period, the 1RM test just prior to the 4-week period was used for calculating percentage of 1RM lifted. For example, baseline 1RM values were used when calculating the intensity at which the participants exercised during weeks 1–4. Training sessions began at approximately 60% of each participant’s 1RM and intensity was slowly progressed to an intensity not exceeding 80% 1RM throughout the 6 months. Once 12 repetitions could be completed with proper form, the weight was</p>

	increased by approximately 10%. The resistance exercise program followed the recommendations of the ACSM (Feigenbaum and Pollock 1999).
Speck ⁶³	During the first eight sessions, new weight-lifting exercises were introduced with little or no resistance. Resistance was increased for each upper body exercise at minimal increments (1/2 pound) after two sessions without change in lymphedema-related arm symptoms. If they experienced no change in lymphedema symptoms, no upper limit was placed on the weight to which women could progress.
Twiss ⁷⁸	For the first 32 weeks, participants exercised twice weekly for 30– 45 minutes in their homes, and they were not to lift beyond 20-pound hand or ankle weights because of safety concerns. **Detailed progression table provided in manuscript
Yuen ⁷⁹	Participants were instructed to progress from one circuit of the eight resistance exercises during weeks 1-3 to 2 circuits in weeks 4-6 and finally 3 circuits from week 7 on. The target number of repetitions was 8-12. Once 12 repetitions could be completed in good form for the prescribed number of circuits, participants were instructed to increase to the next highest resistive load/level. P
Winters-stone ^{9,64,65}	POWIR complied with the American College of Sports Medicine (ACSM) recommendations for preserving bone health in postmenopausal women by using resistance and/or impact exercise at moderate to high bone loading forces [23, 33] and with ACSM recommendations for resistance training at loads corresponding to 60–70% of 1-RM for 1–3 sets of 8–12 repetitions to build lean mass and strength in novice weightlifters and older adults [34, 35]. Free weights were used to apply resistance—dumbbells for upper body, weighted vests for lower body, and a barbell for one combined upper + lower body exercise. Initial intensity and progression were based on our previous studies [31] (Table 1). Selected exercises utilized

	<p>musculature with attachments directly on the skeletal sites of interest [31, 36] and included wall-sits, 90° squats, bent-knee dead lifts, forward lunges, lateral lunges, 1- arm row, chest press, lateral raise, and push-ups. Impact exercise consisted of two-footed jumps from the ground to a target height 1" from the floor with a bent-knee landing, performed with weighted vests on and in sets of 10. During a single exercise session participants warmed up, performed 1–6 jump sets, 1–2 sets of 3–4 upper body, and 3–4 lower body exercises, then cooled down. At home the same exercises that were performed in class were done except the deadlift, resistance bands replaced free weights for upper-body exercises, and lower body exercises were performed without weighted vests because of the inconvenience of transporting them. Training volume progressively increased by increasing band thickness, squat and lunge depth, and sets and repetitions.</p>
<p>Winters-stone²⁵</p>	<p>The POWIR program has been described previously [15] but important elements, including training volume and rate of training progression are summarized (Table 1). Free weights (e.g., dumbbells, barbells, resistance bands, and weighted vests) were used to apply resistance. Intensity for lower body training was prescribed as percentage of body weight loaded into a vest and for upper body training as an 8–15 repetition maximum. Adjustments in vest weight were made on a monthly basis according to the training plan and in adjustment with participant tolerance. The exercise instructor continuously monitored upper body effort and increases in weight were made when a participant could complete or exceed the highest number of specified repetitions for a given training phase. Specific resistance exercises engaged muscles attached to skeletal sites of interest (proximal femur and lumbar spine) while impact loading consisted of two-footed jumps wearing weighted vests.</p>
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	<p>increased their number of sets of each exercise per session from two to three, with 10 repetitions per set. If no changes in symptoms were noted for a particular exercise after two sessions at a given weight, the resistance was increased by the smallest possible increment. If fatigue prevented the completion of a third set of 10 repetitions of a given exercise with proper biomechanical form, resistance for that exercise would remain the same at the next session. After two sessions at which three sets of 10 repetitions could be performed with proper form at a given level of resistance, without changes in arm and hand symptoms, the trainer guided the participant to increase the resistance by the smallest possible increment at the next session. No upper limit was placed on the weight to which women could progress in any exercise. During lymphedema exacerbations, women continued all exercises except the upper-body exercises, which were resumed only after approval of their lymphedema therapist, with resistance reset to the lowest possible level and then increased again as described above.</p>
<p>Steindorf⁶⁷</p>	<p>Both interventions were administered for about 60 min twice weekly over a 12-week period together with other cancer patients under the supervision of trained and experienced physiotherapists in specific training facilities at the study center. The intervention started at the day of the first radiotherapy treatment. Physical status, adverse events and adherence were recorded for each training session by the participants and the trainers. The progressive exercise intervention comprised eight different machine-based resistance exercises (3 sets, 8–12 repetitions at 60%–80% of 1 repetition maximum) [12]. The control group carried out progressive muscle relaxation without any aerobic or muscle strengthening components.</p>
<p>Jensen⁶⁸</p>	<p>Strength exercises were performed at 60–80 % of the one- repetition maximum (1-RM) and consisted of two to three sets of 15–25</p>

	repetitions each.
Lonbro ⁸²	<p>All patients received individual instruction two to three times during the initial five training sessions in order to determine the appropriate starting loads, to ensure a proper and safe technique and to make sure that the participants understood the progressive overload principle. During the remaining training period the patients received individual follow-ups as needed to ensure optimal progression and safe technique (from 3 – 7 times). Instruction was conducted by an instructor at the training facility, who before startup had been informed by the principal investigator on how to perform the protocol. After two introductory training sessions with two sets at a load corresponding to 15 repetitions maximum (RM, e.g. 15 RM indicating the heaviest load that can be lifted 15 times using proper technique), volume and load progressed throughout the training period from two sets of 12RM towards three sets of 8RM. The PRT protocol was designed with reference to the American College of Sports Medicine (ACSM) guidelines regarding exercise type, progression, volume and load [1].</p>
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Nilsen ²⁸	After 2 weeks of familiarization, using low resistance (40–50% of one repetition maximum (1 RM) in two sets of 10 repetitions), the training program followed a daily undulating periodization model, where the training volume increased during the intervention period; from one to three sets of 10RM on Mondays, and from two to three sets of 6RM on Fridays. On Wednesdays, a submaximal session was carried out, with 10 repetitions with 80–90% of 10RM in two to three sets.
Nilsen ²⁷	Each session included nine exercises (Smith machine half squat, leg press, Smith machine standing calf raises, knee flexion, knee extension, chest press, seated row, seated shoulder press, and biceps curl). After two weeks of familiarisation, including low resistance corresponding to 40–50% of one repetition maximum (1 RM, i.e. the maximal load that can be lifted once with full range of motion in the exercise) in two sets of 10 repetitions, the training programme followed a daily undulating periodisation model, with a linear progression in training volume through the intervention period: from one to three sets of 10RM on Mondays, and from two to three sets of 6RM on Fridays. A sub-maximal session was carried out on Wednesdays, with 10 repetitions with 80–90% of 10RM in 2–3 sets. An instructor supervised all “heavy” sessions, to ensure that the prescribed training load was used. The instructor also recorded any kind of pain during the intervention period and adjusted the training load if necessary.
Norris ²⁹	During the first 3 weeks, participants trained at 60–70% of their predicted 1-repetition maximum (p1RM) and performed two sets of

	<p>12 and 8–10 repetitions, respectively, with 1–2min rest between sets for five exercises (chest press, leg press, lat pulls, leg curls and shoulder press). All participants progressed to phase II, where one set of 8 repetitions at 80% of p1RM for chest press and leg press was added in addition to two sets of 12 and 8–10 repetitions of a sixth exercise (leg extension). During the third phase, an additional set of 8 repetitions at 80% was added to lat pulls and leg curls. During phase IV, another set of 8 repetitions at 80% of p1RM was added to shoulder press and leg extension. To individualize the RT program, each participant increased the weight lifted if they could complete more repetitions than was prescribed on the last set of any exercise. In addition to the RT prescription, a series of trunk strengthening exercises for the abdomen and lower back were performed.</p>
<p>Santa Mina⁸¹</p>	<p>For each RET exercise, three levels of intensity (beginner, intermediate, and advanced) were provided in the manual and explained during the baseline demonstration to accommodate different levels of physical fitness. Individualization to the exercise prescription for RET participants was provided by indicating which classification for each exercise the participant was currently able to do and a goal for program progression (i.e., the beginner, or green, resistance band to intermediate, or blue, resistance band). Participants were instructed to increase their exercise intensity to the next intensity level once they could complete 12 repetitions without significant muscle fatigue.</p>
<p>Segal⁷³</p>	<p>Resistance training participants exercised three times per week performing two sets of eight to 12 repetitions of 10 different exercises (leg extension, leg curl, seated chest fly, latissimus pulldown, over-head press, triceps extension, biceps curls, calf raises, low back extension, and modified curl-ups) at 60% to 70% of their estimated one-repetition maximum (1 RM).¹⁴ Resistance was</p>

	increased by 5 lb when participants completed more than 12 repetitions.
Segal ²³	Resistance exercise consisted of a 12-week program of nine strength-training exercises carried out under supervision three times per week, at 60% to 70% of one-repetition maximum (1-RM; the maximum amount of weight that can be lifted once), estimated from the standard load 40 test. Two sets of eight to 12 repetitions of the following nine exercises were performed: leg extension, calf raises, leg curl, chest press, latissimus pulldown, overhead press, triceps extension, biceps curls, and modified curl-ups. Sixty percent of the participant's 1-RM was used as the starting 40 resistance. Patients were instructed to increase the resistance by 5 lb when they were able to complete more than 12 repetitions.
Winters-stone ⁷⁴	Participants performed 8–15 repetitions of an exercise at intensities that progressed from 4 to 15 % of body weight in a weighted vest for lower body exercises (ex. chair rises, 90° squats, multi-directional lunges) and from a weight that could be lifted for 15 repetitions (15-repetition maximum (RM)) to a heavier weight that could be lifted eight times (8-RM) for upper body exercises (ex. rows, bench press, push-ups, triceps extension, shoulder raise) using free weights. Within a session, participants performed 8–10 different exercises, evenly split between upper and lower body training.
Winters-stone ^{66,75,76}	A detailed description of the interventions, including program progression, is provided elsewhere (Winters-Stone et al., 2014). Participants in both groups were prescribed an exercise program consisting of two one-hour supervised classes and one 30- to 45-minute home-based session per week for 12 months. POWIR was based on prior interventions in people without cancer (Winters & Snow, 2000) and followed American College of Sports Medicine's recommendations for preserving bone health and muscle strength in older adults (Chodzko-Zajko et al., 2009;

	<p>Kohrt, Bloomfield, Little, Nelson, & Yingling, 2004). Resistance training used free weights (e.g., dumbbells, barbells, weighted vest) for 1–3 sets per exercise at a weight that could be lifted for 8–12 repetitions (about 60%–80% of one repetition maximum [RM]). Impact exercises were included to place a load on the skeleton by generating ground reaction forces and consisted of 50 two-footed jumps from the ground with weighted vests. An exercise session consisted of wall-sits, squats, dead lifts, lunges, rows, chest presses, lateral raise, push-ups, and two-footed jumps.</p>
<p>Litterini ⁷⁷</p>	<p>All participants started with 1 set of 8 to 15 repetitions. Unless a lifting restriction was imposed, resistance was set to a level where the participant felt he or she needed a short (1-2min) rest at the end of a set. Amount of resistance, repetitions, and sets were increased as tolerated.</p>