Title: Do women with breast cancer-related lymphedema need to wear compression while exercising: results from a systematic review and meta-analysis.

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Abstract

Purpose of review: To undertake a systematic review and meta-analysis to evaluate the effects of wearing compression versus no compression during a single bout of exercise, and during an exercise intervention. A multiple database search was undertaken to identify eligible randomised controlled trials (RCTs) and non-RCTs involving those with BCRL. The primary outcome variable was lymphoedema and pooled statistics were calculated using standardised mean differences (SMDs) within or between compression and no compression groups.

Recent findings: Six eligible studies were identified and rated as either moderate (n=5) or strong (n=1) quality. No within group change in lymphoedema was observed after a single bout of exercise or after an exercise intervention period with compression (SMD=-0.08 [95% CI= -0.36, 0.21]; and SMD= -0.20 [95% CI=-0.63, 0.22], respectively) or without compression (SMD=0.05 [95% CI=-0.23, 0.34]; and, SMD=-0.17 [95% CI= -0.56, 0.22], respectively). There was also no between group difference found post-exercise (single bout or intervention period) between those exercising with and without compression (SMD=-0.08 [95% CI=-0.28, 0.12]).

Summary: There appears to be no consistent benefit or adverse effect of wearing compression for BCRL during a single exercise bout or an exercise intervention period.

Keywords: lymphoedema, exercise, compression, breast cancer

Introduction

Exercise is considered an important and effective means of reducing morbidity and improving quality of life for those with cancer, with much of the evidence in support of exercise drawn from studies involving women with breast cancer [1, 2]. Specifically, consistent evidence from clinical trials shows that mixed mode exercise (i.e., aerobic and resistance exercise) for women with breast cancer is safe, feasible, and effective at improving fitness, strength, psychosocial well-being (including anxiety and depression), and treatment-related side effects (such as fatigue) during and following breast cancer treatment [2]. Further, strong observational evidence links exercise post-breast cancer with reduced risk of chronic disease (such as, cardiovascular disease and type II diabetes), breast cancer recurrence, cancer-related mortality and all-cause mortality [3]. Despite widespread endorsement of participation in regular physical activity by cancer organisations worldwide, the majority of women experience declines in physical activity post-breast cancer or fail to meet recommended physical activity levels [4-6]. A subgroup of the breast cancer population at increased risk of declines in physical activity post-breast cancer are those who develop breast cancer-related lymphoedema (BCRL) [7].

Lymphoedema manifests as a consequence of lymphatic system insufficiency, whereby lymph load exceeds lymph transport capacity [8]. Approximately 21% of women develop BCRL within 2 years post-diagnosis, and compared with women without BCRL, those with BCRL are likely to have received more extensive surgical treatment (in particular lymph node dissection) and adjuvant therapy, be overweight, obese and/or insufficiently active, and have additional comorbidities, treatment-related side effects and psychosocial concerns (including anxiety, lower self-esteem and body image) [9, 10]. These same characteristics highlight the potential benefit to be gained through participation in physical activity, and specifically individualised, regular exercise.

In the absence of scientific evidence, a range of theoretically-underpinned prevention and management guidelines have been developed in an attempt to reduce lymphoedema-associated morbidity. Historically, guidelines advised caution for those with BCRL in participating in certain activities, including repetitive use of an affected limb, which inadvertently may have encouraged physical inactivity. However, over the past two decades, evidence from trials evaluating the effect of exercise on BCRL has accumulated [11]. The weight of this evidence supports participation in physical activity that includes planned, mixed mode exercise prescribed at appropriate starting loads and intensities, with progressive overload and patient-education on lymphoedema care [12, 13]. In doing so, women can benefit from the positive effects of exercise observed in the wider exercise and breast cancer evidence-base, without fear of exacerbating existing lymphoedema. Indeed, lymphoedema

organisations worldwide now promote physical activity recommendations endorsed by cancer organisation to their membership base [14, 15]. However, a major caveat to these recommendations is that women are advised to wear compression on their affected limb(s) when exercising [14, 15].

Compression on a limb creates a pressure gradient, potentially aiding the lymphatic system's transport capacity by promoting fluid flow away from the built-up area. Compression treatment has been identified as the most effective form of treatment for early and persistent BCRL [16, 17]. Exercise increases blood flow to working muscles, and potentially whole body and/or segmental lymph load. However, concurrently, working muscles and the increased cardiac and respiratory response to exercise support lymphatic flow [18]. Nonetheless, segmental swelling may occur post-exercise. This represents a normal physiological response to exercise, with factors such as temperature, load (or intensity) of the exercise and hydration status influencing the presence and extent of post-exercise swelling, and is reflective of a short-term imbalance in lymph load and lymph transport capacity [19]. It seems plausible that those with lymphoedema may be at higher risk of exercise-induced swelling and longer durations of exercise-induced swelling, and that therefore use of compression during exercise may counteract that risk. However, the need to wear compression during exercise has also been identified as a barrier to participation in exercise and its use has been associated with patient-reports of discomfort [20] (including restricted movement and increased heat), which may in turn minimise lymphatic system support provided by the musculoskeletal and cardiorespiratory system during exercise. Therefore, the purpose of this systematic review and meta-analysis was to summarize evidence from randomised and non-randomised controlled trials (RCTs) evaluating the effects of exercise, with and without compression, on lymphoedema outcomes in women with BCRL.

Methods

Search strategy and selection criteria

The PICO (participants, intervention, comparator, and outcome) framework [21] was used to establish the eligibility criteria for study inclusion:

- **Participants:** Studies involving participants with clinically diagnosed BCRL were eligible for inclusion. Studies comprised solely of participants considered “at risk” or without a clinical diagnosis of lymphedema were excluded.

- **Intervention:** Studies must have evaluated resistance (weight-bearing exercise that loads the musculoskeletal system) or aerobic (exercise that loads the cardiovascular and respiratory system) exercise. Exercise that was not specified as aerobic or resistance, were considered the exercise component of complete decongestive therapy (a common form of lymphedema treatment) or were considered to be mobility exercises conducted as part of standard breast cancer treatment rehabilitation exercises (e.g., those that could be conducted multiple times per day) were excluded. Studies that assessed the effects on lymphoedema after single bouts of exercise or following an intervention period (e.g., 4 weeks of exercise training) were included. Single exercise bout studies were those in which single bouts of exercise were performed, with and without compression, and the short-term effect on lymphedema was assessed after each exercise bout (i.e., immediately post- and up to 72 hours post-exercise). Intervention studies were considered studies that involved more than one bout of exercise; that is, involved regular exercise training with lymphedema assessed pre- and post-intervention. Studies that involved exercise in addition to other interventions were excluded if the effects of exercise could not be isolated.
 - **Comparators:** Studies comparing exercise with and without compression were eligible for inclusion.
 - **Outcomes:** Studies involving the objective assessment of lymphedema (i.e., swelling) were included.
- There were no exclusion criteria on the methods used to assess lymphedema.

A database search of CINAHL, Cochrane, EBSCOhost, MEDLINE, PubMed, ProQuest Health and Medical Complete, ProQuest Nursing and Allied Health Source, ScienceDirect, and SPORTDiscus, limited to peer-reviewed scholarly journal articles published in English before February 1, 2020, was undertaken to identify potentially eligible RCTs and non-RCTs. To determine eligibility, first a title and keyword (“lymphoedema or lymphedema” AND “exercise or physical or aerobic or resistance or training or fitness or strength or weight lifting” AND “compression”) search was conducted. Further, a manual search of reference lists from identified original and review articles was also undertaken.

Data extraction and management

All identified articles using the search strategy were evaluated for inclusion by one reviewer (BS) as follows: (1) screening of titles; (2) retrieval and screening of relevant abstracts; (3) retrieval and review of full texts of remaining records. Relevant study, exercise, and participant characteristics and outcomes from the

included articles were extracted into tabular format using pre-defined data fields (BS). Studies were grouped as either single exercise bout studies or intervention studies. The Effective Public Health Practice Project Quality Assessment Tool [22] was used to assess study quality and risk of bias by two authors (BS, SH) with any discrepancies resolved through discussion. Based on ratings given for selection bias, study design, confounders, blinding, data collection methods, and withdrawals and dropouts, each study was given an overall rating as weak, moderate or strong.

Statistical analysis

This meta-analysis combined data at the study level. The primary outcome variable was lymphedema, assessed using any objective, validated method (e.g. limb volume assessed via water displacement or circumferences, bioimpedance spectroscopy). To allow comparison of data from different scales, pooled statistics were calculated using standardized mean differences (SMDs), which were computed using RevMan software (version 5.3). Means and standard deviations (SDs) before and after exercise for the compression and no-compression groups were used to compute SMDs. Estimated effect size was calculated if the outcome variable was reported in at least 2 studies. When two or more methods of assessing lymphedema were used, the method defined by the authors as being their primary method was used in the meta-analysis. If not defined by the authors, we prioritised bioimpedance spectroscopy assessment over volume, due to its sensitivity to change in extracellular fluid (which was considered more likely than change in volume in studies evaluating single bouts of exercise) [23, 24]. Continuous outcomes were pooled across studies and analysed using a random-effects model. Separate meta-analyses were also performed for single exercise bout and intervention studies to assess the immediate and longer-term effects of exercise, with or without compression, on lymphedema. For single exercise bout studies that involved multiple post-exercise assessments, the immediately post- and 24-hour post-exercise time points were used to calculate effect size. Heterogeneity was assessed between studies using the I^2 statistic to quantify the proportion of the total outcomes attributed to variability among studies, with $I^2=0-30\%$, $30-49\%$, $50-74\%$ and $75-100\%$ suggesting no heterogeneity, moderate heterogeneity, substantial heterogeneity and considerable heterogeneity, respectively. SMDs and corresponding standard errors (SEs) were plotted against each other, and asymmetries or missing sections within the funnel plot were assessed to determine the presence of publication bias.

The summary measure was the within group effects (change) on lymphoedema between pre- and post-exercise for compression and no compression groups, and the difference in post-intervention effects between

compression and no compression groups. Therefore, SMD was computed using either (1) pre- and post- exercise means and SDs for the compression and no-compression groups; or (2) difference between compression and no compression post-exercise means and SDs. No included study reported significant baseline differences in lymphedema outcomes between compression and no-compression groups; therefore, use of post-exercise means were considered appropriate. Depending on the meta-analysis, negative SMD values denote a decrease in lymphoedema outcome or change favouring the use of compression during exercise.

Results

A total of 1,363 articles were retrieved after a search of databases, and 1,242 articles remained after removing duplicates (Figure 1). Following screening of titles and abstracts, 1,193 were excluded, leaving 49 full-text articles for retrieval and review. Of these, seven studies were initially deemed eligible for inclusion (Supplementary Table 1) [20, 25-30] and a search of their reference lists did not reveal any additional potentially eligible studies. Subsequent to data extraction of the seven studies and further review (SH, KB), one of the studies [29] was deemed ineligible. Of the six included studies, five received a moderate and one received a strong study quality rating (Table 1).

An overview of study characteristics is shown in Table 2. All trials involved women with unilateral BCRL. Four studies [20, 25, 27, 28] involved a crossover design whereby the sample performed two single bouts of exercise, one bout while wearing compression and one without compression, in a randomised order, with sample size ranging from 18 [28] to 31 [20]. One of the remaining studies was a RCT [30], while the other was a non-RCT design [26], both of which evaluated the effect of an exercise intervention (intervention duration: 8 and 12 weeks; sample size, 41 [26] and 60 [30], respectively) with or without compression (Table 3). The single exercise bout studies involved performing arm ergometry / pulley system [27, 28], or upper-body resistance exercises [20, 25]. Exercise in the intervention studies evaluated aerobic (walking, jogging, cycling, aerobic-class [26]) and resistance-based exercise (upper- and lower-body, [26, 30]). Pressures of compression garments used in studies included 23-32 mmHg [20, 25] or were not specified [26-28, 30]. One study [20] reported that the compression garments were specialist-fitted.

Effect of compression

Between pre- and immediately post- a single exercise bout, no change in lymphoedema outcomes were observed, irrespective of compression use (Figure 2). Both the compression and no compression groups showed a trend towards a decrease in lymphoedema outcomes between pre- and post-intervention (compression: SMD=-0.20 [95% CI= -0.63, 0.22]; no compression: SMD=-0.17 [95% CI= -0.56, 0.22]; Figure 3). However, confidence intervals spanned 0. The differences between the compression and no compression lymphoedema outcomes immediately post- a single exercise bout tended to favour the compression group, although results were not supported statistically (SMD=-0.21 [95% CI= -0.50, 0.08], $p=0.15$; Figure 4). Further, by 24 hours post- a single exercise bout, no difference was found (SMD= -0.02 [95% CI=-0.39, 0.35], $p=0.91$, Figure 4). There was also no between group differences in lymphoedema outcomes post-exercise intervention between those in the compression and no compression groups (SMD= 0.13 [95% CI=-0.29, 0.54], $p=0.71$).

Discussion

Key findings of this meta-analysis suggest that there is no benefit to lymphoedema outcomes through the use of compression during a single exercise bout or throughout an exercise intervention. Further, findings suggest that performing exercise without compression does not exacerbate lymphedema. As such, the findings of this systematic review and meta-analysis neither support widespread endorsement to wear compression for those with BCRL during exercise, nor do they support encouragement of exercise without compression.

The quality of all, except one, studies included in this review was rated as moderate (the remaining study was rated as strong), and results were generally consistent. However, a number of factors need to be considered which limit the extent to which these findings can be used to guide clinical practice. First, the number of studies contributing to this meta-analysis is limited ($n=6$; 4 evaluated a single exercise bout; 2 evaluated an exercise intervention), the sample size within the intervention studies was small and overall, lymphoedema duration, severity, stage, and/or location was not well characterised (although it was clear that women with stage 0 BCRL were not included). Information about compression use (e.g., class, type – sleeve vs gauntlet, use pre- and post-an exercise bout) was also limited or missing. As such, while it is clear that the findings from this review are not generalisable to those with preclinical BCRL, current data prevents exploring associations between effect and specific patient or compression factors. Further, the intensity of the exercise evaluated in all studies was low or moderate, and the exercise intervention trials evaluated either resistance or aerobic exercise. Yet, for those with BCRL, current exercise prescription guidelines support participation in mixed mode exercise (aerobic and

resistance exercise), at moderate intensity with potential progression to high intensity [12, 13]. While a single high intensity resistance exercise bout without compression, as well as a high intensity resistance exercise intervention without compression, has been found to be safe for those at risk of developing BCRL [31, 32], and no immediate change in lymphoedema outcome was found after a high single intensity resistance exercise bout in those with BCRL without compression (no control group)[33], there is clear scope for future research to formally evaluate the exercise dosage currently recommended (with and without compression) in those with BCRL.

Overall, these findings ultimately highlight the importance of discussing the use of compression during exercise with each patient and to determine use on an individualised basis. For example, compression during exercise may be advised for a woman who associates an acute response to exercise with worsening of lymphoedema that takes longer than one-hour post-exercise to dissipate. In contrast, if this acute increase in swelling is noted, but not perceived as bothersome, and the recommendation to wear compression would make this patient less likely to exercise, exercise without compression may be recommended. Before commencing or changing an exercise program, patients should be encouraged to keep a diary of their lymphoedema status (using objective or self-report measures of lymphoedema status and associated symptoms), as well as relevant activities undertaken throughout the recording period. This will enable the patient to develop a clear picture of what constitutes normal lymphoedema fluctuations. From there, exercise can be introduced or modified, with or without compression, with continued diary-keeping/record-taking of lymphoedema fluctuations. These steps will enable each patient to understand how their lymphoedema responds to a single exercise bout, as well as exercise over time, while also developing an understanding of the positives and negatives that come with exercising with or without compression.

Conclusion

The known and compelling benefits of exercise for women with breast cancer clearly demonstrate the need to encourage physical activity, including participation in planned, purposeful exercise for all women with breast cancer, but in particular for subgroups such as those with BCRL who typically experience higher morbidity, lower quality of life, and threatened survival. As part of encouraging physical activity, it is important for allied health professionals to assist women in identifying and overcoming barriers to regular exercise participation. The results from this review highlight that evidence in support or refute of wearing compression during exercise is lacking. As such, the need for compression during exercise needs to be determined on an individualised basis,

taking into consideration each woman's perceptions about the pros and cons of compression during exercise, alongside perceived (or measurable) acute and longer term lymphoedema responses to exercise.

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Availability of data and material (data transparency): Available on request.

Figures:

Figure 1: Systematic review flow diagram

Figure 2. Meta-analysis of change in lymphoedema (increase or decrease) between pre- and immediately post-exercise for single exercise bout studies (subgroups presented as compression and no compression).

Figure 3. Meta-analysis of change in lymphoedema (increase or decrease) between pre- and post-intervention for exercise intervention studies (subgroups presented as compression and no compression).

Figure 4. Meta-analysis of differences in post-exercise lymphoedema outcome between compression and no compression groups (subgroups presented as: immediately post- a single exercise bout, 24-hours post- a single exercise bout, and post- an exercise intervention).

Table 1: Ratings of studies included in this systematic review using the Effective Public Health Practice Project Quality Assessment Tool [22].

	Selection Bias	Study Design	Confounders	Blinding	Data Collection Methods	Withdrawals and Dropouts	Overall Rating
Studies evaluating the effect a single exercise bout with and without compression, on lymphoedema outcomes							
Godoy 2012	Strong	Strong	Strong	Weak	Strong	Strong	Moderate
Johansson 2005	Strong	Strong	Strong	Weak	Strong	Strong	Moderate
Singh 2015	Moderate	Strong	Strong	Weak	Strong	Strong	Moderate
Vale 2011	Moderate	Strong	Moderate	Weak	Strong	Strong	Moderate
Studies evaluating the effect of an exercise intervention, with and without compression, on lymphoedema outcomes							
Omar 2019	Strong	Strong	Strong	Moderate	Strong	Strong	Strong
Singh 2016	Moderate	Moderate	Moderate	Weak	Strong	Strong	Moderate

Table 2: Summary of studies involving women with breast cancer-related lymphoedema examining the effects of exercise, with and without compression, on lymphoedema outcomes.

Study Characteristic (n=)	N=	References
Country		
Australia	2	[25, 26]
Brazil	2	[27, 28]
Egypt	1	[30]
Sweden	1	[20]
Sample size (n=)		
≤20	2	[27-28]
>20	4	[20, 25, 26, 30]
Measurement of lymphedema		
BIS	3	[20, 25, 26]
Water displacement	3	[20, 27, 28]
Circumferences	3	[25, 26, 30]
Single exercise bout or intervention		
Single exercise bout	4	[20, 25, 27, 28]
Exercise Intervention	2	[26, 30]
Level of evidence ¹		
Level II	1	[26]
Level III	5	[20, 25, 27, 28, 30]
Sample size calculations (yes)	2	[25, 30]
Intention to treat (yes) 0 NA	0	-
Timing of assessments/follow-up		
Single exercise bout studies		
Immediately pre-exercise	4	[20, 25, 27, 28]
Immediately post-exercise	4	[20, 25, 27, 28]
24h post-exercise	2	[20, 25]
Intervention study:		
Baseline and 8 weeks	1	[30]
Baseline and 12 weeks	1	[26]

¹ In accordance with the National Health and Medical Research Council (NHMRC) document: NHMRC additional levels of evidence and grades for recommendations for developers of guidelines: pilot program 2005-2007.

Table 3. Overview of exercise prescription within studies examining the effects of exercise (single exercise bout or intervention), with and without compression, on lymphoedema outcomes.

Parameter	Details
Exercise mode	
Single exercise bout studies	Upper-body resistance exercise using free weights; table-mounted pulley system; arm ergometry.
Intervention studies	Aerobic (walking, jogging, cycling, aerobic-class) exercise; free weights or body weight upper- (with or without) lower-limb resistance exercises.
Frequency	
Single exercise bout studies	2 bouts of exercise in total (performed on separate days).
Intervention studies	3 times per day (15-60 min per day) for 6 months; 3 times per week for 8 weeks; 3 times per week for 12 weeks.
Intensity	
Single exercise bout studies	One study at low-load resistance exercise; one at moderate load resistance exercise; intensity unclear in two studies (use of pulley system or arm ergometry).
Intervention studies	One study at low intensity/load; one study at moderate intensity.
Duration	
Single exercise bout studies	30-60 min session.
Intervention studies	30-60 min per session.

Supplementary Table 1: Overview of study characteristics.

Study details					
Study	Recruitment (eligible / total number screened)	Retention	Reasons for withdrawal	Adherence (to scheduled exercise sessions)	Adverse events
Godoy 2012 Brazil	NR	100% Baseline: n=21 Completed: n=21	NA	NR	Not reported
Johansson 2005 Sweden	31/42 eligible and consented 74%	100% Baseline: n=31 Completed: n=31	NA	NR	Not reported
Vale 2011 Brazil	NR	100% Baseline: n=18 Completed: n=18	NA	NR	Not reported
Omar 2019 Egypt	70/82 eligible & consented 85%	Compression+ exercise: 91% Baseline: n=35 Completed: n=32 Exercise: 94% Baseline: n=35 Completed: n=33	Exercise + compression: n=3 cellulitis Exercise: n=2 cellulitis	Exercise + compression: 97% Exercise: 90%	Not reported
Singh 2015 Australia	28/126 eligible & consented 22%	86% Baseline: n=28 Completed: n=24	n=4 (unrelated health concerns n=1; time constraints n=2; no reason n=1)	NA for acute studies	No adverse events
Singh 2016 Australia	41/103 eligible & consented 40%	95% Baseline: n=41 Completed: n=39	n=2 (reasons not reported)	92%	No adverse events

Online Supplementary Content 2: Overview of intervention and exercise characteristics

Interventions and exercise details							
	Acute or intervention	Study design	During or post treatment	Sample and garment details:	Exercise	Supervision & setting	Study exclusion criteria
Godoy 2012	Acute	Randomised trial: 2 bouts of acute exercise	Post	n=20 BCRL: inter-limb volume difference in of >200 mL Age: mean=63 (range 49-82) Compression: short-stretch 'home-made' compression sleeve made of a cotton-polyester textile	Mode: Arm exercises using a table-mounted pulley system; participants grip the device and revolve a wheel using shoulder and arm movements. Frequency: 2 exercise bouts: one wearing compression and one without. Intensity: Not specified. Duration: 4×12-minute bouts of continuous exercise with 3 minutes rest between bouts.	Supervised (university research setting, physical therapist)	None reported
Johansson 2005	Acute	Randomised trial: 2 bouts of acute exercise	Post	n=31 BCRL: inter-limb volume difference of 10-40%; time since lymphoedema diagnosis: Mean (SD) months 66.7 (51.7) Age: 55±7 BMI: 25±3 Compression: could be standard type or custom made of at least class II (23-32mmHg)	Mode: Resistance exercise (shoulder flexion, shoulder horizontal adduction, elbow extension, elbow flexion). Frequency: Two exercise sessions: one wearing compression and one without. Intensity: 10 repetitions per exercise with 0.5- to 1.0-kg loads. Duration: Not specified.	Supervised, physical therapist (university research setting)	<ul style="list-style-type: none"> recurrence of cancer comorbid diseases affecting the swollen limb difficulties in participating in the study such as dementia or language limits
Vale 2011	Acute	Randomised trial: 1 bout of acute exercise	Post	n=18 BCRL Age: mean=57 (range= 34-78) Compression: low elastic compression sleeve made of 40-40% cotton-polyester textile	Mode: Arm ergometry. Frequency: Two exercise sessions: one wearing compression and one without. Intensity: Not specified. Duration: 4×12-minute bouts separated by 3 minutes rest (60min total).	Supervised (university research setting, Physical therapist)	<ul style="list-style-type: none"> active infections or severe restrictions in movement

Omar 2019	Intervention	8-week RCT: randomised to resistance exercise only or resistance exercise + compression	Post	<p>N=70 BCRL</p> <p>Exercise + compression group: Age: 53±2 BMI: 30±4 Time since LE diagnosis: 12±5 months LE stage: I: 22 (73%) II: 6 (20%) III: 2 (6%)</p> <p>Exercise: Age: 52±2 BMI: 29±4 Time since LE diagnosis: 11±5 months LE stage: I: 21 (70%) II: 6 (20%) III: 3 (10%)</p>	<p>Mode: Resistance exercise Frequency: 3/wk for 8 wks Intensity: 7 exercises; 10-12 reps; 2 sets per exercise; 50-60% 1RM Duration: 30-60 min</p>	Supervised (hospital; physical therapist)	<ul style="list-style-type: none"> • bilateral BCRL • current metastases • continuing radiotherapy • cellulitis • venous thrombosis • infection • congestive heart failure • paralysis and severe trauma • previous lymphedema therapy within the last 3 months • required medication that might affect body fluid and electrolyte balance • participated in an exercise program (defined as 1 h of moderate intensity exercise performed three times per week) during the last month
Singh 2015	Acute	Randomised crossover trial: 2 acute bouts of exercise (compression and no compression)	Post	<p>N=25 BCRL</p> <p>Exercise group: Age: 61±9 Time since cancer diagnosis: 9±9 years Time since LE diagnosis: 7±8 years</p> <p>Compression: own garment (n=20); personally-fitted sleeve (23-32mmHg) (n=5)</p>	<p>Mode: Resistance exercise Frequency: 2 bouts Intensity: 2 sets of 10-20 repetitions; 6 exercises Duration: 30-60 min</p>	Supervised (university health clinic; exercise physiologist) `	<ul style="list-style-type: none"> • >70 years old • diagnosed with any musculoskeletal, cardiovascular or neurological disorder that may limit their ability to safely exercise
Singh 2016	Intervention	<p>12-week Non-randomised trial (performed exercise with or without compression)</p> <p>*Secondary analysis of an RCT</p>	Post	<p>N=39 BCRL</p> <p>Compression group / no compression group: Age: 52±9 / 59±10 Body mass: 77±15 kg / 79±18 kg Time since cancer diagnosis: 5±3 years / 6±4 years Time since LE diagnosis: 3±3 years / 5±4 years LE stage: I: 6 (40%) / 15 (63%) II: 9 (60%) / 9 (37%)</p>	<p>Aerobic-based group Mode: Aerobic (walking, jogging, cycling, aerobic-class) Frequency: ≥2 times per week for 12 weeks (150 min/week total) Intensity: 3-5 METS, 12-14 RPE Duration: 50min per session</p> <p>Resistance-based group Mode: Resistance exercise Frequency: ≥2 times per week for 12 weeks (150 min/week total)</p>	Supervised (home-based, exercise physiologist)	<ul style="list-style-type: none"> • currently undertaking >75 min of weekly moderate-intensity exercise • diagnosed with any musculoskeletal, cardiovascular or neurological disorder that may limit their ability to exercise safely

					Intensity: 12-14 RPE; 10-15 repetitions per exercise, 6-8 upper- and lower-body exercises Duration: 50 min per session		
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Compliance with Ethics Guidelines

Conflict of Interest

Sandi Hayes, Ben Singh, Kira Bloomquist and Karin Johansson declare no conflicts of interest relevant to this manuscript.

Human and Animal Rights and Informed Consent

This article does not contain any studies with human or animal subjects performed by any of the authors.

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- Of importance
- Of major importance

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