REVIEW ARTICLE

The acute effects of resistance training on arterial stiffness: A systematic review

Eleftherios Karanasios, Helen Ryan-Stewart, James Faulkner

Objectives: The effects of resistance training (RT) and the potential role of isolated training variables on arterial stiffness (AS) remain inconclusive. This review summarises the current literature examining the acute effects of RT on AS from a distinct perspective, considering 'intensity of effort' as an independent loading variable, potentially affecting AS responses to RT.

Design: Systematic review

Methods: SPORTDiscus, PubMed/MEDLINE, CHINAHL and Google Scholar electronic databases were searched between 2000 and 2022. Randomised control trials, non-randomised or repeated measures comparative studies assessing arterial responses to acute RT protocols measured by pulse wave velocity (PWV) were included.

Results: From the 645 articles identified, 16 articles were included. Ten studies reported a significant increase in carotid-femoral PWV (cfPWV) post-exercise ($p < 0.05$), with increases between 2% and 20.8% reported. Five studies found no significant differences in cfPWV while in one study femoral-dorsalis pedis PWV decreased by 14%. Loading intensities ranging from 30% to 95% of 1RM had an ambiguous effect on AS, although there was a trend towards increased AS following acute RT. Higher intensities of effort and slower repetition velocities appeared to further increase AS.

Conclusions: Available evidence shows a trend for increased AS following acute RT. Nonetheless, it remains to be determined whether additional RT variables (e.g., intensity of effort, repetition duration) could attenuate or limit increases in AS. Further research, having more RT variables controlled, is needed to draw definite conclusions.

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Key words: resistance exercise ■ arterial stiffness ■ pulse wave velocity ■ intensity of effort

INTRODUCTION

Stiffening of the arterial tree is a major contributor of cardiovascular disease (CVD) in at risk population groups (e.g., hypertensives) as well as in asymptomatic individuals without apparent CVD factors.[1] Measurement of pulse wave velocity (PWV) is widely accepted as the gold standard method of determining arterial stiffness (AS) and has a strong prognostic value for the occurrence of CVD.[2] Considering that PWV is an independent risk factor for the development of CVD and a good predictor of future cardiovascular events, several non-pharmacological strategies have been proposed to attenuate arterial stiffening and improve cardiovascular health.[3]

Participation in regular physical activity may attenuate poorer cardiovascular outcomes.[4] Indeed, aerobic exercise (AE) has been well documented to improve cardiorespiratory fitness and reduce AS.[5] Similarly, resistance training (RT) improves bone health and insulin sensitivity[6,7], is associated with decreased mortality and CVD risk[8], and may elicit comparable or superior benefits to AE in the treatment of hypertension[9]. Yet, the effects of RT on AS within both acute and long-term interventions appears equivocal, with studies indicating increases[10-12], decreases[13] or no changes[14]. Likewise, evidence from systematic reviews and meta-analyses has revealed inconsistent findings.

Nonetheless, the variety of RT protocols (i.e., combined interventions with supplementation or blood flow restriction) and the diversity of inclusive populations (i.e., healthy subjects, populations at risk) in previous reviews[15-17] indicate a lack of homogeneity potentially contributing to the discrepancies reported. Particularly, acute RT training investigations have been neglected in previous analyses[18]. Although findings from acute interventions may not necessarily represent long-term adaptions to RT, they can provide a valuable insight regarding the transient and functional adaptive responses of the vasculature and a better understanding of the responsible mechanisms underpinning chronic adaptations.[19] Furthermore, pooled data from training protocols consisting exclusively of circuit resistance training have been considered for analysis in previous reviews.[18] Indeed, this training modality seems to attenuate peaks in systolic blood pressure resulting in improved arterial function.[20] Lastly, the concept of exercise intensity has been addressed in recent reviews which have concluded that loading intensity is the main factor determining arterial adaptations to RT.[16,18] Nevertheless, the

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From the School of Sport, Health and Community, Faculty of Health & Wellbeing, University of Winchester, United Kingdom (E.K., J.F.), and School of Health and Sport Science, Faculty of Education, Humanities and Health Science, Eastern Institute of Technology, New Zealand (H.R-S.)
Communicated by Takashi Abe, Ph.D.
Correspondence to: Eleftherios Karanasios, University of Winchester, Sparkford Road, Winchester, SO22 4NR, United Kingdom
E-mail: e.karanasios.17@unimail.winchester.ac.uk
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majority of the studies included in the above mentioned reviews prescribed loading intensity in relative terms (% of one repetition maximum) without a reference to the effort applied. That said, trying to isolate the effects of loading intensity in RT protocols prescribed at relative load (% of one repetition maximum) with a fixed number of repetitions (e.g., 10 repetitions at 70% of 1RM) may be problematic given the great variability in the number of repetitions (i.e., proximity to task failure) that can be performed at a relative loading intensity.[21] Indeed, proximity to task failure, an indication of the effort exerted during RT, is a main determinant of health related outcomes, such as strength and cardiovascular fitness[22,23] and may be an independent loading parameter influencing arterial responses to RT[11,24]. To date the concept of 'intensity of effort' has neither been specifically addressed in the literature, nor considered in previous reviews.

Given the divergent findings and the great variety of training protocols included in previous reviews, the purpose of this investigation was to systematically summarise the available literature examining the acute effects of traditional RT (e.g., excluding circuit training) on AS measured by PWV, the gold standard method to assess AS[25], and to investigate the potential influence of additional RT variables on arterial function.

METHODS

The systematic review process conformed to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines when reporting items for systematic reviews and meta-analyses [26]. The review was registered on Prospero in June 2022 before commencing the search process (Registration number: CRD42022339777).

Search Strategy

A systematic literature review was performed using the SPORTDiscus, PubMed/MEDLINE, CHINAHL and Google Scholar electronic databases, to identify relevant studies published from January 2000 until the 2nd of June 2022 when the searches were conducted. The following Boolean string was applied in all databases: ("resistance training" OR "weight training" OR "strength training" OR "resistance exercise") AND ("arterial stiffness" OR "arterial compliance" OR "pulse wave velocity"). Where applicable, the option 'should be in title or abstract' was applied. Reference lists of the articles deemed eligible for inclusion were screened for additional findings. Titles and abstracts of the initial search results were screened individually by one author E.K. After the removal of duplicates and irrelevant articles, co-authors J.F and H.R-S were included in the full text screening process to reduce selection bias.

Inclusion and exclusion criteria

To be considered for inclusion, studies had to meet the following criteria: (1) participants were adults aged > 18y; (2) AS was measured using PWV; (3) measurements were conducted pre- and post-exercise (0 to 60 min post); (4) an acute RT protocol was the only training modality; (5) training protocols were performed in a conventional dynamic fashion using both concentric and eccentric muscle actions; (6) studies were conducted between 2000 and 2022 (a time frame that assures current evidence is analysed) and were written in English language. In studies with additional interventions (e.g., aerobic exercise) only the resistance exercise protocol was considered for analysis.

Studies were excluded according to these criteria: (1) the training protocol was combined with other interventions (e.g., aerobic exercise, supplementation, diet); (2) the training protocol was performed using other types of RT (e.g., eccentric, isometric, concentric only); (3) circuit resistance training was the main training intervention; (4) the exercise protocols were intentionally designed to cause an increase in AS.

Data extraction

For the included studies, the following data were extracted: study characteristics (author, year), participant characteristics (sex, age, medical condition if present), resistance exercises, loading intensity, session sets and repetitions, rest interval duration, repetition duration, outcome data (PWV) and proximity to task failure if measured either subjectively (i.e., perceived effort assessed using a Ratings of Perceived Exertion scale) or objectively (i.e., repetition velocity loss relative to maximum possible) or whether participants executed sets task failure.

Quality assessment

Methodological quality and a risk of bias within the selected studies was evaluated using the Cochrane Risk of Bias Tool (ROB) .

RESULTS

As presented in Figure 1, the initial search identified 645 potentially relevant studies. At first, 43 duplicates were removed. Secondly, the titles and abstracts of the remaining studies were screened for relevance, whereby 564 articles were excluded. Lastly, the full texts of the remaining 38 articles were assessed in accordance with the inclusion criteria. Ultimately, 16 articles were included in this review.

A total number of 363 participants (287 men, 76 women) were involved in the 16 trials included (Table 1). The majority of the studies (14 out of 16) involved young healthy participants (18-39 years) while two studies included middle aged (40-59 years) and older (60-82 years) participants taking some form of medication.

Summary of risk of bias

Overall, the studies included can be characterized as methodologically sound and the methodologies utilised seem to have no considerable impact on the results obtained (Table 3). All studies reported to have low risk of bias for the following criteria: Random sequence generation (selection bias), incomplete outcome data (attrition bias), selective reporting (reporting bias). One study [27] was classified as having an unclear risk of bias for allocation concealment (selection bias) due to study design (pre-post intervention including only one group). Two

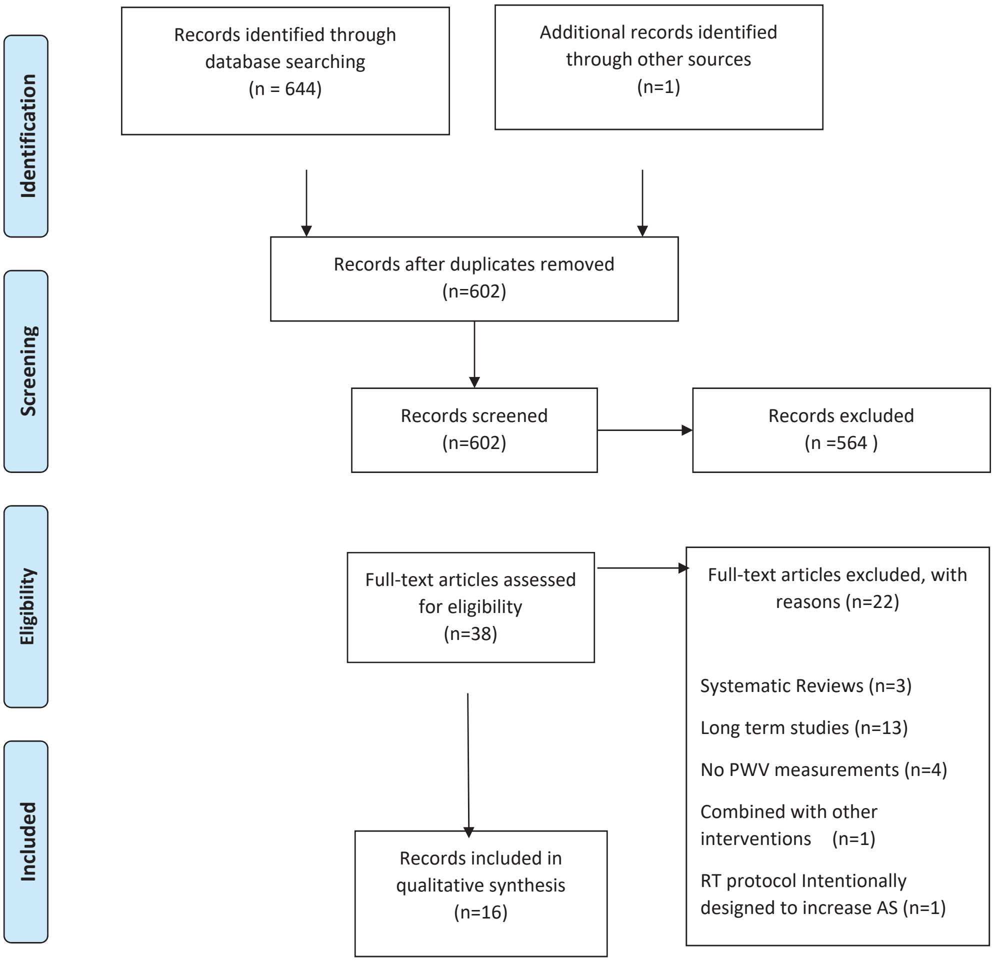

Figure 1 Flow diagram illustrating the search process.

Table 1 Participant's characteristics.

Study	Participants	Age (Years)	Medication
Amorim et al. (2022)	1 old man and 6 old women with gait speed < 0.9 m/s	82 ± 7.4	YES - various medications including: Anti-hypertensives Anti-hypercholesterolemia Anti-depressant Anti-psychotic Platelet anti-aggregant
Collier et al. (2010)	10 young men	21 - 29	NO
Heffernan et al. (2006)	7 young men, 6 young women	21.5 ± 0.7	YES -3 female participants were taking oral contraceptives
Heffernan et al. (2007a)	14 young men mean age	27.9 ± 2	NO
Heffernan et al. (2007b)	13 young men	21 - 29	NO
Kingsley et al. (2016)	11 young men and 5 young women resistance trained	23 ± 3	NO
Kingsley et al. (2017)	14 young men and 12 young women resistance trained	18 - 30	NO
Li et al. (2015)	20 men	20 - 40	NO
Nitsche et al. (2016)	36 young men and 5 young women	23.8 ± 2.3	NO

Parks et al. (2020)	12 young men and 20 young women resistance trained	18 - 28	NO
Rodriguez-Perez et al. (2020)	32 young men	21.7 ± 1.2 for the low effort group, 21.8 ± 1.1 for the high effort group	NO
Thiebaud et al. (2016)	12 young men, 14 middle aged men and 10 old men	Young (20 - 39), Middle aged (40 - 59), Old (60 - 75)	YES - 2 young participants were taking stimulants (Adderall) and hypothyroid medication. 2 middle aged and 3 old participants were taking cholesterol and hypertensive medication.
Tagawa et al. (2019)	52 young men	22 - 35	NO
Tomschi et al. (2018)	20 young women	20 - 30	NO
Tomschi et al. (2019)	16 young men and 2 young women non-professional, experienced weightlifters	24.2 ± 1.9	NO
Yoon et al. (2010)	13 young men	20 - 29	NO

Note: Age is expressed as mean and standard deviation or range.

Table 3 Summary of Risk of Bias

Study	D1	D2	D3	D4	D5	D6	D7	Overall
Amorim et al. (2022)	+	+	X	X	+	+	+	
Collier et al. (2010)	+	+	X	X	+	+	+	
Heffernan et al. (2006)	+	+	X	X	+	+	-	
Heffernan et al. (2007a)	+	+	X	X	+	+	+	
Heffernan et al. (2007b)	+	+	X	X	+	+	+	
Kingsley et al. (2016)	+	+	X	X	+	+	+	
Kingsley et al. (2017)	+	+	X	X	+	+	+	
Li et al. (2015)	+	+	X	X	+	+	+	
Nitsche et al. (2016)	+	+	X	X	+	+	+	
Parks et al. (2020)	+	+	X	X	+	+	+	
Rodriguez-Perez et al. (2020)	+	+	X	X	+	+	+	
Thiebaud et al. (2016)	+	+	X	X	+	+	+	
Tagawa et al. (2019)	+	+	X	X	+	+	-	
Tomschi et al. (2018)	+	+	X	X	+	+	+	
Tomschi et al. (2019)	+	-	X	X	+	+	+	
Yoon et al. (2010)	+	+	X	X	+	+	+	

Risk of bias

D1: Random sequence generation
D2: Allocation concealment
D3: Blinding of participants and personnel
D4: Blinding of outcome assessment
D5: Incomplete outcome data
D6: Selective reporting
D7: Other sources of bias

Judgement
X High
- Unclear
+ Low
Not applicable

studies [13,28] were identified with other risk of bias due to training protocol adopted (a single exercise was performed; thus, it is unknown if the inclusion of additional exercises would have influenced the results). Lastly, all studies were identified as having a high risk of bias for the criteria related to blinding of participants and personnel.

Pulse wave velocity

Ten studies reported an significant increase in cfPWV[10-12,27-33], five studies observed no significant differences[13,14,34-36] while one study reported a significant decrease of 14% in peripheral PWV[13]. Increases in PWV from baseline to post-exercise values ranged from 2% to 20.8%.

Exercise protocols

A whole-body resistance training protocol (Table 2.) was adopted by ten studies[10-12,14,27,30-33,36] while three studies prescribed exercises for the lower[13,29,34] or upper body[28] only. Two studies compared differences in AS between upper and lower body muscle groups[35,37] two studies compared the effects of aerobic vs resistance exercise[10,30] while others compared differences between males and females[31], weight machines and free weight exercises[32], a RT protocol and a bout of Valsalva manoeuvres[34], traditional RT and blood flow restriction RT[29], among different levels of effort[33], across the age span[14] and between different loading intensities[36].

Table 2 Exercise protocols

Study	Exercise intervention	Sets x Reps	Loading Intensity	Effort	Rest Interval		Repetition Speed		Results (BL to post differences/between groups or conditions differences)
					Inter-set	*Inter-exercise*	*Con*	*Ecc*	
Amorim 2022	Leg extension, leg press	3 x 15	60% of 1RM	n/a	60s	60s	2s	2s	cfPWV significantly increased by 9% at 60 min post
Collier 2010	Bench press, bent-over row, leg extension, leg curl, shoulder press, biceps curl, triceps bench press, abdominal crunch	3 x 10	10 RM	MAX	90s	90s	n/a	n/a	cfPWV significantly increased by 9.8% at 40 and 60 min post/ No changes in femoral -dorsalis pedis PWV
Heffernan 2006	Unilateral leg press (dominant limb)	6 to volitional failure	85% of 1RM	MAX	n/a	n/a	n/a	n/a	No differences in cfPWV. Femoral dorsalis PWV significantly decreased by 14% at 5 post and remained lower than BL by 10% at 25 min post in the exercised limb compared to the non-exercised limb
Heffernan 2007a	Unilateral leg press and leg extension	15 x 10	75% of 1RM	n/a	70s	n/a	n/a	n/a	No differences in cfPWV and Femoral dorsalis pedis PWV
Heffernan 2007b	Bench press, bent-over row, leg extension, leg curl, shoulder press, biceps curl, triceps bench press, abdominal crunch	3 x 10	10 RM	MAX	90s	n/a	n/a	n/a	cfPWV significantly increased by 20.8% at 20 min post. No differences in Femoral dorsalis PWV
Kingsley 2016	Squat, bench press, and deadlift	3 x 10	75% of 1RM	n/a	120s	120s	n/a	n/a	cfPWV significantly increased by 9.6% at 10 min post
Kingsley 2017	Squat, bench press, and deadlift	3 x 10	75% of 1RM	n/a	120s	120s	n/a	n/a	cfPWV significantly increased by 7.3% (in men) and 9.8% (in women) at 10 min post/ No differences between sexes

Li 2015	**C1** (Lower Body): seated leg press, leg curl and leg extension **C2** (Upper Body): chest press, fly backward and fly forward	4 x 10	70% of 1RM	n/a	n/a	120s	1s	1s	baPWV was significantly lower for **C1** compared to **C2** immediately post, at 20 and 40 min post
Nitsche 2016	Squats, bench press, rowing with the barbell, biceps curl with the EZ curl bar, lying triceps extensions with the EZ curl bar	**G1** (Low Load): 3 x 30 **G2** (Med Load): 3 x 20 **G3** (High Load): 4 x 10	**G1**: 30 % 1RM **G2**: 50 % 1RM **G3**: 70 % 1RM	n/a	**G1**: 30s **G2**: 90s **G3**: 120s	**G1**: 120s **G2**: 120s **G3**: 120s	n/a	n/a	PWV significantly increased by 13.8% for G**1** and 8% for **G2** immediately post. At 10 min post PWV significantly increased by 6% for **G1**. No differences in any time point (immediately post, 5 and 10 min post) for **G3**
Parks 2020	**G1** (Free Weights): bench press, squat, deadlift **G2** (Weight Machines): leg press, lat pull down, leg extension, chest press, seated leg curl	3 x 10	75% 1RM	n/a	120s	120s	n/a	n/a	cfPWV significantly increased in both groups between 10 - 20 min post/ no differences between groups
Rodriquez-Perez 2020	Bench press, back squat	**G1** (High Effort):3 to task failure **G2** (Low Effort): 3 x approximately half number of maximum possible repetitions	75% 1RM	**G1**: Max **G2**: Submax (Approximately half the number of reps to failure)	180s	180s	max	max	cfPWV increased immediately post by 4% in **G1** / cfPWV was higher (Effect size > 0.20) for **G1** than **G2** at all time points (immediately post, 5 min and 24h post)
Thiebaud 2016	Leg press, chest press, knee flexion, lat pull down, leg extension	3 x 10	65% of 1RM	n/a	120s -180s	120s	n/a	n/a	No differences in cfPWV / no differences between groups.
Tagawa 2019	Bicep curls	5 to task failure	75% of 1RM	MAX	120s	n/a	3s	3s	cfPWV significantly increased at 30 min and 60 min post for the experimental group compared to the control group
Tomschi 2018	**G1** (Lower Body): leg curl, leg press, calf lifter, and leg extension **G2** (Upper Body): butterfly, latpull down, abdominal press, and butterfly reverse	3 x 12	70% of 1RM	n/a	90s	120s	2s	2s	No differences in cfPWV / no differences between groups
Tomschi 2019	20 min weightlifting specific warm up working up to maximum for a single clean and jerk lift	1 x 1	90-95% of 1RM	n/a	120s (during warm up)	120s (during warm up)	max		cfPWV significantly increased by 7% immediately post / no significant differences at 15 and 30 min post
Yoon 2010	Bench press, squat, lat pull down, biceps curl, leg extension, leg curl, upright row, triceps extension	2 x 15	60% of 1RM	n/a	n/a	n/a	n/a	n/a	cfPWV significantly increased by 2% at 20 min post for the experimental group compared to the control group

Note. C: Condition; G: Group; BL: Baseline; Con: Concentric; Ecc: Eccentric; n/a: Not available;
RM: Repetition maximum; Max: To task failure; Min: minimum repetition duration/at maximal speed

Loading intensity

Loading intensity (Table 2.) was prescribed in relative terms with a predetermined number of repetitions in eleven studies[11,12,14,27,29,31,32,34-37], three studies prescribed a relative load with repetitions performed to task failure[13,28,33], while in two trials[10,30] load was prescribed based on repetition maximum (RM) targets (i.e., 10RM). The majority of studies prescribed moderate to high loading intensities (60 – 95% 1RM) with one exception[36]. Irrespective of loading intensity AS either increased[10-12,27-33,36,37], decreased[13], or remain unchanged[13,14,34-36].

Intensity of effort

Intensity of effort (Table 2.) was objectively monitored in one study only[33] using velocity loss as an indicator of effort. In four studies repetitions were performed to task failure[10,13,28,30] thus it can be assumed that participants most probably trained at a maximal effort. The remaining nine studies did not provide relevant information. Higher intensities of effort seem to have a more pronounced effect on arterial stiffening[33].

Repetition duration – Rest interval

Rest interval duration (Table 2.) varied across studies ranging from 30 to 180 seconds, and repetition duration was reported in six trials[27-29,33,35,37]. CfPWV increased or remain unchanged in both moderate and long rest intervals[33,35]. Short repetition durations performed in an explosive tempo may attenuate increases in AS[27]. Individual study characteristics are summarised in Table 2.

DISCUSSION

The aim of the present systematic review was to identify and analyse the available literature examining the acute effects of RT on AS assessed by PWV. The current body of evidence indicates that acute RT may cause an increase in cfPWV (63% of studies) although this finding is not universal. Such discrepancy may originate from differences in the loading characteristics (i.e., loading intensities prescribed, participant's proximity to task failure, velocity of repetition), among the RT protocols.

Exaggerated peaks in systolic blood pressure during RT have been suggested to cause alterations in arterial structure, by transferring arterial wall stress from the more elastic elastin fibers to the inherently stiffer collagen fibers, thus contributing to arterial stiffening over time.[38] Recently, Zhang et al. (2021) suggested that loading intensity is the key variable determining long term arterial adaptations to RT. Hence, it is reasonable to assume that loading intensity may also influence acute vascular function. Analysing the existing evidence, it can be observed that the majority of the studies (11 out of 16) prescribed loading intensity in relative terms (i.e., as percentage of 1RM) with a fixed number of repetitions and seven of them reported a significant increase in PWV post-exercise. This limits the value of any conclusions since research has shown considerable heterogeneity in the number of repetitions performed at the same relative load, among individuals and between different exercises.[39,40] For instance, in a study prescribing loading intensity at the same percentage of 1RM, some individuals may prematurely achieve task failure while others might be able to perform additional repetitions, above the predetermined ones, indicating a different level of effort among the same study population.[21] Based on these observations, it has been argued that attempting to isolate the effects of one training variable (loading intensity in this instance) without controlling the effort applied by the individual may be problematic since the RT stimulus is not uniform among the participants investigated.[41,42] This is an important consideration given the differential physiological responses that may be evident when training closer to or further away from task failure.[43] Research has shown that performing repetitions closer to failure augments the amount of muscles fibres recruited[44], thus increasing the amount of muscle mass involved in the training task. Considering that sympathetic adrenergic vasoconstriction is a potential mechanism explaining increases in AS[45], a larger amount of activated muscle mass may lead to a greater sympathetic response therefore restraining arterial distensibility[46].

In addition, longer set configurations performed with a higher number of repetitions (closer to task failure) promote a greater parasympathetic withdrawal and blood pressure response compared to shorter set configurations (i.e., cluster sets) possibly indicating a greater vasoconstrictor tone and a higher arterial wall stress that may promote arterial stiffening [45]. The notion that proximity to task failure may be a contributing factor in vascular function independently of the load used was supported by Rodriguez-Perez et al. (2020). The authors compared two groups performing 3 sets of repetitions executed as fast as possible at a relative load of 75% of 1RM for the bench press and squat exercises. The high-effort group performed all sets to failure while the low-effort group stopped the set approximately halfway before failure (as indicated by the loss of repetition velocity). At the same loading intensity cfPWV was meaningfully higher (effect size > 0.20) for the high effort compared to the low effort group at all three time points assessed, indicating that different degrees of effort could affect the vascular response. Considering that the majority of the included studies prescribed loading intensity without controlling nor reporting the effort applied, evidence from this study may be valuable, highlighting the importance of considering effort as an independent variable during RT. Nonetheless, it should be noted that the overall volume load (calculated as number of sets x repetitions performed x load lifted) was lower in the low effort group, therefore future investigations may consider addressing AS responses among volume equated RT protocols to eliminate a potential volume-induced effect on AS.

A growing body of evidence has recently suggested that performing RT using heavier loads with fewer repetitions may be less cardiovascular taxing for cardiac patients than executing a higher number of repetitions with lighter loads.[24,47] Gjovaag et al. (2016) reported greater systolic blood pressure following a moderate load/high rep (15RM) compared to a high load/low rep (4RM) RT protocol in patients with coronary artery disease. Similarly, Vale et al. (2018) observed a greater sympathetic activation in hypertensive women during a 15RM when compared to a 6RM loading scheme. Results by Nitzsche et al. (2016) who directly compared AS responses between different loading intensities support this notion given that cfPWV was significantly increased by 13.8% immediately post exercise for the low load/high rep group (30 reps at 30% 1RM). In contrast, no significant differences were observed for the group using a high load/low rep protocol (10 reps at 70% 1RM). However, results of the above study should be interpreted with caution since volume load and effort were not matched among the study participants.

Regarding repetition duration only six studies of the current review prescribed a specific repetition tempo. Research has shown that repetition velocity may affect arterial responses to RT with a fast execution of the concentric portion of the lift potentially attenuating increases in AS.[48] It is postulated that prolonged concentric contractions are associated with a more pronounced increase in sympathetic activation and endothelin 1 secretion, compared to eccentric contractions, potentially enhancing arterial stiffening. In addition, previous studies have indicated a higher cardiovascular demand with slow tempo repetitions in both healthy individuals[49] and coronary patients. Individual study data of the present review seem to support the notion that repetition duration may influence vascular responses. Participants in the study by Takawa et al., (2019) employed a repetition tempo of 3s for both concentric and eccentric contractions. The authors reported that cfPWV increased and remained elevated, significantly different from baseline values, at 30min and 60min post training. In contrast, cfPWV although increased immediately post returned to baseline (or even lower) at 5min and 15 min post when trainees performed the lifts as fast as possible in the studies by Rodriguez-Perez et al. (2020) and Tomschi et al. (2019) respectively. Nonetheless, data availability is limited on this topic, thus additional studies may be needed to test this hypothesis.

Collectively findings of the present review indicate that arterial responses to acute RT may be influenced by additional RT variables (i.e., intensity of effort, repetition duration) which are usually left uncontrolled/unreported in research settings. Manipulation of these variables may attenuate or even prevent arterial stiffening, which is commonly observed following acute RT. Thus, future research should aim to investigate the potential implication of these RT variables in more standardised training protocols providing a more homogenous stimulus to study participants. Specifically, different loading intensities may be more appropriately compared by matching intensity of effort. For instance, by having participants perform repetitions to task failure, two loading intensities (e.g., 5RM vs 15RM) can be more appropriately compared, since the intensity of effort would most likely be similar (i.e., maximal). Similarly, different intensities of effort may be investigated at different proximities to task failure using different set configurations (i.e., cluster sets) or the repetitions in reserve approach (RIR).[50] Several limitations of the present review have to be acknowledged. The majority of the included studies involved young healthy participants, thus applicability of the results on populations at risk such as hypertensives or CVD patients remains unclear. In addition, current findings are specific to acute RT, thus generalisability to chronic adaptations remains uncertain. Although a Meta Analysis could have been conducted, its applicability on heterogenous RT studies has been recently questioned [41].

CONCLUSION

Findings of the current review indicate that an acute resistance training bout may cause a transient increase in PWV. However, the lack of standardization in important training variables (e.g., intensity of effort) within the current body of literature limits interpretation of the results. Future investigations should consider the limitations discussed herein and aim to adopt more standardised RT protocols which accurately control for training variables such as, load, effort, and repetition duration, to adequately address the topic.

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DECLARATION OF INTEREST

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