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Review Article

Exercise Interventions for Subjects with Hypertension: A Systematic Review of Systematic Reviews

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ABSTRACT

Background: Physical activity has been advocated as a first line intervention for prevention and treatment of Hypertension. Effects of exercise training may vary with different exercise modalities. We aimed to summarize systematic reviews on various types of exercise interventions for subjects with Hypertension.
Objective: To provide an overview on various types of exercise interventions for reduction of blood pressure in subjects with Hypertension.
Methods: The electronic databases of Pub Med and the Cochrane library were searched up to August 2019 for systematic reviews on exercise training for Hypertension using index term combinations of the keywords Hypertension, systematic review, exercise training and blood pressure. Methodological quality of included systematic reviews was assessed with the assessment of multiple systematic reviews (AMSTAR). Narrative synthesis of review findings was used to present the results.
Results: Total 8 systematic reviews were identified comprising of following exercise interventions. 1. Aerobic exercise. (3 reviews and 132 trials) 2. Resistance exercise. (3 reviews and 97 trials) 3. Isometric hand grip exercise (4 reviews and 27 trials) 4. Combined training (1 review). Overall methodological quality of reviews was moderate. Most reviews tend to support potential benefit of aerobic, resistance and isometric resistance training for subjects with Hypertension.
Conclusion: There is moderate quality evidence about effectiveness of aerobic exercise for blood pressure management in subjects with Hypertension. There is emerging evidence about efficacy of dynamic resistance training in subjects with hypertension. There is low quality evidence for isometric resistance training.
Key Words: Hypertension, Systematic review, Exercise training

INTRODUCTION

Hypertension affects more than 1 billion people, [1] accounting for 13% of total deaths worldwide. [2] Interventions to decrease blood pressure have been extensively studied, [3–8] and among them, lifestyle modifications are a cornerstone in hypertensive subjects. [9,10] HTN, or the chronic elevation of resting arterial blood pressure (BP) >140 mm Hg systolic (SBP) and/or 90 mm Hg diastolic BP (DBP), remains one of the most significant modifiable risk factors for cardiovascular disease (e.g., coronary artery disease, stroke, heart failure). [11] Although antihypertensive medications are efficacious and most have minimal side effects, the economic health care costs are increasing. [12] Both national and international treatment guidelines for the primary and secondary prevention of HTN recommend non pharmacological lifestyle modifications as the first line of

therapy, including increasing levels of physical activity. [13] There is Class I, Level B evidence that 150 minutes of weekly physical activity offers an alternative that may be used to complement antihypertensive medication. [14] The American College of Sports Medicine position stand on exercise and HTN [15] recommends dynamic aerobic endurance training for at least 30 minutes daily, preferably supplemented with dynamic resistance exercise. The effects of exercise training may vary with different exercise modalities (eg, endurance training or resistance exercise) and dose parameters, specifically program length, session duration, frequency, and workload or intensity. As such, the optimal exercise training prescription remains unclear. Dynamic aerobic endurance exercise involves large muscle groups in dynamic repetitive activities that result in substantial increases in heart rate and energy expenditure. Resistance training is activity in which each effort is performed against a specific opposing force generated by resistance and is designed specifically to increase muscular strength, power, and/or endurance. According to the type of muscle contraction, resistance training can be divided into 2 major subgroups: "dynamic" versus "static or isometric" resistance training. Dynamic resistance training involves concentric and/or eccentric contractions of muscles while both the length and the tension of the muscles change. Isometric exertion involves sustained contraction against an immovable load or resistance with no or minimal change in length of the involved muscle group. Historically endurance training has been preferred. Isometric activity has previously been associated with exaggerated hypertensive responses, but recent work has suggested isometric handgrip activity may become a new tool in the non pharmacological treatment of high BP. [16,17] Many systematic reviews have been published on effects various types of exercise interventions in subjects with Hypertension. Therefore it becomes more and more difficult to deal with huge amount of literature. Therefore, the specific scope of this paper is to provide an overview of all the systematic reviews and to perform a synthesis of the evidence on effect of various types of exercise interventions in subjects with essential Hypertension.

MATERIALS AND METHODS

- The method to conduct this review was according to "*Methodology in conducting a systematic review of systematic reviews of healthcare interventions*" by smith et al (2011). [18]

a. Search strategy:

A systematic search was conducted of Pub Med and Cochrane library until August, 2019 for systematic reviews and/or Meta analysis on effects of exercise training to lower blood pressure. The search strategy included systematic review, Meta analysis and free text terms for the key concepts aerobic/dynamic/endurance/ resistance exercise, training, HTN, and SBP/DBP, and these were combined with a sensitive search strategy to identify randomized controlled trials.

b. Inclusion criteria:

Two criteria were considered for further evaluation of an abstract:

(1) Must be a English paper defined as a systematic review and/or a meta-analysis;
(2) Must about use of exercise interventions to lower blood pressure in patients with "Essential" or "Primary Hypertension".
(3) The publication years ranged from 2008 to August 2019

Exclusion criteria:

(1) review comments, overviews of evidence, guidelines, editorials;
(2) Systematic reviews involving use of Yoga/Pranayama/dance therapy/tai chi as a exercise intervention for management of hypertension
(3) Systematic reviews which included only normotensive subjects

We assessed the methodological quality of each review using the AMSTAR (A Measurement Tool to Assess Reviews) instrument that contains 11 items. [19] Final grading of the methodological quality of each SR was based on the overall score and reported as either 'high' (score≥8), 'medium' (score 4–7) or 'low' (score≤3). Two reviewers independently assessed the quality of
the SRs, and disagreements were resolved by consensus.

Data extraction

From each SR, the following data were collected:
The publication year,
the databases searched,
the study population,
the type of exercise interventions,
the number of primary studies included,
the outcome measures
the AMSTAR score.

Two reviewers independently screened titles, abstracts and full texts of articles. Disagreements were resolved by discussion.

RESULTS

Systematic review selection:

Our search strategy resulted in the identification of 3649 records; after excluding duplicates, 702 publications were manually screened by titles and abstracts, and 52 papers were eligible for inclusion**. (Figure 1**) On the basis of review of full-text articles, 42 systematic reviews were excluded and 10 met our inclusion criteria. After discussion, three reviews were subsequently removed as they were duplicate. Thus a total of 8 systematic reviews were finally included in this overview.

Systematic review characteristics

The main characteristics of systematic reviews are displayed in **Table 1**. Four systematic reviews performed meta-analyses, one conducted best-evidence syntheses, and one used both quantitative and qualitative analysis. The included systematic reviews were published between 2011 to 2019. The number of trial included in the reviews varied widely from 5 to 93 studies. Two of the reviews included subjects with Hypertension and Pre hypertension, four included Hypertension and one included Hypertension, pre hypertension and normal blood pressure.

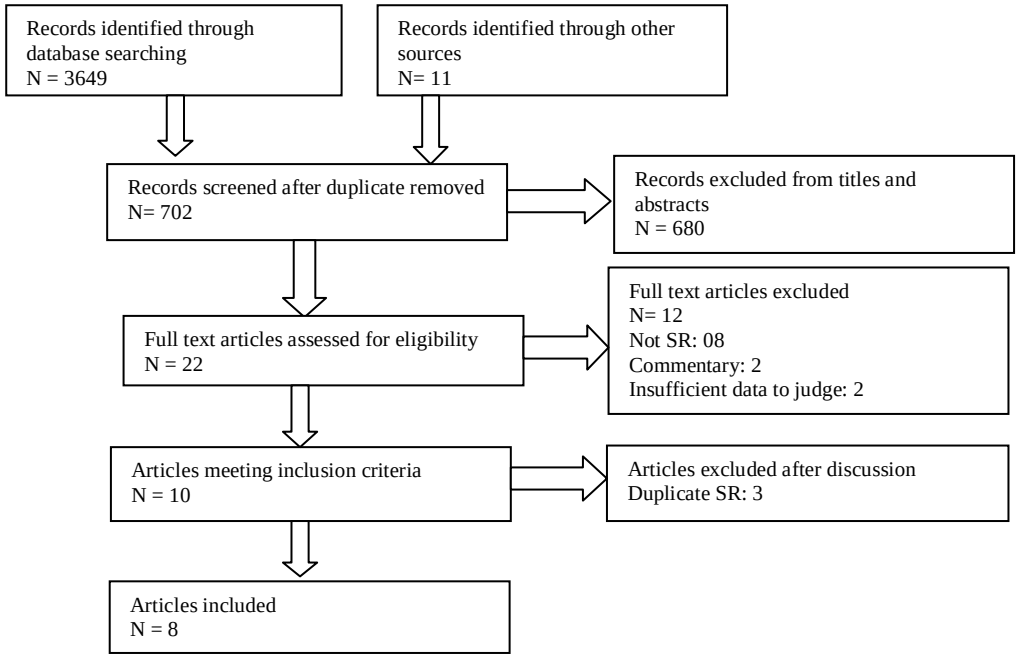

Figure 1 Flow diagram of literature search

Table 1 General characteristics of reviews included in the study, SBP- Systolic blood pressure, DBP- Diastolic blood pressure

Author (Year)	Database searched	Primary studies (patients)	Type of exercise intervention	Data analysis methods	Quality of original studies scale/level	comparisons	Authors conclusion/comments
Cao 2019	PubMed, Embase, Cochrane Library, and Web of Science databases	N= 14 (860)	Aerobic Exercise	Meta analysis	Cochrane's risk of bias tool Moderate to High	Aerobic exercise no exercsie	Aerobic exercise has favorable effects on blood pressure, heart rate, and ambulatory blood pressure of hypertensive patients.
Wen 2017	Pub Med, EMBASE	N=13 (802)	Aerobic exercise	Meta analysis	Not reported	Aerobic exercise no exercise	Aerobic exercise may be a potential non pharmacological treatment for blood pressure improvement in essential hypertensive patients
Farah 2017	Pub Med	N=7(173)	Isometric Hand grip exercise	Best evidence synthesis	TESTEX score 6-13	Isometric hand grip exercise No exercise	Acute isometric handgrip exercise does not affect post-exercise blood pressure in hypertensive subjects, although the need for further studies is clear. On the other hand, chronic isometric handgrip training significantly decreases blood pressure.
De sousa 2017	BIREME, PubMed, Cochrane Library, LILACS and SciELO	N=5(201)	Resistance exercise	Meta analysis	Not reported	Resistance training No exercise	resistance training alone reduces systolic and diastolic blood pressure in prehypertensive and hypertensive subjects
Mac Donald 2016	PubMed (including Medline), Scopus (including EMBASE), SportDiscus, and Web of Science	N=64 (2344)	Resistance exercise	Meta analysis	Modified version of the Downs &black check list 63%	Dynamic resistance training No exercise	Dynamic resistance training may elicit BP reductions that are comparable to or greater than those reportedly achieved with AE training.
Carlson 2016	PubMed, CINAHL, and the Cochrane Central Register of Controlled Trials	N=9(223)	Isometric resistance exercise	Meta analysis		Isometric exercise No exercise	Isometric resistance training lowers SBP, DBP, and mean arterial pressure. The magnitude of effect is larger than that previously reported in dynamic aerobic or resistance training. Our data suggest that this form of training has the potential to produce significant and clinically meaningful blood pressure reductions and could serve as an adjunctive exercise modality.
Cornelissen 2013	Medline (Ovid), Embase.com, and SportDiscus	N=93 (5223)	Aerobic exercise Resistance exercise Isometric resistance exercise	Meta analysis	PEDro 6/8	Endurance training Resistance training Combined training Isometric resistance training	Endurance, dynamic resistance, and isometric resistance training lower SBP and DBP, whereas combined training lowers only DBP. Data from a small number of isometric resistance training studies suggest this form of training has the potential for the largest reductions in SBP.
Cornelissen 2011	MEDLINE, PubMed, SPORTDiscus, and EMBASE	N=28 (1012)	Isometric Hand grip training Dynamic resistance training	Meta analysis	2.5/5 Jadad Scale	Isometric Hand grip exercise Dynamic resistance training	handgrip training may be more effective for reducing blood pressure than dynamic resistance training.

Table 2 summary of Positive results with meta analysis, reduction in Blood pressure, NR - Not reported, MD- Mean difference

Comparator	Authors (Date)	Number of RCTs (Patients)	Outcome measured time point	Effect estimate SMD/MD 95 % confidence interval
Isometric resistance training	Carlson DJ et al (2014)	9 (223)	≥ 4 weeks	SBP MD = -6.77(-7.93 to -5.62) DBP MD = -3.94(-4.73 to -3.16)
	Cornelissen et al (2013)	5	NR	SBP MD= -10.9 (-14.5 to -7.4) DBP MD = - 6.2(-10.3 to -2.0
Isometric Hand Grip exercise	Farah et al (2017)	5	6-10 weeks	SBP ↓ 5-19mmHg DBP ↓ 6 mmHg Mean BP ↓ 3-6 mmHg
Aerobic exercise	Wen et al (2017)	13 (802)	4-24 weeks	SBP SMD= -0.79 (-1.29 to -0.28) DBP SMD = -0.63 (-1.14 to -0.12)
	Cornelissen et al (2013)	19	< 12 weeks	SBP MD = -6.4 (-9.9 to -2.9) DBP MD = -4.0 (-6.4 to -1.6)
		51	12-24 weeks	SBP MD = -4.1 (-5.2 to -3.0) DBP MD = -3.0 (-4.0 to -1.9)
		35	>24 weeks	SBP MD = -16.66 (-18.55 to -14.76) DBP MD = -6.43(-7.83 to -5.03)
	Cao et al (2019)	14(860)	≤ 8 weeks	SBP MD = -11.74 (-15.94 to -7.54) DBP MD = -5.44(-8.22 to -2.66)
			8-12 weeks	SBP MD = -8.84 (-13.52 to -4.15) DBP MD = -7.52(-12.42 to -2.62)
			>12 weeks	
Combined Endurance and dynamic resistance training	Cornelissen et al (2013)	5	NR	SBP MD =-1.4 (-4.2 to +1.5) DBP MD= -2.2 (-3.9 to -0.48)

Table 3. Quality of Systematic reviews and Quality of Evidence

Type of exercise intervention	No of systematic reviews	Methodological Quality of Systematic review (AMSTAR score)	Quality of evidence (GRADE)
Aerobic	3	5-7	Moderate
Resistance	4	6-8	Low to Moderate
Combined	1	7	Moderate
Isometric resistance training	4	5-9	Very low to Low

Exercise intervention details

Two systematic review were on aerobic exercise, two were on dynamic resistance exercise, two were on isometric resistance training and one each was on combination of aerobic, resistance, isometric resistance and combined aerobic and resistance training. Duration of exercise training varied from 4 to 52 weeks in the included systematic reviews.

Methodological quality

The quality assessment scales of the original studies varied across the included systematic reviews; One used PEDro, One used TESETEX (Tool for the Assessment of Study Quality and reporting in Exercise scale, [20] one used Jadad scale, one used modified version of the downs and black checklist. [21] One of the reviews used Cochrane's risk of bias tool**.** [22] Two of the reviews did not report about quality of original studies. Overall, the quality of the studies included in the reviews was moderate. Methodological quality of each review was assessed using AMSTAR independently by two reviewers. [19] After discussion, the reviewers reached consensus giving a kappa index of 0.818 (substantial agreement).

There are total 11 items in AMSTAR. For each "Yes" = 1 and No or can't answer = 0. Quality of review is graded according to AMSTAR score.

Low = 0-3

Moderate = 4-7

High = 8-11

Outcomes

Magnitude of reduction in Systolic and diastolic blood pressure varied widely among the included reviews. Summary of

positive findings have been shown in **Table 2**.

Quality of evidence

Quality of evidence was assessed by GRADE approach.[23] The GRADE system rates the quality of evidence for each outcome, from a rating of HIGH to VERY LOW.

DISCUSSION

This systematic review of systematic reviews provides an overview of the best current evidence available for use of exercise intervention in subjects with hypertension. This review included total 8 systematic reviews having variable quality on effect of different type of exercise on blood pressure in Hypertensive individuals (Table 3).3 systematic reviews [3,22,27] with Moderate quality provided evidence that moderate to high intensity aerobic exercise significantly decreases SBP and DBP with effects are most pronounced in male subjects. 4 systematic reviews, two with moderate quality [3,25] and two with high quality [4,24] reported that dynamic resistance exercise is effective as standalone anti hypertensive therapy. 4 systematic reviews two with moderate [3,26] and two with high quality [4,7] provided evidence on effect of isometric resistance training to lower blood pressure in hypertensive subjects. There is paucity of trials involving larger and broader populations which may merit even stronger recommendations about these types of training in future. Overall quality of evidence supporting beneficial effect of aerobic and dynamic exercise was moderate while quality of evidence for isometric resistance training was low (Table 3). Findings of present reviews support recommendations by AHA (2013). [28] This study has several limitations. Firstly, although a comprehensive search strategy was conducted, the current study only included studies that were written in the English language. Therefore, it is likely that relevant published or unpublished studies were missed. Secondly, because not all included reviews were of high quality, the estimates of therapeutic effects may have been impacted.

CONCLUSION

Based on 8 systematic reviews, [3,4,8,22,24-27] there is moderate quality evidence about Aerobic exercise as a potential non pharmacological treatment for Hypertension. There is moderate to low quality evidence about Dynamic Resistance training and Low quality evidence about Isometric resistance training as standalone anti hypertensive therapy.

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