Journal of Human Hypertension (2019) 33:837–843
https://doi.org/10.1038/s41371-019-0266-z

REVIEW ARTICLE

Exercise and sport science australia position stand update on exercise and hypertension

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Received: 7 April 2019 / Accepted: 15 April 2019 / Published online: 3 October 2019

Abstract

Hypertension is the most common circulatory system condition, accounting for >40% of the cardiovascular disease total burden. One-third of Australians aged over 18 years have hypertension and in 68% of these it is uncontrolled. Australian data show hypertension accounts for 6% of general practitioner (GP) consults. Recent evidence has confirmed exercise is an effective adjunct therapy for hypertension management and the objective of this document is to provide a contemporary, evidence-based guide for optimal delivery of an exercise programme for blood pressure management. This work is an update to the 2009 Exercise and Sport Science Australia (ESSA) position stand. In most cases, the first line treatment to reduce BP is initiation of lifestyle changes, of which regular aerobic exercise is a principal component. Aerobic and resistance activities remain the cornerstone of exercise-based management of blood pressure, but recent work has uncovered variations on traditional delivery of exercise, such as high intensity interval training (HIIT) and a new exercise modality, isometric resistance training (IRT) may offer alternative management regimens. Exercise Physiologists, as well as other health care professionals, play an important role in helping to achieve BP control in patients with hypertension by reinforcing healthy lifestyle habits and prescribing appropriate exercise.

Introduction

This document provides an update on the 2009 position stand and offers guidance on appropriate exercise intervention for the special needs of patients with high blood pressure (high BP; hypertension). While it is beyond the scope of this paper to review all available material relating to this subject, important publications have been highlighted for recommended reading (RR). For over 100 years, clinicians have used upper arm BP to define hypertension, assess associated risk and guide therapy. The two BP values recorded during each measurement represent the maximal pressure of the blood within the brachial artery during cardiac contraction (systolic BP; SBP) and the minimal pressure during relaxation (diastolic BP; DBP). These give an estimate of the BP occurring within other large arteries in the body. Hypertension is one of the major potentially modifiable risk factors for cardiovascular disease and death [1]. Most of this risk results from structural damage to the heart (which is required to work harder as a pump in the face of high BP) and also atherosclerosis of large and small arteries, and the organs they supply.

The Australian National Health Survey found that just over one-third (34%) of adults reported high BP in 2014–15 [2]. High BP is the most frequently managed problem by general practitioners [3]. Although the aetiology is unknown, genetic factors are thought to play a role, and a family history of hypertension is frequently encountered. Importantly, *hypertension is more likely to develop in people who are physically inactive*, overweight (BMI ≥30 kg/m [2]; waist circumference >102 cm [men] or >88 cm

NB: This is an update to the 2009 Position Stand originally published in the Journal of Science and Medicine in Sport (2009) 12, 252–257

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Table 1 Classification of clinical blood pressure levels in adults

Diagnostic Category	Systolic (mmHg)		Diastolic (mmHg)
Optimal	<120	And	<80
Normal	120–129	And/or	80–84
High-normal	130–139	And/or	85–89
Grade 1 (mild) hypertension	140–159	And/or	90–99
Grade 2 (moderate) hypertension	160–179	And/or	100–109
Grade 3 (severe) hypertension	≥180	And/or	≥110
Isolated systolic hypertension	>140	And	<90

When a patient's systolic and diastolic blood pressure levels fall into different categories, the highest diagnostic category and recommended actions apply

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[women]) [4] or who consume excess dietary sodium (>100 mmol/d or >2.4 g/d) or alcohol (>2 standard drinks/d [men]; >1 standard drink [women]) [5]. Australian guidelines for the definitions and classifications of BP, which are similar to the European guidelines, are shown in Table 1 [6], and Williams et al. (European Hypertension Guidelines; RR) [7] provide a comprehensive review of clinical considerations relating to the detection and management of hypertension. Lower targets recommended by the American College of Cardiology and the American heart association [8] have been criticised [9] and not generally been accepted by other countries for a variety of reasons, including the logistic difficulties and potential for harm (for example, acute kidney injury and falls) associated with applying them on a broad scale, and concerns about the validity and generalisability of the SPRINT Trial data [10] on which they were based.

Once hypertension has been diagnosed, a management plan is initiated by the treating clinician with the goal of reducing BP as well as overall cardiovascular risk. This may involve the identification and, where possible, correction of "curable" forms of hypertension caused by a variety of endocrine conditions, but this applies to a minority of patients with hypertension. A fundamental, and in most cases the initial, "tool" to achieve a reduction in BP as well as cardiovascular risk is lifestyle modification (including regular physical activity, weight reduction, reduction in alcohol intake and smoking cessation and dietary modification), whether in conjunction with drug therapy or otherwise. Therapeutic lifestyle changes (including regular physical activity and restriction of sedentary activity, weight loss and dietary modification) are also recommended in children and adolescents with high BP. In this patient population the criteria for the diagnosis of hypertension are different to adults and are dependent on age, gender, and height-specific normative values (RR). [11]

It is recognised that health care professionals other than doctors (e.g. Exercise Physiologists, Physiotherapists and Nurses) play an important role in the management of patients with hypertension by influencing and reinforcing appropriate lifestyle behaviours to achieve BP control [12]. Positive lifestyle modification and, in some cases, medication to lower BP may be recommended in individuals who do not have hypertension, but have high-normal BP (as defined in Table 1) and are at high risk of, or exhibit cardiovascular disease, diabetes or kidney disease. For example, the Dietary Approaches to Stop Hypertension diet is a programme designed to reduce BP (without medication), as well as other cardiovascular risk factors [13], and is an excellent adjunct to specific exercise advice.

Competency in measuring BP

In order to accurately assess resting and exercise BP, exercise physiologists (and other health care professionals) need to undertake appropriate training and be aware of the correct techniques, as well as the numerous potential sources or error associated with measuring BP (described in detail in the *Heart Foundation of Australia Guide for the Diagnosis and Management of Hypertension in Adults* [6]). Knowledge of the confounding influence of "white coat hypertension" (isolated clinic/office hypertension), "masked hypertension" (normal clinic BP with raised BP outside the clinic environment), circadian BP fluctuations, as well as the utility of home and 24 h ambulatory BP monitoring will also aid the proper assessment of BP (RR) [14–16]. Further, incorrect cuff size is a common error which may lead to inappropriate diagnosis. It is important to note that if the cuff bladder is too small, BP will be overestimated, whereas if the cuff bladder is too large, BP will be underestimated. A detailed summary of recommendations for performing exercise BP monitoring was recently published [17].

Role of exercise for prevention and treatment of hypertension

Aerobic exercise

Several large studies have shown regular aerobic exercise, or high levels of fitness (VO_2 max), to be protective against the future development of hypertension in men [18–20]. However, there are fewer studies and less prognostic information available in women. On the other hand, there is compelling evidence that dynamic aerobic training (even at a relatively low intensity [e.g. 50% VO_2 max]) reduces resting BP [21–24] as well as light exercise BP and 24 h ambulatory BP in both normotensive and hypertensive individuals, irrespective of sex (RR) [25, 26]. More significant reductions in BP are observed following exercise training in patients with high initial BP. Importantly, even relatively small increases in physical activity above sedentary levels correspond with BP reductions in a dose-dependent fashion [27].

On a population average, the reduction in SBP and DBP for patients with hypertension who undertake habitual aerobic exercise is ~7/6 mmHg [22]. These reductions are of major clinical significance because it has been estimated that a 5 mmHg drop in SBP, on a population level, is associated with a reduction in all-cause mortality, death due to stroke and death due to coronary heart disease by 7%, 14% and 9% respectively [5]. Thus, aerobic exercise is regarded as an important approach towards primary prevention and treatment of hypertension.

Resistance exercise

Compared with aerobic exercise training, there is less evidence available and results are more conflicting on the chronic effect of resistance training on BP. However, the available data suggest that moderate intensity resistance training is not contraindicated in healthy adults [28] and strength training decreases BP. Indeed, when progressive resistance exercises are performed according to American College of Sports Medicine guidelines (RR) [29, 30], a small (≈3/3 mmHg) but significant decrease in BP may be achieved [31]. In general these guidelines recommend that dynamic resistance exercises be performed in a rhythmical fashion, through the full range of motion, at a moderate-to-slow and controlled speed with emphasis on eccentric (lengthening) contractions and maintenance of a normal breathing pattern (no breath holding) [29, 30]. Heavy weight lifting of an intensive, isometric nature with breath holding has a pronounced pressor effect (BP raising) and should be avoided [32]. Recent work has shown non-heavy weight bearing isometric exercise involving the lower limbs or handgrip squeezing (forearm muscle activation), while producing an acute pressor effect during muscle activation, appears to elicit a rebound anti-hypertensive effect on resting BP [33] (see next section on isometric resistance training).

Isometric resistance training (IRT)

Meta-analyses of several studies have reported significant anti-hypertensive effects of IRT [34]. Meta-analyses of these trials have confirmed these anti-hypertensive effects, suggesting a reduction of SBP of −5 to −11 mmHg, DBP −4 to −6 mmHg and MAP −4 mmHg [33, 35], these reductions are similar to those reported with anti-hypertensive mono-therapy [36]. Findings from IRT trials and subsequent meta-analyses led to the recent update of the American Heart Association/American college of Cardiology Joint guidelines [8] recommending IRT as an adjunct therapy for managing hypertension.

Current evidence shows BP-related benefits of isometric exercise are obtained when the maximal voluntary contraction (MVC) is in the range 10–30%. The most common isometric protocol used is thrice weekly sessions of 4 × 2 min (single-arm or alternating arm) handgrip or single/double-leg muscle activation at 30% MVC (determined by 1RM testing) with 2–3 min rest between sets [34]. Single, rather than alternating limb activity appear to proffer greater BP reduction [34]. Similarly those over the age of 45, who are hypertensive appear to reduce their BP more than younger, normotensive participants.

High intensity interval training (HIIT)

HIIT involves alternating periods of high intensity aerobic exercise at intensities between 85 and 95% of peak heart rate with periods of lower intensity or no exercise between intervals [37]. A common protocol uses 4 × 4 min intervals interspersed with 3 min recovery periods. Completing bouts of higher intensity exercise allows for greater physiological stimulus and adaptation than moderate intensity continuous training (MICT) [37]. This produces larger benefits for cardiorespiratory fitness, vascular function, skeletal muscle metabolism, and other metabolic processes that are important for primary and secondary prevention of cardiometabolic diseases [37, 38]. HIIT has also been shown to be more enjoyable than MICT in various populations, which may encourage long-term exercise adherence [39]. HIIT was recognised as an appropriate and beneficial adjunct to MICT in the 2013 joint position statement on aerobic exercise intensity assessment and prescription in cardiac rehabilitation by the European Association for Cardiovascular Prevention and Rehabilitation, the American Association of Cardiovascular and Pulmonary Rehabilitation and the Canadian Association of Cardiac Rehabilitation [40]. A recent systematic review and meta-analysis combined data from seven studies (164 participants) that compared HIIT with MICT and most studies used the 4 × 4 approach [41]. Inclusion criteria were a group mean SBP ≥ 130 mmHg and/or DBP ≥ 85 mmHg and/or under anti-hypertensive medication(s). They found that although HIIT significantly improved cardiorespiratory fitness more than MICT (4.3 vs. 1.6 ml/kg/min), there were no significant between group differences in the BP lowering effects. HIIT decreased SBP/DBP by 6.3/3.8 and MICT by 5.8/3.5 mmHg, which are clinically significant reductions. In regards to safety, limited data were reported from the included studies regarding adverse events during the interventions. The small amount of data available indicated low rates of adverse events associated with both HIIT and MICT.

Table 2 Exercise prescription recommendations for patients with hypertension

Type of exercise	Intensity	Duration	Frequency
Warm-up/cool down	RPE 10–12 (Borg)	5–10 min	Before and after aerobic and resistance
Aerobic (endurance) For example; ∘ Walking ∘ Cycling ∘ Jogging ∘ Running	Moderate Equal to 40–59% of VO_2 or HRR, or 11–13 RPE.	30 min	5 days/week
	OR		
	Vigorous Equal to 60–84% of VO_2R or HRR, or 14–16 RPE.	20 min	3 days/week
	OR		
	High Intensity Interval Training (HIIT) 4 × 4 min intervals at 85–95% HRpeak separated by 3 min intervals at 50–70% HRpeak	25 min	3 days/week
	AND		
Resistance (strength) For example; ∘ Progressive weight training using major muscles (eg seated row, bench press, shoulder press) ∘ Stair climbing ∘ Body weight exercises ∘ Theraband exercises	8–12 repetitions resulting in substantial fatigue	One set of 8–10 exercises (multiple sets if time allows)	Two or more non-consecutive days/week
	AND		
Isometric resistance training (IRT)	2 min @ 30%MVC arms/legs	Four sets with 2–3 min rest in between work intervals	Three non-consecutive days/week

Combinations of moderate and vigorous intensity aerobic activity can be performed to meet the weekly recommendations (eg 2 × 30 min moderate sessions and 2 × 20 min vigorous sessions). Exercise intensity attributed according to ESSA position stand [55].

HRR heart rate reserve, *RPE* Borg rating of perceived exertion 6–20 point scale.

Although the efficacy and safety of HIIT in people with hypertension appears promising, the strength of the evidence is moderate due to the small overall sample size within the meta-analysis. Nonetheless, there is sufficient data to recommend inclusion of HIIT in exercise prescription for people with hypertension (Table 2). Further research should evaluate the effectiveness of HIIT in real-world situations.

Exercise prescription: recommendations

The exact type and amount of training required to optimally lower BP is unclear. However, the recommendations in Table 2, which are derived from the 2018 American Heart Association hypertension management [8], are predicted to result in a lowering of BP in patients with hypertension, based on an extensive review of the literature. It should be noted that, due to the dose-response relationship between physical activity and health, levels of exercise performed beyond the minimum recommendations are expected to provide greater health benefits [30, 42].

Special considerations

In general, vigorous aerobic exercise (i.e. <90%HR maximum or <85% VO_2 peak) is safe and well tolerated by most people including those with hypertension. On the other hand, the risk of exercise-induced adverse events is heightened in older people with coronary artery disease, a condition often associated with hypertension. However, habitual exercise is protective against exercise-related acute cardiovascular events, and overall the benefits of regular physical activity substantially outweigh the risks. [43] Nonetheless, it is advisable that supervising exercise physiologists (or other health care professionals) routinely check the resting and exercise BP of patients with hypertension undergoing exercise training. A standardised approach of recording BP during exercise should be adopted, as is recommended under resting conditions [17]. Training should be postponed if resting BP is poorly controlled (eg ≥180 mmHg or DBP ≥110 mmHg) and these people advised to visit their doctor as a matter of priority. Other special considerations include the ones described below.

Hypertensive heart disease

Chronically raised BP may result in left ventricular hypertrophy and diastolic or systolic heart failure, which places these individuals at higher risk of life threatening arrhythmias [44]. While aerobic exercise is usually clinically beneficial and apparently safe in these patients [45], it is recommended that initial exercise sessions are supervised by an exercise specialist or medical or allied health personnel competent in the conduct exercise testing/training and familiar with the range of physiological responses to exercise, until the safety of the prescribed activity is established [46].

Anti-hypertensive medication

Medications to lower BP do not preclude people participating in exercise programmes [47]. However, beta blockers may reduce maximal aerobic power and exercise heart rate [48]. It may, therefore, be more appropriate to use rating of perceived exertion, or target heart rate responses during exercise testing while maintaining usual medication dosing, to gauge the intensity of prescribed exercise. Beta blockers also may impair thermoregulation during exercise in warmer temperatures [49]. As a precaution, people taking these agents should be advised to limit the amount and intensity of exercise in hot weather, as well as to ensure appropriate hydration and clothing to aid cooling by evaporation. Furthermore, diuretics reduce plasma volume and impair exercise capacity in the first few weeks of treatment. The reduced plasma volume implies a need to ensure appropriate hydration during the initial phase of treatment in these patients.

Older individuals (>65 years)

An extended cool down period after physical activity is advised in older individuals because there is a greater chance of hypotension, syncope (fainting) or arrhythmias during the post-exercise recovery period [46]. Dehydration is also more likely to occur in older people taking diuretics. Therefore, fluid intake is recommended before, during and after exercise. People should also be made aware of the symptoms of dehydration (e.g., thirst, fatigue, loss of appetite, dizziness) [46].

Abrupt termination of exercise

Stopping exercise suddenly should be avoided as it may result in a precipitous drop in SBP (and possible syncope). This occurs due to venous pooling and a delayed increase in peripheral vascular resistance designed to offset the acute reduction in cardiac output. Some anti-hypertensive agents (eg alpha blockers or some calcium channel blockers) may exacerbate this effect. An alternative to suddenly stopping exercise is to reduce workload to ~30% peak exercise capacity for 3–5 min.

Hypertensive response to exercise

An exaggerated BP during moderate or maximal intensity exercise in people normotensive individuals is associated with an increased risk of developing hypertension later in life [50]. Moreover, an excessive rise in BP with moderate intensity exercise appears to hold greater prognostic strength for predicting cardiovascular events [51] and mortality than the maximal exercise BP response. Threshold values as to what determines exaggerated exercise BP are yet to be established, although there is some evidence that SBP ≥150 mmHg at light-to-moderate intensity or SBP ≥210 (men) or ≥190 (women) mmHg at maximal intensity exercise are beyond the upper limits of normal. These people should be advised to maintain regular screening visits to their doctor. If SBP rises >250 mmHg and/or DBP >115 mmHg during exercise, the training session should be terminated [46] and the person advised to visit their doctor, as this may indicate the need to adjust medical therapy.

Hypotensive response to exercise

An inadequate rise in SBP (<20 to 30 mmHg) or a drop in SBP with increasing intensity of exercise is associated with increased mortality [52]. This response may indicate an aortic outflow obstruction, severe left ventricular dysfunction, chronotropic incompetence or myocardial ischaemia. Exercise-induced hypotension may also occur during prolonged strenuous exercise, or if the patient is dehydrated or taking beta blocker medication. If SBP drops >10 mmHg below resting levels, despite an increase in workload, exercise should be stopped and the patient advised to seek further medical advice.

Symptoms during exercise

Further medical assessment is required for people who complain of chest discomfort, palpitations or dyspnoea (breathlessness beyond normal expectations) associated with exercise, as these symptoms may indicate underlying heart disease.

Automotive pollution

People should exercise away from busy roadways where the concentration of harmful pollutants may increase BP and exacerbate cardiovascular risk [53, 54]. Exercising alongside quiet roads or in parks and recreation areas away from heavy traffic is recommended.

Summary

Elevated BP (hypertension) is one of the major modifiable risk factors for cardiovascular disease. Once an individual is diagnosed with hypertension, a goal of clinical therapy is to reduce BP as well as overall cardiovascular risk. In most cases, the first line treatment to reduce BP is initiation of lifestyle changes, of which regular aerobic exercise is a principal component. Exercise physiologists, as well as other health care professionals, play an important role in helping to achieve BP control in patients with hypertension by reinforcing healthy lifestyle habits and prescribing appropriate exercise training.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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