

Physical exercise in the management of hypertension: a consensus statement by the World Hypertension League*

Journal of Hypertension 1991, 9:283–287

Keywords: Physical exercise, hypertension.

Introduction

The World Hypertension League (WHL) is an association of antihypertensive leagues, hypertension societies, committees and other national bodies aimed at the control of hypertension in populations. The present paper (prepared by R. Fagard, Leuven, Belgium) is the third in a series of 'In the Focus Statements' on topics selected for their practical importance to the management of hypertension, and addressed to practising physicians. Like the earlier papers [1,2], it has been repeatedly and extensively discussed by the representatives of WHL's member organizations and accepted as a consensus document.

Physical activity is widely regarded as a protective factor against cardiovascular diseases. Conversely, physical inactivity is considered a cardiovascular risk factor.

The relationship between physical activity and blood pressure has been determined from epidemiological data and from various controlled studies in which normotensive and hypertensive subjects underwent physical training.

Physical activity, physical fitness and blood pressure

Epidemiological studies

Various studies have analysed the relationship between blood pressure and physical activity, using data obtained

by means of questionnaires and interviews concerning the physical activity of people at work or at leisure or both. Other studies have used an exercise test to assess physical fitness or performance capacity. However, this is determined not only by physical activity and training but also by genetic factors [3]. The assessment of physical activity from responses to a questionnaire and interview is poorly related to measured physical fitness: some physically active people may appear unfit on testing and some physically inactive may appear fit. In general, the methods of assessing physical activity lack accuracy and differ widely among various studies.

Several confounding variables may affect the relationship between physical activity, physical fitness and blood pressure. Some of these, such as age, weight and obesity, can be accounted for in analyses; others, such as self-selection and genetic effects, cannot easily be controlled. Several large studies, involving more than 13 500 subjects and allowing for age and anthropometric characteristics, have reported an inverse relationship between blood pressure and either habitual physical activity [4–6] or measured physical fitness [7,8]. Also, in a follow-up study of college alumni, Paffenbarger *et al.* [9] observed that vigorous exercise was inversely related to the later development of hypertension, especially in the obese.

Not all epidemiological studies support this view however [10], but the low level of physical activity in Western societies may have hampered the detection of such a relationship. Moreover, in studies which found a significant association, the difference in blood pressure between the most and the least physically active subjects amounted to no more than 5 mmHg [7,8]. Such a small reduction may

*The present text has been accepted by the member organizations of The World Hypertension League, which in March 1990 comprised the following: National Heart Foundation of Australia; Belgium Hypertension Committee; British Hypertension Society; Canadian Coalition for High Blood Pressure Prevention and Control; Chinese Hypertension Society; Danish Society of Hypertension; French National Committee against Arterial Hypertension; German League against Hypertension; Hellenic Society of Hypertension; Hypertension Society of the Hungarian Society of Cardiology; All India Heart Foundation; Israel Hypertension Society; Italian League against Hypertension; Japan Heart Foundation; Hypertension League of Morocco; Netherlands Heart Foundation — Hypertension Committee; Norwegian Society of Hypertension; Polish Society of Hypertension; Portuguese League against Hypertension; Senegal Foundation for Hypertension and Heart Disease Council; Southern African Hypertension Society; Spanish League against Hypertension; Swiss Association against High Blood Pressure; Uruguayan Hypertension League; US National High Blood Pressure Education Program; Zaire League against Arterial Hypertension and the International Green Cross.

Requests for reprints to: Dr T. Strasser, Secretary General, World Hypertension League, 20 Avenue du Bouchet, CH-1209, Geneva, Switzerland.

Date of receipt: 17 May 1990; revised: 18 September 1990.

have important consequences for the morbidity and mortality of populations, but is not of obvious benefit to the individual.

Training studies

The effect of physical training on blood pressure has been assessed in many studies [11]. Only controlled studies are considered in this review, that is studies in which parallel non-training control groups were followed or which included a non-training phase. It should be realised, however, that patients cannot be blinded to the treatment in training studies. Most studies used so-called 'endurance' training, i.e. prolonged dynamic, predominantly isotonic, exercise of large muscle groups; examples are walking, running, cycling, swimming and cross-country skiing. In this context, endurance does not imply extreme exertion such as marathon competition. There have been studies of the effect of 'static' or isometric training, which involves muscle contractions with limited or no movement and is thus performed at relatively constant muscle length; examples are weight-lifting and wrestling.

Endurance training

Data on the effect of endurance training on blood pressure have been reported in at least 29 groups of normotensive and hypertensive subjects, mostly men, in an average age range of 16 to 70 years. Duration of training ranged from 1 to 8 months, with a frequency of mostly three weekly sessions of 30–120 min each. Intensity of training varied from 50 to 90% of maximal exercise capacity. The training programmes resulted in increases in exercise capacity of 6–38%. Weight usually remained unchanged.

In normotensive subjects, the change of systolic/diastolic blood pressure in response to training, after adjustment for control observations, averaged $-4/-4$ mmHg. The adjustment for control observations took into account the blood pressure changes in the parallel control group or the changes during the non-training phase in crossover studies. This is similar to the difference in pressure found between physically active and inactive populations. Training produced an average change of $-11/-6$ mmHg in hypertensive patients. Figure 1 gives the training-induced change in systolic blood pressure for each study or as a function of the change in physical work capacity. It shows that a greater blood pressure can be expected in the patients with the greatest increase in work capacity, but the association is weak. This relationship was also less clear when the effects of several levels of exercise were studied in the same subjects [12,13]. The relationship was not significant for the changes in diastolic blood pressure. Further analysis of these reports suggests that age is not a significant determinant of the blood pressure response to training.

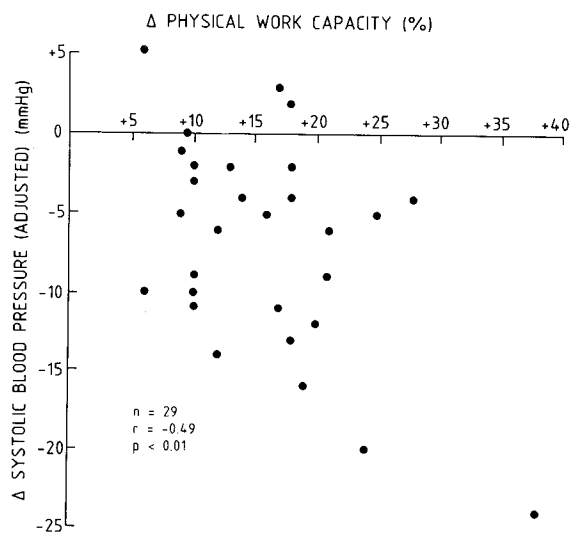


Fig. 1. Changes in systolic blood pressure with training, adjusted for control data, versus change in physical work capacity. Each point represents the average for one group of subjects [11].

The effect of training on blood pressure measured during exercise has also been assessed (Fig. 2). The results were not consistent in normotensives and ranged from 0–12 mmHg decrease in systolic blood pressure at a certain fixed submaximal work-load [14–17]. In hypertensives, changes of -20 and -25 mmHg have been observed [18,19]. Some benefit could accrue from having lower blood pressure during submaximal exercise because most people spend most of their time in a non-basal state. A 24-h monitoring of blood pressure showed that physical training lowered blood pressure during the day but not during the night [16].

Although the hypertensive effect of endurance training seems to be established, the haemodynamic mechanism remains controversial. It is not clear whether the decrease in blood pressure is due to reduced cardiac output [20] or reduced systemic vascular resistance [12,13]. Reduced sympathetic activity is most likely involved [12,13,20]. An increase in the cross-sectional area of resistance vessels following opening and proliferation of the capillary bed in trained muscles could be responsible [21].

Isometric training

Isometric exercise produces an acute increase in blood pressure [22]. However, most studies indicate that strength-training does not lead to persistent changes in blood pressure; some have found limited falls. However, any hypotensive effect seems considerably smaller than the effect that can be achieved with dynamic, predominantly isotonic, exercise training [11]. There is no evidence that strength-training is associated with increased morbidity or mortality.

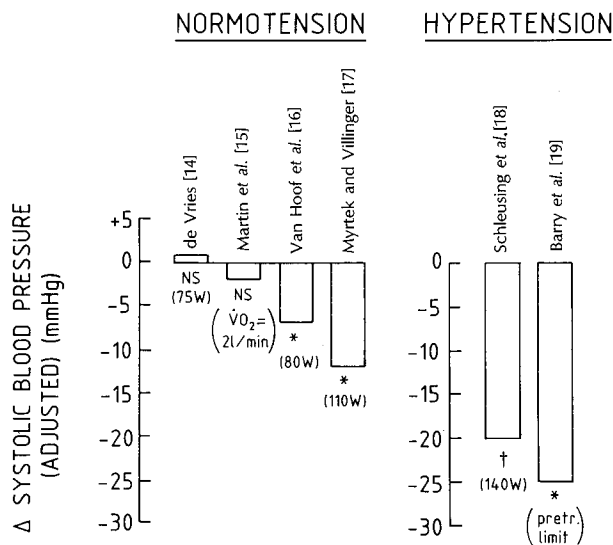


Fig. 2. Changes in exercise systolic blood pressure with training, adjusted for control data, in normotensive and hypertensive subjects. Data are reported at a fixed work-load [VO_2 , watt or pretraining (pretr.) work-load limit]. * $P < 0.05$; †, significance not given.

Other effects of physical activity

Physical activity is an important adjunct to the treatment of obesity and has a favourable effect on insulin sensitivity, diabetes control and plasma lipids [23]. Studies have demonstrated that physically active individuals live longer [24,25] and that the favourable association persists after adjustment for confounding factors. A recent meta-analysis of the combined results of 10 randomized clinical trials in patients after myocardial infarction has suggested that comprehensive cardiac rehabilitation, including exercise and risk factor reduction, reduced total and cardiovascular mortality by 25% [26]; the results were similar in the studies in which rehabilitation included exercise with some risk factor management and in those with emphasis on risk factor management plus exercise or exercise advice.

Exercise-related sudden death in middle-aged men is due to ischaemic heart disease in 80% of the cases. Hypertension was found in approximately one-third of the cases in whom blood pressure could be traced, which could suggest that patients with hypertension run a higher risk of sudden death during exercise. Exercise-related sudden death is rare in women [11].

Recommendations

Physical training can be advocated together with other non-pharmacological measures in the mild hypertensive, or as an adjunct to pharmacological treatment in more

severe hypertension. Whether the effect on blood pressure control of these various measures is merely additive or synergistic is not known. It is proposed that the usual guidelines for initiating drug therapy be followed [27]. Detailed exercise prescription and regular encouragement and follow-up are necessary to improve compliance.

Characteristics of the recommended exercise

Type of exercise

It is clear from the literature that endurance training is the preferred type of exercise. This includes walking, running, cycling, swimming, cross-country skiing and calisthenics.

Frequency, duration and intensity of exercise

Epidemiological studies have shown that individuals who have a more physically active life-style have lower blood pressure than the less physically active [4–10]. The effect on blood pressure of introducing an active life-style has never been investigated. Intervention studies have used structured training programmes which, in addition to the type of exercise, are characterized by duration, frequency, time per session and intensity of exercise. A favourable effect on capacity for physical work and probably on blood pressure can be achieved by various combinations of these training characteristics. Low-intensity exercise requires more time than high-intensity training. Three weekly sessions of 45 min at 60–70% of maximum work capacity for 1 month [13] and three weekly sessions of 60 min at 47% intensity for 2.5 months [28] have produced similar results. The exercise can therefore be tailored to the individual patient. For some, moderate cycling or brisk walking for 30–60 min, three to five times a week will be suitable, whereas others will be able to take up more intensive cycling or jogging for 20–30 min three times a week.

The advice to the patients should be given in terms which they can understand:

(1) *Type, frequency and duration.* Examples: brisk walking five times a week for 30 min; jogging three times a week for 20 min.

(2) *Intensity* Intensity can be expressed by level of perceived exertion. For example, 'You should be able to talk during your exercise; if you cannot, you should decrease the exercise'.

Training intensity can also be based on heart rate. The heart rate (HR) at which the subject is advised to train is calculated from the formula:

$$\text{Exercise HR} = \text{resting HR} + x\% \text{ of } (\text{maximal} - \text{resting HR})$$

Where $x < 50\%$ is considered light exercise, $x = 50\text{--}70\%$ is considered moderate exercise and $x > 75\%$ is considered heavy exercise.

Maximal heart rate can be determined accurately by an exercise test. It can also be calculated by the equation: maximal heart rate = $220 - \text{age}$, but this formula is not very accurate; the variance of peak heart rate which is explained by age is about 40%. Furthermore, exercise heart rate is affected by antihypertensive drugs, particularly β -

blockers. If the initial training intensity based on this formula appears to be inappropriate, the intensity can be adjusted individually.

In general, it is prudent to start with light to moderate exercise and to increase the intensity progressively, adapted to the individual subject.

Implementation

Most patients with hypertension are middle-aged or elderly and have not been exercising regularly. Therefore, regular physical activity will involve a change in life-style and will require regular encouragement and follow-up. Group programmes are likely to improve adherence.

Assessment of the hypertensive patient before training

Hypertension is a risk factor for cardiovascular morbidity and mortality. A resting electrocardiogram should be included in the work-up of a hypertensive patient. In addition, an exercise test may be recommended for previously sedentary patients before starting an exercise programme, particularly when other risk factors such as smoking, obesity or hyperlipidaemia are present, or when the patient complains of dyspnoea or chest pain. Knowledge of the patient's exercise capacity and heart-rate response to exercise will assist in advising on exercise intensity.

When left ventricular hypertrophy is present, a cautious approach should be advocated and a low-density exercise protocol recommended. In the presence of ischaemic heart disease, it is advisable to start exercise with a supervised programme.

Drug treatment of the exercising hypertensive patient

Care is needed in the choice of antihypertensive drugs for the exercising patient [11]. Beta-blockers can have an unfavourable effect on sustained submaximal exercise; the duration of exercise at 50–60% of maximal oxygen uptake is reduced by 40–50% with non-selective β -blockers and by about 20% with selective β -blockers. The impairment of peak oxygen uptake averages about 7%. Diuretics, particularly during short-term treatment, reduce exercise capacity, probably through the reduction of plasma volume; there are no data on the effect of long-term diuretic treatment. Drugs that reduce systemic vascular resistance, such as calcium channel-blockers, converting enzyme inhibitors and α -blockers, have no effect on exercise capacity, but α -blocking drugs may produce symptomatic post-exercise hypotension. Beta-blockers, but not calcium-antagonists, may impair the cardiovascular response to physical training.

Conclusion

Exercise programmes can contribute to the management of hypertension and enhance the sense of well-being, and they may improve life-expectancy. They need not be arduous and can be designed to fit into everyday activities.

Acknowledgement

The preparation of this report by R. Fagard, Leuven, Belgium, is gratefully acknowledged.

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