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The Role of Resistance Training in the Non-Pharmacological Management of Hypertension in Adults Over 50: A Narrative Review

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Abstract

Background. Hypertension remains a major cardiovascular risk factor, particularly in older adults, and non-pharmacological interventions are increasingly emphasized.

Aim. The aim of this narrative review was to evaluate the role of resistance training in the management of hypertension in adults over 50. The paper focuses on its effects on blood pressure, possible mechanisms, and clinical relevance.

Methods. A narrative review design was used. The analysis was based on current clinical guidelines and selected randomized controlled trials, systematic reviews, and meta-analyses related to resistance training and blood pressure. Studies involving older adults and different resistance training modalities were included.

Results. Evidence from meta-analyses indicates that resistance training can reduce both systolic and diastolic blood pressure. This has been observed in older adults with prehypertension and diagnosed hypertension. The effect is usually moderate, with decreases of around 3-8 mm Hg in systolic blood pressure and smaller changes in diastolic values. Several mechanisms have been proposed, including endothelial function, vascular compliance, and autonomic regulation, although their exact contribution is not always clear.

Different forms of resistance training, such as dynamic, circuit-based, and isometric exercise, seem to have beneficial effects, but results vary depending on training parameters.

Conclusions. Resistance training can be considered a useful part of non-pharmacological management of hypertension in adults over 50. It should be treated as a complementary strategy, alongside other lifestyle modifications and pharmacological treatment when needed. Further research is still needed to better define optimal training protocols and understand individual differences.

Keywords: resistance training; hypertension; blood pressure; older adults; non-pharmacological treatment; exercise therapy

1. Introduction

1.1. Epidemiology and global burden of hypertension

Hypertension is one of the most common cardiovascular risk factors, although the actual scale of the problem is difficult to estimate. Even with ongoing improvements in treatment and prevention, elevated blood pressure accounts for a substantial proportion of global morbidity and mortality [2].

One aspect that comes up quite consistently in the literature is the role of age. In people over 50 years of age, hypertension becomes much more frequent, and in many cases also more pronounced. This is often linked to changes in the vascular system that develop over time. Arteries gradually lose elasticity, and endothelial function is no longer as effective as before. As a result, systolic blood pressure tends to increase, although the exact contribution of each mechanism is not always entirely clear [2,24].

It is also worth mentioning that, with aging populations, this issue will likely become even more relevant. For this reason, hypertension in older adults is sometimes discussed not only in clinical terms, but also in the context of public health.

At the same time, treatment outcomes are not always optimal. Despite the availability of pharmacological therapies, many patients still do not achieve target blood pressure levels. This seems to be especially visible in older groups, although the reasons behind this are probably multifactorial [24]. Because of that, additional approaches to support treatment are being explored more frequently.

1.2. Hypertension as a cardiovascular risk factor

The importance of hypertension is mainly related to its association with cardiovascular diseases. Elevated blood pressure has been linked to conditions such as coronary artery disease, stroke, and heart failure, which is relatively well established in the literature [3].

Interestingly, this relationship does not seem to depend on a strict threshold. In other words, risk appears to increase gradually, and even small reductions in blood pressure may be clinically beneficial [3]. This might be relevant when full normalisation of blood pressure is difficult to achieve.

In older adults, long-term exposure to elevated blood pressure leads to various changes in the cardiovascular system. These include, among others, vascular remodelling and increased arterial stiffness. Cardiac adaptations, such as left ventricular hypertrophy, are also observed. It is often difficult to separate cause and effect in that regard, however in general these processes are associated with increased cardiovascular risk [24].

For this reason, maintaining blood pressure within recommended values over time seems important. However, in practice, this goal is not always achieved, which makes the management of hypertension somewhat challenging.

1.3. Non-pharmacological management and the role of exercise

The current consensus is that pharmacological treatment alone is not sufficient in treating hypertension. The ESC 2024 guidelines emphasize the role of lifestyle interventions, including diet, body weight control, and physical activity [1]. These broad recommendations apply to different stages of hypertension.

There is evidence suggesting that regular exercise is a key lifestyle intervention required to lower both systolic and diastolic blood pressure, also in older adults [22]. At the same time, exercise may influence other aspects of health, such as vascular function or overall fitness, although the magnitude of these effects can vary.

For a long time, aerobic exercise has been the main focus in this area. It is probably the most studied form and, in many guidelines, still plays a central role. However, more recently, resistance training has started to appear more often in the literature.

It seems that resistance training could offer some additional benefits, especially in people over 50 years of age. Besides its possible effect on blood pressure, it may improve muscle strength and help maintain functional ability. This might be relevant, since loss of muscle mass and strength is commonly observed with aging. At the same time, it is not entirely clear to what extent these effects translate directly to cardiovascular outcomes.

2. Materials and methods

This study was conducted as a narrative review of the available literature on resistance training and blood pressure in adults over 50 years of age, focusing on studies published between 2020 and 2026. Relevant publications were identified using PubMed and the Consensus search engine.

The search included keywords such as “resistance training”, “strength training”, “hypertension”, “blood pressure”, “older adults”, and related terms. Additional articles were identified through reference lists of selected papers.

The review included clinical guidelines, randomized controlled trials, systematic reviews, and meta-analyses. Particular attention was given to studies involving older adults and different forms of resistance training, including dynamic, isometric, and circuit-based exercise.

Basic inclusion criteria were defined to improve consistency of the selection process. Studies were included if they: (1) involved adult participants with a mean or median age of approximately 50 years or older, (2) examined resistance training as a primary or combined intervention, and (3) reported outcomes related to blood pressure. Preference was given to peer-reviewed articles published in English.

Studies were excluded if they: (1) did not report blood pressure outcomes, (2) focused exclusively on non-human models, or (3) lacked sufficient methodological description.

3. Results

3.1. Mechanisms of Blood Pressure Reduction Following Resistance Training

3.1.1. Vascular and endothelial adaptations

The endothelium plays a key role in regulating vascular tone, mainly through substances like nitric oxide. In hypertension, this system does not seem to work as efficiently, which may increase vascular resistance.

Exercise has been shown to improve in endothelial function. This has been shown in different types of training, not only resistance-based ones. Liang et al. [4] reported better endothelial-dependent vasodilation after exercise interventions in hypertensive patients. However, a large part of those interventions was aerobic, thus it is a bit difficult to estimate how much of the effect comes specifically from resistance training.

There are also studies focusing more directly on resistance exercise. Banks et al. [5] showed that this type of training can improve endothelial function in people with elevated blood pressure. The authors reported better nitric oxide availability and lower vascular stiffness.

Arterial stiffness is another factor that is often discussed in this context, inasmuch as it tends to increase with age and is linked to higher systolic blood pressure. Some studies suggest that resistance training does not increase arterial stiffness. Moreover, there is limited evidence that resistance training might improve arterial elasticity in some cases [4,5]. In summary, current evidence suggests that resistance training can influence vascular function.

3.1.2. Acute and chronic responses to resistance exercise

The vascular response to resistance training varies over time. During exercise, blood pressure increases as a result of muscle contractions and elevated sympathetic activity.

However, after exercise, blood pressure may decrease below baseline levels. This phenomenon is commonly referred to as post-exercise hypotension, although other terms are also used in the literature.

Benavides-Roca et al. [23] observed reductions in blood pressure following resistance exercise in hypertensive adults, with the magnitude of this effect varying. It may depend on factors such as training intensity, volume, and individual characteristics.

It is often suggested that repeated exposure to this response may contribute to longer-term adaptations. The meta-analysis by Henkin et al. [7] showed that regular resistance training is associated with reductions in both systolic and diastolic blood pressure. The effect is generally described as moderate and relatively consistent across studies [16,23].

The mechanism of post-exercise hypotension is considered multifactorial and involves vascular and neural adaptations [5,23].

3.1.3. Influence of training variables (intensity, volume, frequency)

It becomes evident that not all resistance training produces the same effects. Outcomes appear to depend on how the training is structured.

Intensity is often discussed first. According to Igarashi [12], moderate intensity tends to produce relatively consistent reductions in blood pressure. Increasing intensity further does not necessarily improve outcomes. This may be particularly relevant in older adults, where higher intensity is not always well tolerated.

Volume and frequency are also considered, although the data remain inconsistent. Some studies suggest that more frequent training does not necessarily lead to better outcomes. Ferrari et al. [20], for example, compared different weekly frequencies and did not demonstrate a clear advantage of a higher number of sessions.

There is also the question of combining different types of exercise. Hejazi et al. [11] reported that mixed programs (resistance combined with aerobic training) may in some cases produce stronger effects. However, this finding is not consistent across studies, making it difficult to draw firm conclusions.

Overall, resistance training is associated with reductions in blood pressure under a range of conditions. At the same time, the optimal training protocol has not been clearly established. For this reason, many authors suggest an individualized approach, although in practice this may depend on available resources and patient adherence.

3.2. Evidence for Resistance Training in Hypertension Management

3.2.1. Overall effectiveness of resistance training

There is a substantial number of studies examining resistance training and blood pressure, particularly in recent years. Evidence from meta-analyses generally indicates that the effect is present, although not always large.

For example, Henkin et al. [7] analysed older adults with elevated blood pressure and reported reductions in both systolic and diastolic values. Resistance training can reduce blood pressure in older individuals at prehypertensive and hypertensive stages, with traditional protocols performed at moderate intensity leading to effect estimates of approximately ~7 mmHg for systolic blood pressure and ~4 mmHg for diastolic blood pressure. These effects were observed across different types of programs, which may suggest that the benefit is not limited to a single training modality. At the same time, the magnitude of reduction was not identical across studies.

Correia et al. [8] reported similar findings, indicating that strength training is effective to some extent. The observed reductions were described as clinically relevant, even if relatively modest.

Wang et al. [9] also confirmed that resistance training can lower blood pressure, while highlighting variability between studies. This variability is frequently observed and may reflect differences in study populations, training protocols, and intervention duration. As a result, although the overall direction of the effect is consistent, direct comparisons between studies remain challenging.

Overall, resistance training is associated with reductions in blood pressure, although the magnitude of this effect is not uniform across studies.

3.2.2. Resistance training modalities

It should be noted that resistance training is not a single, uniform intervention. Different modalities exist, and they are not equivalent.

Dynamic training is the most commonly studied form. Most available studies are based on this modality, involving movements performed through a full range of motion. In general, it is associated with notable reductions in resting blood pressure [7-9], although the findings are not entirely consistent.

Circuit-based training represents a different structure, with exercises performed sequentially, typically with shorter rest intervals. Hu et al. [10] reported reductions in blood pressure, as well as changes in arterial stiffness and body composition. It has been suggested that this modality may combine elements of both resistance and aerobic training, although this interpretation is not consistently stated across studies.

Isometric training is another approach, based on static contractions, often using handgrip exercises. Some meta-analyses [13,14] report notable reductions in blood pressure, potentially greater than in other modalities. However, the number of studies is smaller and protocols vary considerably, which limits the strength of these conclusions.

Overall, different resistance training modalities appear to be effective. However, it remains unclear whether any single modality is clearly superior, and in practice the differences between them may be relatively small.

3.2.3. Comparison with other exercise modalities

Resistance training is often compared with aerobic exercise, largely because aerobic training has been more extensively studied in this context.

Available evidence suggests that both modalities reduce blood pressure. Edwards et al. [6] demonstrated this in a large-scale analysis. Aerobic exercise was sometimes associated with slightly greater reductions; however, resistance training produced comparable effects, and the difference does not appear substantial.

Yang et al. [15] evaluated different exercise modalities and suggested that combined training may lead to greater reductions in blood pressure. Although this is a plausible finding, not all studies demonstrate a clear advantage of combined approaches, and the evidence remains inconsistent.

Aerobic exercise as a standalone intervention is well established, with its effectiveness confirmed by Fu et al. [16]. However, when both modalities are considered together, they appear to be complementary rather than mutually exclusive.

From a practical perspective, this distinction may be relevant. Patient preferences, physical limitations, and feasibility should be considered when selecting an exercise modality. Even if combined training provides slightly greater benefits, it may not always be practical, and resistance training alone still appears to offer clinically relevant effects.

3.3. Resistance Training in Adults Over 50

3.3.1. Age-related physiological considerations

Aging is associated with several physiological changes, some of which are directly relevant to blood pressure regulation. One of the most commonly discussed is arterial stiffness. Over time, large arteries lose elasticity, which typically leads to increased systolic blood pressure. This phenomenon has been well described in older hypertensive populations [24].

At the same time, changes occur in skeletal muscles, with gradual declines in muscle mass and strength. This process is commonly referred to as sarcopenia. Although it does not directly explain changes in blood pressure, it may affect overall physical function and thereby have indirect relevance.

Some studies suggest that resistance training can influence both muscle-related outcomes and blood pressure. Coelho-Júnior and Uchida [18] reported improvements in strength and functional status, along with reductions in blood pressure in prefrail and frail older adults. The relationship between these effects is not fully understood, although they are observed concurrently in some studies.

Another important consideration is that older adults often present with multiple comorbidities, which makes exercise prescription more complex. Training programs therefore typically require adjustment. In practice, lower or moderate intensity is often selected, not necessarily because it is the most effective approach, but because it is more feasible and better tolerated.

3.3.2. Effectiveness in older hypertensive populations

When focusing on older individuals with hypertension, resistance training appears to remain effective. The meta-analysis by Henkin et al. [7] included this population and reported reductions in both systolic and diastolic blood pressure, indicating that the response is preserved to some extent.

There are also studies examining specific training modalities. Hu et al. [10] demonstrated that circuit-based resistance training can improve blood pressure and arterial stiffness in community-dwelling older adults. This may be particularly relevant, as such conditions more closely reflect real-world settings.

More recent data from Laddu et al. [21] further support the role of resistance training in reducing blood pressure in this population. However, the magnitude of the effect varies across studies, with some reporting more pronounced reductions and others more modest changes.

Overall, the direction of the effect is consistent, indicating that resistance training contributes to blood pressure reduction. However, the magnitude of this effect is variable and, in some cases, relatively modest.

3.3.3. Interindividual variability in response

Another important issue is interindividual variability in response. Not all individuals respond in the same way to a given training program.

Cano-Montoya et al. [17] demonstrated that both resistance training and high-intensity interval training can reduce blood pressure; however, the magnitude of the response differs between participants. Some individuals exhibit noticeable reductions, whereas others show minimal change.

The underlying reasons for this variability are not fully understood. Baseline blood pressure may be one contributing factor, and fitness level may also play a role. Additional factors, including genetic influences, have been suggested, although they are not consistently addressed in the literature.

From a practical perspective, this variability reduces predictability of outcomes. A single approach may not be equally effective for all individuals, and adjustments over time may be required, although this can be challenging in real-world settings.

Overall, although resistance training is generally effective, the response is not uniform and should be considered in clinical practice.

3.4. Clinical Evidence from Randomized Trials

3.4.1. Resistance training interventions

Randomized controlled trials are generally considered a stronger form of evidence, primarily because they allow for better control of the intervention. However, even in this context, the findings are not always entirely consistent, particularly when different types of exercise are included.

One example is the study by Lopes et al. [19], which investigated patients with resistant hypertension. The intervention involved structured exercise training, not limited to resistance training alone. Nevertheless, the results demonstrated a reduction in ambulatory blood pressure, which is noteworthy, as ambulatory measurements are generally considered more reliable than office-based readings.

Another trial by Ferrari et al. [20] compared different training frequencies in older adults with hypertension. Participants trained either twice or four times per week. Both groups showed improvements in blood pressure, but no clear advantage of higher training frequency was observed, suggesting that increased training frequency does not necessarily lead to superior outcomes.

It should also be noted that many randomized trials involve combined interventions, with resistance training frequently performed alongside aerobic exercise. As a result, isolating the specific effect of resistance training can be challenging. Nevertheless, the overall pattern of findings appears consistent with results reported in meta-analyses.

3.4.2. Practical implications for clinical practice

From a practical perspective, an important question is how these findings can be applied in everyday settings. Current guidelines, such as the ESC 2024 document, recommend including exercise as part of standard hypertension management [1], encompassing both aerobic and resistance training.

In older adults, safety and adherence appear to be particularly important. According to Egan et al. [24], management in this population should consider comorbidities, functional status, and tolerance to exercise. This supports the need for a more individualized approach.

Resistance training can be implemented using a variety of protocols. Moderate intensity is commonly recommended, with gradual progression. Evidence from clinical trials indicates that very high frequency or intensity may not be necessary to achieve reductions in blood pressure [20].

Adherence over time represents another important consideration. Even well-designed programs are unlikely to be effective if they are not maintained. Simpler training routines, performed several times per week, may therefore be more feasible for many older patients.

In practice, the focus may be less on identifying the optimal protocol and more on selecting an approach that can be sustained over time.

4. Discussion

4.1. Summary of evidence

Across the available studies, the overall direction of findings appears consistent. Most analyses report that resistance training is associated with reductions in blood pressure, observed across different populations, including older adults and individuals with diagnosed hypertension [7-9].

At the same time, the magnitude of the effect is generally not large and is often described as moderate. Nevertheless, even small reductions may have clinical relevance, as frequently noted in the literature [6].

Evidence also suggests that resistance training may be effective as a standalone intervention. Some studies include only this modality and still report reductions in blood pressure [7,8]. However, findings are not entirely uniform, and variability between studies remains evident.

Overall, resistance training is associated with reductions in blood pressure, although the magnitude of the effect varies across studies.

4.2. Mechanisms and clinical outcomes

The mechanisms discussed earlier may provide aid in explaining the observed effects, although they do not provide a complete explanation. Improvements in endothelial function are frequently cited as a

potential mechanism [4], with increased nitric oxide availability and enhanced vascular responsiveness likely contributing.
There is also evidence suggesting that resistance training may influence arterial stiffness [5]. This is particularly relevant in older adults, in whom arterial stiffness tends to increase with age. However, findings in this area are not entirely consistent across studies.
From a clinical perspective, these mechanisms are important, but their translation into measurable outcomes is not always straightforward. Reductions in blood pressure can be readily assessed, whereas other changes, such as improvements in vascular function, are more difficult to evaluate directly.
Overall, while the proposed mechanisms are plausible, they do not fully account for all observed effects.

4.3. Comparison with other non-pharmacological strategies

When comparing resistance training with other approaches, particularly aerobic exercise, the differences are not always clearly defined. Some analyses suggest that aerobic training may produce slightly greater reductions in blood pressure [6].
However, resistance training consistently demonstrates reductions in blood pressure, even if they are sometimes smaller. This supports its role as a relevant intervention, particularly when considering additional health benefits.
The role of combined training has also been examined. Some studies indicate that combining resistance and aerobic exercise may result in greater reductions in blood pressure [6]. However, these findings are not entirely consistent across the available evidence.
From a practical perspective, this distinction may be of limited importance. Not all patients are able to follow more complex training programs, and in such cases a simpler approach may be more feasible, even if the effect is slightly smaller.

5. Limitations of available evidence

Several limitations should be acknowledged. One of the main issues is variability between studies. Training protocols differ considerably in terms of intensity, duration, and frequency [11], which makes direct comparisons more challenging.
Another important limitation is interindividual variability in response. Not all participants demonstrate the same changes in blood pressure, with some showing more pronounced effects than others [17]. The reasons for this variability are not fully understood.
In addition, many studies have relatively short follow-up periods, which limits the ability to assess long-term effects. It is not always clear how long the observed changes are maintained.
There is also the issue of combined interventions. In some studies, resistance training is not applied in isolation, which makes it more difficult to determine its specific contribution.

6. Conclusions

Resistance training is increasingly discussed in the context of hypertension, particularly in older adults. Based on the studies included in this review, it is associated with reductions in both systolic and diastolic blood pressure [7-9]. Although the magnitude of this effect is not always large and varies across studies, the overall direction is consistent.

At the same time, it remains difficult to identify a single resistance training modality as clearly superior. Dynamic, circuit-based, and isometric approaches have all demonstrated beneficial effects, albeit under somewhat different conditions [7-10,13,14]. Therefore, the choice of training may depend more on individual factors than on differences between specific protocols.

It should also be recognized that the effect on blood pressure represents only part of the overall benefit. Resistance training is associated with improvements in muscle strength and physical function, which may be particularly relevant in individuals over 50 years of age. In some cases, these effects may be as important as reductions in blood pressure.

However, resistance training should not be considered a replacement for other treatment strategies. Current recommendations continue to emphasize lifestyle modification and pharmacological therapy when indicated [1]. It is therefore more appropriate to view resistance training as a complementary approach rather than a primary intervention.

Nevertheless, some uncertainties should be acknowledged. Findings vary between studies, and responses differ between individuals. It is not yet clear which training protocols are optimal or how long the observed effects can be sustained. In addition, the relatively short duration of many studies further limits interpretation.

Overall, resistance training appears to have a role in the non-pharmacological management of hypertension, although its application is not yet fully defined. It may be implemented in clinical practice, particularly when tailored to the individual, but further research is needed to clarify remaining uncertainties.

Supplementary Materials

Not applicable.

Author Contributions

Jakub Gałwiaczek – conceptualisation, methodology, formal analysis, writing – review and editing, supervision

Jarosław Dudek – investigation, formal analysis, project administration

Michał Łebek – investigation, resources, formal analysis, review

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Wiktor Zdeb – formal analysis, resources
Damian Grębosz – formal analysis, resources
Jakub Piec – investigation, resources, writing
Angelika Juszczyk – resources, writing, rough preparation
Sylwia Pietrajtis – writing, investigation
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Conflicts of Interest

The authors declare no conflict of interest in relation to this study.

AI Statement

Artificial intelligence tools have not been used to produce or alter the scientific content of the paper. Publicly available AI-powered websites have been used to identify better wording for certain expressions and sentences to ensure a smooth reading experience, while having no impact on the interpretation of cited evidence.

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