CorSalud 2026;18(1):e1254

CorSalud

Cuban Society of Cardiology

Original Article

Cardiocentro Ernesto Che Guevara Santa Clara Cuba

Usefulness of ambulatory blood pressure monitoring in former athletes and exercise practitioners

Utilidad del monitoreo ambulatorio de la presión arterial en exatletas y practicantes de ejercicios

Agustín Paramio Rodríguez, MD[1]✉; Myder Hernández Navas, MD[1]; Emérito Pérez Acosta, PhD[1]; Cesia Rivera Garmendia, MD[2]

[1] Instituto de Medicina del Deporte. La Habana, Cuba.
[2] Centro de Investigaciones del Deporte Cubano. La Habana, Cuba.

ARTICLE INFORMATION

Received: 02/11/2025
Accepted: 09/04/2026

Competing interests:
The authors declare no competing interests.

Article category:
Clinical Cardiology and Risk Factors

Contribution of the authors:

Data curation: Agustín Paramio Rodríguez (APR), Myder Hernández Navas (MHN).
Formal analysis: APR, MHN, Cesia Rivera Garmendia (CRG).
Investigation: APR, MHN, Emérito Pérez Acosta (EPA), CRG.
Methodologies: APR, MHN.
Writing – original draft: APR, MHN, EPA, CRG.
Writing – review & editing: EPA, CRG.

ecimed EDITORIAL CIENCIAS MÉDICAS

Corresponding Author:
Agustín Paramio Rodríguez, MD
agustinparamio1972@gmail.com

ABSTRACT:
Introduction: Former athletes and those who exercise regularly generally have a favorable cardiovascular profile, although they may exhibit masked hypertension or abnormal blood pressure patterns. Ambulatory blood pressure monitoring offers a more accurate assessment than conventional clinical measurements. Objective: To evaluate the effects of physical exercise on blood pressure using ambulatory blood pressure monitoring in former athletes and physical activity practitioners with a history of arterial hypertension. Material and Methods: A cross-sectional and analytical study was carried out from January to December 2023 with 76 former athletes and practitioners of hypertensive exercises. Ambulatory blood pressure was measured by 24-hour monitoring and in office. The effect of risk factors on blood pressure control was evaluated using non-parametric tests and odds ratio. Results: 80.3% of patients had controlled blood pressure. The ambulatory measurement of these values had lower results than those of office. Smoking was the most frequent cardiovascular risk factor with a 27.6% and the only one significantly associated with uncontrolled blood pressure. Conclusions: Ambulatory blood pressure monitoring showed that regular physical exercise significantly contributes to blood pressure control in former athletes and those who engage in physical activity. In this population, the prevalence of cardiovascular risk factors was low.

KEYWORDS: Risk factors; Blood pressure monitoring, ambulatory; Hypertension; Cardiovascular risk.

RESUMEN:
Introducción: los exatletas y practicantes sistemáticos de ejercicios presentan en general un perfil cardiovascular favorable, aunque pueden manifestar hipertensión enmascarada o alteraciones del patrón tensional. El monitoreo ambulatorio de la presión arterial ofrece mejor precisión que las mediciones clínicas convencionales. Objetivo: valorar los efectos del ejercicio físico sobre la presión arterial mediante el uso del monitoreo ambulatorio de la presión arterial en exatletas y practicantes de actividad física con antecedentes de Hipertensión Arterial. Material y métodos: se realizó un estudio transversal y analítico de enero a diciembre de 2023 con 76 exatletas y practicantes de ejercicios hipertensos. Se midió la presión arterial ambulatoria por monitoreo de 24 horas y en consulta. El efecto de los factores de riesgo sobre el control de la presión arterial se evaluó mediante pruebas no paramétricas y el odds ratio. Resultados: el 80,3 % de los pacientes tenía control de la presión arterial. La medición ambulatoria de estos valores tuvo resultados más bajos que los de consulta. El tabaquismo fue el factor de riesgo cardiovascular más frecuente con un 27,6 % y el único asociado de forma significativa con el descontrol de la presión arterial. Conclusiones: el monitoreo ambulatorio de la presión arterial evidenció que la práctica regular de ejercicio físico contribuye significativamente al control de la presión arterial en exatletas y practicantes de actividad física. En esta población, la prevalencia de factores de riesgo cardiovascular resultó baja.

PALABRAS CLAVE: *Factores de riesgo; Monitoreo ambulatorio de la presión arterial; Hipertensión arterial; Riesgo cardiovascular.*

 © 2009-2026 Hospital Provincial Universitario Cardiocentro Ernesto Guevara, Villa Clara, Cuba.
Article licensed under ***Creative Commons Attribution - CC BY-NC-ND 4.0***

Introduction

Arterial hypertension is the main risk factor for the development of cardiovascular diseases worldwide. Its high incidence and prevalence are observed in both general population and physically active individuals or athletes. The guidelines of the European Society of Cardiology for the management of arterial hypertension recommend practicing physical activity regularly as a Class IA measure for the prevention and treatment of cardiovascular diseases. In this context, there is a progressive increase in the number of hypertensive individuals who engage in systematic training and express interest in participating in competitive sports. [1]

The scientific evidence supporting the beneficial effects of regular aerobic exercise on the cardiovascular system is extensive and consistently favorable. Several studies have demonstrated that systematic physical activity, both aerobic and resistance, produces a significant reduction in systolic and diastolic blood pressure. This hypotensive effect is primarily observed in individuals with a prior diagnosis of arterial hypertension at rest. At the same time physical exercise produces a positive impact on other cardiovascular risk factors such as obesity, dyslipidemia and type 2 diabetes *mellitus.* These benefits are largely related to improved insulin sensitivity and body weight control, which contribute to a decrease in the overall incidence of cardiovascular events. [2]

The 2024 European Society of Cardiology (ESC) guidelines on the management of high blood pressure and hypertension maintain the definition of office hypertension as a systolic blood pressure ≥140 mmHg or a diastolic blood pressure ≥90 mmHg. However, a new category: "elevated blood pressure," is introduced, defined as an office systolic blood pressure between 120 and 139 mmHg or a diastolic blood pressure between 70 and 89 mmHg.[3]

In the guideline for prevention, detection, assessment and treatment of arterial hypertension in adults of the American College of Cardiology in conjunction with the American Heart Association (ACC/AHA), the term elevated blood pressure is also introduced when systolic blood pressure is between 120 and 129 mmHg. But arterial hypertension is defined in two stages: the first, with systolic blood pressure figures between 130 and 139 mmHg and diastolic between 80 and 89 mmHg; the second stage, with systolic blood pressure of 140 mmHg or more and diastolic blood pressure of 90 mmHg or more.[4]

The hypertensive response to physical exercise is characterized by an increase in maximum systolic blood pressure respect to the baseline one of at least 60 mmHg in men and 50 mmHg in women during stress tests or by reaching absolute values greater than 210 mmHg in men and 190 mmHg in women. As for the 24-hour ambulatory blood pressure monitoring (ABPM), it is considered an appropriate control when average values are less than 130/80 mmHg, with specific thresholds of 135/85 mmHg for daytime and 120/70 mmHg for nighttime. [3,5]

It is recognized that, for the hypotensive effect of exercise to be clinically relevant, blood pressure reduction must reach a considerable magnitude and be sustained after completion of the training session. In this context, ambulatory blood pressure monitoring is a useful tool for assessing the impact of exercise on blood pressure behavior over 24 hours. This method allows for the detection of physiological fluctuations during daily activities, including those related to physical practice, which reinforces its value in the assessment and clinical follow-up of hypertensive patients.[6]

In a review published in 2022, which included 18 studies, the utility of the 24-hour ABPM was analyzed to assess blood pressure behavior in response to physical exercise. The results showed that their use allowed to identify periodized combinations of training strategies capable of generating broader and sustained benefits in hemodynamic parameters.[7]

In relation to former athletes, some studies have suggested that prolonged high-performance exercise practice could have adverse effects on long-term health by increasing the risk of premature mortality and cardiovascular events associated with a history of strenuous physical activity.[8] However, a meta-analysis and a systematic review, which included 24 and 44 studies respectively, with a combined sample of 165 000 former athletes, showed that the overall mortality in this group was lower than that observed in the general population, except for those individuals who had high blood pressure figures.[9]

In Cuba, according to the review carried out, no studies have been developed that assess blood pressure control in former athletes or exercise practitioners with a history of arterial hypertension. Hypertensive individuals present a higher cardiovascular risk, so ABPM could be a useful tool to explore this risk in this population. In this context, the current research aims to evaluate the effects of physical exercise on blood pressure by using ABPM in former athle-

tes and practitioners of physical activity with a history of arterial hypertension.

Method

A descriptive cross-sectional observational study was conducted with a population of 76 former athletes and exercise practitioners who attended the health promotion office consultation at the *Instituto de Medicina Deportiva* from January to December 2023. They were considered former athletes those who retired from active sport and did not receive any training designed for competitive activities. For their part, physical exercise practitioners were those who practice it regularly, with moderate to high intensity, at least 30 minutes a day and with a minimum frequency of three sessions per week.

For inclusion in the study, participants had to meet the following criteria: history of arterial hypertension with pharmacological treatment, age between 18 and 50 years old. Individuals with prior diagnosis of established atherosclerotic cardiovascular disease, cerebrovascular disease, peripheral vascular disease or chronic renal failure were excluded, as well as those who did not consent to participate in the research. All patients who met the selection criteria were included in the current study, so the use of sampling was not necessary.

In the office consultation, all participants were given a detailed clinical anamnesis, with the aim of identifying personal history of diabetes *mellitus*, dyslipidemia and smoking. Subsequently, a routine measurement of blood pressure was carried out following the criteria established in the 2018 Cuban guidelines for the diagnosis, evaluation and treatment of high blood pressure.[10] For this measurement, a digital sphygmomanometer HiperMax-BF model (COMBIOMED, Cuba) was used., certified by the *Servicio Nacional de Metrología*.

Anthropometric measures were also recorded including height, body weight and abdominal circumference. Height was measured with a stadiometer in a vertical position, with the participant barefoot and the body in contact with the measurement plane at four anatomical points. Weight was determined by a floor scale placed on a stable surface, with the subject without shoes and with as little clothing as possible. The results were expressed in kilograms (kg) for the weight and in centimeters (cm) for the height.

Body mass index was calculated using the formula: weight in kg / height in m^2 Obesity was considered when it was ≥ 30 kg/m^2 and/or abdominal circumference exceeded 102 cm in men, or 88 cm in women. The latter was measured at the midpoint between the mid-axillary line and the superior border of the iliac crest, using a flexible measuring tape, maintained perpendicular to the longitudinal body axis with the participant in a standing position. The measurement of the 24-hour ABPM was carried out with a HiperMax Plus equipment (COMBIOMED, Cuba), also certified by the *Servicio Nacional de Metrología*. The registration procedure and the reference values were based on the recommendations of the American College of Cardiology Foundation and the American Heart Association.[11,12] Blood pressure was considered controlled when average values were below 125/75 mmHg in 24 hours, 130/80 mmHg during the daytime period and 110/65 mmHg during the nighttime period; based on which two groups of patients were obtained in the research: controlled and uncontrolled blood pressure.

Data obtained from a primary observation guideline were initially introduced into an automated system developed in Microsoft Excel (Microsoft Office 2013). Subsequently, the information was transferred to a database created specifically for this purpose and processed using the Statistical Package for the Social Sciences (SPSS) version 23.0 for the statistical analysis.

A series of variables were compared in both groups of patients using different statistical tests. To do so it was determined whether quantitative variables presented a normal distribution using the Shapiro-Wilk test. When the normality requirement was met, these variables were expressed as mean ± standard deviation. Qualitative variables were presented in absolute and relative frequencies (percentages). Chi-square and Fisher's exact probability test were used, as well as the Student`s t test for mean difference in continuous variables.

The odds ratio (OR) with its corresponding confidence intervals of 95 % (CI 95 %) was calculated to estimate the association magnitude between the risk factors and the blood pressure control. A statistical significance level of $\alpha < 0.05$ was considered. Results were presented in tables and figures to facilitate their interpretation.

All participants signed their informed consent before being included in the study. In each case, the purpose of the research was explained in detail, ensuring confidentiality of data and no negative impact in case of a refusal to participate. The research complied with institu-

tional ethical principles and was carried out in accordance with the guidelines of the Helsinki Declaration.[13] This study is part of the project entitled "Intervention strategy to modify the overall cardiovascular risk in former athletes and exercise practitioners", approved and endorsed by the scientific council and the medical ethics committee of the *Instituto de Medicina Deportiva.*

Results

Table 1 presents the sample demographic characteristics. Participants mean age was 34.4 ± 8.9 years old. It was observed a higher proportion of men, who represented the 53.9 % of the total of subjects included in the study.

Table 1 Distribution of patients according to demographic and clinical variables.

Demographic variables	n=76 (100 %)
Age (mean ± SD)	34.4 ± 8.9
Males	41 (53.9)

SD: standard deviation Source: medical records

Most of the participants included in the study did not present cardiovascular risk factors in addition to arterial hypertension. Nevertheless, smoking was the more frequent risk factor with a prevalence of the 27.63 %, followed by dyslipidemia, present in 14.47 % of cases. It was observed that most patients with dyslipidemia also had obesity and diabetes *mellitus*, while all participants with diabetes *mellitus* were obese, as shown in figure 1.

Figure 2 shows the results of the anthropometric measurements expressed as mean ± standard deviation. Mean abdominal circumference was of 79.0 ± 11.9 cm, suggesting that most of participants did not present abdominal obesity. Likewise mean weight was 72.4 ± 13.2 kg and mean size 1.74 ± 0.1 m, which allowed to calculate an average body mass index of 23.7 ± 3.3 kg/m². This last value strengthens the evidence that obesity was not a frequent finding in the population studied.

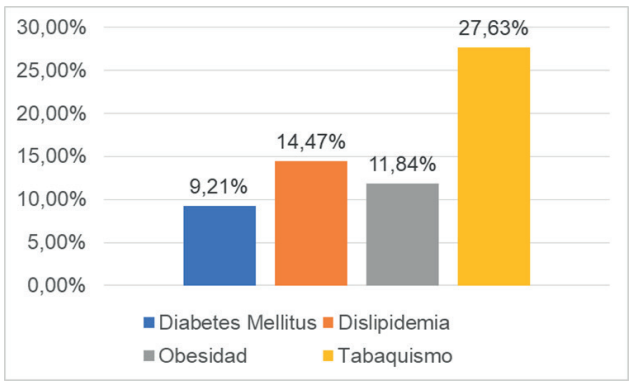

Figure 1. Distribution of patients according to the presence of risk factors

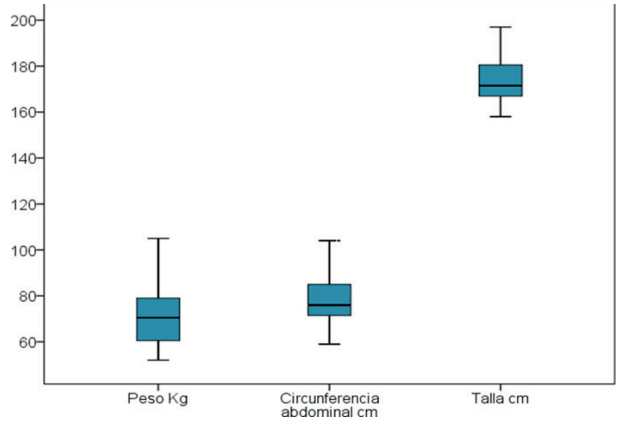

Figure 2. Result of anthropometric measurements

Table 2 shows that the mean values of systolic and diastolic blood pressure were within normal ranges, both in the measurements made at the office and in the 24-hour ABPM. In this sense, it was found that most hypertensive participants who practiced physical exercise maintained adequate control of blood pressure, achieved in 61 patients (80.3% of the total). However, the mean blood pressure values obtained through ABPM were significantly lower than those recorded in the office, a difference that was statistically significant in the comparative analysis.

It was evidenced that cardiovascular risk factors were more frequent among the participants with uncontrolled blood pressure.

Table 2. Ambulatory blood pressure of 24 hours and in office

Variable	In office *	Ambulatory*	p-value
SBP (mmHg)	121,5 ± 14,4	116,6 ± 12,8	< 0,001
DBP (mmHg)	72,3 ± 9,7	67,4 ± 8,9	< 0,001

*Mean ± SD: standard deviation; DBP: diastolic blood pressure; SBP: systolic blood pressure
Source: medical records

Table 3. Risk factors according to blood pressure control

Factores de riesgo	Controlled n=61 (80,3 %)	Uncontrolled n=15 (19,7 %)	Total n=76 (100 %)	p-value	OR (IC 95%)
Diabetes	1 (1,6)	6 (40,0)	7 (9,2)	< 0,001	0,2 (0,0 — 1,0)
Obesity	2 (3,3)	7 (46,7)	9 (11,8)	< 0,001	0,3 (0,1 — 1,0)
Dyslipidemia	3 (4,9)	8 (53,3)	11(14,5)	< 0,001	0,3 (0,1 — 1,0)
Smoking	12 (80,0)	9 (14,8)	21 (27,6)	< 0,001	6,2 (0,04 — 0,54)

Source: medical records

However, only smoking showed a statistically significant association with uncontrolled blood pressure. In the analysis, it was observed that smoking increased more than six times the risk of presenting uncontrolled blood pressure, regardless of the form of regular physical exercise, these results are illustrated in Table 3.

Discussion

In the current study it was evidenced that, in a population of former athletes and physical exercise practitioners, the prevalence of cardiovascular risk factors was low, particularly those related to metabolic alterations and obesity. In addition to these favorable effects on metabolic health, the ABPM results showed that most participants had adequate blood pressure control, suggesting a positive impact of regular exercise on hemodynamic regulation.

Among the lifestyle habits contributing to blood pressure control, regular physical activity plays a central role. The physiological mechanisms involved in the hypotensive effect of physical exercise are multiple and include a decrease in sympathetic activity; an increase in vagal tone; a reduction in plasma concentrations of catecholamines, both at rest and during exertion; a decrease in peripheral vascular resistance; an improvement in endothelial function and a reduction in body weight.[14]

Several studies have demonstrated that physical exercise has hypotensive effects comparable to those achieved with antihypertensive drugs. It has been estimated that regular aerobic exercise can reduce systolic blood pressure by about 8 mmHg, which is more effective than resistance training although, there is still no consensus on which type of physical activity yields greater benefits in blood pressure control.[15]

Like the findings of this study, in a meta-analysis[16] that included 270 randomized controlled trials with 15 827 participants, physical exercise was found to be effective in controlling blood pressure. This was regardless of the training modality with significant reduction values, both systolic and diastolic.

The use of ABPM offers significant advantages over office measurements, allowing for continuous blood pressure assessment during daily activities and sleep. This method has been identified as a stronger predictor of cardiovascular events and mortality than isolated measurements in the clinical setting.[17] Also, the clinical practice guidelines of both United States[11] and Europe[18] set lower diagnostic thresholds for hypertension for ABPM than for measurement in office.

In the current study, the measured systolic and diastolic blood pressure values showed significant differences between those obtained at the office and the ABPM result, which supports the greater sensitivity of the latter method to evaluate blood pressure control. This phenomenon is attributed, among other factors, to the stress of medical office and the well-known "white coat" effect, which tends to temporarily raise blood pressure and make it difficult to assess the hypertensive patient accurately.[19] For these reasons, the ABPM has been promoted as an effective method for the assessment and diagnosis of arterial hypertension in physically active persons.[20]

Other studies have assessed the usefulness of ABPM to evaluate the effects of physical exercises on blood pressure values. A systematic review with meta-analysis of randomized controlled trials,[21] which included 910 hypertensive patients aged 45-70 from 15 studies, showed that physical exercise significantly reduced all the parameters of ABPM, including systolic and diastolic blood pressure in the 24-hour periods, day and night.

Similarly, another meta-analysis,[22] with 14 studies and 806 hypertensive participants aged 30-85, showed that aerobic exercise, compared to control groups without physical activity,

significantly reduced both systolic and diastolic blood pressure studied with ABPM. The authors conclude that physical exercises practice is an effective therapeutic option in hypertensive patients.

These results are also consistent with the report of the multicenter, controlled study Exercise Training in the Treatment of Resistant Hypertension (EnRicH),[23] in which 53 patients with resistant hypertension, aged 40-75 years, were randomized into groups with and without intervention of physical exercise. The 24-hour ABPM showed significant reductions in systolic and diastolic blood pressure, both in the total period and in the daytime in the intervention group, results that were also reproduced in the measurements obtained in office.

The findings of this study are consistent with international literature, demonstrating the beneficial effect of physical exercise on blood pressure control and the utility of ABPM for more appropriate assessment. However, unlike the studies cited above, this research identified smoking as the only risk factor significantly associated with uncontrolled blood pressure in physically active individuals. This result highlights the negative influence of smoking on cardiovascular function, regardless of the training level.

In Cuba, the prevalence of smoking reaches the 23.7 % of the population older than 15 years old, with an increasingly early start age. There are an estimated of two million of active smokers, with a male prevalence of 41.4% compared to 23% in women[24]. Nicotine and other tobacco compounds induce the release of cortisol and catecholamines, which increases blood pressure through arteriolar vasoconstriction and reduced oxygen flow to the myocardium. In addition, smoking promotes increased serum lipids and the development of atherosclerosis, which contributes to vascular damage and persistent blood pressure rising.[25] A meta-analyses[26] based on the data from the FinnGen biobank in 2022 explored the causal role of smoking in multiple systemic diseases. This research confirmed its significant association with high blood pressure and other cardiovascular diseases, showing that smokers have a 1.21 times higher risk of developing it, relative to the time of onset and duration of the habit.

Moreover, Zhou *et al*.[27] observed that in smokers, physical exercise may improve withdrawal symptoms and cravings but is not associated with cessation of smoking ($p > 0.05$). This phenomenon helps to understand the findings of the current research where smokers, by continuing with the habit, reduce the positive effect of physical activity.

The current research constitutes one of the first national experiences in evaluating the use of ABPM in a hypertensive and physically active population and provides evidence on hemodynamic behavior in a poorly studied group. However, some limitations are recognized, including the small sample size, unicentric design and absence of a control group, which constrain generalization of results. Therefore, findings should be interpreted with caution and multicenter and longitudinal studies involving a larger number of participants and follow-up variables are recommended.

Conclusion

Ambulatory blood pressure monitoring showed that regular physical exercise practice significantly contributes to blood pressure control in former athletes and those who engage in physical activity. In this physically active population, the prevalence of cardiovascular risk factors was low and not associated with uncontrolled blood pressure, except for smoking, which significantly increased the risk of presenting uncontrolled blood pressure.

References

1. Niebauer J, Börjesson M, Carre F, Caselli S, Palatini P, Quattrini F, et al. Recommendations for participation in competitive sports of athletes with arterial hypertension: summary of a position statement from the sports cardiology section of the european association of preventive cardiology (EAPC). European Heart Journal. [Internet]. 2018 [cited 21 ago 2025];39(40):3664-3671. Available from: https://doi.org/10.1093/eurheartj/ehy511
2. Würzburger L, Wiech P, Rossi VA, Neunhäuserer D, Caselli S, Schmied CM, et al. Hypertensive response to exercise in athletes: unremarkable finding or relevant marker for future cardiovascular complications? Int J Hypertens. [Internet]. 2022 [cited 21 ago 2025]; 2022: 8476751. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9678482/
3. McEvoy JW, McCarthy CP, Bruno RM, Brouwers S, Canavan MD, Ceconi C et al. 2024 ESC Guidelines for the management of elevated blood pressure and hypertension. Eur Heart J. 2024;45(38):3912-4018. DOI: 10.1093/eurheartj/ehae178. Errata en: Eur Heart J. 2025;46(14):1300. DOI: 10.1093/eurheartj/ehaf031. Errata en: Eur Heart J. 2025;46(45):4949. DOI: 10.1093/eurheartj/ehaf659.

4. Daniel W. Jones, Chair; Keith C Ferdinand, Sandra J. Taler, Heather M. Johnson, Daichi Shimbo, Marwah Abdalla, Martine Altieri, et al. 2025 AHA/ACC/AANP/AAPA/ABC/ACCP/ ACPM/AGS/AMA/ASPC/NMA/PCNA/ SGIM Guideline for the prevention, detection, evaluation and management of high blood pressure in adults: a report of the american college of cardiology/american heart association joint committee on clinical practice guidelines. Circulation. 2025;152:e114–e218. DOI: 10.1161/CIR.0000000000001356
5. Schweiger V, Niederseer D, Schmied C, Attenhofer-Jost C, Caselli S. Athletes and hypertension. Current Cardiology Reports. [Internet]. 2021 [cited 21 ago 2025];23(12):176. Available from: https://doi.org/10.1007/s11886-021-01608-x
6. Barroso WKS, Rodrigues CIS, Bortolotto LA, Mota-Gomes MA, Brandão AA, Feitosa ADM, et al. Brazilian guidelines of hypertension - 2020. Arq Bras Cardiol. [Internet]. 2021 [cited 23 ago 2025];116(3):516-658. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/pmid/33909761/
7. Correia D. Influence of resistance training on ambulatory blood pressure monitoring: a brief review. Arterial Hypertension. [Internet]. 2022 [cited 23 ago 2025];26(4):180–186. Available from: https://doi.org/10.5603/AH.a2022.0019
8. O'Keefe JH, O'Keefe EL, Lavie CJ. The goldilocks zone for exercise: not too little, not too much. Missouri Medicine. [Internet]. 2018 [cited 30 ago 2025];115(2):98-105. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6139866/
9. Runacres A, Mackintosh KA, McNarry MA. Health consequences of an elite sporting career: long-term detriment or long-term gain? a meta-analysis of 165,000 former athletes. Sports Medicine. [Internet]. 2021 [cited 30 ago 2025];51(2):289-301. Available from: https://link.springer.com/article/10.1007/s40279-020-01379-5
10. Pérez Caballero MD, León Álvarez JL, Dueñas Herrera A, Alfonzo Guerra JP, Navarro Despaigne DA, de la Noval García R, et al. Guía cubana de diagnóstico, evaluación y tratamiento de la hipertensión arterial. Rev Cubana Med [Internet]. 2017 [cited 30 ago 2025];56(4):242–321. Available from: http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0034-75232017000400001
11. Whelton PK, Carey RM, Aronow WS, Casey DE, Collins KJ, Dennison Himmelfarb C, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the prevention, detection, evaluation, and management of high blood pressure in adults: a report of the american college of cardiology/american heart association task force on clinical practice guidelines. J Am Coll Cardiol [Internet]. 2018 [cited 11 ago 2025];71(19):e127–248. Available from: https://doi.org/10.1016/j.jacc.2017.11.006
12. Muntner P, Shimbo D, Carey RM, Charleston JB, Gaillard T, Misra S, et al. Measurement of blood pressure in humans: a scientific statement from the american heart association. Hypertension. [Internet]. 2019 [cited 11 ago 2025];73(5):e35-e66. Available from: https://doi.org/10.1161/HYP.0000000000000087
13. Médica Mundial A. Declaración de helsinki de la asociación médica mundial. principios éticos para las investigaciones médicas en seres humanos. An Sist Sanit Navar [Internet]. 2009 [cited 20 ago 2025];24(2):209-12. Available from: https://recyt.fecyt.es/index.php/ASSN/article/view/5964
14. Colectivo de autores. Consejo de cardiología del ejercicio. Consenso argentino de rehabilitación cardiovascular. Rev Arg Card. [Internet]. 2019 [cited 2 sep 2025]; 87(3):1-57. Available from: https://www.metodologo.com/wp-content/uploads/Consenso-de-Rehabilitacion-Cardiovascular-2019.pdf
15. Boeno FP, Ramis TR, Munhoz SV, Farinha JB, Moritz CEJ, Leal-Menezes R, et al. Effect of aerobic and resistance exercise training on inflammation, endothelial function and ambulatory blood pressure in middle-aged hypertensive patients. Journal of Hypertension. [Internet]. 2020 [cited 11 ago 2025];38(12):2501-2509. Available from: https://doi.org/10.1097/HJH.0000000000002581
16. Edwards JJ, Deenmamode AHP, Griffiths M, Arnold O, Cooper NJ, Wiles JD, et al. Exercise training and resting blood pressure: a large-scale pairwise and network meta-analysis of randomised controlled trials. Br J Sports Med [Internet]. 2023 [cited 14 dic 2025];57(20):1317-1326. Available from: https://bjsm.bmj.com/content/bjsports/57/20/1317.full.pdf
17. Yang WY, Melgarejo JD, Thijs L, Zhang ZY, Boggia J, Wei FF, et al. Association of office and ambulatory blood pressure with mortality and cardiovascular outcomes. JAMA. [Internet]. 2019 [cited 11 ago 2025];322(5):409-420. Available from: https://doi.org/10.1001/jama.2019.9811
18. Williams B, Mancia G, Spiering W, Agabiti Rosei E, Azizi M, Burnier M, et al. 2018 ESC/ESH Guidelines for the management of arterial hypertension: the task force for the management of arterial hypertension of the european society of cardiology (ESC) and the european society of hypertension (ESH). *European Heart Journal*. [Internet]. 2018 [cited 11 ago 2025];39(33):3021-

3104. Available from: https://doi.org/10.1093/eurheartj/ehy339
19. Parati G, Omboni S, Staessen J, Thijs L, Fagard R, Ulian L, et al. Limitations of the difference between clinic and daytime blood pressure as a surrogate measure of the 'white- coat' effect. Journal of Hypertension. [Internet]. 1998 [cited 2 feb 2024];16(1):23-9. Available from: https://journals.lww.com/jhypertension/abstract/1998/16010/limitations_of_the_difference_bet ween_clinic_and.5.aspx
20. Ferrari R, de Oliveira Carpes L, Domingues LB, Jacobsen A, Frank P, Jung N, et al. Effect of recreational beach tennis on ambulatory blood pressure and physical fitness in hypertensive individuals (BAH study): rationale and study protocol. BMC Public Health. [Internet]. 2021 [cited 2 sep 2025];21(1):56. Available from: https://doi.org/10.1186/s12889-020-10117-5
21. Saco-Ledo G, Valenzuela PL, Ruiz-Hurtado G, Ruilope LM, Lucia A. Exercise reduces ambulatory blood pressure in patients with hypertension: a systematic review and meta- analysis of randomized controlled trials. J Am Heart Assoc. [Internet]. 2020 [cited 2 sep 2025];9(24):e018487. Available from: https://doi.org/10.1161/JAHA.120.018487
22. Cao L, Li X, Yan P, Wang X, Li M, Li R, Shi X, Liu X, Yang K. The effectiveness of aerobic exercise for hypertensive population: A systematic review and meta-analysis. J Clin Hypertens [Internet]. 2019 [cited 2 sep 2025];21(7):868-876. Available from: https://doi.org/10.1111/jch.13583
23. Lopes S, Mesquita-Bastos J, Garcia C, Bertoquini S, Ribau V, Teixeira M, et al. Effect of exercise training on ambulatory blood pressure among patients with resistant hypertension: a randomized clinical trial. JAMA Cardiol. [Internet]. 2021 [cited 2 sep 2025];6(11):1317-1323. Available from: https://doi.org/10.1001/jamacardio.2021.2735
24. Becerra N, García-Padilla P, Gil F, Vergara A. Características biopsicosociales relacionadas con el consumo de cigarrillo y la intención de cesación en fumadores en un entorno universitario. Rev. Fac. Med. [Internet]. 2020 [cited 2 sep 2025];68(4):517-526. Available from: https://revistas.unal.edu.co/index.php/revfacmed/article/view/77666
25. Hernández YZ, Fernández JE, Montero T, Bacallao J. Impacto del tabaquismo en la aterosclerosis coronaria de fallecidos por muerte violenta. Rev. cuban. med. mil. [Internet]. 2018 [cited 2 sep 2025];47(4):369-379. Available from: https://revmedmilitar.sld.cu/index.php/mil/article/view/202/245
26. Larsson SC, Burgess S. Appraising the causal role of smoking in multiple diseases: a systematic review and meta-analysis of mendelian randomization studies. EBioMedicine. [Internet]. 2022 [cited 11 sep 2025];82:104154. Available from: https://doi.org/10.1016/j.ebiom.2022.104154
27. Zhou Y, Feng W, Guo Y, Wu J. Effect of exercise intervention on smoking cessation: a meta-analysis. Front Physiol [Internet]. 2023 [cited 14 dic 2025]; 14:1221898. Available from: https://www.frontiersin.org/journals/physiology/articles/10.3389/fphys.2023.1221898/full