**Título**: Relationship of cardiorespiratory control and vascular compliance in elite junior athletes.

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## Resumen:

**Objetivo**: […]. **Métodos**: […]. **Resultados**: […]. **Conclusión**: […].

**Palabras clave**: […].

## Abstract:

**Objective**: […]. **Methods**: […]. **Results**: […]. **Conclusion**: […].

**Keywords**: […].

# Introducción:

Exercise offers a variety of benefits, such as increased mitochondrial activity, restoration and enhancement of vasculature and skeletal muscle myokine synthesis, which aid in the maintenance and improvement of cardiovascular function (1).

Exercise promotes increased cardiorespiratory fitness, which as a health-related marker has been linked to an improved cardiometabolic profile (2,3), increased blood volume, myocardial contractility, ventricular compliance, angiogenesis (4), and improved arterial compliance (AD) (5,6). The presence of these characteristics has been associated with a lower risk of mortality from cardiovascular disease (7).

AD is the ability of blood vessels to expand and contract appropriately in response to changes in volume and pressure. Pulse pressure (PP) is the difference between systolic pressure (SP) minus diastolic pressure (DP) and reflects pulsatile blood circulation, in contrast to mean arterial pressure (MAP), which reflects steady blood circulation, and is therefore considered an indicator of AD (8).

AD, along with other parameters, has been studied in swimmers and cyclists to compare the cardiovascular profile with that of untrained subjects (9), and although elevated PP has been associated with increased cardiovascular risk in hypertensive and older subjects (10,11), in young athletes it is unclear what role it plays on cardiorespiratory control and its relationship to other aspects of athletic performance.

During exercise, the increased adaptability of vascular architecture favours energy supply to muscles (**REF?**), which may be beneficial to athletic performance by reducing the ventilatory load required to compensate for reduced cardiovascular adaptability. In this context, understanding the effect of the haemodynamic characteristics of the peripheral circulation on cardiorespiratory control opens up new areas for the development of training modalities aimed at maximising the vascular adaptations required by athletes in competition, expanding new areas of expertise for coaches and health professionals.

We hypothesise that vascular biomechanical characteristics, reflected by AD, influence proper cardiorespiratory regulation during exercise and may be critical to athletic performance. It is for these reasons that we propose to study the haemodynamic properties of the peripheral circulation and its relationship with cardiorespiratory control in young elite athletes.

# Material y methods.

## Design

Our study employed a descriptive, comparative, transversal, and quantitative method. The participants were chosen using non-probabilistic sampling and were split into two groups: girls (n=2) and males (n=7). Athletes were observed for at least twenty days before any scheduled competition throughout their pre-competition period. Anthropometric (body weight, height, and percentage of body fat) and cardiovascular (blood pressure) data were recorded before and after the anaerobic muscle fatigue test (Wingate test).

## Subjects

Nine adolescent of national and international competition level were recruited to participate in this study (age: 15.6 ± 1.9 years; height: 167 ± 8.2 cm; body mass: 69.9 ± 15.6 kg; body fat: 22.2 ± 6.4 %).

The athletes were from the Magallanes Fiscal Gymnasium and the Chilean Antarctic region. A minimum of three years of competitive training, at least six times per week, and at least 14 hours of training per week were required for entry. Take any supplements or drugs that might influence heart rate, have had musculoskeletal injuries in the past three months, or be in pain at the time of the assessments were all exclusion factors. The exclusion criteria were not satisfied by any of the participants. The aims, methods, obligations, and dangers of participation in the study were explained to the participants and their legal guardians.

## Procedure

Measurement stations were built within the same laboratory to better optimize the time necessary for the athlete evaluations: Station 1: the athlete comes at the lab, sits for 5 minutes, and then has their blood pressure taken; station 2: the athlete is assessed on his morphological measures (around 10 minutes); station 3: the athlete is assessed in the Wingate test.

### Acute muscle fatigue protocol

The participants were required to wear a shirt, shorts, and footwear. All participants were told to (a) obtain enough rest the night before, sleeping 8 hours or more, (b) avoid stimulant beverages or drugs before the measures, (c) drink at least 2 liters of water the day before, and (d) eat regularly without changing their diet. 15 minutes before to the test, the participants arrived in the laboratory. The Wingate protocol was conducted out in a laboratory designed for the experiment at 22 °C and 15% RH regulated by air conditioning.

## Assessment

### Morphological measures

The Tanita BC-558 Ironman Segmental Body Composition Monitor (Tanita Ironman, Arlington Heights, IL 60005 USA) was used to measure body mass (kg) and total body fat (percent) with a concordance of 89.3 percent when compared to the Dual X-ray Absorption test using standard measurement protocols (12,13). The CHARDER® HM230M manual height rod was used to determine height (Charder Electronics Co., Ltd. No.103, Guozhong Rd., Taiwan, R.O.C.).

### Anaerobic muscle fatigue test

The Wingate anaerobic test was used to determine anaerobic muscle endurance. This test is used to determine an individual’s anaerobic capacity and power (14) and has been widely researched in children and young people (15), showing to be a safe and reproducible procedure (16). As previously stated (17), a cycle ergometer test was conducted with a customized load for each athlete. We were able to compute the lowest, mean, and peak power outputs using the test as follows: Load (kp) x spins in 5 seconds x 11.76; for each power measurement, the lowest, average, and maximum number of revolutions were utilized (18). Throughout the exam, each athlete was continually checked for discomfort or pain via verbal communication.

### Cardiovascular parameters

Blood pressure (Omron® Pressure Monitor), SP, DP were measured. The evaluation was carried out with the subject sitting in a chair, allowing to calculating MAP and pulse pressure PP.

## Statistical Analyses

Continuous variables are reported as mean and standard deviation (*M* and *SD*) or median and interquartile range (*Mdn* and *IQR*), while absolute (n) and relative (%) frequencies were used for categorical variables. In testing the parametric assumptions associated with hypothesis testing, the *Shapiro-Wilk* test was used to test for normality and the *Levene* test was used to assess homogeneity of variances, using the median as a more robust estimator of centrality (19).

[…], using the *R* programming language for statistical computing, (20).

# Results

Los estadísticos descriptivos de la muestra pueden apreciarse en la tabla 1.

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| --- | --- |
| Characteristic | N = 91 |
| Sex |  |
| Female | 2.0 (22.2%) |
| Male | 7.0 (77.8%) |
| Age | 15.6 ± 1.9 |
| Weigth (kg) | 69.9 ± 15.6 |
| height (cm) | 167.0 ± 8.2 |
| BMI (kg/m2) | 24.8 ± 3.3 |
| Body fat (%) | 22.2 ± 6.4 |
| Peak power (W) | 551.6 ± 149.8 |
| Mean power (W) | 460.3 ± 113.8 |
| Minimum power (W) | 339.3 ± 84.2 |
| Fatigue (%) | 37.2 ± 9.2 |
| 1 n (%); Mean ± SD |  |

# Discusion

[…].

# Conclusion

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# Acknowledgments

[…].

# Conflicts of interest

[…].

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