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Association between physical fitness and body composition with blood pressure in night school students in Brazil

Asociación entre la aptitud física y la composición corporal con la presión arterial en estudiantes de educación nocturna en Brasil

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Abstract

Aim: To compare levels of physical fitness and body composition according to the cardiovascular risk group in blood pressure for each gender among evening students. **Methods:** The sample consisted of 186 students (121 males) attending a night school in southern Brazil, aged between 15 and 30 years (mean: 17.51 ± 3.62 years in males and 17.74 ± 2.71 years in females), without a diagnosis of hypertension and no limitations for performing physical fitness tests. Data on strength were collected through the sit-up test, and VO₂max was estimated through the six-minute walk/run test, for both cases following the PROESP-Br protocol. Body mass index (BMI), waist circumference, waist-to-height ratio, and hip circumference were also assessed. Systolic (SBP) and diastolic blood pressure (DBP) were evaluated using the Korotkoff technique. **Results:** There are significant interactions and differences between gender and risk categories, mainly for blood pressure profiles to SBP (effect $R^2 = 0.465$; $p = 0.001$) and DBP (effect $R^2 = 0.243$; $p = 0.001$). Participants with higher physical fitness exhibit better blood pressure. In the risk group, men showed a difference of 7.71 kg compared to the healthy risk group, while in women, the difference was 27.59 kg. **Conclusion:** The level of physical fitness and body composition are associated with cardiovascular risk in blood pressure according to the risk group.

Keywords: hypertension; cardiorespiratory fitness; muscle strength; adiposity; young adults

Resumen

Objetivo: comparar los niveles de aptitud física y composición corporal según el grupo de riesgo cardiovascular en la presión arterial en cada sexo en estudiantes nocturnos. **Métodos:** la muestra fue de 186 estudiantes (121 hombres) que participan en una escuela nocturna al sur de Brasil, de entre 15 a 30 años (media: 17.51 ± 3.62 años en hombres y 17.74 ± 2.71 años en las mujeres), sin diagnóstico de hipertensión arterial y sin limitaciones para realizar las pruebas de aptitud física. Los datos sobre la fuerza se recopilaban mediante la prueba de abdominales, y el VO₂max se estimó a través de la prueba de caminata/carrera de seis minutos, para ambos casos se siguió el protocolo PROESP-Br. También se evaluó el índice de masa corporal (IMC), perímetro de cintura, relación cintura estatura y perímetro de cadera. La presión arterial sistólica y diastólica se evaluaron según la técnica de Korotkoff. **Resultados:** Hay interacciones significativas y diferencias entre género y categorías de riesgo, principalmente en los perfiles de presión arterial para la PAS (efecto $R^2 = 0,465$; $p = 0,001$) y la PAD (efecto $R^2 = 0,243$; $p = 0,001$). Los participantes con mayor condición física presentan una mejor presión arterial. En el grupo de riesgo, los hombres mostraron una diferencia de 7.71 kg en comparación con el grupo de riesgo saludable, mientras que, en las mujeres, la diferencia fue de 27.59 kg. **Conclusión:** El nivel de aptitud física y la composición corporal están asociados con el riesgo cardiovascular en la presión arterial según grupo de riesgo.

Palabras clave: hipertensión; aptitud cardiorrespiratoria; fuerza muscular; adiposidad; adultos jóvenes

Key Points

- Arterial hypertension affects a significant portion of the adolescent and adult population in Brazil.
- Research linking physical fitness and body composition in vulnerable sectors with low educational levels in Brazil is necessary.
- Physical education is one of the main means for promoting health in vulnerable environments.
- Identifying risk factors in night education could enable the development of interventions and public health policies for health promotion.

Introduction

In a global context, hypertension is also a matter of significant relevance. According to the World Health Organization (WHO), approximately 1.13 billion people worldwide have arterial hypertension, representing around a quarter of the global adult population¹. These alarming numbers underscore the need for global efforts in prevention, early diagnosis, and appropriate treatment of this condition². Hypertension is a medical condition characterized by persistently elevated blood pressure in the arteries. This condition affects a significant portion of the population, both in Brazil and worldwide, and poses relevant risks and occurrences, particularly among young adults³⁻⁴. According to the Ministry of Health, approximately 36 million Brazilian adults suffer from this condition. Additionally, it is estimated that around 5% of children and adolescents also have high blood pressure. These figures are concerning since hypertension is a significant risk factor for cardiovascular diseases such as myocardial infarction and stroke, and it also contributes to the development of renal, ocular, and other complications⁵.

Considering this scenario, it is possible to presume that conducting scientific research on the relationship between blood pressure and physical fitness is of utmost importance in today's world. These studies contribute to understanding the physiological mechanisms involved in this relationship, helping to identify the most effective types of exercises, optimal intensities, and specific benefits for each individual⁶. Furthermore, scientific research provides a foundation for the development of guidelines and public health policies, guiding the population on the importance of engaging in physical activities and assisting in the development of strategies for the prevention and treatment of arterial hypertension. As indicated by the recommendations of the Pan American Health Organization (PAHO)⁷ and the American Journal of Hypertension⁸, which consider a healthy lifestyle, meeting the weekly minutes of physical activity, and maintaining a low-sodium diet as a fundamental pillar for the control of these diseases.

There are previous research showing the relationship between arterial pressure and physical fitness in some components⁹⁻¹⁰. It suggests that physical fitness can be a powerful marker of cardiovascular health status. In this sense, elevated levels of body mass index (BMI), indicating overweight or obesity, are associated with an increased workload on the heart and blood vessels. Excess body fat can lead to increased peripheral resistance, resulting in elevated blood pressure¹¹. A larger waist circumference is associated with a higher incidence of arterial hypertension. Visceral fat is metabolically active and releases inflammatory substances that can contribute to increased blood pressure¹².

On the other hand, individuals with high cardiorespiratory fitness (CRF) generally have a lower risk of developing arterial hypertension. Regular aerobic training improves the heart's ability to pump blood more efficiently, thereby reducing resting blood pressure¹³. The main measure for CRF is VO2 max; thus, individuals with a higher VO2 max generally have a lower risk of developing hypertension. This is because a higher VO2 max is associated with better cardiovascular fitness and increased vasodilation capacity, which can lead to a reduction in blood pressure¹⁴⁻¹⁵⁻¹⁶.

Although there are several global epidemiological studies on hypertension and physical fitness, including those mentioned earlier, there is still a shortage of research conducted in Brazil in vulnerable contexts with low educational levels^{17,18-19}. It is important to highlight the low-income population that experiences educational delays, such as those attending schools for youth and adult education^{17,18-19}. In this context, young adults and elderly individuals who dropped out of school prematurely or experienced multiple grade repetitions return to school in an accelerated education format, condensing the academic year into just six months¹⁷.

Even more, physical education becomes one of the primary means through which these individuals gain access to information and interventions for health promotion. It is an opportune moment for assessing physical fitness and various health indicators to help vulnerable people reach a better health status. However, it is still necessary for educational systems to exert enhanced focus on these aspects in the Brazilian national context¹⁸⁻¹⁹.

Therefore, it is of utmost importance for the academic community to conduct research that divides young and adult individuals into clusters based on hypertension and healthy blood pressure while associating them with physical fitness. Such research enables the identification of specific risk factors, the development of personalized guidelines and public policies, the customization of interventions, and the acquisition of up-to-date scientific evidence. This contributes to the effective prevention and treatment of arterial hypertension, promoting cardiovascular health and improving the quality of life for the Brazilian population²⁰⁻²¹. It is worth noting that this represents one of the initial research proposals on this topic in youth and adult education in Brazil. Thus, the aim of the present study was to compare the levels of physical fitness and body composition according to cardiovascular health risk cluster in blood pressure in each sex.

Methods

Design

This is a descriptive cross-sectional study. It was done in a low-income and vulnerable school population of 273 night-time students from a southern Brazilian city. The sample was composed of 186 (121 male sex), with a mean age of 17.51 (± 3.62) years in males and 17.74 (± 2.71) years in females, from the first to ninth year grade of elementary education. Participants were selected according to convenience criteria. The Brazilian National Ethics Committee approved this study through Universidade Federal do Rio Grande do Sul (approve number: 1.662.821). All human guidelines were signed according to the Helsinki Declaration²².

School Vulnerability context

The school is located in a penitentiary neighborhood and in a periphery region of the city. The vulnerability, low income and low educational index of school can be assumed by an educational basic index (IDEB) of 2.3, considering it was half of the points above the Brazilian national mean (5.0). Additionally, some studies suggest that youth and adult education is, in essence, a vulnerable and low-income social means of education for people who do not have access to formal education at the appropriate age¹⁷⁻¹⁸⁻¹⁹⁻²³⁻²⁴.

Population and Sample

Selection procedures

The 273 students were invited to participate in the research due to the necessity of schools providing better physical education classes for youth and adults at night-time, considering a diagnosis of

health. To guarantee a better quality of present research, the present sample was selected according to inclusion and exclusion criteria. The procedures of the Strobe were followed²⁵.

Inclusion criteria

The inclusion criteria were as follows: a) be between 15 and 30 years old; b) sign a voluntary participation consent form. For those under 18 years old, the form needed to have the authorization of a parent or legal guardian; c) not having a diagnosis of arterial hypertension and not using medications to control blood pressure; and d) not having physical health limitations or body issues that restrict the performance of physical fitness tests.

Exclusion criteria

The exclusion criteria were as follows: a) not attending any upper cited inclusion criteria; b) participants who didn't have completed all physical fitness and blood pressure evaluations; c) participants who did not want to participate in the evaluations when it was developed (no consent); d) participants who were absent from the school during evaluations time (no presence); and e) take medicine for blood pressure.

Sample size power

The sample size was calculated a posteriori by the G*Power software. Considering 4 subgroups (each ex; and risk or healthy cardiovascular profile), 1 covariable predictor (age), an effect size intermediate $F^2=0.15$, an error of 0.05, at 12 outcomes variables and the sample of 186 in a multivariate generalized linear model that provides an adequate power (1-b) of 0.95.

Outcome measures

General procedure

The present study was conducted in a school where physical education classes are held three times a week, for 45 minutes each session. During these classes, students were educated about maintaining a healthy lifestyle, and the importance of sleep, physical activity, and nutrition. On the days when physical fitness and blood pressure measurements were taken, the researchers emphasized that students should avoid the consumption of stimulants, alcoholic beverages, and medication, as well as refrain from smoking cigarettes. To ensure more accurate evaluations, no physical activities were scheduled in the physical education classes during the week of evaluations.

Physical fitness

The abdominal sit-up test was applied to determine muscular strength. Participants repeated abdominal/hip flexion exercises with arms in the trunk and knees flexed and fixed on the floor by the evaluator in 60 seconds according to PROESP-Br protocol¹⁷⁻¹⁸⁻²⁶.

The six-minute walk/run test around the 54-meter circuit, measured previously in a volleyball court, was used to determine the cardiovascular fitness in meters performed in 6 minutes according to PROESP-Br protocol¹⁷⁻¹⁸⁻²⁶.

After, the estimative of the relative volume of oxygen peak during the test (VDOTmax in ml.kg.min) was obtained according to the formulas proposed by Daniels²⁷, as follows:

$$\text{Percent maximal} = 0.8 + 0.1894393 * \exp(-0.012778 * t) + 0.2989558 * \exp(-0.1932605 * t),$$

$$t = \text{time of running in minutes. } Vo_2 = -4.6 + 0.182258 * (\text{speed}) + 0.000104 * (\text{speed})^2, \text{ Velocity} =$$

$$\text{meter/minute. VDOT in ml.kg.min} = Vo_2 / \text{Percent maximal}.$$

Anthropometric measures

It was measured according to PROESP-Br protocols for weight (kg), height (cm), waist circumference (cm), body mass index (BMI in kg/m²) and waist-to-height ratio (WhR in cm)¹⁷⁻¹⁸⁻²⁶ and hip circumference²⁸. Weight was measured using a digital anthropometric scale (OMRON HBF-214, China), graduated from 0 to 150 kg, with a resolution of 0.05 kg and recorded in kilograms, using one digit after the decimal point. Height was measured using a metric tape (Cescorf, Brazil) fixed on the wall and extended from the bottom upwards, with the subject in the upright position, with feet and trunk touching the wall. BMI was calculated by dividing body mass (in kilograms) by height (in squared meters). Waist circumference was evaluated with a tape measure (Cescorf, Brazil) with 0.01 cm precision, it was placed horizontally at the midpoint between the lower edge of the last rib and the iliac crest, which was tightly wound around the body without compressing the measured region and waist to height ratio was calculated according to division of waist measure by height in centimeters¹⁷⁻¹⁸⁻²⁶. The Hip circumference was also measured over a larger gluteal portion with the tape passed around this body region²⁸.

Systolic and diastolic blood pressure

The equipment used in the blood pressure measure was the Littmann Stethoscope and Pamed Sphygmomanometer, imported by Brazil and authorized by Anvisa and Inmetro. The Systolic (SBP) and diastolic (DBP) blood pressures were assessed according to the Korotkoff technique²⁹. The subjects were seated for 10 minutes for the first measurement. The second measurement was performed with the participants after sitting for 20 minutes. The brachial artery was blocked by the sphygmomanometer cuff. As the cuff deflated, the first pulsating sound from the brachial artery was heard using the stethoscope, thus detecting the SBP on the instrument's hand. The DBP was detected at the fifth sound heard, both were recorded in millimeters of mercury (mmHg). The cardiovascular risk in blood pressure was identified when the average between the two measures of SBP / DBP exceeded 120/80 mmHg²⁹.

Statistical analysis

Initially, we performed a visual inspection according to box plots and histogram graphs for all variables in each sex. The centroid D distance in the Mahalanobis test was adopted to identify normality for all variables. Considering this, we opted to present a description of means and standard deviations according to ages and sexes for all outcome variables. Then, we describe the occurrences of participants in healthy and risk zones for blood pressure in each sex. We compare these occurrences between sexes considering a chi-square test with relative risk rate proportion calculi, with an alpha of 0.05%. Then, we verify if there are differences in physical fitness and body composition variables according to blood pressure profiles with interaction in genders and adjusted for age in a multivariate generalized linear model, considering an alpha of 0.05, in a robust method with a power (1- β) of 0.95. The Bonferroni test was calculated to identify the differences, and interactions in sex versus blood pressure health profiles according to delta means (Δ), determination coefficient (R²) and confidence intervals of 95%. All analysis was done in IBM SPSS and AMOS for Windows version 22.0.

Results

Table 1 displays the distribution of participants by sex, providing the mean and standard deviation (SD) of various outcome measures. The data reveals substantial variability in these measures, indicating that the initial distribution could potentially influence subsequent analyses. Consequently, we will incorporate sex as a variable in our analyses, adjusting for age. It's noteworthy that the age variability for females ranges from 15 to 26 years, while for males, it spans from 15 to 30 years.

Table 1. General variable sample characteristics

Variables	Male (n=121)		Female (n=65)	
	Mean	SD	Mean	SD
Age (years)	17.51	3.62	17.74	2.71
Weight (kg)	69.85	9.95	81.82	27.80
Height (m)	1.71	0.05	1.60	0.05
BMI (kg/m ²)	23.92	2.88	31.91	7.28
Hip Circumference (cm)	95.78	6.53	108.82	16.40
Waist Circumference (cm)	78.72	6.61	92.60	18.00
WHtR (cm)	0.46	0.04	0.58	0.11
SBP mean (mmHg)	120.42	7.24	125.68	12.16
DBP mean (mmHg)	80.07	5.50	80.20	8.47
ABD (rep)	28.74	9.25	17.36	11.60
CRF (m)	869.62	169.67	609.42	154.45
VO2max (ml.kg.min)	22.53	5.25	14.07	4.64

SD: standard deviation; BMI: Body mass index; WHtR: waist to height ratio; SPB: Systolic Blood pressure; DBP: Diastolic Blood Pressure; ABD: abdominal sit-up; CRF: Cardiorespiratory fitness; VO2max: estimated oxygen maximum consumption.

Figure 1 shows the occurrences of participants with risk and healthy blood pressure. It is possible to perceive that less than half (47.1%) of the male presents a risk in blood pressure, and females have a slightly higher occurrence of this risk (58.5%).

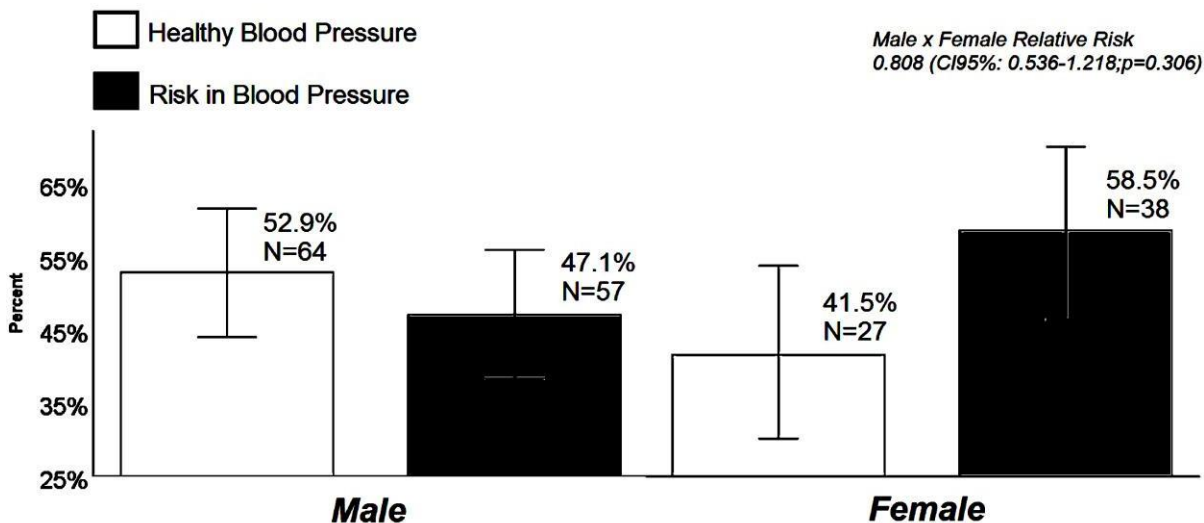
**Figure 1.** Relative risk between sex and prevalence of health profiles for blood pressure.

Table 2 presents that there are interactions and significative differences between sex and risk categories for blood pressure health profile risk. According to this, it is possible to perceive that the physical fitness of healthy blood pressure in males is higher than in females with healthy blood pressure. Females with healthy blood pressure present fewer body composition measures than all other subgroups, including sex and risk profile. The CRF of females at risk is very low compared to all of the other profiles of participants.

**Table 2.** Physical Fitness and body composition according to sex by profiles of cardiovascular health blood pressure

Variables	Male				Female				Interactions/ differences		
	Healthy BP (n=64)		Risk in BP (n=57)		Healthy BP (n=27)		Risk in BP (n=38)		Sex*Risk		
	Δ Mean	95%CI	Δ Mean	95%CI	Δ Mean	95%CI	Δ Mean	95%CI	F	R2	p
Weight (kg)	63.14	59.58, 6.70	70.42	66.66, 74.19	53.97	48.51, 59.43	83.20	78.59, 87.81	24.62	0.352	0.001
Height (m)	1.70	1.69, 1.72	1.72	1.70, 1.73	1.61	1.59, 1.64	1.63	1.61, 1.65	21.12	0.318	0.001
BMI (Kg/m ²)	21.73	20.47, 22.99	23.81	22.48, 25.15	20.79	18.86, 22.72	31.46	29.83, 33.09	33.01	0.422	0.001
HC (cm)	91.38	89.21, 93.56	95.74	93.44, 98.03	89.52	86.19, 92.85	108.96	106.15, 111.77	35.31	0.438	0.001
WC (cm)	73.01	70.64, 75.37	78.64	76.14, 81.14	69.65	66.02, 73.28	89.48	86.42, 92.54	32.89	0.421	0.001
WHtR (cm)	0.43	0.42, 0.44	0.46	0.44, 0.47	0.43	0.41, 0.45	0.55	0.53, 0.57	38.34	0.459	0.001
SPB (mmHg)	113.58	111.64, 115.51	123.69	121.64, 125.74	112.33	109.36, 115.30	130.12	127.61, 132.63	39.31	0.465	0.001
DBP (mmHg)	76.36	74.68, 78.05	81.08	79.30, 82.86	74.86	72.28, 77.44	84.81	82.63, 86.99	14.51	0.243	0.001
ABD (rep)	34.79	32.39, 37.19	30.45	27.91, 32.99	28.34	24.65, 32.02	14.54	11.43, 17.65	28.83	0.389	0.001
APCR (m)	972.56	932.37, 1012.74	899.28	856.79, 941.77	716.93	655.31, 778.54	637.85	585.81, 689.89	34.53	0.433	0.001
VO2max (ml.kg.min ⁻¹)	25.95	24.62, 27.28	23.54	22.14, 24.94	17.53	15.49, 19.57	14.96	13.24, 16.68	34.17	0.430	0.001

Analyzes were adjusted for age. BMI: Body mass index; HC: Hip Circumference; WC: Waist Circumference; WHtR: waist to height ratio; SPB: Systolic blood pressure; DBP: Diastolic blood pressure; ABD: abdominal strength; CRF: Cardiorespiratory fitness; VO2 max: oxygen maxim consumption. F: multivariate generalized linear model result.

Table 3 presents the difference between measures for each outcome variable adjustment for age in each sex. In the male sex, the participants with risk showed 7.71 kg more than those with healthy risk. For the female sex, the difference was 27.59 kg. Males in the risk profile present four repetitions of abdominal than healthy males. And, in females at risk, the difference can be at 19 abdominal unless health profile. In general, physical fitness and body composition of the male sex have slight differences, but significant, between risk and healthy profile in blood pressure. These differences are strongest in the female sex.

Table 3. Bonferroni delta (Δ) differences in physical fitness and body composition according to sex and cardiovascular health profiles.

Variables	Male			Female		
	Risk x Healthy BP			Risk x Healthy BP		
	Δ Mean	95% IC	p-value	Δ Mean	95%IC	p-value
Weight (kg)	7.71	3.56, 11.87	0.001	27.59	18.03, 37.15	0.001
Height (m)	0.01	-0.01, 0.03	0.352	0.02	-0.01, 0.04	0.119
BMI (Kg/m ²)	2.31	1.13, 3.49	0.001	9.82	6.09, 13.54	0.001
HC (cm)	4.59	1.94, 7.24	0.001	18.53	12.88, 24.18	0.001
WC (cm)	5.97	3.21, 8.74	0.001	18.53	12.23, 24.82	0.001
WHtR (cm)	0.032	0.01, 0.04	0.001	0.10	0.06, 0.14	0.001
SPB (mmHg)	10.23	8.22, 12.24	0.001	17.32	11.66, 22.99	0.001
DBP (mmHg)	4.72	2.63, 6.82	0.001	9.91	5.52, 14.30	0.001
Abd. Strength (rep)	-4.11	-7.76, -0.47	0.027	-14.62	-19.28, -9.90	0.001
CRF (m)	-71.29	-134.53, -8.05	0.027	-86.50	-158.56, -14.45	0.019
VO ₂ max (ml.kg.1min)	-2.33	-4.44, -0.02	0.030	-2.83	-5.14, -0.52	0.017

Analyses were adjusted by age. BMI: body mass index; WHtR: waist to height ratio; SBP: Systolic Blood pressure; DBP: Diastolic Blood Pressure; Abd: Abdominal strength; CRF: cardiorespiratory fitness in meters at six minutes running; VO₂max: estimated oxygen maximum consumption.

Discussion

This study aimed to compare levels of physical fitness and body composition according to cardiovascular health risk profiles in blood pressure in each sex. The primary findings revealed that the risk of hypertension in young adults attending evening school is approximately 47.1% for males and 58.5% for females. Both men and women with healthy blood pressure demonstrated superior cardiovascular capacity and abdominal strength compared to those at risk of hypertension. Similarly, participants with elevated body composition indicators (BMI, hip circumference, waist circumference, and waist-to-height ratio) exhibited high blood pressure. Consequently, it is inferred that low levels of physical fitness and unsuitable body composition are predictors of cardiovascular risk in blood pressure.

Blood pressure is influenced by a set of interrelated factors, such as sex, increasing age, smoking, adiposity, and the level of physical fitness⁹. Regarding the role of sex, the results of this study align with those presented by Fiório et al³, in which adult women had a higher risk of high blood pressure. Contrary to our study, Ntineri et al³⁰ demonstrated in their research, which included adolescents and young adults, that blood pressure levels were higher in men following a one-day observation period. With respect to body composition, obesity is widely recognized as one of the primary risk factors for the development of

hypertension⁴. In fact, our findings indicated that different adiposity indicators (BMI, waist circumference, hip circumference, and waist-to-height ratio) are positively associated with blood pressure, which is in line with previous studies such as those by Hardy et al.³¹ and Reges et al.³², who indicate that maintaining a healthy weight is related to better blood pressure levels. Similarly, studies conducted by Korhonen et al.³³ and Jayanthi et al.³⁴ demonstrate a relationship between BMI values and blood pressure levels, with individuals having a high BMI at a greater risk of arterial hypertension. Another study, conducted on adolescents and young men indicated that different body composition variables measured (BMI, body fat percentage, and waist circumference) influence blood pressure variability¹⁰. As for abdominal adiposity, the literature suggests that waist circumference, hip circumference, and/or waist-to-height ratio values are related to the risk of developing cardiovascular diseases in the young adult population, including hypertension³⁵, which aligns with our findings.

The current results also indicate that CRF and muscular strength play a significant role in blood pressure, which aligns with Haapala et al.³⁶ study, participants with better CRF, and a lower percentage of body fat presents better blood pressure. Similarly, other adolescents and adults who improved cardiorespiratory fitness and muscular strength were more likely to maintain adequate blood pressure levels³⁷. Likewise, the study by Ras et al.³⁸ suggests that higher VO₂max is associated with lower blood pressure and greater abdominal repetitions. Similar findings were observed according to Correa-Rodríguez et al.³⁹, lower strength in dynamometry was associated with increased cardiometabolic risk probabilities and higher blood pressure.

In this context, there is evidence in the literature that considers the simultaneous role of adiposity and CRF on cardiometabolic risk factors. Díez-Fernández et al.¹⁰ mentions that having better CRF does not provide complete protection against the risks of maintaining high body adiposity. On the other hand, some studies indicate that individuals with higher levels of CRF tend to exhibit better blood pressure, even in the presence of obesity^{36,40}. The present study suggests that both CRF and adiposity should be considered when addressing blood pressure in adolescents and young adults. Grässler et al.⁶ indicates the same, the improvements in CRF are beneficial for the maintenance of blood pressure, and they mediate a healthy impact on BMI and body fat. Therefore, the current findings emphasize the importance of adhering to physical activity guidelines to enhance physical fitness and, consequently, reduce adiposity.

From a public health perspective, identifying the characteristics associated with maintaining normal blood pressure could inform the development of future policies³¹. Therefore, this study holds great importance because there is limited existing literature associating physical fitness, body composition, and blood pressure among participants in adult and young adult education. In this regard, this work serves as a valuable theoretical tool to begin developing policies that emphasize physical education as a relevant and influential space for increasing and improving physical fitness and body composition parameters in adolescents and young adults participating in this type of education, ultimately promoting better cardiovascular health.

It is crucial to consider the social environment in which adult and young adult education takes place, as participants often lack access to basic healthcare and regular health assessments^{41,42}. Evaluating blood pressure and physical fitness in adolescents and young adults participating in this kind of education is relevant because early diagnosis of these risk factors promotes the prevention and treatment of cardiovascular diseases, such as hypertension.

Limitations and Strengths

Some limitations of the research can be mentioned, due to its cross-sectional design, causal relationships between the data cannot be inferred. Additionally, there is no additional information about participants' habits, whether related to diet or physical activity, which could be addressed in future

research. While it is known that physical fitness and body composition are markers of blood pressure, it is essential to incorporate other variables that may influence it, such as mental health or socioeconomic status. Regarding the strengths, this article demonstrates the existence of cardiovascular risk in the young and vulnerable population associated with physical fitness and body adiposity, reflecting a health issue in this age group, and adding evidence to a topic with limited literature.

Conclusions

The results obtained indicate that the level of physical fitness and body composition is associated with cardiovascular risk in blood pressure. It was observed that higher physical fitness is associated with healthy blood pressure, being more pronounced in males than in females. Additionally, participants with lower measures of body composition were associated with healthy blood pressure. Regarding the risk group, the level of physical fitness and body composition in males shows slight but significant differences compared to the healthy blood pressure group. However, these differences are more pronounced in females. The data obtained in this study suggest the importance of further investigating the factors influencing blood pressure in this age group, identifying causes and consequences. Furthermore, our results serve as a source of information for future strategies involving physical education as a protective factor against cardiovascular risk for young students and adults participating in evening education in Brazil.

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