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Original Article

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Cardiovascular risk in bodybuilders in gyms in São Luís, state of Maranhão

Risco cardiovascular em praticantes de musculação em academias de São Luís – MA

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Resumo

Introdução: O uso dos indicadores antropométricos tem crescido como forma simples e eficaz para identificar o risco de doença cardiovascular que é a principal causa de morte no mundo. **Objetivo:** Verificar os fatores associados aos indicadores antropométricos de risco cardiovascular em praticantes de musculação em duas academias de São Luís – MA. Materiais e Métodos: Trata-se de um estudo transversal realizado com 302 praticantes de musculação de duas academias em São Luís – MA. A coleta de dados foi realizada nos meses de agosto e setembro de 2019. Utilizou-se um questionário socioeconômico e demográfico. Foram aferidas as medidas antropométricas. A regressão de Poisson foi realizada no programa Stata® versão 14.0. **Resultados:** Dos praticantes de musculação, 52,3% eram do sexo feminino e 86,7% tinham de 20 a 39 anos de idade. Para o desfecho CC, ser do sexo feminino (IRR=1,10; IC=1,02-1,18), morar com companheiro (IRR=1,17; IC=1,08-127), ter tempo de exercício físico de sete a doze meses (IRR=1,14; IC=1,01-1,30), ser diabético (IRR=1,06; IC=1,24-1,69) e ter histórico de DCV na família (IRR=1,07; IC=0,99-1,16) foram fatores de risco para DCV. Quanto ao desfecho RCEst, ser diabético (IRR=2,30; IC=1,34-3,93) foi fator de risco para DCV. Com relação ao desfecho CP, ter ensino superior completo (IRR=1,14; IC=1,02-1,27), fumar (IRR=1,12; IC=1,03-1,21), histórico de DCV na família (IRR=1,07; IC=1,00-1,15) foram fatores de risco a DCV. Quanto o indicador RCQ, ser diabético (IRR=9,47; IC= 1,21-2,00) foi fator de risco a DCV. **Conclusão:** Observaram-se vários fatores de riscos associados aos indicadores antropométricos de risco cardiovascular (CC, RCEst, CP e RCQ) em praticantes de musculação.

Palavras-chave: fatores de risco; indicadores antropométricos; doenças cardiovasculares; musculação

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Abstract

Introduction: The use of anthropometric indicators has grown as a simple and effective way to identify the risk of cardiovascular disease, which is the main cause of death in the world. Objective: To verify the factors associated with anthropometric indicators of cardiovascular risk in bodybuilders in two gyms in São Luís, state of Maranhão. **Material and Methods:** This was a cross-sectional study with 302 bodybuilders from two gyms in São Luís, state of Maranhão. Data were collected in August and September 2019. A socioeconomic and demographic questionnaire was used. Anthropometric measurements were taken. Poisson regression was performed using the Stata® 14.0 software. **Results:** Of the bodybuilding practitioners, 52.3% were female and 86.7% were between 20 and 39 years old. For the outcome CC, being female (IRR = 1.10; CI = 1.02-1.18), living with a partner (IRR = 1.17; CI = 1.08-127), having physical activity time from seven to twelve months (IRR = 1.14; CI = 1.01-1.30), being diabetic (IRR = 1.06; CI = 1.24-1.69) and having a history of cardiovascular disease in family (IRR = 1.07; CI = 0.99-1.16) were a risk factor for CVD. As for the outcome RCEst, being diabetic (IRR = 2.30; CI = 1.34-3.93) was a risk factor for CVD. Regarding the outcome CP, having completed education (IRR = 1.14; CI = 1.02-1.27), smoking (IRR = 1.12; CI = 1.03-1.21), family history of cardiovascular disease (IRR = 1.07; CI = 1.00-1.15) were a risk factor for CVD. As for the WHR indicator, being diabetic (IRR = 9.47; CI = 1.21-2.00) was a risk factor for CVD. **Conclusion:** There were several risk factors associated with anthropometric indicators of cardiovascular risk (WC, WHtR, CP and WHR) in bodybuilding practitioners.

Keywords: risk factors; anthropometric indicators; cardiovascular diseases; weight training

Introduction

Due to changes in life habits in recent decades, such as inadequate nutrition and lack of physical exercise, chronic non-communicable diseases (NCDs) are currently a public health problem with the greatest impact on the causes of death[1]. According to the Pan American Health Organization[2] among NCDs, cardiovascular disease (CVD) is the leading cause of death in the world, more than 289 thousand people died of CVD in 2019[3].

The onset of CVD is related to several aspects, in which risk factors are directly linked as causal agents that predispose to the onset and development of this disease[4]. Some of these factors can be modified, such as systemic arterial hypertension, high serum cholesterol, diabetes, physical inactivity, smoking, use of contraceptives, stress, obesity and abdominal fat, and others that cannot be modified, such as sex, heredity and old age [5,6].

Identifying one or more of these risk factors serves to distinguish individuals who are prone to develop CVD, which makes cardiovascular risk factors an important tool for preventing and promoting health[7].

The use of anthropometric indicators has grown as a simple and effective way to estimate the risk of CVD[8]. Anthropometric indicators most used in the assessment of cardiovascular risk are the Waist Circumference (WC), the Waist-to-Hip Ratio (WHR) and the Waist-to-Height Ratio (WHtR) which are easily applied and widely used in epidemiological studies, enabling the identification of individuals more likely to have excess visceral fat and increased cardiovascular risk.[9,10,11]

More recently, another measure of anthropometric assessment that has been used is the neck circumference (NC). According to Preis et al.[12], the fat deposit in this region confers a risk of CVD, as well as abdominal visceral fat.

In recent years, there has been an increase in the practice of physical exercise, as well as people's demand for fitness centers. According to the International Health, Racquet and Sportsclub Association (IHRSA), Brazil has more than 34 thousand gyms, and about 9.6 million customers[13].

Thus, the interest in studying this theme arose when verifying the high number of people with cardiovascular risk

factors and also with the growing demand for physical exercise in gyms in the city of São Luís, state of Maranhão. A series of studies on cardiovascular risks have been carried out with specific population extracts, such as, for example, in university professors, health workers and university students, in addition to studies conducted to identify the dietary profile or evaluate the consumption of supplements. Therefore, studying groups of bodybuilding practitioners, gains importance for ruling out possible triggers for health complications and preventing the risk of cardiovascular disorders. Therefore, this investigation whose aimed to verify the factors associated with anthropometric indicators of cardiovascular risk in bodybuilding practitioners in two gyms in São Luís, state of Maranhão.

Material and Methods

Sample and type of study

This is a cross-sectional analytical study. The research was conducted in August and September 2019, with practitioners of weight training in two gyms in São Luís, state of Maranhão. The sample was non-probabilistic, totaling 302 individuals.

Research design

The study is part of a larger research entitled "Level of anxiety in practitioners of physical exercise and its associated factors", approved by the Research Ethics Committee of University CEUMA, as recommended by Resolution 466 of December 12, 2012 of the National Council of Health, under opinion 3.540.161.

Inclusion and Exclusion Criteria

As inclusion criteria, we selected individuals who practiced weight training for at least 3 months, aged 20 to 59 years, of both sexes and who voluntarily accepted to sign the Informed Consent Form (ICF). Individuals who performed other types of physical exercise (jump, functional, fit dance classes, etc.) were excluded.

Procedures

A questionnaire adapted from Hilgenberg[14] was applied, containing socioeconomic, demographic, lifestyle and anthropometric variables. The use of supplements was also assessed according to consumption (no or yes).

In the anthropometric evaluation, the measurements of weight, height, WC, hip circumference (HC) and NC were measured, and from these data the BMI, WHtR and WHR were calculated.

To measure the weight, a digital scale Plenna®, with a capacity of 150 kg and accurate to 100 grams, was used. Interviewees were weighed without sneakers, with gym clothes and before beginning any physical exercise. To measure height, a Filizola® stadiometer with a graduation in centimeters and a capacity of two meters was used.

All circumferences were measured in duplicate with the aid of a non-inextensible measuring tape, Sanny®, accurate to 0.1 cm. WC was measured in the free or naked abdominal region and using the midpoint found by palpating the last rib and the iliac crest. Interviewees were standing, with the abdomen relaxed, arms extended under the body and feet together; the measurement was made after expiration with the tape positioned horizontally at the marked point, touching the skin and following the contours, but without the underlying tissues.[15]

WC was expressed in centimeters (cm) and the cut-off points adopted for women were: no risk for CVD (WC <80 cm), increased risk for CVD (WC ≥ 80 cm and <88 cm) and very increased risk for CVD (WC ≥ 88 cm) and for men: no risk for CVD (WC <94 cm), increased risk for CVD (WC ≥ 94 cm and <102 cm) and very increased risk for CVD (WC ≥ 102 cm)[16].

HC was measured at the most prominent point in the gluteal region with the individual wearing light clothing. The interviewee was in an upright position, with their arms flexed at a 90° angle and feet together[15]. The WHR was obtained by dividing the WC by the HC, both in centimeters; values above 0.85 for women and above 0.95 for men were considered high[17].

NC was measured with a tape positioned at the height of the cricothyroid cartilage. In men with prominence, NC was measured below prominence. NC was classified according to the recommendations of Bem-Noun and Laor[18], with men with NC> 37cm and women with NC> 34cm being considered to be at increased risk for CVD.

WHtR was calculated by dividing WC (cm) by height (cm), and women with WHtR values ≥ 0.53 and men with WHtR ≥ 0.52[19] were categorized as cardiovascular risk.

BMI was calculated using the equation: BMI = weight (Kg)/height^2 (m). BMI values were grouped and classified according to the recommendations of the World Health Organization (WHO): <18.4 Kg/m^2, underweight; 18.5 to 24.9 Kg/m^2, normal weight; 25 to 29.9 Kg/m^2 overweight and ≥ 30 Kg/m^2, obesity[20].

Data were analyzed using the Stata® 13.0 software. The descriptive analysis of qualitative variables was described by absolute and relative frequencies. Multivariate analysis was also applied, using the Poisson regression method, in which all the independent variables associated with the four outcomes of interest (WC, WHtR, NC and WHR) were included in the multiple model, with a statistical significance of up to 20%. To accept the associations investigated in the final model, a value of $p < 0.05$ was adopted.

Results

Of the 302 weight training practitioners evaluated, 52.3% were female, 86.7% were 20 to 39 years old, 64.2% lived without a partner, 89.1% had completed or incomplete higher education and 46.3% had a family income greater than four minimum wages. As for lifestyle, 96% did not smoke and 50.7% reported drinking some type of alcoholic beverage. Regarding physical activity, 39.5% practiced weight training 3 to 4 times a week, 54.3% practiced weight training for more than a year and 59.3% did not use supplements. As for stress, 50.7% considered themselves stressed, 59.3% had no history of CVD in the family, 96% were not hypertensive and 99.7% were not diagnosed with diabetes (Table 1).

Table 1: Socioeconomic, demographic and lifestyle characteristics in bodybuilding practitioners at two gyms in São Luís, state of Maranhão, 2020.

Variables	n	%
Gender		
Male	144	47.8
Female	158	52.3
Age		
20 – 39	262	86.7
40–59	40	13.3
Marital status		
No partner	194	64.2
With a partner	108	35.8
Education		
Complete and Incomplete High School	33	10.9
Complete and Incomplete Higher Education	269	89.1
Income		
Up to a minimum wage	9	3

From one to two minimum wages	24	8
Two to three minimum wages	57	19
Three to four minimum wages	71	23.7
Higher than four minimum wages	139	46.3
Smoke		
No	290	96
Yes	12	4
Alcohol		
No	149	49.3
Yes	153	50.7
Frequency of Physical Exercise		
6 times a week	68	22.6
5 times a week	100	33.2
3 to 4 times a week	119	39.5
2 times a week	14	4.7
Physical Exercise Time		
Less than three months	49	16.2
3 to 6 months	59	19.6
7 to 12 months	30	9.9
More than a year	164	54.3
Supplement Use		
No	179	59.3
Yes	123	40.7
Stress		
No	153	50.7
Yes	149	49.3
Family CVD		
No	179	59.3
Yes	123	40.7
Hypertension		
No	290	96
Yes	12	4
Diabetes		
No	301	99.7
Yes	1	0.3
Total	302	100

As for anthropometric characteristics, 55% were overweight, according to the BMI. According to NC, 60.9% were at no risk for CVD. With regard to WC, 63.6% were not at risk for CVD, in relation to WHtR, 72.8% were not at risk and as for WHR, 80.1% had no risk of CVD (Table 2).

Table 2: Anthropometric data of bodybuilding practitioners in two gyms in São Luís, state of Maranhão, 2020.

Variables	n	%
BMI		
Eutrophic	136	45
Overweight	166	55
Neck circumference		
No risk	184	60.9
At risk	118	39.1
Waist circumference		
No risk	192	63.6
At risk	110	36.4
WHtR		
No risk	220	72.8
At risk	82	27.2

WHR		
No risk	242	80.1
At risk	60	19.9
Total	302	100

BMI: Body Mass Index; WHtR: Waist-to-Height Ratio; WHR: Waist-to-Hip Ratio.
Source: Research Data

In the unadjusted analysis, for the WC outcome, being woman (IRR = 1.14; CI = 1.05-1.23), living with a partner (IRR = 1.18; CI = 1.09-1, 28), being 40 to 59 years old (IRR = 1.11; CI = 0.99-1.29), having an income of two to three minimum wages (IRR = 0.85; CI = 0.68-1.07) and three to four minimum wages (IRR = 0.84; CI = 0.67-1.05), to have physical exercise time of three to six months (IRR = 1.09; CI = 0.98 -1.21) and from seven to twelve months (IRR = 1.10; CI = 0.96-1.26), consuming a supplement (IRR = 0.83; CI = 0.77-0.90), being stressed (IRR = 1.09; CI = 1.01-1.18), diabetic (IRR = 1.46; CI = 1.41-1.52), hypertensive (IRR = 1.16; CI = 0.97-1.40) and having a family history of CVD (IRR = 1.10; CI = 1.02-1.19) were a risk factor for CVD. As for the outcome WHtR, being woman (IRR = 0.47; CI = 0.31-0.70), consuming alcohol (IRR = 1.52; CI = 1.03-2.23), having time of physical exercise of less than three months (IRR = 1.58; CI = 1.01-1.26), using a supplement (IRR = 0.38; CI = 0.23-0.61), being diabetic (IRR = 3.71; CI = 3.08-4.47) and having a family history of CVD (IRR = 1.31; CI = 0.91-1.90) were associated with CVD (Table 3).

Table 3 – Unadjusted analysis of the association of socioeconomic, demographic and lifestyle characteristics of bodybuilding practitioners in two gyms in São Luís, state of Maranhão, 2020.

	WC			WHtR			NC			WHR		
Variable	**IRR**	**(95% CI)**	**p-value**	**IRR**	**(95% CI)**	**p-value**	**IRR**	**(95% CI)**	**p-value**	**IRR**	**(95% CI)**	**p-value**
Gender												
Male	1	-	1	1	-	1	1	-	1	1	-	1
Female	1.14	(1.05-1.23)	<0.001	0.47	(0.31-0.70)	<0.001	0.69	(0.31-0.07)	<0.001	0.39	(0.23-0.64)	<0.001
Marital status												
No partner	1	-	1	-	-	-	-	-	-	1	-	1
With a partner	1.18	(1.09-1.28)	< 0.001	-	-	-	-	-	-	1.57	(1.00-2.46)	0.049
Age (years)												
20 – 39	1	-	1	-	-	-	-	-	-	1	-	1
40 – 59	1.11	(0.99-1.29)	0.054	-	-	-	-	-	-	1.81	(1.08-3.03)	0.024
Education												
Complete and Incomplete High School	-	-	-	-	-	-	1	-	1	1	-	1
Complete and Incomplete Higher Education	-	-	-	-	-	-	1.19	(1.06-1.34)	0.003	3.55	(0.90-13.9)	0.068
Income												
Up to a minimum wage	1	-	1	-	-	-	-	-	-	-	-	-
From one to two minimum wages	1.91	(0.70-1.17)	0.466	-	-	-	-	-	-	-	-	-
Two to three minimum wages	0.85	(0.68-1.07)	0.186	-	-	-	-	-	-	-	-	-
Three to four minimum wages	0.84	(0.67-1.05)	0.134	-	-	-	-	-	-	-	-	-

Higher than four minimum wages	0.89	(0.71-1.10)	0.305	-	-	-	-	-	-	-	-	-
Alcohol												
No	-	-	-	1	-	1	1	-	1	-	-	-
Yes	-	-	-	1.52	(1.03-2.23)	0.032	1.10	(1.01-1.19)	0.015	-	-	-
Smoke												
No	-	-	-	-	-	-	1	-	1	1	-	1
Yes	-	-	-	-	-	-	1.27	(1.09-1.47)	<0.001	2.19	(1.07-4.47)	0.030
Physical Exercise Time												
More than a year	1	-	1	1	-	1	1	-	1	-	-	-
3 to 6 months	1.09	(0.98-1.21)	0.083	1.24	(0.98-1.21)	0.383	0.9	(0.80-1.00)	0.050	-	-	-
7 to 12 months	1.10	(0.96-1.26)	0.153	1.28	(0.96-1.26)	0.410	0.92	(0.83-1.02)	0.128	-	-	-
Less than three months	1.13	(1.01-1.26	0.027	1.58	(1.01-1.26	0.051	0.80	(0.66-0.98	0.033	-	-	-
Supplement												
No	1	-	1	1	-	1	-	-	-	1	-	1
Yes	0.83	(0.77-0.90)	<0.001	0.38	(0.23-0.61)	<0.001	-	-	-	0.48	(0.28-0.83)	<0.008
Stress												
No	1	-	1	-	-	-	-	-	-	1	-	1
Yes	1.09	(1.01-1.18)	0.019	-	-	-	-	-	-	1.43	(0.90-2.28)	0.123
Diabetes												
No	1	-	1	1	-	1	1	-	1	1	-	1
Yes	1.46	(1.41-1.52)	<0.001	3.71	(3.08-4.47)	<0.001	0.71	(0.69-0.74)	<0.001	2.33	(3.22-1.68)	<0.001
Hypertension												
No	1	-	1	-	-	-	-	-	-	1	-	1
Yes	1.16	(0.97-1.40)	0.092	-	-	-	-	-	-	1.72	(0.74-3.98)	0.200
Family history of CVD												
No	1	-	1	1	-	1	1	-	1	1	-	1
Yes	1.10	(1.02-1.19)	0.013	1.31	(0.91-1.90)	0.140	1.10	(1.01-1.19)	0.016	1.77	(1.12-2.80)	0.013

IRR: Relative Risk; CI: Confidence Interval; CVD: Cardiovascular disease.
Source: Research Data

Still in the unadjusted analysis, with regard to the outcome NC, being woman (IRR = 0.69; CI = 0.31-0.07), having completed higher education (IRR = 1.19; CI = 1.06 -1.34), smoking (IRR = 1.27; CI = 1.09-1.47), having time of physical exercise of less than 3 months (IRR = 0.80; CI = 0.66-0.98), from three to six months (IRR = 0.9; CI = 0.80-1.00), from seven to twelve months (IRR = 0.92; CI = 0.83-1.02), being diabetic (IRR = 0.71; CI = 0.69-0.74) and having a family history of CVD (IRR = 1.10; CI = 1.01-1.19) were associated with CVD and as for the anthropometric indicator WHR, being woman (IRR = 0.39; CI = 0.23-0.64), living with a partner (IRR = 1.57; CI = 1.00-2.46), being 40 to 59 years (IRR = 1.81; CI = 1.08-3.03), having completed higher education (IRR = 3.55; CI = 0.90-13.9), smoking (IRR = 2.19; CI = 1.07-4.47), taking a supplement (IRR = 0.48; CI = 0.28-0.83), being stressed (IRR = 1.43; CI = 0.90 -2.28), diabetic (IRR = 2.33; CI = 3.22-1.68), hypertensive (IRR = 172; CI = 0.74-3.98) and having a family history of CVD (IRR = 1.77; CI = 1.12-2.80) were associated with CVD (Table 3).

In the adjusted analysis, for the outcome WC, being woman (IRR = 1.10; CI = 1.02-1.18), living with a partner (IRR = 1.17; CI = 1.08-127), having time of physical exercise of seven to twelve months (IRR = 1.14; CI = 1.01-1.30), being diabetic (IRR = 1.06; CI = 1.24-1.69) and having a family history of CVD (IRR = 1.07; CI = 0.99-1.16) were a risk factor for CVD and using a supplement (IRR = 0.86; CI = 0.80-0.93) was a protective factor. As for the outcome WHtR, being diabetic (IRR = 2.30; CI = 1.34-3.93) was a risk factor for CVD and being woman (IRR = 0.45; CI = 0.30-0, 67) and consuming a supplement (IRR = 0.37; CI = 0.23-0.61) were a protective factor (Table 4).

Still in the adjusted analysis, regarding the outcome NC, having completed higher education (IRR = 1.14; CI = 1.02-1.27), smoking (IRR = 1.12; CI = 1.03-1.21) and family history of CVD (IRR = 1.07; CI = 1.00-1.15) were risk factor for CVD, and being female (IRR = 0.71; CI = 0.66-0, 76) and diabetic (IRR = 0.62; CI = 0.57-0.67) had a protective effect and as for the anthropometric indicator WHR, being diabetic (IRR = 9.47; CI = 1.21-2.00), was a risk factor for CVD and being woman (IRR = 0.35; CI = 0.21-0.58) and using a supplement (IRR = 0.46; CI = 0.26-0.79) were a protective factor (Table 4).

Table 4 – Adjusted analysis of the association of socioeconomic, demographic and lifestyle characteristics of bodybuilding practitioners in two gyms in São Luís, state of Maranhão, 2020.

	WC			**WHtR**			**NC**			**WHR**		
Variable	**IRR**	**(95% CI)**	**p-value**	**IRR**	**(95% CI)**	**p-value**	**IRR**	**(95% CI)**	**p-value**	**IRR**	**(95% CI)**	**p-value**
Gender												
Male	1	-	1	1	-	1	1	-	1	1	-	1
Female	1.10	(1.02-1.18)	**<0.012**	0.45	(0.30-0.67)	**<0.001**	0.71	(0.66-0.76)	**<0.001**	0.35	(0.21-0.58)	**<0.001**
Marital status												
No partner	1	-	1	-	-	-	-	-	-	1	-	1
With a partner	1.17	(1.08-1.27)	**< 0.001**	-	-	-	-	-	-	1.37	(0.87-2.15)	0.164
Age (years)												
20 – 39	1	-	1	-	-	-	-	-	-	1	-	1
40 – 59	1.04	(0.93-1.15)	0.433	-	-	-	-	-	-	1.55	(0.90-2.67)	0.106
Education												
Complete and Incomplete High School	-	-	-	-	-	-	1	-	1	1	-	1
Complete and Incomplete Higher Education	-	-	-	-	-	-	1.14	(1.02-1.27)	**0.015**	3.08	(0.86-10.9)	0.082
Income												
Up to a minimum wage	1	-	1	-	-	-	-	-	-	-	-	-
From one to two minimum wages	0.92	(0.72-1.17)	0.514	-	-	-	-	-	-	-	-	-
Two to three minimum wages	0.85	(0.68-1.07)	0.192	-	-	-	-	-	-	-	-	-
Three to four minimum wages	0.87	(0.69-1.09)	0.230	-	-	-	-	-	-	-	-	-
Higher than four minimum wages	0.92	(0.73-1.14)	0.468	-	-	-	-	-	-	-	-	-
Alcohol												
No	-	-	-	1	-	1	1	-	1	-	-	-

Yes	-	-	-	1.35	(0.93-1.96)	0.107	1.02	(0.06-1.10)	0.403	-	-	-
Smoke												
No	-	-	-	-	-	-	1	-	1	1	-	1
Yes	-	-	-	-	-	-	1.12	(1.03-1.21)	**0.007**	1.36	(0.71-2.61)	0.345
Physical Exercise Time												
More than a year	1	-	1	1	-	1	1	-	1	-	-	-
3 to 6 months	1.08	(0.98-1.19)	0.107	1.17	(0.75-1.83)	0.479	0.94	(0.86-1.03)	0.249	-	-	-
7 to 12 months	1.14	(1.01-1.30)	**0.032**	1.25	(0.68-2.29)	0.459	0.98	(0.91-1.07)	0.847	-	-	-
Less than three months	1.08	(0.96-1.21	0.157	1.22	(0.76-1.95	0.393	0.88	(0.71-1.08	0.847	-	-	-
Supplement												
No	1	-	1	1	-	1	-	-	-	1	-	1
Yes	0.86	(0.80-0.93)	**<0.001**	0.37	(0.23-0.61)	**<0.001**	-	-	-	0.46	(0.26-0.79)	**0.005**
Stress												
No	1	-	1	-	-	-	-	-	-	1	-	1
Yes	1.06	(0.98-1.14)	0.120	-	-	-	-	-	-	1.47	(0.95-2.27)	0.083
Diabetes												
No	1	-	1	1	-	1	1	-	1	1	-	1
Yes	1.45	(1.24-1.69)	**<0.001**	2.30	(1.34-3.93)	**0.002**	0.62	(0.57-0.67)	**<0.001**	9.47	(1.21-2.00)	**<0.001**
Hypertension												
No	1	-	1	-	-	-	-	-	-	1	-	1
Yes	1.16	(0.97-1.40)	0.092	-	-	-	-	-	-	0.95	(0.35-2.53)	0.923
Family history of CVD												
No	1	-	1	1	-	1	1	-	1	1	-	1
Yes	1.07	(0.99-1.16)	**0.050**	1.22	(0.85-1.75)	0.259	1.07	(1.00-1.15)	**0.033**	1.32	(0.83-2.09)	0.231

IRR: Relative Risk; CI: Confidence Interval; CVD: Cardiovascular disease.
Source: Research Data

Discussion

In the present study, we investigated the factors associated with four anthropometric indicators of cardiovascular risk (WC, WHtR, NC and WHR) in bodybuilding practitioners. The first outcome studied was WC, showing in the adjusted analysis an association with male gender, living with a partner, having less physical exercise time, a family history of CVD and being diabetic. However, taking a supplement showed a protective factor for cardiovascular risk according to the outcome WC.

According to data from a study carried out with adults who practice physical activity in a gym in the city of Belo Horizonte[21], men also had a higher risk of developing CVD than women, possibly because they have more fat in the abdominal region, which is associated with greater cardiovascular risk.[22]

Regarding marital status, in the present study, living with a partner was a risk factor for CVD according to the WC indicator. Research aimed at determining the prevalence of abdominal obesity and identifying an association between socioeconomic factors and lifestyle in adults treated at a school clinic in São Luís, state of Maranhão, found that abdominal obesity diagnosed by WC was associated with living with a partner (OR = 1.53; CI = 1.07-2.28; p = 0.017)[23]. It is suggested that

living with a partner may possibly influence the increase in abdominal obesity due to changes in the couple's social behavior, leading to increased frequency to restaurants and snack bars, in addition to greater consumption of caloric foods[24].

As for the association with individuals who practiced physical exercise for less time, it was observed that they had a higher risk of CVD. A study by Trapé et al.[25], they related the Habitual Level of Physical Activity (NHAF) and physical fitness to the cardiovascular health of adults and the elderly, reported that 31.9% interviewees were classified as active and showed that the groups of General Functional Aptitude Index (IAFG) classified as "good" and "very good" showed a higher proportion of individuals with regular physical exercise practice over six months, with emphasis on a greater number who underwent the practice with supervision ($p < 0.0001$). Moreover, the authors point out that the groups with higher IAFG had better results in all these variables (BMI, HDL-c, TG, PAS and PAD) suggesting a strong relationship between the IAFG and the variables related to CVD risk factors. In this case, it is believed that the higher the frequency and fitness, the lower the cardiovascular risk.

Regarding the family history of CVD, data in this study are similar to the results obtained by Silva[26], who found a significant association between WC and family history of CVD ($p = 0.012$) and also a high percentage of respondents with a family history of CVD (78.4%). In another study, whose objective was to assess the risk of cardiovascular accidents in bodybuilding practitioners, family history was observed as one of the main risk factors; a portion of the bodybuilding participants presented significant data to present later some metabolic disorder[27]. Therefore, it is important that family data be investigated in order to prevent CVD.

Bodybuilders who were diabetic were at increased risk for CVD, according to WC. In a study to verify the anthropometric profile of individuals who started exercising in a gym in Goiânia[28], it was found that WC values can predispose to high blood pressure, diabetes mellitus, among other risk factors.

It is worth mentioning, among anthropometric measures, WC has been the most used to assess CVD risks, since it is associated with the accumulation of visceral adipose tissue[29].

The second outcome studied was the WHtR, which has been indicated as a good anthropometric indicator to identify the risk of CVD[30].

According to the adjusted analysis, female gender was a risk factor for CVD, according to the WHtR. A study of 120 women used the BMI to check the correlation with anthropometric indicators of cardiovascular risk[31], found that 60.8% women evaluated were at risk for CVD through the WHtR, in addition, pointed out that all the anthropometric indicators evaluated were moderately correlated with BMI, with the exception of the WHtR which had a strong correlation.

Having diabetes increases the risk of CVD, according to WHtR. A study carried out in diabetic patients, in Vitória de Santo Antão, state of Pernambuco, among the variables that had the highest prevalence ratio, the WHtR was present, indicating that abdominal fat affects the body composition of the diabetic patient[32], confirming the finding of the present research.

The third outcome studied was NC, as it is a marker for measuring subcutaneous fat located in the upper body and has been shown to be metabolically active, capable of releasing free fatty acids into the circulation[29]. Thus, this type of fat can favor the appearance of adverse metabolic changes[33], which makes NC an important measure for the assessment of cardiovascular risk.

For the outcome NC, the female sex, education, smoking, family history of CVD were risk factors and having diabetes was a protective factor. As far as the risk is higher in females, this result disagrees with

Santiago et al.[35], who found an association with males. This difference in results can be explained, as in the study by Santiago et al.[34], there was a higher percentage of males, a high frequency of sedentary individuals and higher consumption of alcoholic beverages.

More years of education is a risk factor for CVD through NC. In the literature search, no studies were found showing this association. However, Lima[35], when analyzed the association between schooling and the occurrence of chronic diseases in adults from 62,986 households, revealed that individuals with less education were more likely to have arterial hypertension (OR: 1.50; 95% CI: 1.30-1.73) and stroke (OR: 2.76; 95% CI: 1.90-4.00).

As for the variable smoking, the literature lacks studies that have evaluated the association between NC and being a smoker. However, a population-based study, carried out with individuals of both genders aged 20 to 59 years, living in the metropolitan region of Maringá, state of Paraná, reported the chance of occurrence of myocardial infarction (p = 0.035; OR = 2.3; CI = 1.06-5.40) and heart failure (p = 0.028; OR = 2.3; CI = 1.09-4.94) was higher in smokers[36].

Having a family history of CVD increases the risk of CVD using the NC indicator. Similar data to the result found in a research carried out with university students from the city of Salvador, state of Bahia, whose objective was to know the distribution of body fat and the social factors of cardiovascular risk, of the 100 students evaluated, 24% had a NC greater than 34 cm, and it was observed that the values of the NC measurement were associated with increased cardiovascular risk, in addition to revealing that the most prevalent comorbidities were family history of coronary artery disease followed by obesity[37].

A finding that drew attention in the present study was the fact that being a diabetic bodybuilder was a protective factor for NC, however this finding differs from that found by Pardo, Cabral and Haddad[38], in a study evaluating the correlation of NC with insulin resistance and with components of the metabolic syndrome, the authors observed a positive correlation between NC and markers of insulin resistance. This result can be explained by the increase in free fatty acids that interfere with the growth in production of reactive oxygen species and activation of pro-inflammatory cells, such as cytokines, which could result in insulin resistance[29].

The fourth outcome was WHR, this index has stood out as an indicator for abdominal fat and is strongly related to cardiovascular risk factors.[30]

For the outcome WHR, associations were found with female gender, being diabetic and consuming supplement. Silva, Reis and Rodrigues[39] analyzed the nutritional profile of employees of the University Hospital of Montes Claros, state of Minas Gerais, found that the WHR indicator indicated altered health risk for women. In women, fat is located in greater amount in the hips, outer thighs and buttocks, in addition to women accumulating more fat so that female hormones work better[40,41], this fact may have contributed to the present finding. Montalvão et al.[42] evaluated WHR in women practicing physical activity in gyms and observed that those aged 18 to 29 years old presented low WHR (<0.71) and women aged 30 to 60 years old, moderate WHR (0.72 to 0.83). In an investigation carried out with 214 servers at the University Hospital in the city of Petrolina, state of Pernambuco, the WHR proved to be more efficient in detecting the health risk in male servers, the level of correlation was moderate for men and weak for women[43], a result that differs from that found in the present research.

The risk in diabetic individuals was also observed by Oliveira et al.[44] when estimating the prevalence of overweight and obesity and determining the relationship of different anthropometric indicators with the glycemic levels of

employees at the Federal University of Viçosa, state of Minas Gerais, observed that the men obtained a weak correlation with glycemic levels and the parameters analyzed, among them the WHR (r = 0.42) disagreeing with the result found in the present investigation.

Supplement consumption was a protective factor against CVD risk for the studied outcomes WC, WHtR and WHR. In a survey with bodybuilding practitioners at a gym in the city of Varginha, state of Minas Gerais, the authors showed that the consumption of thermogenic supplement, composed of caffeine, green tea, capsaicinoids and citrus aurantium, proved to be effective in reducing body fat percentage and abdominal circumference of weight training practitioners[45]. This result is possibly related to greater oxidation of muscle fatty acids, which in turn saves carbohydrate reserves, thus delaying fatigue and decreasing body fat[46].

Muraro and Saldanha[47] emphasize in their research that the use of thermogenic drugs results in changes in body composition parameters and metabolic rates, with significant decreases in weight, body fat and BMI, however, they emphasize that these results were found in a study that associated the use of thermogenic drugs in physical exercise practitioners.

It is important to highlight some limitations found in the development of this study. During data collection, the individuals' level of physical activity was not assessed, nor were the biochemical tests that characterize cardiovascular risk verified. Another limitation to consider refers to the cross-sectional design, which makes the analysis of causal association difficult.

The strength of the present study is the fact that it works with a sample formed by bodybuilding practitioners, a population in which little is investigated regarding cardiovascular risks, in addition to the use of the four anthropometric indicators (WC, WHtR, NC and WHR). These indicators have been widely used to assess CVD risks.

Conclusion

Our findings show that there are several factors that have been associated with anthropometric indicators of cardiovascular risk (WC, WHtR, NC and WHR) in weight training practitioners. These indicators were predictors in the detection of cardiovascular risk in this population studied. Therefore, practicing physical exercise should not be a single factor of prophylaxis, other habits should be modified to reduce cardiovascular risk.

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