Anthropometric measures associated with incarceration length of persons deprived of their liberty

Medidas antropométricas associadas ao tempo de encarceramento de pessoas privadas de liberdade

Medidas antropométricas relacionadas con el tiempo de encarcelamiento de personas privadas de la libertad

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Abstract

Objective: To analyze the anthropometric measures associated with incarceration length of people deprived of their liberty.

Methods: This is a cross-sectional study carried out with 220 men deprived of their liberty. Data were collected using an instrument that included information on current incarceration, sociodemographic information and living conditions before incarceration, in addition to measuring anthropometric measures. Descriptive statistics, association tests and adjustment of binary logistic regression models controlled by incarceration length (up to 1 year and more than 1 year) were used.

Results: There was a significant association between incarceration length and abdominal circumference (OR 0.41; 95%CI 0.16-0.97). The results of Spearman's correlation showed that, as the incarceration length increased, the anthropometric measures decreased, with a negative relationship of weak magnitude and significant only for the conicity index (r=-0.1648; p=0.0144). Adjusted models controlled for incarceration length showed significant associations with age in years (OR 1.08; 95%CI=1.04;1.12) and abdominal circumference; age (OR 1.08; 95%CI 1.04-1.12) and waist-to-height ratio; and age (OR 1.10; 95%CI 1.06-1.14), years of education (OR 2.17; 95%CI 1.10-4.26) and having a partner (OR 0.46; 95%CI0.22-0.93) with the conicity index.

Conclusion: As incarceration length increases, there is a reduction in the anthropometric measures of persons deprived of their liberty. Anthropometric variables directly influence the development of non-communicable chronic diseases and must be monitored to develop strategies that minimize the risks and health problems of this vulnerable population.

Resumo

Objetivo: Analisar as medidas antropométricas associadas ao tempo de encarceramento de pessoas privadas de liberdade.

Métodos: Estudo transversal, realizado com 220 homens privados de liberdade. Os dados foram coletados por meio de instrumento que abrangia informações do encarceramento atual, sociodemográficas e das condições de vida antes do encarceramento, além de aferição de medidas antropométricas. Utilizaram-se estatística descritiva, testes de associações e ajuste de modelos de regressão logística binária controlados pelo tempo de encarceramento (até 1ano e mais de 1ano).

Resultados: Houve associação significativa entre o tempo de encarceramento e a circunferência abdominal (RC de 0,41; IC95%0,16-0,97). Os resultados da correlação de Spearman apontaram que, à medida que aumentou o tempo de encarceramento, as medidas antropométricas diminuíram, com relação negativa de

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fraca magnitude e significativa apenas para o índice de conicidade (r=-0,1648; p=0,0144). Os modelos ajustados controlados pelo tempo de encarceramento mostraram associações significativas com idade em anos (RC de 1,08; IC95%=1,04;1,12) e circunferência abdominal; idade (RC de 1,08; IC95%1,04-1,12) e razão cintura e estatura; e idade (RC de 1,10; IC95%1,06-1,14), anos de estudo (RC de 2,17; IC95%1,10-4,26) e possuir parceiro(a) (RC de 0,46; IC95%0,22-0,93) com o índice de conicidade.

Conclusão: À medida que aumenta o tempo de encarceramento, há redução das medidas antropométricas das pessoas privadas de liberdade. As variáveis antropométricas influenciam diretamente no desenvolvimento de doenças crônicas não transmissíveis e devem ser monitoradas para elaboração de estratégias que minimizem os riscos e os agravos à saúde dessa população vulnerável.

Resumen

Objetivo: Analizar las medidas antropométricas relacionadas con el tiempo de encarcelamiento de personas privadas de la libertad.

Métodos: Estudio transversal, realizado con 220 hombres privados de la libertad. Los datos fueron recopilados mediante un instrumento que incluía información del encarcelamiento actual, sociodemográfica y de las condiciones de vida antes del encarcelamiento, además de la comparación de medidas antropométricas. Se utilizó estadística descriptiva, pruebas de asociación y ajuste de modelos de regresión logística binaria controlados por el tiempo de encarcelamiento (hasta 1 año y más de 1 año).

Resultados: Hubo asociación significativa entre el tiempo de encarcelamiento y la circunferencia abdominal (RC de 0,41; IC95%0,16-0,97). Los resultados de la correlación de Spearman indicaron que, a media que aumentaba el tiempo de encarcelamiento, las medidas antropométricas disminuían, con relación negativa de escasa magnitud y significativa para el índice de conicidad (r=-0,1648; p=0,0144). Los modelos ajustados controlados por el tiempo de encarcelamiento mostraron asociaciones significativas con la edad en años (RC de 1,08; IC95%=1,04;1,12) y circunferencia abdominal; edad (RC de 1,08; IC95%1,04-1,12) y razón de cintura y estatura; y edad (RC de 1,10; IC95%1,06-1,14), años de estudio (RC de 2,17; IC95%1,10-4,26) y tener pareja (RC de 0,46; IC95%0,22-0,93) con el índice de conicidad.

Conclusión: A medida que aumenta el tiempo de encarcelamiento, hay una reducción de las medidas antropométricas de las personas privadas de la libertad. Las variables antropométricas influyen directamente en el desarrollo de enfermedades crónicas no transmisibles y deben controlarse para la elaboración de estrategias que minimicen los riesgos y los agravios a la salud de esta población vulnerable.

Introduction

With one of the largest prison populations in the world, the situation of people deprived of liberty in Brazil is extremely vulnerable.[1] By the end of 2019, the Brazilian prison population had 755,274 inmates for 442,349 places. Paraná registered 29,831 inmates, and of these, 8,664 (29%) were on a provisional basis,[2] and the penal system capacity in the state holds just over 21 thousand vacancies, indicating that the number of people deprived of liberty per institution is much greater than the existing and available vacancies. Considering overcrowding, the unhealthy environment and non-access to physical activity practices, this environment contributes to the development of diseases, including non-communicable chronic diseases.[3]

The conditions necessary for assisting the population deprived of liberty, such as provision and provision of health care, adequate food, clothing and sanitized actions in the sectors that constitute the prison structure, are provided for in Art.12 of the Penal Execution Law,[4] in Art.196 of the 1988 Federal Constitution, which provides for health as a right for all and a duty of the State,[5] and in the Brazilian National Policy for Comprehensive Health Care for Persons Deprived of Liberty in the Prison System (PNAISP - *Política Nacional de Atenção Integral à Saúde das Pessoas Privadas de Liberdade no Sistema Prisional*) guidelines.[6]

Despite the established rights regarding access to health care, the conditions to which people deprived of their liberty are exposed place them in a situation of greater vulnerability to the development or worsening of diseases, according to their chronicity. This illness is largely stimulated by changes in the dietary/nutritional pattern and insufficient daily practices of physical activities within criminal institutions.[7]

The period of incarceration is also an important factor and is correlated with the prison population's quality of life. Evidence indicates a high prevalence of overweight and obesity related to eating and life habits in criminal institutions worldwide.[8,9] Estimates point to the growth of obesity in 18% of the world's male population by 2025.[10] In Brazil, 55.4% of the population reported being overweight and 20.3% reported being obese.[11] Therefore, knowing the alterations in anthropometric parameters of persons deprived of liberty can contribute to the formulation of public policies for this vulnerable population.[12]

However, measures of the effect of incarceration length on anthropometric parameters in persons deprived of their liberty are still not well known nationally. Although the international literature already deals with the issue of factors associated with chronic non-communicable diseases (NCDs) in people deprived of their liberty and presents positive and negative factors, with regard to the anthropometric profile associated with incarceration length, such as reduced body weight by physical activity and reduced quality diet over confinement length[13] or weight gain due to the individual behavior of persons deprived of liberty and the prison culture,[14] the evidence in the Brazilian context, which has correlated incarceration length with anthropometric factors in this population, is still scarce.

It is understood that there are numerous factors that contribute to the lack of research in the prison setting, such as the institutional regulations that make it difficult for researchers to access and the precarious structure of the prison environment. Allied to them, the social vulnerability experienced by the person deprived of liberty stands out, which intensifies the inequity of this population and the difficulty of accessing health services. Thus, the relevance of this research is justified by the importance of circumventing the invisibility that affects this population, which, many times, has their health neglected by the public authorities and constitutes a particularly vulnerable group.

It is expected that this study will produce subsidies that promote changes in the actions of coping and preventing NCDs in people deprived of liberty and that, from this, new strategies can be developed. Given these assumptions, this study aimed to analyze the anthropometric measures associated with the incarceration length of persons deprived of their liberty.

Methods

This is a cross-sectional research, based on the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE).[15] The research scenario was a custody house in a medium-sized municipality, located in northwestern Paraná State. The maximum security penal institution was inaugurated in 2008, with the aim of allocating vacancies only to male provisional prisoners awaiting criminal conviction. However, due to the scarcity of vacancies in the state penitentiary of reference, the penal unit absorbs provisional inmates and those already convicted.

At the initial moment of the research, the custody house had 648 detainees, in a provisional period, awaiting conviction. We included those with a period of imprisonment longer than 25 days (minimum time for formalizing the detainee's admission to the penal unit) and those in a provisional regime. We excluded those with clinical diagnoses related to neurology and psychiatry and/or cognitive limitations that made communication and responses to interviews difficult.

With the list of the number of people deprived of liberty per cell and gallery, provided by the institution, a sample of this population was carried out, calculated by stratified random sampling, with an estimate error of 5%, a confidence interval of 95% (95%CI) and a prevalence of 30%, resulting in the minimum sample of 216 people to be interviewed. After the sample calculation, a random draw was carried out, considering 160 cells that housed, on average, eight people. All detainees considered provisional were likely to belong to the sample. At the end of the application of selection criteria, the study sample comprised 220 persons deprived of liberty.

The study was conducted by the main author, a nurse and researcher, with authorization to carry out the collections at that place. The researcher presented and clarified all the information in the study. The invitation to participate in the research was held, and the Informed Consent Form (ICF) was read aloud. The objectives and ethical issues were passed on, and confidentiality was guaranteed for all involved and information regarding the right of free and voluntary participation in the research, in addition to the possibility of withdrawing at any time during the interview. It is emphasized that the interview took place at the same time of the approach. It is also noteworthy that all participants were receptive, with no refusal.

Data were collected from June to November 2019, and eight to ten interviews were conducted per week. The research took place in a private place, to minimize constraints during the responses. The persons deprived of provisional who underwent a change in sentencing status were replaced during the study period, but it did not affect the sampling process.

Anthropometry was assessed by abdominal circumference (in centimeters), Body Mass Index (in kg/m²), waist-to-height ratio and conicity index. The equipment used to measure anthropometric measures belonged to the researcher, who was responsible for calibrating the analog scale, with a contribution to measure the height (in meters) of participants in a company certified by the Brazilian National Institute of Metrology, Quality and Technology (Inmetro - *Instituto Nacional de Metrologia, Qualidade e Tecnologia*).

To measure the abdominal circumference, a 150 cm inelastic tape was used, and, for the classification, the cut-off point established by the Brazilian Association for the Study of Obesity and Metabolic Syndrome (Abeso - *Associação Brasileira para o Estudo da Obesidade e da Síndrome Metabólica*) was adopted, in which altered abdominal circumference is considered. , for the male population, the value greater than or equal to 94 cm.[16] Body Mass Index was calculated using the interviewee's weight (kg) divided by the square of height (m), and categorized as eutrophic (18.5≤Body Mass Index<25), overweight (25.0≤ of body mass<30) and obesity (Body Mass Index≥30).[16] For the analyses, Body Mass Index was considered altered when greater than or equal to 25 kg/m².[16]

To verify abdominal obesity, the waist-to-height ratio was calculated with both measures in centimeters, and cardiovascular risk values above 0.5 were considered.[17] The conicity index was set to values above 1.25 for the male population, resulting from the calculation of equation 1.[18]

$$\frac{Circunferência\ da\ cintura\ (m)}{0,109\ \sqrt{\dfrac{Peso\ corporal\ (kg)}{Estatura\ (m)}}} \qquad \text{Equation 1}$$

The four anthropometric measures obtained as a continuous variable and classified as normal or altered/risk were considered as outcomes. To assess associations with anthropometric data, the categorized current incarceration length (days) (up to 1 year and more than 1 year) was considered as an exposure variable, in addition to three groups of independent variables. The first group contained two other characteristics of current incarceration: reason for arrest, classified as assault/theft, trafficking in psychoactive substances and/or association with trafficking and others (assault, robbery, robbery, reception, homicide, sexual crime, domestic violence and currency counterfeiting); and number of arrests (one, two and three or more).

The sociodemographic characteristics were considered in the second group: age (years), categorized by age group (18 to 29, 30 to 44, 45 to 59 and 60 to 74 years); skin color, divided into white and another (black, brown or yellow); years of education (<8 or ≥8); partner (no and yes); and children (no and yes). The last group presented the characteristics of life before incarceration: housing conditions, categorized as own, rented or others (borrowed, relatives' house or homeless person); worked (no and yes) and family income in minimum wages (no income, less than one, one to three or more than three), based on the amount of R$ 998.00 (minimum salary of 2019).

Descriptive analysis (mean, standard deviation, median and absolute and relative frequencies) was performed for the three groups of independent variables (current incarceration, sociodemographic and living conditions before incarceration) and for the four anthropometric measures (abdominal circumference, Body Mass Index, waist-to-height ratio and conicity index). The assumption of normality was not met when assessing outcomes (continuous) and incarceration length (days) using the Shapiro-Wilk test.

For associations, Pearson's chi-square test and Fisher's exact test were performed, in addition to the calculation of odds ratios (OR) between categorized information from anthropometric measures (normal or altered/risk) and incarceration length (up to 1 year or more than 1 year), as well as Spearman's

correlation with these continuous variables, considering coefficients <0.30 as of weak magnitude, between 0.30 and 0.49, as moderate, and equal or >0.50, as strong magnitude.[19]

Multiple logistic regression models controlled by incarceration length (up to 1 year and more than 1 year) were used to determine factors associated with alteration/risk of anthropometric measures. We used the stepwise both method for the selection of variables and adjustment of the final models. Collinearity was verified with the variance inflation factor and model adequacy with analysis of randomized quantile residuals. Associations were estimated by calculating the OR with 95%CI. The data were compiled in electronic spreadsheets after the collection of information and the analyzes carried out in R version 4.0.4. All analyzes considered the 5% level of significance.

The study complied with national regulations on research involving human subjects. The Technical Advisory Office of the Penitentiary Department of Paraná authorized the conduction of this study, which was approved by the Standing Committee on Ethics and Research with Human Beings, under opinion 3,211,746, CAAE (*Certificado de Apresentação para Apreciação Ética* - Certificate of Presentation for Ethical Consideration) 08936619.4.0000.0104, on March 20, 2019.

Results

A total of 220 people deprived of their liberty participated in the study; 157 (71.4%) of them had been in custody for a maximum of 1 year and 63 (28.6%) had been in custody for more than 1 year. The average incarceration length was 285 days, and the predominant reason for arrest was trafficking in psychoactive substances and/or association with trafficking (39.5%). It is important to note that most of them were repeat offenders, with 74.1% arrested two or more times. The mean age of these men was 31 years, with a standard deviation of 10.1 years and a median of 29 years. Table 1 shows the characterization of other variables of current incarceration, sociodemographic and living conditions before incarceration of study participants.

Regarding incarceration length according to anthropometric data, most people deprived of liberty with up to 1 year in prison presented alteration/risk, with 83.7% in the abdominal circumference, 74.1% in the Body Mass Index, 76.3% in the waist-to-height ratio and 80.6% in the conicity index, with a significant association only for abdominal circumference (p=0 .0474). Participants with incarceration length ≥8 years showed a predominance of alteration/risk for all altered anthropometric measures, with a significant coincidence index (p=0.0352), in addition to abdominal circumference (28; 57.1%), Body Mass Index (59; 52.7%) and waist-to-height ratio (51; 52.7%) were not significant (p>0.05).

The age group was significant for all anthropometric measures (p<0.0001), with 30 to 44 years being the most predominant for alteration/risk in abdominal circumference (27; 55.1%), Body Mass Index (55; 45.1%), waist-to-height ratio (52; 53.6%) and conicity index (29; 46.8%). White skin color showed the greatest alteration in abdominal circumference (25; 51%). The other colors (black and yellow) had higher percentages of alteration for Body Mass Index (72; 62.5%) and waist-to-height ratio (54; 55.7%). Still for skin color, there was a significant relationship with the conicity index, with a p value of 0.0352. The variable children showed a significant association with waist-to-height ratio (p=0.0301) and family income with waist-to-height ratio (p=0.0034) and conicity index (p=0.0462) measures.

When assessing the associations between the outcomes and incarceration length (Table 2), it was observed that the chances of presenting altered anthropometry were lower in people deprived of liberty with more than 1 year of incarceration; however, this result was only significant for abdominal circumference (OR 0.41; p=0.0323). Similar results were observed in Spearman's correlation coefficients, indicating that as incarceration length increased, the anthropometric measures decreased; however, these correlations were of weak magnitude, with abdominal circumference with r=-0.1319 (p=0.0508),

Table 1. Characteristics of current incarceration, sociodemographic and living conditions before incarceration according to anthropometric measures of persons deprived of their liberty

Characteristics of PDLs	n(%)	AC (cm)		BMI (kg/m²)		WHtR		CI	
		Normal (<94.0) (n=171;77.7%)	Altered (≥94.0) (n=49;22.3%)	Normal (18.5≤IMC<25.0) (n=108;49.1%)	Altered (≥25.0) (n=112;50.9%)	Normal (≤0.50) (n=123;55.9%)	Risk (>0.50) (n=97;44.1%)	Normal (≤1.25) (n=158;71.8%)	Altered (>1.25) (n=62; 28.2%)
		n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)
Current incarceration									
Incarceration length		p=0.0474*		p=0.4428*		p=0.1989*		p=0.0815*	
Up to 1 year	157 (71.4)	116 (67.8)	41 (83.7)	74 (68.5)	83 (74.1)	83 (67.5)	74(76.3)	107(67.7)	50(80.6)
More than 1 year	63(28.6)	55(32.2)	8(16.3)	34(31.5)	29(25.9)	40(32.5)	23(23.7)	51(32.3)	12(19.4)
Reason for incarceration		p=0.5004*		p=0.8168*		p=0.8103*		p=0.3808*	
Robbery/theft	65(29.5)	48(28.1)	17(34.7)	31(28.7)	34(30.4)	38(30.9)	27(27.8)	44(27.8)	21(33.9)
Trafficking†	87(39.5)	71(41.5)	16(32.7)	45(41.7)	42(37.5)	49(39.8)	38(39.2)	61(38.6)	26(41.9)
Others	68(30.9)	52(30.4)	16(32.7)	32(29.6)	36(32.1)	36(29.3)	32(33)	53(33.5)	15(24.2)
Number of incarcerations		p=0.4695*		p=0.5252*		p=0.0779*		p=0.1198*	
1	57(25.9)	41(24)	16(32.7)	25(23.1)	32(28.6)	25(20.3)	32(33)	35(22.2)	22(35.5)
2	61(27.7)	49(28.7)	12(24.5)	29(26.9)	32(28.6)	39(31.7)	22(22.7)	47(29.7)	14(22.6)
≥3	102(46.4)	81(47.4)	21(42.9)	54(50)	48(42.9)	59(48)	43(44.3)	76(48.1)	26(41.9)
Sociodemographic									
Age group, years		p<0.0001‡		p<0.0001‡		p<0.0001‡		p<0.0001‡	
18-29	114(51.8)	103(60.2)	11(22.4)	73(67.6)	41(36.6)	89(72.4)	25(25.8)	97(61.4)	17(27.4)
30-44	80(36.4)	53(31)	27(55.1)	25(23.1)	55(49.1)	28(22.8)	52(53.6)	51(32.3)	29(46.8)
45-59	22(10)	13(7.6)	9(18.4)	10(9.3)	12(10.7)	6(4.9)	16(16.5)	9(5.7)	13(21)
60-74	4(1.8)	2(1.2)	2(4.1)	0	4(3.6)	0	4(4.1)	1(0.6)	3(4.8)
Skin color		p=0.0534*		p=0.9417*		p=0.1267*		p=0.0352*	
White	84(38.2)	59(34.5)	25(51)	42(38.9)	42(37.5)	41(33.3)	43(44.3)	53(33.5)	31(50)
Other	136(61.8)	112(65.5)	24(49)	66(61.1)	70(62.5)	82(66.7)	54(55.7)	105(66.5)	31(50)
Years of study		p=0.1820*		p=0.1731*		p=0.2530*		p=0.0176*	
<8	115(52.3)	94(55)	21(42.9)	62(57.4)	53(47.3)	69(56.1)	46(47.4)	91(57.6)	24(38.7)
≥8	105(47.7)	77(45)	28(57.1)	46(42.6)	59(52.7)	54(43.9)	51(52.6)	67(42.4)	38(61.3)
Partner		p=0.7965*		p=0.2567*		p=0.4927*		p=0.4112*	
No	127(57.7)	100(58.5)	27(55.1)	67(62)	60(53.6)	74(60.2)	53(54.6)	88(55.7)	39(62.9)
Yes	93(42.3)	71(41.5)	22(44.9)	41(38)	52(46.4)	49(39.8)	44(45.4)	70(44.3)	23(37.1)
Children		p=0.1506*		p=0.0573*		p=0.0301*		p=0.9998*	
No	75(34.1)	63(36.8)	12(24.5)	44(40.7)	31(27.7)	50(40.7)	25(25.8)	54(34.2)	21(33.9)
Yes	145(65.9)	108(63.2)	37(75.5)	64(59.3)	81(72.3)	73(59.3)	72(74.2)	104(65.8)	41(66.1)
Living conditions before incarceration									
Housing condition		p=0.2671*		p=0.2510‡		p=0.4089*		p=0.3230*	
Own	132(60)	98(57.3)	34(69.4)	59(54.6)	73(65.2)	72(58.5)	60(61.9)	94(59.5)	38(61.3)
Rent	74(33.6)	62(36.3)	12(24.5)	42(38.9)	32(28.6)	45(36.6)	29(29.9)	56(35.4)	18(29)
Other	14(6.4)	11(6.4)	3(6.1)	7(6.5)	7(6.3)	6(4.9)	8(8.2)	8(5.1)	6(9.7)
Worked		p=0.2628		p=0.1557		p=0.6892		p=0.4039	p=0.2628
No	24(10.9)	16(9.4)	8(16.3)	8(7.4)	16(14.3)	12(9.8)	12(12.4)	15(9.5)	9(14.5)
Yes	196(89.1)	155(90.6)	41(83.7)	100(92.6)	96(85.7)	111(90.2)	85(87.6)	143(90.5)	53(85.5)
Family income§		p=0.1717‡		p=0.0692‡		p=0.0034‡		p=0.0462‡	
No income, minimum wage	15(6.8)	13(7.6)	2(4.1)	7(6.5)	8(7.1)	8(6.5)	7(7.2)	11(7)	4(6.5)
<1	11(5)	10(5.8)	1(2)	8(7.4)	3(2.7)	8(6.5)	3(3.1)	10(6.3)	1(1.6)
1-3	157(71.4)	124(72.5)	33(67.3)	81(75)	76(67.9)	96(7.8)	61(62.9)	117(74.1)	40(64.5)
>3	37(16.8)	24(14)	13(26.5)	12(11.1)	25(22.3)	11(8.9)	26(26.8)	20(12.7)	17(27.4)

*Pearson's chi-square; †trafficking in psychoactive substances and/or association with trafficking; ‡Fisher's exact test; §income in minimum wage (based on the amount of R$ 998.00 (about US$181.45) in 2019, minimum wage). PDL: persons deprived of liberty; AC: abdominal circumference; BMI: Body Mass Index; WHtR: waist-to-height ratio; CI: conicity index.

Body Mass Index with r=-0.0575 (p=0.3961), waist/height with r=-0.1308 (p=0.0526) and the conicity index with r=-0.1648 (p=0.0144).

Table 3 shows the adjusted models controlled for the effect of imprisonment length (up to 1 year and more than 1 year) for the associations between the characteristics of persons deprived of their liberty and the four anthropometric measures. For abdominal circumference (model 1), there was a significant association with imprisonment length (OR 0.27; 95%CI 0.11-0.67) and age (OR 1.08; 95%CI 1, 04-1.12). Although

Table 2. Odds ratio and correlation between anthropometric measures and incarceration length of people deprived of liberty

Anthropometric measures	Reference levels	n(%)	Incarceration length		OR	95%CI	p-value†	Spearman's correlation*	
			Up to 1 year n(%)	More than 1 year n(%)				r‡	p-value
AC, cm	Normal (<94.0)	171(77.7)	116(67.8)	55(32.2)	0.41	0.16-0.97	0.0474	-0.1319	0.0508
	Altered (≥94.0)	49(22.3)	41(83.7)	8(16.3)					
BMI, kg/m²	Normal 18.5≤BMI<25.0)	108(49.1)	74(68.5)	34(31.5)	0.76	0.40-1.42	0.4428	-0.0575	0.3961
	Altered (≥25.0)	112(50.9)	83(74.1)	29(25.9)					
WHtR	Normal (≤0.50)	123(55.9)	83(67.5)	40(32.5)	0.65	0.34-1.23	0.1989	-0.1308	0.0526
	Risk (>0.5)	97(44.1)	74(76.3)	23(23.7)					
CI	Normal (≤1.25)	158(71.8)	107(67.7)	51(32.3)	0.51	0.22-1.07	0.0815	-0.1648	0.0144
	Altered (>1.25)	62(28.2)	50(80.6)	12(19.4)					

*Applied to continuous data from anthropometric measures and incarceration length (days); †Pearson's chi-square test; ‡estimation of the correlation coefficient. OR: Odds Ratio; 95%CI: 95% Confidence Interval; AC: abdominal circumference; BMI: Body Mass Index; WHtR: waist-to-height ratio; CI: conicity index

Table 3. Adjusted models controlled for the effect of incarceration length variable for the associations between incarceration, sociodemographic and living conditions characteristics before incarceration and anthropometric measures in persons deprived of their liberty

Model 1			Altered AC (AC≥94.0) in PDLs		
Characteristics	Categories	β*	OR	95%CI	p-value
Intercept	-	-3.0092	-	-	<0.0001
Incarceration length‡	Up to 1 year	Reference†	-	-	0.0050
	More than 1 year	-1.3188	0.27	0.11-0.67	
Age, years	-	0.0751	1.08	1.04-1.12	<0.0001
Skin color	White	Reference†	-	-	0.0569
	Other	-0.6747	0.51	0.25-1.02	
RQR: p=0.9373 value					

Model 2			Altered BMI (BMI≥25.0) in PDLs		
Characteristics	Categories	β*	OR	95%CI	p-value
Intercept	-	-1.9753	-	-	<0.0001
Incarceration length‡	Up to 1 year	Reference†	-	-	0.1380
	More than 1 year	-0.4754	0.62	0.33-1.17	
Age, years	-	0.0702	1.07	1.04-1.11	<0.0001
RQR: p=0.1205 value					

Model 3			Altered WHtR (WHtR>0.50) in PDLs		
Characteristics	Categories	β*	OR	95%CI	p-value
Intercept	-	-4.0552	-	-	<0.0001
Incarceration length‡	Up to 1 year	Reference†	-	-	0.0128
	More than 1 year	-0.9312	0.39	0.19-0.82	
Age, years	-	0.1323	1.14	1.10-1.19	<0.0001
RQR: p=0.7112 value					

Model 4			Altered CI (CI>1.25) in PDLs		
Characteristics	Categories	β*	OR	95%CI	p-value
Intercept	-	-3.3665	-	-	<0.0001
Incarceration length‡	Up to 1 year	Reference†	-	-	0.0051
	More than 1 year	-1.1941	0.30	0.13-0.70	
Age, years	-	0.0927	1.10	1.06-1.14	<0.0001
Skin color	White	Reference†	-	-	0.0734
	Other	-0.6155	0.54	0.27-1.06	
Years of study	<8	Reference†	-	-	0.0252
	≥8	0.7728	2.17	1.10-4.26	
Partner	No	Reference†	-	-	0.0300
	Yes	-0.7846	0.46	0.22-0.93	
RQR: p=0.4626 value					

*Estimate; †reference level; ‡controlled variable. AC: abdominal circumference; PDL: persons deprived of liberty; OR: Odds Ratio; 95%CI: 95% Confidence Interval; RQR: randomized quantile residual; BMI: Body Mass Index; WHtR: waist-to-height ratio; CI: conicity index

skin color did not show significance at the 5% level, the variable was marginally significant (p=0.0569). For the Body Mass Index (model 2), there was a significant association only with the age variable, in years (OR 1.07; 95%CI 1.04-1.11).

The waist-to-height ratio (model 3) showed a significant relationship with incarceration length (OR 0.39; 95%CI 0.19-0.82) and age (OR 1.14; 95%CI 1.10- 1.19). Finally, significant associations were found between the conicity index (model 4) and prison length (OR 0.30; 95%CI 0.13-0.70), age (OR 1.10; 95%CI 1.06-1.14), years of education (OR 1.10; 95%CI 1.06-1.14), and having a partner (OR 0, 46; 95%CI 0.22-0.43).

Discussion

Anthropometric dependent variables showed statistical significance with time in prison, age, years of education and having a partner. Most participants were between 18 and 29 years old, with a greater predominance of up to 1 year of imprisonment and less than 8 years of study. The fact that most interviewees are less than three decades old and have a low educational level enhances the evidence on social security instituted in the country, which strengthens the reduction in the transfer of public resources from the social area to the public security area.[4,20,21]

In this premise, the penal state hypertrophy, with the lengthening of the prison length, has turned the custody houses into a security establishment that houses convicts, which escapes their responsibility to keep people awaiting trial. Given these facts, most interviewees in this study have up to 12 months of imprisonment, which denotes the procedural delay. Another important aspect is that most participants had a different skin color (black/brown/yellow) and low financial income, which enhances the state of exception of the poor and black population, which constitutes a large part of the Brazilian territory.[21,22]

Anthropometric parameters are indicators that make it possible to identify the need for health interventions. Most participants had altered Body Mass Index, with a greater predominance in the population with less than 12 months of imprisonment. A study carried out in southwest Bahia showed that most people deprived of their liberty did not present abnormality in the parameters related to obesi-

ty,[22] but the work does not mention incarceration length of the population studied.

A study conducted in Maranhão[23] also showed that the majority of the population studied maintained a normal weight during the period of incarceration, but a part of the interviewees was in a semi-open regime, leaving the penal complex during the day for work. In a study with a population deprived of liberty in sub-Saharan Africa, obesity, diagnosed with the values of body weight and high Body Mass Index, proved to be one of the cardiovascular risk factors in the population studied. The authors encouraged the implementation of interventions based on a balanced diet and physical exercise routine.[24]

A follow-up study carried out in two male prisons in the United Kingdom found that younger people were more prone to weight gain after 6 months of incarceration, while abdominal circumference was maintained within ideal parameters. These findings can be explained by the fact that younger inmates are concerned with the stereotype, and therefore, practice more physical activities, being more likely to gain lean mass and, therefore, weight.[14]

Aging brings metabolic changes, with a progressive loss of lean mass and an increase in the proportion of body fat. There is also a decrease in stature, relaxation of the abdominal muscles and kyphosis.[25] In this study, abdominal circumference, Body Mass Index, waist-to-height ratio and conicity index were statistically associated with age, which is consistent with other national[26] and international studies.[27] In Australia, a study found that middle-aged people deprived of liberty were more likely to be overweight or obese, corroborating another study carried out in the United States, where average age was statistically associated with obesity.[28]

It is noteworthy that, when assessing altered weight in the prison population, it is important to consider other factors inherent to this population group. Rates of mental health problems are significant in this population. The use of antidepressant and antipsychotic drugs and the withdrawal of psychoactive substances during incarceration may favor weight gain.[12]

Although the Body Mass Index is not considered unique for the development of nutritional interven-

tion measures in the treatment of overweight, this is still the most economical and accessible method for anthropometric screening.[29] This issue is more incisive in the population deprived of liberty, which does not have the option of choosing to treat their health needs, relying only on teams of qualified professionals available to work in the prison system, which are not even part of the reality of the entire Brazilian territory,[30] even with the implementation of PNAISP.[6]

The waist-to-height ratio was within normal parameters, according to the guidelines of Abeso[16] and the Brazilian Society of Cardiology (SBC).[31] Abdominal circumference and waist-to-height ratio parameters reinforce the normality of the weight of people deprived of their liberty, which tend to decrease during the longer period of imprisonment. Both are important markers of excess weight and can contribute to the development of nutritional interventions in the population studied. In addition, the literature points out that the waist-to-height ratio can be a marker of cardiometabolic risk and should not be neglected, mainly because of its easy application and interpretation.[30]

Results of a study carried out in Rio Grande do Sul showed that isolated anthropometric measures are not risk predictors of cardiovascular problems, such as coronary artery disease. The investigation of more detailed parameters, in addition to weight, Body Mass Index and abdominal circumference, is necessary to compose investigation measures capable of reducing the risks related to metabolic and cardiovascular events. Linked to this, measures such as waist-to-height ratio and conicity index, in addition to blood pressure values and invasive measures, such as the marker of subclinical atherosclerosis, especially in the population deprived of liberty, which will hardly have fruitful monitoring of a preventive nature, are important complementary data to define clinical diagnosis, predict effective intervention and reduce complications inherent to obesity.[32]

The conicity index was normal in the studied population. Considered the best parameter to identify the accumulation of central fat, this index was developed and proposed in the 1990s and is based mainly on the hypothesis that the fat accu-

mulated in the abdominal region, which physically presents as the shape similar to a double cone, may express the risk of obesity-related diseases. It is determined by measuring weight, height and abdominal circumference, using an equation developed by Pitanga and Lessa.[18]

This parameter is still resisted by health professionals due to the complex mathematical equation, and, in the literature, no studies were found with people deprived of their liberty who used the conicity index. However, research indicates that the male population is more susceptible to cardiovascular events associated with the conicity index values. Thus, public policies for the inclusion of this parameter in clinical management are of great value to reduce the risk of occurrence of cardiovascular events.[33] A study points to the relationship between the conicity index in the other anthropometric measures and blood pressure values, with assiduous and periodic clinical assessment of health professionals, being necessary to identify and promote resolute interventions in the face of obesity and the increase in cardiometabolic and cardiovascular risk, potentiated by excess weight.[34]

The limitations of this research included the impossibility of attributing causality to the results due to the nature of cross-sectional studies and the fact that it was carried out in a single municipality and in a specific region, which may reduce its generalization potential. However, it presents relevant and incisive results for new practices and new studies to control anthropometric parameters, mainly because of its easy replication. Thus, the information contained in this study may allude to new proposals for studies that address the nutritional issue, dietary practices and physical activities and access to health as a right of every citizen.

Conclusion

Incarceration length was an important factor in anthropometric parameters. It is hoped that this study will contribute to health professionals and custodial house managers by demonstrating the health inequality that affects the population deprived of liberty and

enhancing new research that address social, environmental and lifestyle factors, which can compromise the health of these people, causing new appropriate measures to meet the needs of this vulnerable population.

Collaborations

Baccon AC, Salci MA, Oliveira RR, Previdelli ITS, Rêgo AS, Sanches RCN, Moraes TENT and Marques PG declare that they contributed to study design, data analysis and interpretation, article writing, review, relevant interpretation of the intellectual content and approval of the final version to be published.

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