Original Article

Prevalence of Excessive Weight and Hypertension in a Low-Income Urban Population

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Objective

To study the relation between body mass and blood pressure in a low-income urban population.

Methods

From July to December 1998, a cross-sectional study was carried out in a representative sample of a low-income urban community with individuals of both sexes, aged ≥ 30 years and living in 67 (30%) blocks selected out of 224. Blood pressure, weight, and height were measured, and completion of a questionnaire provided information on sex, age, familial income, educational level, and occupation. Body mass index was obtained by dividing weight (kilogram) by height squared (square meter), and the following values were considered: BMI < 25, normal; 25 ≥ BMI < 30, overweight; BMI ≥ 30, obesity. In addition, excessive weight was defined as BMI ≥ 25, and arterial hypertension was defined as systolic blood pressure ≥ 140 mm Hg and diastolic blood pressure ≥ 90 mm Hg.

Results

In 1078 dwellings, 1137 eligible individuals resided, and complete information was obtained from 1032 (91%) individuals. The prevalences of arterial hypertension and excessive weight were 22.58% and 51.26%, respectively. Before adjustment, the OR for arterial hypertension for overweight individuals was 1.85 (95% CI: 1.52-2.25) and, for obese individuals, 3.7 (95% CI: 3.04-4.50); after adjustment, the ORs were 2.04 (95% CI: 1.65-2.54) and 4.08 (95% CI: 3.30-5.08), respectively.

Conclusion

A strong association between body mass and blood pressure exists, independently of sex, age, familial income, educational level, and occupation.

Keywords

excessive weight, body mass index, hypertension

Primary prevention of blood pressure elevation may be obtained through changes in life style, which include control of weight, of excessive alcohol and salt ingestion, of smoking, and of the practice of physical activity [1]. Considering that body mass increase is strongly associated with blood pressure elevation [2-4], and is highly prevalent both in rich [5] and less developed countries [6], excessive weight may be considered the major preventable determinant of the occurrence of arterial hypertension.

Sex, age, and some socioeconomic variables are potential confounders of the relation between body mass and blood pressure, because those variables are related to body mass [7,8]. Thus, to know the relative importance of body mass as a determinant of arterial hypertension in a specific population, an adjusted estimate of the relation between body mass and blood pressure is required. In Brazil, only 4 studies have assessed this adjusted estimate [9-12].

This study presents an estimate of the relation between body mass and occurrence of arterial hypertension adjusted for sex, age, income, and educational level in a low socioeconomic population of the metropolitan region of Fortaleza.

Methods

A cross-sectional study was carried out in a housing complex of Caucaia in the metropolitan area of Fortaleza. Of 224 blocks of the housing complex, 67 (30%) contiguous blocks were included in the study. As the housing complex was homogeneous from the point of view of the construction pattern of the dwellings and urbanization pattern, this sample of blocks was considered representative of the housing complex.

All individuals aged ≥ 30 years were interviewed and examined, and more than one participant per dwelling could be included. The individuals who could not be found in 3 domiciliary visits were excluded from the study. The objectives of the study were presented to the participants, who could accept or refuse to participate. From July to December 1998, the individuals were interviewed and examined (measurement of blood pressure, weight, and height) at their own dwellings from 8 to 11 AM or 2 to 5 PM, and some were requested to go to a health care center for measurement of their weight and height.

Blood pressure was measured twice, before and after administering the sociodemographic questionnaire, which lasted an average of 30 minutes. This study used the values obtained in the second blood pressure measurement. The measurements were always taken in the right arm in the sitting position. The systolic pressure was recorded in the first Korotkoff phase (appearance of

the noise), and the diastolic pressure was recorded in the fifth Korotkoff phase (disappearance of the noise). The VI Joint National Committee - JNC [13] criterion was used for defining arterial hypertension. Thus, the individuals with systolic blood pressure (SBP) ≥ 140 mm Hg or diastolic blood pressure (DBP) ≥ 90 mm Hg, or both, were considered hypertensive. Blood pressure was also classified according to the cited consensus as follows: normal (DBP < 90 mm Hg and SBP < 140 mm Hg); mild hypertension (90 ≤DBP < 100 or 140 ≤SBP < 160); moderate hypertension (100 ≤DBP < 110 or 160 ≤SBP < 180); and severe hypertension (DBP ≥ 110 or SBP ≥ 180).

The individuals were weighed and measured in their dwellings while wearing light clothes and barefoot. Weight was measured with a precision electronic scale in grams. For calibrating the scale, a set of 7 weights (4.91 kg; 4.92 kg; 9.65 kg; 9.83 kg; 14.15 kg; 14.60 kg; 14.90 kg) standardized by INMETRO was used. The scale was calibrated weekly using a load composed by 3 weights randomly chosen. During the entire study, the measurements with the scale never differed by more than 2% from the standardized load. Height was obtained in centimeters, with a metric ruler fixed on a base, upon which the individual stood. The body mass index (BMI) was calculated dividing the weight (in kilograms) by squared height (in square meters) and categorized according to the criteria recommended by the World Health Organization [14] as follows: 1) normal weight: BMI < 25 kg/m^2; overweight: 25 ≤BMI < 30; obese: BMI ≥ 30. In addition, we defined excessive weight as BMI ≥ 25.

Information on sex, age, familial income, educational level, and occupation was obtained through a questionnaire administered at the dwelling. Information regarding the presence of running water, a sewage system, shower equipment, and a flushing toilet in the bathroom was recorded. The familial income (in reais) was defined as the summation of the monthly income of all individuals in the same dwelling of the interviewee. Occupation was categorized as follows: 1) with occupation: self-employed worker, employee, homemaker; 2) no occupation: no occupation, unemployed, dependent, pensioner, and retiree.

The familial income (in reais R$) was categorized as minimum wages (R$ 136.00) to allow stratification in a sample with similar sizes. The variable educational years was divided into 2 strata defined by the median of distribution. The univariate association between the variables was measured through the ratio of prevalence and its 95% confidence interval calculated by using the Stata Software [15]. The linear variation of proportions throughout the strata of a categorical variable was estimated by using a test for trend [16] calculated with the Epi-Info software [17]. Linear variations were those whose trend curves did not significantly differ from a straight line (P = 0.05). The univariate association between potential risk factors and the prevalence of arterial hypertension was also estimated using the odds ratio calculated through logistic regression and with the Stata software. At the end, a logistic regression model was used to measure the independent or adjusted association of each risk factor and the occurrence of arterial hypertension. In the estimates of the odds ratio through univariate and multivariate logistic regression, the strata of the categorical variables were classified as 1, 2, and 3 or 1, 2, 3, and 4, according to the number of categories and the sequence of their appearance in the tables. In all statistical tests, we considered significant those whose probabilities of the null hypothesis being true were ≤5%.

Results

In the 67 blocks sampled, 1,078 dwellings existed, 958 (89%) of which were investigated. The remaining were not inhabited or housed individuals who could not be interviewed in at least 3 attempts. At the end, of 1137 individuals eligible for the study, complete information was obtained from 1032 (91%). Only 15 individuals refused to participate in the study, and the others did not go to the medical center for measurement of weight and height. The general epidemiological result was a 22.58% prevalence of arterial hypertension and a 51.26% prevalence of excessive weight (data not shown in the tables).

Aiming at measuring the association between the potential determiners of blood pressure elevation and body mass, the ratio of the prevalence of excessive weight was calculated (tab. I). Of the variables studied, only sex, age, and familial income were significantly associated with excessive weight. The prevalence of excessive weight was greater in the female sex and increased with the increase in familial income. However, the relation between age and excessive weight was not linear (test of linearity: P = 0.006; the trend curve was significantly different from a straight line), because the prevalence of excessive weight increased and then decreased with an increase in age. On the contrary, the educational level and occupation were not associated with excessive weight.

Then, the association of some variables with blood pressure was estimated through the ratio of prevalence of arterial hypertension (tab. II). The prevalence of arterial hypertension significantly increased with the increase in body mass. The prevalence of arterial hypertension was 59% greater among overweight individuals and 149% among obese individuals as compared with that in normal-weight individuals. The prevalence of arterial hypertension also significantly increased with the increase in age. On the other hand, individuals with less schooling and those who reported no occupation had a significantly greater prevalence of arterial hypertension. However, no association was observed between sex, familial income, and blood pressure.

The prevalence of different blood pressure levels and their association with excessive weight were also estimated (data not shown in tables). The following prevalences were observed: 77.42% of normal blood pressure levels; 13.95% of mild hypertension; 4.65% of moderate hypertension; and 4.07% of severe hypertension. In addition, 22.58% of the individuals had one of the forms of hypertension. In regard to the association of excessive weight and blood pressure elevation, among normal-weight individuals, the following prevalences of hypertension were observed: mild, 10.05%; moderate, 2.99%; and severe, 2.99%. Among individuals with excessive weight, the prevalences of hypertension were 17.04%, 5.68%, and 4.94%, respectively. Thus, the prevalence of each level of arterial hypertension was approximately twice in individuals with excessive weight, although only the prevalence of mild hypertension was significantly different.

Finally, the confounding potential of the other variables in the relation between body mass and arterial hypertension was assessed, calculating the nonadjusted and adjusted odds ratio of arterial hypertension by using multivariate logistic regression (tab. III). Before adjustment, the odds ratio for arterial hypertension was

Table I - Ratio of prevalence of excessive weight according to potential risk factors for arterial hypertension.					
Risk factors	Total	Prevalence of excessive weight	Ratio of prevalence of excessive weight		P value
			At a point	95% CI	
Sex:					
female	533	55.16	1	-	
male	499	47.09	0.85	0.76-0.96	0,010[¶]
Age: 30 to 39 years	513	47.17	1	-	
40 to 49	262	58.40	1.24	1.08-1.42	
50 to 59	128	57.03	1.21	1.01-1.44	
60 to 86	129	47.29	1.00	0.82-1.23	0,010[¶]
Familial income (R$[#]):					
30 a 136	224	48.68	1	-	
137 a 272	277	44.04	0.91	0.75-1.09	
273 a 408	261	52.49	1.08	0.90-1.29	
409 a 2000	270	59.63	1.23	1.04-1.45	0,002[§]
Schooling years					
0 a 3	503	48.31	1	-	-
4 a 12	529	54,06	1.12	0.99-1.26	0,065[¶]
Type of occupation [¥]:					
With occupation	574	52.44	1	-	-
No occupation	458	49.78	0.95	0.84-1.07	0,396[¶]

£Excessive weight: BMI ≥ 25 kg/m²; #Income in reais (R$) (national minimum wage = R$ 136,00); ¥Type of occupation; (1) with occupation: self-employed worker, employee, homemaker; (2) no occupation: no occupation, unemployed, dependent, pensioner, retiree; ¶ Pearson chi-square test; §Test for trend.

Table II - Ratio of prevalence of hypertension according to potential risk factors					
Risk factor	Total	Prevalence of hypertension	Ratio of prevalence of hypertension		P value
			At a point	95%CI	
BMI:					
BMI < 25	503	15.71	1	-	
25 = BMI < 30	373	24.93	1.59	1.21-2.07	
BMI = 30	156	39.10	2.49	1.88-3.29	0.000[§]
Sex:					
female	533	20.64	1	-	
male	499	24.65	1.19	0.95-1.49	0.123[¶]
Age:					
30 a 39 years	513	12.48	1	-	
40 a 49	262	23.28	1,87	1.36-2.56	
50 a 59	128	33.59	2,69	1.93-3.76	
60 a 86	129	50.39	4.04	3.03-5.38	0.000[§]
Familial income (R$[#]):					
30 to 136	224	27.23	1	-	
137 to 272	277	21.30	0.78	0.57-1.07	
273 to 408	261	19.16	0.70	0.51-0.98	
409 to 2000	270	23.33	0.86	0.63-1.16	0.300[§]
Schooling years:					
0 to 3	503	27.04	1	-	
4 to 12	529	18.34	0.68	0.54-0.85	0.001[¶]
Type of occupation [¥]:					
With occupation	574	18.99	1	-	
No occupation	458	27.07	1.43	1.14-1.79	0.002[¶]

#Income in reais (R$) (national minimum wage = R$ 136.00); ¥Type of occupation; (1) With occupation: self-employed worker, employee, homemaker; (2) No occupation: no occupation, unemployed, dependent, pensioner, retiree. ¶ Pearson chi-square test; §Test for trend.

1.85-fold greater in overweight individuals and 3.7-fold greater in obese individuals as compared with that in normal-weight individuals. After adjustment, these odds ratios were 2.04 and 4.08, respectively, showing that the other variables had a small confounding effect. We concluded that a strong association exists between body mass and blood pressure, which is independent of sex, age, familial income, educational level, and occupation.

Discussion

The population studied had a high prevalence of excessive weight and arterial hypertension, and the occurrence of arterial hypertension was strongly associated with excessive weight. The prevalence of excessive weight was 51.26% and that of arterial hypertension was 22.58%. The prevalence of arterial hypertension after adjusting for sex, age, familial income, years of schooling, and occupation significantly increased with the increase in body mass.

The specificity of this study is because its object of observation is a homogeneous sample of individuals in a low socioeconomic level. The community lives in an urban unpaved region, with no sewage system, and most of the dwellings have no public water supply, no shower equipment, and no flushing toilet. Approximately, half of the population attended school for less than 4 years, had an income ≤2 minimum wages, and 44% had no occupation. Howe-

Table III – Nonadjusted and adjusted association between risk factors and arterial hypertension

Risk factor ≤	Non-adjusted odds ratio		Adjusted odds ratio	
	At a point	95%CI	At a point	95%CI
BMI[¥]	1,85	1,52-2,25	2,04	1,65-2,54
Sex	1,26	0,94-1,69	1,68	1,19-2,36
Age	1,91	1,67-2,18	1,88	1,61-2,19
Familial income	0,93	0,82-1,06	0,97	0,84-1,12
Schooling years	0,61	0,45-0,81	1,02	0,72-1,44
Occupation	1,58	1,18-2,12	1,47	1,03-2,10

Categorical variables. The categories were codified as 1, 2, and 3, or 1, 2, 3, and 4, according to the number of categories and always in that sequence; [¥] BMI was the variable of exposure and the remaining were the confounders.

ver, the prevalence of excessive weight in that community (51.26%) is very close to values found in populations with much higher socioeconomic levels, such as those from the USA (54.85%) [18] and the city of Pelotas, in the Brazilian state of Rio Grande do Sul (61%) [7]. Similarly, the prevalence of arterial hypertension (22.58%) is close to that of the previously mentioned North American population (24%) and that of the city of Catanduva, in the Brazilian state of São Paulo (32%) [19]. The 3 studies cited in this discussion used the same definition of excessive weight and of arterial hypertension adopted in this study, and the prevalence of excessive weight and of arterial hypertension of the population is similar to those of populations with much higher socioeconomic levels.

Studies have shown that such variables as sex, age, income, educational level, and occupation are associated with excessive weight, constituting, therefore, potential confounders of the relation between excessive weight and arterial hypertension [7,8]. However, in this study, the nonadjusted and adjusted odds ratio of the relation between excessive weight and arterial hypertension are similar. Consequently, the nonadjusted prevalence of arterial hypertension according to BMI could be a good estimate of the adjusted prevalence. One could conclude that the increase in the prevalence of arterial hypertension is directly proportional to the increase in body mass, so that overweight and obese individuals have a 59% and 149% greater prevalence, respectively, than that in normal-weight individuals.

A cause and effect relation between body mass increase and blood pressure elevation has already been demonstrated in several cohort studies. In the cohort of the Framingham offspring, the increase in the incidence of arterial hypertension was observed to be directly proportional to the increase in body mass [20]. In the cohort of the North American nurses, elevated initial weight and weight gain were strong predictors of the development of arterial hypertension [21]. In another cohort of individuals of both sexes, a 5% increase in body mass was estimated to cause a 20-30% elevation in the odds of arterial hypertension (BP ≥ 140/90) [4]. An estimate of blood pressure reduction in response to a reduction in body mass was proposed: a reduction in body mass index (BMI) to values lower than 23 kg/m^2 would avoid 46.7% of the cases of arterial hypertension (BP > 165/95) [3].

Four national, cross-sectional, population-based studies obtained an adjusted estimate of the relation between body mass and blood

pressure. In the population of the city of Porto Alegre, in the state of Rio Grande do Sul, a strong association (OR=2.08) was observed between body mass (BMI>27) and arterial hypertension (BP≥160/95) after adjusting for age, familial predisposition, educational level, and alcohol abuse [9]. In the Ilha do Governador, in the Brazilian state of Rio de Janeiro, the prevalence of arterial hypertension (BP≥160/95) adjusted for age is 2.2 times greater among individuals with BMI ≥ 27 [10]. In the city of Pelotas, in the state of Rio Grande do Sul, the odds ratio of arterial hypertension (BP≥160/95) is 2.03 for obese individuals (BMI > 27.3 for women and 27.8 for men) after adjustment for sex, age, skin color, social class, and educational level [11]. And finally, in the city of Bambuí, in the state of Minas Gerais, the odds ratio of arterial hypertension (BP≥140/90) for overweight (25≤BMI<30) is 2.82 and for obesity (BMI>30) is 4.29, adjusting for sex, age, educational level, familial income, smoking habit, and physical activity [12]. The 3 first studies had an odds ratio around 2. But, as in those studies, arterial hypertension and the risk category of weight were defined in more elevated levels than those used in our study, and those studies were expected to obtain more elevated odds ratios than those obtained in this study; the results suggest that the strength of association between body mass and blood pressure is slightly stronger than that in the populations of the studies cited. On the other hand, while the odds ratio for hypertension for overweight individuals in this study was lower than that in the population of Bambuí, the odds ratio for hypertension for obese individuals was similar. Although the studies discussed include populations with socioeconomic and cultural characteristics different from those of this study's population, our estimate of the association between body mass and arterial hypertension (OR=2.04 for overweight and 4.08 for obesity) is within the variation range of the estimates obtained for those studies.

Although we did not use a random sample of individuals, the possibility of selection biases is minimal, because we studied a sample of 89% of the dwellings in a continuous area representing 30% of the blocks of the housing complex. It is worth noting that the socioeconomic characteristics of the area of the housing complex, which were not included in the sample, are similar to the characteristics of the area included. Therefore, we suggest that the sample of this study represents the community from which it was obtained, and that that community represents the low-income urban population in Fortaleza.

One of the limitations of this study is that we did not adjust our estimate of the relation between body mass and blood pressure to other potential confounders, such as smoking habit, alcohol ingestion, and physical activity. However, cohort and cross-sectional studies have shown that blood pressure is strongly associated with body mass, independent of the smoking habit [10,11], the ingestion of alcoholic beverages [9,11], and the practice of physical activity [10,11].

In conclusion, in a low-income urban population, body mass is an important determinant of blood pressure elevation, because the 2 factors are strongly associated and because of the elevated prevalence of individuals with excessive weight. Therefore, as a primary prevention strategy, weight control should be a pertinent intervention to reduce the occurrence of arterial hypertension.

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