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Dietary habits and inadequate control of blood pressure in hypertensive adults assisted by a Brazilian Family Doctor Program

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Abstract
Objective: To estimate dietary habits and other factors associated with inadequate blood pressure (BP) control in hypertensive patients adherent to antihypertensive drug treatment assisted by a Brazilian Family Doctor Program (FDP).
Design: A cross-sectional study.
Setting: FDP units, Niterói, Rio de Janeiro, Brazil.
Subjects: We included data from both male and female participants aged ≥20 years. Participants completed a standardized questionnaire containing questions related to demographics, socio-economic factors, comorbidities and lifestyle, as well as a validated FFQ and eleven additional qualitative questions to investigate dietary habits. Food items were divided into sixteen groups. Medical consultations were performed, BP measurements were taken, blood and urine samples were assessed and anthropometric and nutritional status was evaluated.
Results: Individuals with inadequate BP control presented higher BMI values (prevalence ratio (PR) = 1·027, 95 % CI 1·009, 1·045) and also consumed more meat (PR = 1·091, 95 % CI 1·022, 1·165), which are potentially modifiable variables. Higher levels of serum creatinine (PR = 1·894, 95 % CI 1·241, 2·892) were also associated with inadequate BP control, as were skin colour (white). After inclusion of the Na excretion index, which is an indirect measure of salt intake, a slight decrease was observed in the PR for meat, which resulted in loss of statistical significance.
Conclusions: The results indicate that salt consumption, skin colour, BMI and serum creatinine are associated with inadequate BP control.

Keywords
Blood pressure control
Hypertension
Lifestyle
Food consumption

Hypertension, defined as blood pressure (BP) ≥140/90 mmHg or use of antihypertensive medications(1), is a major risk factor for CVD, which is the primary cause of death in Brazil and worldwide(2). Hypertension is prevalent in a number of countries. In Brazil, the rate varies between 22·3 % and 43·9 %(3).

The main objective of treating hypertension is to reduce cardiovascular morbidity and mortality through decreased levels of BP(4). Decision regarding whom to treat should be based on estimation of the total cardiovascular risk, not just on BP(5).

Adoption of lifestyle changes has proven to be effective in reducing BP and is recommended for all patients with hypertension. Such modifications include weight control, increased physical activity, dietary restrictions, including the reduction of Na and increase of K, moderation of alcohol intake and adoption of the DASH (Dietary Approaches to Stop Hypertension) diet plan that emphasizes a high intake of fruits and vegetables, complex carbohydrates, low-fat dairy products and the restriction of saturated fat(6). Na restriction in hypertensive patients reduces BP, but the long-term impact of reduced salt intake on BP, mortality and morbidity remains to be defined(7). However, the quality of diets of hypertensive Americans following the publication of the DASH diet has not improved, suggesting that secular trends have minimized the impact of the DASH message(8).

In most hypertensive patients, drug therapy is required to achieve adequate BP levels(9). The Lowering Treatment Trialists' Collaboration has shown that differences between

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drug classes are quite small, even across different age groups, compared with the benefits of maximizing the reduction in BP, especially systolic blood pressure (SBP)[5]. Despite the availability of various classes of antihypertensive medications, rates of BP control have remained low[1], accounting for <27 % of patients in developed countries and for approximately 10 % in developing countries[10].

Non-compliance may have a substantial role in BP control. Patients' non-adherence to therapy is increased by misunderstanding of the condition or treatment, denial of illness because of lack of symptoms or perception of drugs as symbols of ill health, lack of patient involvement in the care plan or unexpected adverse effects of medications[1]. In addition, one of the main factors related to the control of hypertension is access to BP drugs. In Brazil, despite the presence of a government-sponsored National Health System to provide medicines, access is limited and unequal[11]. However, in some municipalities, for some highly prevalent conditions such as hypertension, particularly in certain primary care programmes, there is a more regular drug supply. An example of such a project is the Family Doctor Program (FDP) in Niterói, Rio de Janeiro, Brazil, which deals with the most disadvantaged members of society.

The present study aims to estimate dietary habits and other factors associated with inadequate BP control in hypertensive patients under treatment assisted by FDP and strengthen complementary approaches to the treatment of hypertension.

Methods

The present study used data from participants in the Cardiometabolic, Renal and Familial (CAMELIA) study, which was conducted between June 2006 and December 2007. A total of 1098 individuals were recruited from a public primary care programme, the FDP, in Niterói, Rio de Janeiro, Brazil. Thirteen FDP units were selected by convenience, covering all administrative areas of the city. Families were enrolled following an initial selection of index cases. To be accepted as an index case, individuals were required to be married to a partner who has agreed to participate in the study and to have at least one descendant between 12 and 30 years of age who would also enrol. Four groups of index cases were recruited: (i) hypertensive patients without diabetes mellitus; (ii) diabetic patients with hypertension; (iii) diabetic patients without hypertension; and (iv) patients without either hypertension or diabetes mellitus. Index cases were randomly selected from those who met the inclusion criteria. Pregnant women, people with immune deficiencies and those taking immunosuppressive agents (steroids and cytostatic drugs) were excluded from the study. The protocol was approved by the Ethics Committee of the Medical School of Universidade Federal Fluminense. Written informed consent was obtained from all participants.

After the pilot project, trained researchers visited the FDP facility in the community. The participants responded to a questionnaire that asked for information related to comorbidities and demographics, as well as information related to socio-economic and lifestyle factors. Medical staff members collected personal and family medical histories. Trained researchers measured the participants' BP and also collected fasting blood samples and first-morning urine spot samples. Dietitians assessed the participants' anthropometric and nutritional status.

BP was measured using an electronic sphygmomanometer (Hem-711AC; Omron Co., Kyoto, Japan). Three measurements were taken and the mean of the second and the third was considered. When the difference between two measurements was >5 mmHg, an additional measurement was taken to replace one of the original values. BP at admission and the mean time of hypertension treatment were extracted from the medical records of the FDP.

The present study was cross-sectional and included data from both male and female participants who were at least 20 years old, all undergoing antihypertensive treatment. Patients were included if they responded 'yes' to the question 'Has a doctor told you that you are a hypertensive patient?' and who, in consultation with medical researchers of the study, indicated what type of antihypertensive medication they had been prescribed and reported taking the prescribed medication. In the CAMELIA study, there was 298 hypertensive patients undergoing treatment and 239 reported adhering to prescription. The number of antihypertensive drugs prescribed to the participant was self-reported to a physician during the visit. More than 80 % of participants presented their prescription(s) to the researchers. Participants were classified as receiving one, two, three or more medications. The FDP does maintain a protocol for the treatment of hypertension consisting of a progressive increase in the number of BP drugs, which are freely available for patients. Inappropriate BP control was classified as SBP ≥ 140 mmHg and/or diastolic BP (DBP) ≥ 90 mmHg at visit.

Age was considered a continuous variable in the present study. Participants were classified as white or non-white according to their skin colour. Marital status was defined as either living with or living without a partner. There were three categories of family monthly income: ≤$US 200·00; >$US 200·00 to ≤$US 400·00; and >$US 400·00 (the minimum wage per month in Rio de Janeiro at the time was approximately $US 200·00). Participants were classified by educational level into three strata: low (never studied or studied up to the 4th grade); intermediate (5th–8th grades); and high (secondary school and beyond). Participants also completed a questionnaire on leisure-time physical activity that contained questions about physical activities performed during the past 15 d detailing the type of activity, the number of times the activity was performed per week and the time spent on

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the activity[12]. Those who reported engaging in <150 min of physical activity in their leisure time[13] were considered physically inactive. Participants were classified as non-smokers, ex-smokers or current smokers. Food consumption was estimated using an FFQ[14]. Food groups were proposed by Nettleton *et al.*[15] and adjusted by dietitians who worked on the research project. To calculate the daily intake of each food group, the frequency reported was converted to daily values. The values of daily intake multiplied by the serving of each item consumed equalled the number of servings consumed per day from each food group. Participants provided information about their use of table salt in the questionnaire by choosing 'never add', 'taste and add if necessary' or 'add always'. Changes in dietary patterns were ascertained on the basis of a yes or no question in the FFQ: 'Have you ever changed your dietary pattern in your adult life?'. Each participant's family history of hypertension was assessed on the basis of whether he or she classified his or her father and/or mother as being hypertensive.

Individuals with a self-reported medical diagnosis of diabetes were classified as such in the study. Dyslipidaemia was considered present when the total levels of cholesterol (≥200 mg/dl), LDL (≥130 mg/dl), HDL (for men <40 mg/dl and for women <50 mg/dl) or TAG (≥150 mg/dl) were altered[16]. Each participant's weight was measured using an electronic digital scale (PL80, Filizola S/A, Brazil) and height was measured using a portable digital stadiometer (Kirchnner & Wilhelm, Medizintechnik, Germany). BMI was calculated as weight in kilograms divided by the square of height in metres (kg/m^2) and was considered as a continuous variable. Biochemical analyses were performed using a chemistry analyser (Selectra; Vital Scientific NE, the Netherlands).

Uric acid (mg/dl), fasting glucose (mg/dl) and creatinine (mg/dl) were analysed as continuous variables. The estimated glomerular filtration rate was calculated using the equation developed in the study Modification of Diet in Renal Disease (MDRD) = 170 × (creatinine) −0·999 × (age) −0·176 × [(20/60 × urea) −0·17] × (albumin) × 0·318 × 0·762 (if female), a formula validated for this purpose[17], and was analysed continuously. Na intake was estimated by determining the rate of excretion of Na ([Na in mEq/l in the sample of urine/urinary creatinine in mg %] ×100) expressed in mEq Na/g creatinine and was also analysed continuously[18]. Participants were classified as having a history of myocardial infarction, cerebrovascular accidents or congestive heart failure when they responded affirmatively to a question about whether their doctor had ever diagnosed them with those conditions.

Statistical analysis

For data analysis, we used the Statistical Package for the Social Sciences statistical software package version 17·0 (SPSS Inc., Chicago, IL, USA). Crude and adjusted prevalence ratios (PR) were calculated to estimate the association between adequate control or inadequate control of BP and other variables. Bivariate and multivariate analyses were performed using the model of generalized estimating equations, which is suitable for non-independent observations, since the unit for inclusion in the original study was each family. Multivariate analysis was carried out step-by-step through the progressive inclusion of independent variables that could influence inadequate BP control. Variables with a statistical significance level <0·10 were retained in subsequent models. In model 1, socio-demographic and lifestyle factors, clinical and biochemical metabolic parameters and time of treatment were included. In models 2–4, food groups were included individually. The final model included food groups and other variables that had $P < 0·10$, and also included the rate of Na excretion. Statistical significance with P value <0·05 was adopted in the final model. Factors associated with the control of BP may in fact be risk factors, such as demographic, socio-economic or lifestyle factors, and comorbidities (obesity and high uric acid) or outcomes such as myocardial infarction, stroke, heart failure and elevated creatinine. To facilitate analysis, all were considered as independent variables.

Results

The study sample consisted of 239 participants (53 % were women) and comprised mostly individuals with intermediate schooling, family income >$US 400·00, non-white and with a partner (Table 1). The prevalence of inadequate BP control was 51·5 %; for SBP alone the prevalence was 43·5 % and for DBP alone it was 33·1 % (data not shown). The mean time of treatment was 7·6 (SD 6·7) years, varying from 1 (10 %) to >10 years (29 %). Approximately 20 % of participants reported smoking currently. Many of the participants reported already having made some changes to their diet, and only a minority said that they regularly added salt at the table. Most were not diabetic and were free of other metabolic disorders, nor did they have a history of CVD (Table 1).

Most participants indicated the drugs they were using by presenting prescriptions at the time of medical consultation with the study investigators. Of those who said they used diuretics, 85·9 % had a prescription; 86·0 % had a prescription for β-blockers; 79·9 % had a prescription for angiotensin-converting enzyme inhibitors (ACEI); and 83·8 % had a prescription for other classes. Approximately 12 % made use of three antihypertensive drugs; 43·9 % used two antihypertensive drugs and 43·9 % used one.

The crude PR of inadequate BP control is shown in Table 1. Skin colour (white), marital status (without a partner), physical activity (inactive), BMI, glucose, creatinine levels, SBP value at admission to the FDP, time of treatment and the consumption of 'red meat, processed and preserved in salt' and 'other alcoholic beverages' were shown to be

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Table 1 Characteristics of participants and crude PR and 95 % CI of adequate and inadequate control of BP groups

	Adequate control (*n* 116)		Inadequate control (*n* 123)				
Variable	*n* or mean	% or SD	*n* or mean	% or SD	PR	95 % CI	*P* value
Demographic and socio-economic factors							
Sex							
Female	66	56·9	60	48·8	1		
Male	50	43·1	63	51·2	1·171	0·919, 1·491	0·202
Age (years)*	49·56	8·94	49·67	9·60	1·001	0·987, 1·015	0·932
Skin colour†							
Non-white	87	75·7	79	64·2	1		
White	28	24·3	44	35·8	1·284	1·002, 1·645	0·048
Educational level†							
Low	39	33·6	52	42·3	1		
Intermediate	53	45·7	46	37·4	0·813	0·618, 1·069	0·139
High	24	20·7	25	20·3	0·893	0·648, 1·231	0·489
Family income/month ($US)†							
≤200·00	11	9·5	14	11·4	1		
201·00–400·00	31	26·7	33	26·8	0·921	0·597, 1·420	0·709
>400·00	74	63·8	76	61·8	0·905	0·614, 1·333	0·613
Marital status†							
With a partner	111	96·5	113	91·9	1		
Without a partner	4	3·5	10	8·1	1·416	0·977, 2·051	0·066
Lifestyle factors†							
Tobacco							
Non-smoker	54	47·4	59	48·4	1		
Ex-smoker	37	32·5	39	32	0·983	0·743, 1·300	0·903
Current smoker	23	20·1	24	19·6	0·978	0·701, 1·364	0·896
Table salt use							
Never add	98	85·2	96	78·7	1		
Taste and add if necessary	13	11·3	20	16·4	1·225	0·905, 1·658	0·189
Add always	4	3·5	6	4·9	1·213	0·718, 2·048	0·471
Physical activity (min/week)							
>150	41	35·3	27	22	1		
≤150	75	64·7	96	78	1·414	1·020, 1·959	0·037
Intentional diet changes							
Yes	75	65·2	75	61·5	1		
No	40	34·8	47	38·5	1·080	0·847, 1·378	0·533
Comorbidities†							
Myocardial infarction							
No	111	95·7	115	93·5	1		
Yes	5	4·3	8	6·5	1·209	0·772, 1·896	0·407
Stroke							
No	111	95·7	114	92·7	1		
Yes	5	4·3	9	7·3	1·269	0·839, 1·920	0·260
Heart failure							
No	110	94·8	116	94·3	1		
Yes	6	5·2	7	5·7	1·049	0·627, 1·755	0·855
Clinical and biochemical metabolic parameters							
Diabetes†							
No	91	78·4	89	72·4	1		
Yes	25	21·6	34	27·6	1·165	0·899, 1·511	0·247
BMI (kg/m^2)*	28·62	5·42	29·89	6·10	1·017	1·000, 1·035	0·048
Dislipidaemia‡							
No	28	28·6	23	22·8	1		
Yes	70	71·4	78	77·2	1·169	0·818, 1·670	0·392
Creatinine (mg/dl)*	0·88	0·21	0·94	0·31	1·473	1·051, 2·063	0·024
Glucose (mg/dl)*	109·28	32·30	120·55	42·19	1·003	1·000, 1·006	0·027
Uric acid (mg/dl)*	5·04	1·53	5·02	1·60	0·997	0·916, 1·086	0·954
Glomerular filtration rate (ml/min per 1·73 m^2)*	95·68	26·35	93·39	32·96	0·999	0·993, 1·004	0·637
Na excretion index (mEq/g)*	143·00	80·00	173·00	154·00	1·081	1·026, 1·139	0·003
BP at admission on FDP*							
SBP	134·15	19·95	140·90	23·83	1·008	1·002, 1·014	0·011
DBP	88·80	16·07	88·15	16·54	0·999	0·989, 1·008	0·764
Time of treatment*	6·56	6·58	8·99	6·63	1·027	1·005, 1·050	0·016
BP medications§							
1	53	45·7	52	42·3	1		
2	49	42·2	56	45·5	1·077	0·825, 1·405	0·585
≥3	14	12·1	15	12·2	1·044	0·711, 1·533	0·824

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Table 1 *Continued*

	Adequate control (*n* 116)		Inadequate control (*n* 123)				
Variable	*n* or mean	% or SD	*n* or mean	% or SD	PR	95 % CI	*P* value
Family history of hypertension†							
No, for both parents	38	32·8	40	32·5	1		
Yes, for one parent	52	44·8	52	42·3	0·975	0·728, 1·306	0·865
Yes, for both parents	26	22·4	31	25·2	1·061	0·767, 1·466	0·722

PR, prevalence ratio; BP, blood pressure; FDP, Family Doctor Program; SBP, systolic BP; DBP, diastolic BP.
*Data are represented as mean and SD.
†Self-reported.
‡Dyslipidaemia was present if the total levels of cholesterol (≥200 mg/dl), LDL (≥130 mg/dl), HDL (for men <40 mg/dl and for women <50 mg/dl) or TAG (≥150 mg/dl) were altered.
§According to prescription.

Table 2 Median with IQR of daily serving consumption of food groups and PR and 95 % CI of inadequate control of BP

Food group	Median	IQR	PR	95 % CI	*P* value
Fruits	3·62	3·80	0·985	0·946, 1·026	0·471
Vegetables	9·33	6·50	0·972	0·942, 1·002	0·065
Read meat, processed and preserved in salt	1·41	1·22	1·096	1·038, 1·158	0·001
Chicken and fish	1·19	1·00	1·024	0·904, 1·159	0·714
Beer	0·00	0·29	1·038	0·912, 1·180	0·573
Other alcoholic beverages	0·00	0·00	1·116	1·018, 1·223	0·019
Caffeinated drinks	2·00	1·79	1·029	0·956, 1·108	0·440
Sweets, sugar and sugary drinks	3·53	4·36	1·009	0·972, 1·046	0·644
Whole dairy products	0·99	1·73	0·971	0·883, 1·067	0·540
Low-fat dairy products	0·00	0·00	1·072	0·979, 1·175	0·134
Wholegrain foods	0·00	0·00	0·879	0·731, 1·057	0·171
Breads, cookies and pasta	4·68	3·68	1·012	0·979, 1·047	0·480
Oils, fats and fried foods	1·17	1·77	0·980	0·872, 1·102	0·735
Rice and beans	8·00	3·64	1·017	0·970, 1·066	0·482
Canned foods	0·67	0·70	1·087	0·538, 2·196	0·817
Eggs	0·14	0·29	0·967	0·691, 1·353	0·845

IQR, interquartile range; PR, prevalence ratio; BP, blood pressure.

positively associated with inadequate BP control ($P < 0·10$). The consumption of 'vegetables' was negatively associated with inadequately controlled BP (Table 2).

Model 1 included skin colour, physical activity, marital status, BMI, serum creatinine and glucose levels, SBP value at the time of admission to the FDP and time of treatment, which had a significance level <0·10 in the bivariate analysis. In this initial model, marital status, glucose, SBP value at the time of admission to the FDP and time of treatment lost statistical significance. In model 2, vegetable consumption and physical activity were not associated with the control of BP. In model 3, consumption of red meat showed a positive association with inadequately controlled BP. In model 4, the consumption of other alcoholic beverages was not associated with the control of BP. In model 5, however, the addition of the Na excretion rate resulted in a loss of statistical significance for the red meat food groups (Table 3).

Discussion

In the present study, we observed a higher prevalence of inadequate BP control, independent of possible confounding variables, in hypertensive patients with higher BMI values and also in those who consumed more meat and alcohol, all potentially modifiable variables. Higher serum creatinine, BMI and skin colour (white) were also factors associated with inadequate BP control. After the inclusion of the Na excretion index in the final model, a loss of statistical significance was observed for red meat consumption, indicating that a part of the association between meat consumption and BP control could be explained by the consumption of salt.

The prevalence of inadequate control of BP in the present study was approximately 50 % lower than that of other Brazilian cities, including Passo Fundo (80 %)[19] and Catanduva (72·4 %)[20], and of other regions such as the USA (71 %) and Europe (~90 %)[21]. However, it was higher than the rates reported by Mejía-Rodríguez *et al.*[22] in Mexico (~39 %) in a study also involving participants treated in care programmes of family medicine. Continuous monitoring and free access to medication may explain the lower prevalence of inappropriate BP control.

Somewhat surprisingly, in our study, the prevalence of inadequate control was higher in whites, before and after adjustment. A contrary association was observed in a

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Table 3 Adjusted PR* and 95 % CI of inadequate control of BP

Variable	Model 1 PR	Model 1 95 % CI	Model 1 *P* value	Model 2 PR	Model 2 95 % CI	Model 2 *P* value	Model 3 PR	Model 3 95 % CI	Model 3 *P* value	Model 4 PR	Model 4 95 % CI	Model 4 *P* value	Model 5 PR	Model 5 95 % CI	Model 5 *P* value
Sociodemographics and lifestyle habits															
Skin colour (white)	1·363	1·006, 1·847	0·046	1·381	1·067, 1·787	0·014	1·393	1·078, 1·799	0·011	1·375	1·059, 1·785	0·017	1·381	1·059, 1·799	0·017
Physical activity (inactive)	1·492	0·930, 2·394	0·097	1·339	0·937, 1·913	0·109									
Marital status (without a partner)	1·055	0·646, 1·722	0·830												
Clinical and biochemical metabolic parameters															
BMI (kg/m²)	1·027	1·009, 1·045	0·004	1·024	1·007, 1·042	0·007	1·025	1·009, 1·042	0·002	1·025	1·007, 1·042	0·006	1·028	1·010, 1·047	0·002
Creatinine (mg/dl)	1·894	1·241, 2·892	0·003	1·470	1·032, 2·094	0·033	1·615	1·153, 2·261	0·005	1·557	1·085, 2·235	0·016	1·690	1·186, 2·407	0·004
Glucose (mg/dl)	1·002	0·999, 1·005	0·174												
Na excretion index (mEq/g)													1·091	1·033, 1·152	0·002
SBP at admission on FDP	0·997	0·989, 1·004	0·394												
Time of treatment	1·008	0·985, 1·031	0·519												
Food groups (servings/d)															
Vegetables				0·987	0·953, 1·022	0·464									
Read meat							1·091	1·022, 1·165	0·009				1·084	0·986, 1·193	0·097
Other alcoholic beverages										1·052	0·960, 1·153	0·275			

PR, prevalence ratio; BP, blood pressure; SBP, systolic BP; FDP, Family Doctor Program.
*Only the variables with PR and 95 % CI presented in the table were included in each model.

multiethnic study conducted among several communities in the USA. When compared with whites, all non-whites including African Americans, Chinese and Hispanics had a higher prevalence of inadequate control[23]. A part of the observed association in the USA can be explained by poorer access to health services and medicines among non-whites because whites are not socially disadvantaged. Such differences were not observed in the present study.

Age was not associated with inadequate control of BP in the present study, contrary to findings by Knight *et al.*[24] in the USA and by Roux *et al.*[25] in France. In both studies increased age was associated with greater prevalence of inadequate control. Again, the fact that patients in the present study had continuous follow-ups may have favoured the control of risk factors and the actual BP measurements, contributing to the lack of correlation between inadequate control and advanced age.

Hypertensive patients without a partner had a higher prevalence of inadequate control of BP, in a statistically significant association, only before adjustment. One possible explanation could be the host family because the presence of a partner may provide an incentive to take medications and, of special importance for our study, contribute to compliance to recommendations regarding both diet and physical activity[26]. Consistent with this interpretation, the prevalence of a raised Na excretion index was higher for patients without a partner (data not shown).

Physically inactive patients had a higher frequency of inadequate control, but the adjustment by other variables resulted in a loss of statistical significance. The role of physical activity in the control of hypertension cannot be ignored[27]. However, in a cross-sectional study such as the present one it is not possible to ascertain whether a deficiency in physical activity contributed to a failure to control BP or whether participants in whom BP was not controlled were less likely to partake in physical activities. Physical inactivity is related to weight gain. A systematic review has shown that individuals performing regular physical activities tend to gain less weight and to be less overweight and obese[28]. This may explain the high prevalence of inadequate control of BP among individuals who had increased BMI, before and after adjustment, similar to that reported by Mejía-Rodríguez *et al.*[22]. It is known that reducing weight contributes to BP control and allows for reducing the dosage of antihypertensive drugs in hypertensive patients[29].

Despite the fact that the prevalence of hypertensive patients with inadequately controlled BP was higher in diabetics, the association was not statistically significant. Results from the Multiple Risk Factor Intervention Trial indicate that diabetes confers an increased cardiovascular risk when compared with other risk factors, suggesting that BP control should be stricter in the presence of diabetes[30]. Since then, the guidelines for hypertension

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recommend the maintenance of lower BP in this population. In populations monitored by care programmes for families (e.g. the case study presented here), it is expected that the actions taken for the control of BP in diabetics are more intense, which may explain the minor difference in the prevalence of inappropriate BP control compared with non-diabetics. However, among those who had elevated fasting glucose levels without a previous diagnosis of diabetes, BP control was poorer, perhaps because of lower level of health monitoring. Studies have shown that the incidence of diabetes is higher in hypertensive patients with inadequate BP control[31,32], which points to the importance of giving special attention to the control of BP, even without a diagnosis of diabetes.

Individuals with higher serum creatinine levels had a higher prevalence of inadequate control, both in crude analysis and after adjustment. This finding was also reported by Mejía-Rodríguez *et al.*[22] in Mexico and by Coresh *et al.*[33] in the USA. The explanation suggested in the two studies was a reduction in the glomerular filtration rate. In the present study, no association was observed between the levels of glomerular filtration rate estimated by the MDRD equation and BP control, perhaps because of the fact that the vast majority of the values of this variable lie within normal limits. A definitive explanation for the positive association between creatinine and BP levels is not available. However, this finding aligns with the fact that African Americans have recorded higher mean serum creatinine and a higher prevalence of hypertension compared with white Americans who do not have lower glomerular filtration rates[34].

A study conducted among Americans identified a higher prevalence of inadequate control in hypertensive patients who used two or more drugs. For the authors, the more difficult the BP control, is the greater the number of medications used[24]. When BP control is not achieved with a drug, an increased dose or combining with an antihypertensive from another class is usually recommended. If the goal is not reached, the addition of two or more medications is recommended[3]. In the study reported here, individuals who reported using one antihypertensive medication had a prevalence of inadequate control similar to those who reported using two or more drugs. The results may indicate that the treatment was not optimal. Diuretics, β-blockers, ACEI and other classes have similar effects on BP, although there are differences between patients[35]. In most patients, two or more antihypertensive medications are needed to achieve the control of BP[9]. However, studies have suggested that 'medical inertia', that is, a failure to start or enhance medication when it is necessary to do so, may contribute to poor BP control[36,37].

The prevalence of inadequate control of BP was lower among those who never added salt at the table, although the association was not statistically significant. However, both crude and adjusted analyses showed a positive association between the Na excretion index and inadequate BP control. The reduction of Na intake is associated with both decreased SBP and DBP[9,38] and with decreased mortality. The benefits would have the same magnitude if Na intake was reduced by only 1 g/d[39]. A recent comprehensive review addressing the issue of the impact of salt restriction on BP control concluded that a lower dietary salt intake may help patients stop BP medications while maintaining good control[7]. In Brazil, the intake of this nutrient greatly exceeds the maximum levels recommended; this finding is true in all regions and across all income strata[40].

There was a higher prevalence of inadequate control of BP in the present study among those who consumed fewer vegetables, as well as among those who consumed more meat and alcohol. After adjusting for confounding variables, including the rate of Na excretion, both lost statistical significance. Steffen *et al.*[41] found that vegetable consumption was inversely proportional to the elevation of BP, whereas red meat consumption had negative effects on the control of hypertension after adjustment. Wakabayashi[42] observed that reducing the intake of alcohol caused a reduction in BP in treated hypertensive patients.

The present study has some limitations. Caution should always be exercised when dealing with cross-sectional studies. The participation rate was approximately 56 %, leading to a possible selection bias. This percentage was similar to that of other studies[43,44]. The reasons for non-attendance given by participants were that they had to work on the day that data collection was carried out, that they had not fasted as required or had consumed alcohol the day before the visit. The highest percentage of missing participants was among young men. One can thus assume that individuals experiencing greater difficulty in BP control as a result of poor adherence to treatment are under-represented in this sample. However, this observation does not affect the associations between inadequate control of BP and risk factors. It is unlikely that individuals with inadequate control of BP with low adherence to treatment have a higher prevalence of healthy lifestyles. The percentage of missing data of biochemical measurements was 16·7. This occurred because of difficulty in processing the samples, and since they were not related to patient characteristics they were considered random losses. It should be emphasized that the FFQ has some disadvantages as well, such as forgetfulness or omission of information, which may contribute to under- or overestimation of results[45]. The results observed in the present study are for adults served by the FDP, residents of socially disadvantaged communities, intermingled and mostly married or living with partners. We believe that the estimated associations would be even greater in a population with a similar socio-economic profile that was not covered by a family medicine programme and that does not have a predominance of adults living with companions.

Conclusion

Inadequate control of BP in patients who were taking antihypertensive drugs, even in a community assisted by a primary care programme, showed statistically significant and independent association with the modifiable factors: salt intake and obesity. Inadequate BP control was also associated with skin colour and serum creatinine. Although the prevalence of inadequate control of BP was lower than that of other populations, the results of the present study indicate that the lifestyle of the population studied, despite the monitoring by the FDP, does not match the recommendations for control of hypertension, especially with regard to salt intake.

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