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# Factors Associated with Microalbuminuria in Non-Diabetic Hypertension Patients

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## Abstract

The objective was to evaluate the factors associated with urinary albumin excretion (UAE) in non-diabetic hypertension (AH) patients in the context of Primary Health Care (PHC). The parameters investigated were per capita salt consumption, lipid and hematimetric profile, waist circumference and glomerular filtration rate (GFR) compared in individuals with microalbuminuria (MA) and without MA. BackWard multiple linear regression analysis was performed to estimate the influence of the analyzed variables on UAE. The prevalence of microalbuminuria was 21.9%, the mean GFR using the CKP-EPI formula was 65.04 and 60.89 mL/min/1.73m², respectively, among the groups without MA and with MA. Waist circumference and serum creatinine contributed in the explanation of 63.5% in the variation of excreted levels. The patients with AH with MA presented lower GFR, suggesting possible progression to renal disease. Screening for MA should be a frequent practice in PHC, especially in patients with HA.

**Keywords:** Hypertension; Albuminuria; Chronic renal disease

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## Introduction

Arterial hypertension (AH) is one of the major causes of chronic kidney disease (CKD). In the world, it is estimated that 972 million people are carriers of AH [1]. In Brazil, this number reaches more than 32 million [2].

Similarly, the prevalence of CKD is expanding, with a global increase of 8 to 16% per year [1,3]. According to the Brazilian Society of Nephrology, 12 million Brazilians have some degree of renal alteration and 52 million present risk factors for the development of CKD, among them, aging, obesity, AH and diabetes mellitus (DM) [4].

The definition of CKD is any structural and, or functional alteration of the kidneys, regardless of cause, in which the glomerular filtration rate (GFR) is <60 mL/min/1.73m² or the GFR>60 mL/min/1.73m² associated with at least one marker of parenchymal renal damage, such as microalbuminuria (MA), present for 3 months or more [5].

The presence of MA is an early and sensitive marker of renal damage and is an important tool for initial assessment and follow-up in populations at risk for the development of CKD [6]. In patients with AH and without DM the presence of microalbuminuria has increased the risk of developing myocardial ischemia by three times [7] and the risk of progression to CKD by seven times [8]. However, the use of microalbuminuria examination in patients with AH is not a common practice in the

 

health care of this population, which should be reviewed in the care of these patients.

The term MA is the classification given to the presence of 30-300 mg of excreted albumin, measured in the 24-hour urine (gold standard method) [9]. The possible pathophysiological mechanism involved between MA and increased morbidity and mortality of individuals is related to inflammation, generalized endothelial dysfunction and increased capillary permeability [9,10].

Some factors corroborate for increased albumin excretion, including central obesity, increased systolic blood pressure, renal dysfunction, hypertriglyceridemia, decreased HDL-cholesterol, and insulin resistance [11].

In this context, the objective of this study was to evaluate the factors associated with urinary albumin excretion in patients with AH without DM.

## Methods

Cross-sectional study conducted during the months of June 2012 to October 2013, with AH carriers registered without CKD previously diagnosed and accompanied by the Family Health Strategy (FHS) of the municipality of Porto Firme, Minas Gerais (MG), Brazil.

The study was conducted at the Unit of Primary Health Care (PHC) in the urban area of Porto Firme, which houses two Family Health teams. At that time, there were 697 AH carriers registered in the Basic Care Information System [12].

Initially, 293 individuals participated in the study, corresponding to 42% of the total number of AH sufferers in the municipality. For inclusion in the study, the individuals should be 18 years of age or older and have AH in follow-up by the municipality's FHS. The exclusion criteria were: pregnant women, individuals with a history of abusive use of alcohol and, or drugs, non-attendance to the exams on the scheduled day, severe clinical conditions requiring specialized care, previous diagnosis of DM (77), glucose intolerance (10), coronary diseases (8), leukocytosis (13), macroalbuminuria (2). 183 individuals were eligible, corresponding to 26.2% of the patients with AH.

Data were collected through interviews, evaluation of anthropometric, clinical and biochemical parameters. Sociodemographic, health and per capita salt consumption variables were addressed. The data collection instrument was a semi-structured and validated interview script [13-15]. The anthropometric measurements collected were: weight, height and waist circumference (WC). The weight was obtained by means of an electronic scale with a capacity of 150 kg; the height was measured by means of a portable anthropometer using the techniques proposed by Jellife [16]; WC was measured with the use of extensible and inelastic tape, using the midpoint between the iliac crest and the outer face of the last rib. The body mass index (BMI) was calculated by means of the relation between weight and height squared, and classified according to the criteria of the World Health Organization [17] for adults and of Lipschitz [18] for the elderly. The values of normality of WC adopted in this article are in accordance with the VI Brazilian Guidelines on Hypertension (2010) [6].

Systolic and diastolic blood pressure were measured with aneroid manometers, previously calibrated according to the procedures recommended by the VI Brazilian Hypertension Guidelines (2010) [6].

The microalbuminuria analysis was performed by 24 hour urine collection. Excretion between 30 mg/dL and 300 mg/dL in 24 hour urine was considered microalbuminuria. The following biochemical tests were performed: analysis of hematocrit and hemoglobin parameters; serum glucose, triglycerides, LDL-cholesterol, HDL-cholesterol, albumin, uric acid, creatinine, urea, serum sodium. The urinary sample was collected using 24-hour urine microalbuminuria by the nephelometric method. Samples with a urinary volume of less than 500mL were excluded. The collection and analysis of the biological material were performed in a single laboratory accredited by the municipality of Porto Firme-MG, using commercial kits. The GFR was calculated using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation [18]. Patients who presented altered GFR were reassessed after three months to confirm diagnosis according to current recommendations [18,19].

The outcome of the study was excreted urinary albumin. The study population was divided between individuals without microalbuminuria (<30 mg/dL/24h) and with microalbuminuria (30 ≤ n<300 mg/dL/24h). Descriptive analyses of the variables were performed to test the normal distribution of data by the Kolmogorov-Smirnoff and Shapiro-Wilk tests. The continuous quantitative variables with normal distribution were treated with the Student t-test, the variables with asymmetric distribution and heteroscedasticity of variances were treated with the nonparametric Mann-Whitney U test, and both were distributed according to their means, standard deviation, median and interquartile range. The categorical variables were presented with their absolute and relative frequencies using the Spearman or Fisher chi-square test.

BackWard multiple linear regression analysis was used after collinearity analysis, with urinary albumin excretion as the response variable. The criterion for inclusion of possible explanatory variables in the linear regression model was ≤ 0.3. The variables per capita consumption of salt and WC had their forced entry in the regression model because they predicted MA [20-24]. As the MA variable did not present normal distribution, its logarithmic transformation in the base 10 was performed. To guarantee the significance of the data, the analysis of the residues was performed using the Kolmogorov-Smirnov adjusted test, construction of graphs of residues and predicted values. The significance level used was $p \leq 0.05$ bicaudal. The statistical analysis was performed in the SPSS program (Statistical Package for the Social Science, version 20; SPSS Inc. Chicago, USA).

This study was approved by the Research Ethics Committee of the Federal University of Viçosa. Protocol number 044/2012/CEPH, in accordance with Resolution No. 466/2012 of the National Health Council.

## Results

The majority of AH patients evaluated were female (77.6%), aged 60 years or older (67.2%), without spouse (58.4%), overweight (65.8%), with schooling up to complete primary school (54.4%), followed by the illiterate population (26.1%), with family income between one and three minimum wages (84.6%), systolic blood pressure lower than 140 mmHg (76.3%) and diastolic blood pressure lower than 90 mmHg (78.6%).

All were using antihypertensive drugs: diuretics (76.6%), angiotensin-converting enzyme inhibitors (ACEi) (39.7%), angiotensin receptor II (ARB) blocker (35.7%). The use of antilipemiants was exclusively from the statins class.

It is noteworthy that 37.8% presented a positive picture for CKD. Among patients without CKD, 16.1% presented microalbuminuria. Of the patients with AH evaluated 21.9% (n=40) presented microalbuminuria (Table 1).

The median number of drugs in use was 3 (minimum 1 and maximum 8). The median per capita consumption of salt was 18.0 g (minimum 1.0 g and maximum 31.0 g). The mean GFR estimated by the CKD-EPI formula was 65.04 mL/min/1.73m² for individuals without MA and 60.89 mL/min/1.73m² for individuals with MA. The mean hemoglobin in the MA group was significantly lower than in the non- MA patients (13.62 and 14.10 mg/dL respectively, p=0.02) **(**Table 2).

The determining factors for the presence of albumin in urine according to multiple linear regression were the highest presence of serum creatinine (β=0.624, p=0.027) and highest WC (β=0.498, p=0.01). This model collaborated with 63.5% in the variation of excreted albumin levels. Homoscedasticity of variances was verified by analysis of normality of residues by Kolmogorov-Smirnov (p=0.200) and Shapiro-Wilk (p=0.728) tests and by distribution of errors in the normal probability plot (Q-Q Plot).

**Table 1** Frequency of sociodemographic, economic, anthropometric, clinical and biochemical variables according to microalbuminuria in patients with AH, Porto Firme, MG, 2012, 2013**.**

| Variables | | Microalbuminuria | | Total | *p*-value |
|---|---|---|---|---|---|
| | | | Yes | | |
| | | n (%) | n (%) | | |
| Sex | Female<br>Male | 110 (77,5)<br>33 (80,5) | 32 (22,5)<br>8 (19,5) | 142 (77,6)<br>41 (22,4) | 0,68* |
| Age | < 60 years | 47 (78,3) | 13 (21,7) | 60 (32,8) | 0,96* |
| | ≥ 60 years | 96 (78,0) | 27 (22,0) | 123 (67,2) | |
| Marital Status | With spouse | 83 (79,8) | 21 (20,2) | 104 (58,4) | 0,65* |
| | No spouse | 57 (77,0) | 17 (23,0) | 74 (41,6) | |
| Schooling | Illeterate | 37 (78,7) | 10 (21,3) | 47 (26,1) | 0,55** |
| | Complete Elementary School | 80 (81,6) | 18 (18,4) | 98 (54,4) | |
| | Complete high school | 13 (68,4) | 6 (31,6) | 19 (10,6) | |
| | Tertiary education | 12 (75,0) | 4 (25,0) | 16 (8,9) | |
| Family Income (in minimum wages) | <1 | 11 (84,6) | 2 (15,4) | 13 (7,4) | 0,93** |
| | 1 a 3 | 115 (77,7) | 33 (22,3) | 148 (84,6) | |
| | ≥ 3 | 11 (78,6) | 3 (21,4) | 14 (8,0) | |
| Smoking | No | 130 (79,8) | 33 (20,2) | 163 (90) | 0,37* |
| | Yes | 12 (70,6) | 5 (29,4) | 18 (10) | |
| Use of Alcohol | No | 123 (78,8) | 33 (21,2) | 156 (88,1) | 0,25** |
| | Yes | 19 (90,5) | 2 (9,5) | 21 (11,9) | |
| Class of antihypertensives used | Diuretic | 104 (79,4) | 27 (20,6) | 131 (76,6) 8 | 0,35* |
| | Alpha-blocker | 6 (75,0) | 2 (25,0) | (4,7) | 0,35* |
| | Beta-blocker | 38 (82,6) | 8 (17,4) | 46 (26,9) | 0,36* |
| | Calcium channel blocker | 23 (71,9) | 9 (28,1) | 32 (18,7) | 0,36* |
| | IECA | 53 (77,9) | 15 (22,1) | 68 (39,7) | 0,99* |
| | ARB | 44 (72,1) | 17 (27,9) | 61 (35,7) | 0,18* |
| Anti-lipomians | Estatinas | 54 (79,0) | 14 (21,0) | 68 (100) | 0,62* |
| Nutritional Statusl[a] | Low-weight | 9 (100) | - | 9 (5,0) | 0,34* |
| | Normal | 38 (79,2) | 10 (20,8) | 48 (27,0) | |
| | Overweight | 94 (77,7) | 27 (22,3) | 121 (68,0) | |

| | | | | | |
|---|---|---|---|---|---|
| Waist circumference[b] | Suitable | 52 (82,5) | 11 (17,5) | 63 (40,9) | 0,42* |
| | Inadequate | 86 (77,5) | 25 (22,5) | 91 (59,1) | |
| Diastolic blood pressure (mmHg) | <140 | 87 (84,5) | 16 (15,5) | 103 (76,3) | 0,40* |
| | ≥140 | 25 (78,1) | 7 (21,9) | 32 (23,7) | |
| Diastolic blood pressure (mmHg) | <90 | 87 (82,1) | 19 (17,9) | 106 (78,6) | 0,78** |
| | ≥90 | 25 (86,2) | 4 (13,8) | 29 (21,4) | |
| GFR (mL/min/1,73m²) | >90 | 6 (66,7) | 3 (33,3) | 9 (5,0) | 0,03** |
| | 60-89 | 88 (85,4) | 15 (14,6) | 103 (57,0) | |
| | 45-59 | 44 (73,3) | 16 (26,7) | 60 (33,0) | |
| | 30-44 | 2 (40,0) | 3 (60,0) | 5 (3,0) | |
| | 15-29 | 2 (66,7) | 1 (33,3) | 3 (2,0) | |
| CKD | Yes | 48 (70,6) | 20 (29,4) | 68 (37,8) | 0,03* |
| | No | 94 (83,9) | 18 (16,1) | 112 (62,2) | |

[a]Nutritional status according to World Health Organization, 1988 for adults and Lipschitz, 1994 for the elderly;
[b*]Pearson's $x^2$ test;
[**]Fisher's exact test;
The values in bold were significant in the research;
GFR: Glomerular Filtration Rate
ARB: Angiotensin receptor blockers
ACEi: Angiotensin-converting enzyme inhibitors

**Table 2** Mean (SD) and median (max-min) of anthropometric, pressure, biochemical variables, according to microalbuminuria in the carriers of AH Porto Firme, MG, 2012, 2013.

| Variables | Microalbuminuria | | | | |
|---|---|---|---|---|---|
| | No | | Yes | | *p*-value |
| | μ (SD) | Median (max - mín) | μ (SD) | Median (max - mín) | |
| Age (years) | 65 (12,38) | 65 (89-28) | 65,35 (11,19) | 65,50 (87-39) | 0,99** |
| Salt consumption (g) | 17,47 (6,8) | 18,00 (31-1) | 15,8 (8,37) | 18,00 (28-1) | 0,47* |
| AH duration (years) | 17,97 (12,52) | 15,00(40-0) | 19,42 (12,57) | 18,5 (28-1) | 0,56* |
| Nº of drugs in use(n) | 3,55(1,53) | 3,00 (8-1) | 3,59 (1,74) | 3 (8-1) | 0,99* |
| Systolic blood pressure (mmHg) | 122,77 (18,41) | 120 (190-90) | 125,22 (24,84) | 120 (200-100) | 0,94* |
| Diastolic blood pressure (mmHg) | 75,45 (14,2) | 80,00 (120-50) | 73,91 (11,18) | 70 (100-60) | 0,70* |
| Glucose (mg/dL) | 92,80 (9,59) | 93,0 (124-73) | 93,60 (9,68) | 92,0 (120-76) | 0,99* |
| Hemoglobin (mg/dL) | 14,11 (1,13) | 14 (17,3-11,6) | 13,62 (1,47) | 13,7 (17-9,4) | **0,02**** |
| Red cells (milh./mm³) | 4,87 (0,46) | 4,87 (6,39-3,6) | 4,63 (0,55) | 4,64 (5,91-2,82) | **0,007**** |
| Hematocrit (%) | 43,05 (3,55) | 42,9 (53,7-34,4) | 41,295 (4,6) | 41,65 (50,7-27,3) | **0,01**** |
| HDL Cholesterol (mg/dL) | 48,80 (7,74) | 49,00 (73-33) | 50,75 (11,95) | 49,5 (95-30) | 0,61* |
| LDL Cholesterol (mg/dL) | 131,213 (29,8) | 128 (214-74,2) | 127,16 (30,28) | 124,2 (197,2-79) | 0,45** |
| Triglycerides (mg/dL) | 139,75 (72,50) | 122 (481-50) | 141,68 (63,94) | 138,00 (315-50) | 0,57* |
| Serum sodium (mEq/L) | 140,3 (1,96) | 140 (146-136) | 140,78 (2,68) | 141,00 (147-133) | 0,16* |
| Serum albumin (g/dL) | 3,97 (0,18) | 3,98 (4,3-3,5) | 4,0 (0,2) | 3,98 (4,34-3,5) | 0,35** |
| Uric acid (mg/dL) | 5,33 (1,25) | 5,1 (9-3,1) | 5,16 (1,30) | 5,0 (8,1-3,4) | 0,41* |
| Serum urea (mg/dL) | 37,59 (7,16) | 36 (58-23) | 38,49 (10,74) | 37,45 (73-24) | 0,92* |
| Serum creatinine (mg/dL) | 1,00 (0,17) | 0,96 (1,87-0,76) | 1,10 (0,39) | 1,015 (2,91-0,72) | 0,28* |
| GFR (mL/min/1,73m²) | 65,04 (13,15) | 64,20 (106,7-26,8) | 60,89 (16,99) | 58,50 (103,3-15,6) | 0,10** |

The values in bold were significant in the research;
*Mann-Whitney U test;
** Student's t test;
SD: Standard Deviation
AH: Arterial Hypertension
GFR: Glomerular Filtration Rate

## Discussion

In the present study, 21.9% of AH carriers evaluated presented MA. In other studies, when AH carriers were not under drug treatment, the prevalence of MA found was 9% and 19%, lower than that found in the present study [20,25].

The median systolic and diastolic blood pressure in the group with MA was 120 and 70 mmHg, respectively, which is in accordance with the goal of pressure levels recommended by the Ministry of Health [26]. Control of blood pressure in patients with AH in addition to the nefarious and cardioprotective effect has a potential role in reducing albumin excretion [6,27].

Of patients with MA, all were on at least one class of antihypertensive medication, respectively: diuretics (76.6%), ARB (35.7%) and ACEi (39.7%). The use of renin angiotensin aldosterone system blockers has been an applicable measure in reducing albumin excretion and therefore nephroprotection [9,27].

Salt consumption was high (median 18 g/day), considering that the maximum WHO recommendation [28] is 5 g/day. A study developed by Sarno et al [29] also found a high consumption of salt, corresponding to 11.75g/day. High salt consumption is closely related to increased blood pressure and the development of AH [30].

The relationship between MA excretion and salt consumption has been proposed in the scientific literature [30], demonstrating that the increase in sodium consumption by the adult population, assessed by urinary sodium excretion, has potentiated the excretion of albumin in urine, especially in overweight individuals [23].

Studies also point out that in the population with AH there is a positive and significant association between higher levels of salt consumption and MA [20,30,22,24]. However, in this study, there was no statistically significant difference in the median consumption of salt between the groups.

It is noteworthy that the mean GFR was lower in the group with MA, which may suggest kidney parenchyma injury [5], since MA is a predictor of risk of development and progression of CKD [8]. This fact highlights, once again, the importance of screening for CKD by means of the MA test.

In this study, the percentage of individuals diagnosed with CKD was 37.8%, which demonstrates a high portion of AH carriers accompanied by PHC without diagnosis. Additionally, 16.1% of the patients without diagnosis of CKD presented with the presence of microalbuminuria, which suggests an initial lesion of the target organ, which may progress to CKD.

The mean values of the hematimetric parameters differed between the groups ($p<0.05$). The group with MA presented lower mean values for red blood cells, hematocrit, and hemoglobin when compared to the group without MA. Although the values found are not characteristic of anemia, the difference between the groups reinforces the need for early diagnosis of CKD and an appropriate therapeutic approach in order to prevent anemia resulting from a possible CKD from causing greater damage to the cardiovascular and nervous systems [32].

As for WC, 59.1% of those evaluated presented inadequate values. The use of WC measurement for central obesity evaluation in risk stratification in patients with AH is an adequate and recommended practice [6]. The presence of central obesity is associated with greater progressive loss of renal filtration and greater risk for albumin excretion due to mechanisms involved in insulin resistance [11].

Finally, knowing that the presence of MA is a risk factor for the progression of CKD and cardiovascular disease, the request for MA examination becomes a potential tool in the prevention of aggravation to the health of patients with AH, by allowing early detection of CKD.

It is noteworthy that the costs caused by CKD are high and demand health actions of medium and high complexity, which highlights the importance of early diagnosis of the disease, especially in those with AH [27].

As a limitation of the study, it is pointed out that urinary sodium excretion is not used to measure salt consumption.

## Conclusion

This study highlights the importance of MA evaluation in AH carriers. The use of the MA test, whose positive result is associated with renal and cardiovascular morbidities, should be a practice implemented, especially in the reality of PHC, which is the individual's gateway to the health system and the strategic place for early diagnosis of diseases and prevention of diseases.

This study suggests new research along these lines in order to get to know the Brazilian reality and the factors that interfere in the increase of urinary albumin excretion.

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