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The Brief Medication Questionnaire and Morisky-Green Test to evaluate medication adherence

ABSTRACT

OBJECTIVE: To analyze the reliability and performance of the Portuguese version of questionnaires used to evaluate adherence to hypertensive treatment.

METHODS: Hypertensive patients attending a primary healthcare unit in Porto Alegre, Southern Brazil, from January to September 2010, were randomly selected (n = 206). To evaluate adherence, Portuguese versions of the Morisky-Green test (MGT) and the Brief Medication Questionnaire (BMQ) were used. The analysis considered internal consistency, temporal stability and performance compared to three gold standards, which are: inadequate control of blood pressure (BP ≥ 140/90 mmHg); insufficient rate of medication acquisition at the institution's pharmacy (<80%) and a combination of both factors.

RESULTS: Of the patients studied, 97 only used medications dispensed by the Basic Health Unit. The tests showed good internal consistency by Cronbach's α: BMQ 0.66 (95%CI 0.60 to 0.73) and the MGT 0.73 (95%CI 0.67 to 0.79). The BMQ Regimen Screen had a sensitivity of 77%, specificity of 58%, and an area under the ROC curve of 0.70 (95%CI 0.55 to 0.86); for MGT sensitivity was 61%, specificity 36% and area under the ROC curve 0.46 (95%CI 0.30 to 0.62). The correlation between the BMQ and the MGT was r=0.28, p> 0.001. Low adherence per the BMQ is associated with higher blood pressure levels when compared to adherent patients (148.4 [SD 20.1] vs 128.8 [SD 17.8]; p <0.001), but not for the MGT.

CONCLUSIONS: The BMQ showed better performance than the MGT, with greater sensitivity and specificity. Evaluation of adherence may help clinicians discriminate between inadequate use of medication and insufficient treatment regimen.

DESCRIPTORS: Hypertension, therapy. Antihypertensive Agents, therapeutic use. Medication Adherence. Questionnaires, utilization. Sensitivity and Specificity. Reproducibility of Results.

INTRODUCTION

Epidemiologic studies point to hypertension as a key risk factor for acute cardiovascular events.[24] The control of blood pressure has decreased mortality from cardiovascular disease, and although the number of treated patients is increasing, more than 50% of hypertensive people have uncontrolled blood pressure.[25] In observational studies, low adherence to hypertensive treatment has been considered a barrier to control of blood pressure.[6,8]

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Although there is no consensus, adherence to medications is understood as use of the prescribed medication at least 80% of the time, including hours, doses and length of treatment. Patients with a use less than 80% present four times the risk for acute cardiovascular risks.[13] Various methods have been utilized to evaluate low adherence, such as self-report, manual and electronic counts of medication, retrieval of medication from pharmacies, laboratory tests for pharmaceuticals or metabolites of pharmaceuticals, and questionnaires.[10]

Despite low sensitivity and accuracy, questionnaires are more often utilized due to low cost and ease of application in large populations. These instruments can be useful in differentiating between low adherence and non-response to antihypertensive medication, when used together with other methods such as electronic counts of pills (Medication Events Monitoring System - MEMS).[26] The Morisky-Green Test (MGT),[16] the most utilized questionnaire in Brazil, performs poorly. This test, validated in the USA with hypertensives, utilizes control of blood pressure as the gold standard and presented a low sensitivity of 43.6% and reasonable specificity of 81% in identifying non-adherent behavior. Evaluation of its performance in Portuguese was described in at least four studies with hypertensive people.[4,17,19,22] We did not identify an evaluation of the Portuguese translation or its reliability in this language in the literature. The Brief Medication Questionnaire (BMQ)[23] was evaluated in English with 43 hypertensive patients using MEMS as the gold standard. The tool is divided in three screens that identify barriers to adherence of a drug regimen, beliefs and patient recall of medication treatment. The original study presented a sensitivity of 80% and specificity of 100% in the regimen screen, although it has not yet been evaluated in Portuguese. Therefore, the BMQ tool appears potentially superior to the MGT, especially in screening for non-adherent behavior, but they were evaluated in different settings. Evaluation of both instruments in the same sample would improve understanding of their respective utility in the clinic and in research.

The objective of this study was to analyze the reliability and performance of these tools to evaluate adherence to antihypertensive treatment.

METHODS

The cross-sectional study used simple random selection of hypertensive people enrolled at least six months in the program to assist hypertensive and diabetic individuals (Hiperdia), in basic health units (unidade básica de saúde, UBS) of the city of Porto Alegre, Southern Brazil, from January to September of 2010. Of the 497 selected individuals, 291 were excluded for the following reasons: cognitive deficit, 13 (2.5%); resident of other areas, 28 (5.3%), death, 18 (3.4%); not reached, 172 (32.7%), not hypertensive, 22 (4.2%); participating in other research, 16 (3.0%) and refusal, 22 (4.2%). Participants answered a questionnaire administered by trained graduate students in medicine.

The questionnaire included data on sociodemographics; clinical aspects such as comorbidities, physiology and name of the antihypertensives utilized; mode of obtaining medication; expenditures on antihypertensive medications and affiliation with a health service.[9] Low adherence was evaluated utilizing two questionnaires: the Portuguese version of the MGT with four questions[16] and the newly translated Portuguese version of the BMQ with 11 questions (Annex).

The version of the MGT included the following questions: 1) Do you sometimes have difficulty to remember to take your medication *(Você às vezes tem problemas em se lembrar de tomar a sua medicação)*? 2) Do you sometimes not pay attention to taking your medication *(Você às vezes se descuida de tomar seu medicamento)*? 3) When you feel better, do you sometimes stop taking your medication? *(Quando está se sentindo melhor, você às vezes para de tomar seu medicamento)*? 4) Sometimes, if you feel worse after taking medication, do you stop taking it *(Às vezes, se você se sentir pior ao tomar a medicação, você para de tomá-la)*?

The score obtained by the BMQ in each screen (regimen, beliefs and recall) were obtained by comparing patient responses to the prescription received. The medical prescription analyzed was documented in the charts of people affiliated with a UBS or a traditional prescription was provided by patients of other physicians or health services.

Other aspects encountered included: level of physical activity, measured by the short version of the International Physical Activity Questionnaire (IPAQ),[2] classifying individuals as sedentary and active; tobacco use defined as current use of any cigarettes; socioeconomic level established by criteria for Brazil 2008;[a] self-perceived health dichotomized in good/very good and fair/poor/very poor;[1] presence of common mental disorders according to the Portuguese version of the Self-Report Questionnaire (SRQ),[20] with a cutoff value of eight positive responses for women and seven responses for men. Comorbidities included obesity (body mass index, BMI $\geq$ 30 kg/m^2); cardiovascular disease (angina, infarction or intermittent claudication) evaluated by the Rose questionnaire[14] or history of cerebrovascular accident reported by the patient and/or recorded in medical records; chronic renal insufficiency

[a] Associação Brasileira de Empresas de Pesquisa. Critério Brasil 2008. São Paulo; 2008 [cited 2012 Jan 11]. Available from: http://www.abep.org/novo/CMS/Utils/FileGenerate.ashx?id=13

(CRI) with endogenous creatine levels estimated by the Cockcroft-Gault formula at ≤ 30 ml/min/1.73m^2;[20] diabetes mellitus; glycemia ≥126 mg/dl, or use of hypoglycemia medications; dyslipidemia reported by the patient; use of cholesterol lowering drugs or record of total cholesterol ≥ 200 mg/dl, LDL ≥ 130 mg/dl; or triglycerides ≥ 150 mg/dl.[12]

During interview, blood pressure was measured with an aneroid manometer (Missouri®, Brazil) using the average of two measurements. When the diameter of the upper arm was greater than 32 cm, a cuff for obese people was used. Height and weight were measured with a digital anthropometric scale (Welmy®, Brazil). Fasting serum levels measured included: creatine, glycemia, total cholesterol, HDL and triglycerides using the colorimetric enzyme method.

Questionnaire validation included: translation and back translation of the BMQ questionnaire and evaluation of internal consistency, temporal stability and performance in regards to the gold standards for the TMG and BMQ.

The BMQ was translated into Portuguese by two researchers and corrected by a third researcher that speaks native English. The questionnaire was then back translated into English by a translator. The version utilized is the result of comparing the original version to the back translation and correcting the differences identified. This phase was performed by two physicians from Brazil with familiarity with English. Finally, the resulting version was administered to four individuals, not included in the study, for final adjustments. A manual for applying the BMQ was developed to train interviewers. In the Portuguese translation of the BMQ (Annex), a simplification was performed regarding the dosing of medications, since in the pilot study the patients could not recall the concentrations of medication per pill. In the original version of the questionnaire, the first question asked the patient the name and dosage of the medications used. Failure in reporting any one of these items was considered a positive response and low adherence. In the translation, if the patient failed to report the name or class of medication, the response was considered positive for the first item in the score of problems encountered by the BMQ for the regimen screen, irrespective of failure to recall dosage. It was assumed that content validity was performed by the authors of the original study. In the analysis of internal consistency, the correlation of each item with the sum of the items and inter item correlation, calculating a Cronbach α coefficient for each questionnaire.

For the analysis of temporal stability, patients with stable therapeutic schemes were retested at an interval of 14 to 30 days. Concordance between test and retest was evaluated by a gamma correlation coefficient.

The performance analysis for the BMQ and MGT used the descriptive statistics of sensitivity, specificity and area under the ROC curve, considering three gold standards: 1- uncontrolled blood pressure (BP≥ 140/90 mmHg); 2- insufficient rate of medication acquisition from UBS pharmacy (acquisition <80% of medication in the period considered); and 3- combination of the first two, which are uncontrolled blood pressure and insufficient acquisition of medication. Gold standards (2) and (3) were only considered in the sub-sample of patients whose therapeutic regimens included medications available from the UBS pharmacy during the entire study period (captopril, propranolol, furosemide and hydrochlorothiazide).

Gold standard 2 was calculated from the agreement between the three measures for acquisition of medicines as defined below:

Continuous single-interval medication availability (CSA): number of days for which medications were provided divided by the interval of days between the last two acquisitions of medications. Dispensing is monthly. Month of interview was evaluated.

Medication possession ratio (MPR): number of days for which medications were acquired divided by the number of days between the first and last acquisition during the six months before the interview.

Acquisition of Medication during the six previous months (AM6M): number of times the patient acquired medications in the pharmacy divided by six, considering the six months before the interview.

The Spearman coefficient was utilized to analyze the correlation between MGT and BMQ. The Kappa coefficient was used to analyze agreement between the two methods. Characteristics of hypertensive people were also described according to the level of adherence identified by the MGT and BMQ. For the comparisons, chi-square tests, t tests and Mann-Whitney tests were used according to the distribution of variables. The significance level was 5%. To analyze potential confounding factors, the variables associated with low adherence at $p< 0.1$ in any of the questionnaires, were analyzed in a logistic regression model with the dependent variable as low adherence on the MGT or the BMQ.

The study was approved by the Research and Post-graduate Ethics Committee of the Hospital das Clínicas in Porto Alegre (appearance no.18883, on 14 July 2010). Participants signed voluntary informed consent forms.

RESULTS

Of the 206 patients evaluated, 105 only used medications available in the UBS pharmacy (group 1) and 101 used other antihypertensives besides those available in

the pharmacy (group 2) (Table 1). Eight patients were removed from the first group, since they purchased the medications utilized, for a total of 97 patients in group 1. These patients were not included in group 2 due to the requirement of different prescription. Comparison between groups showed the similarity regarding sociodemographic characteristics, level of physical activity, tobacco use, self-perceived health and other comorbidities investigated. Group 2 showed the highest proportion of hypertensive people with CRI (17.0% vs 29.7%, p=0.04) and higher blood pressure levels [SBP 131.6 mmHg (SD 17.3) vs 139.3 mmHg (SD 22.2), p=0.008; DBP 80.5 (SD 11.7) vs 84.5 (SD 14.1), p=0.03].

Table 1. Characteristics of all hypertensive individuals evaluated, patients that only use medications provided at basic health units (group 1) and patients that use other medications in addition to those available in the health unit (group 2). Porto Alegre, Southern Brazil, 2010.

Variable	Total n = 206		Group 1 n(%) = 97		Group 2 n(%) = 101		p*
	n	%	n	%	n	%	
Sociodemographic							
Age	66.6 (SD 13.2)		67.1 (SD 12.5)		66.1 (SD 14.1)		0.57
Male sex	73	35.4	33	34	37	36.6	0.76
White	168	81.6	81	83.5	79	78.2	0.3
Years of education	8.3 (dp 4.4)		7.9 (dp 4.5)		8.6 (dp 4.5)		0.31
Married / partner	94	45.6	48	49.5	43	42.6	0.39
Retired	77	37.4	30	30.9	44	43.6	0.07
Average household monthly income R$	1892 (SD 1564)		2010.0 (SD 1599.6)		1730 (SD 1503.6)		0.13
Class D and E	13	6.3	7	6.7	6	6.0	0.78
Affiliated with basic health unit	173	84.0	85	87.6	81	80.2	0.17
Has health insurance	54	26.2	37	27.8	24	23.8	0.52
Comorbidities							
Cardiovascular disease	693	33.5	28	28.3	39	38.6	0.18
Chronic renal insufficiency	48	23.8	16	17	30	29.7	0.04
Obesity	82	39.8	32	33	44	43.6	0.14
Diabetes	64	31.3	27	27.8	36	35.6	0.29
Common mental disorders	34	16.5	17	17.5	17	16.8	1.0
Dyslipidemia	107	51.9	50	51.5	54	53.5	0.89
Cardiovascular risk factors							
Sedentarism	80	40.4	44	45.4	36	35.6	0.19
Tobacco use	26	12.6	13	13.5	12	11.9	0.83
Blood pressure level							
Mean systolic BP	135 (SD 20.0)		131.6 (SD 17.3)		139.3 (SD 22.2)		0.008
Mean diastolic BP	82.4 (SD 13.0)		80.5 (SD 11.7)		84.5 (SD 14.1)		0.03
Uncontrolled BP	95	46.1	40	42.6	54	57.4	0.09
Perception of very good or good health	153	74.3	72	74.2	76	75.2	0.87
Adherence							
Morisky-Green Test							
Adherent	80	38.8	34	35.1	41	40.6	0.46
Moderate adherence	106	51.5	50	51.5	53	52.5	1.0
Low adherence	20	9.7	13	13.4	7	6.9	0.16
BMQ							
Regimen screen	99	48.1	45	46.4	49	48.5	0.77
Belief screen	56	27.2	23	23.7	31	30.7	0.39
Recall screen	191	92.7	88	90.7	97	96.6	0.15

* Tests utilized: chi-square for dichotomous variables; t Test for continuous variables with a parametric distribution and Mann-Whitney for continuous variables with a non-parametric distribution; AP controlled: controlled arterial pressure < 140/90 mmHg , Classes D and E: economic classification criteria for Brazil 2008; R$: reais; BMQ: Brief Medication Questionnaire.

Analysis of internal consistency in the BMQ and MGT was performed with 206 patients interviewed. BMQ, considering the three screens together (total BMQ), presented a Cronbach α of 0.67 (95%CI 0.60;0.73). The Cronbach α in the regimen screen was equivalent to 0.67 (95%CI 0.60;0.73). The Cronbach α for the beliefs screen was 0.84 (95%CI 0.80;0.87). The Cronbach α for the recall screen was 0.76 (95%CI 0.70;0.81). The MGT presented a Cronbach α of 0.73 (95%CI 0.67;0.79).

In the analysis of temporal stability performed in a subsample of 19 patients, the average length of time between test and retest was 22.2 days. The total BMQ and the regimen, beliefs and recall screens presented respective gamma coefficients of r=0.83; p<0.001; r=0.84; p=0.01; r=0.86; p=0.004; r=0.94; p=0.12. The MGT presented less stability between test and retest (r=0.70; p=0.02).

In regards to the choice of gold standard 2, insufficient acquisition of medications from the pharmacy, agreement between MPR, AM6M and CSA was assessed. Agreement between MPR and AM6M per the kappa coefficient was 0.86; p<0.001. Therefore, they both assess non-adherence over six months, and adherence was considered low during this period if either one was <80%. Agreement between CSA, which evaluated adherence in the last 30 days, with MPR and AM6M was 0.45; p<0.001 and 0.51; p<0.001, respectively. Therefore we considered adherence low when CSA was <80% and MPR or AM6M was <80%, in other words, during the month preceding interview date and the six months before interview date.

In regards to questionnaire performance in regards to the gold standards (Figure), for gold standard 1 the following values were found: total BMQ, area of 0.65 (95%CI 0.57;0.72); BMQ regimen screen, area of 0.73 (95%CI 0.66;0.80) and MGT, area of 0.52 (95%CI 0.44;0.60). For gold standard 2, the areas were: total BMQ, 0.54 (95%CI 0.44; 0.67); BMQ regimen screen, 0.55 (95%CI 0.44;0.67) and MGT, 0.53 (95%CI 0.41;0.64). And for gold standard 3, the values were: total BMQ, 0.63 (95%CI 0.47;0.79); BMQ regimen screen, 0.71 (95%CI 0.55;0.86) and MGT, 0.46 (95%CI 0.30;0.62). There were significant differences in performance only in relation to gold standard (1), between the BMQ regimen screen and MGT.

As the number of positive responses to the questionnaires increased, the specificity in screening for low adherence also increased in relation to the three gold standards (Table 2). The BMQ regimen screen with a cutoff value of ≥1 for the score of problems identified by the BMQ presented better equilibrium between sensitivity and specificity for the three gold standards. This cutoff value can be utilized in screening for low adherence.

To identify a more specific clinical standard associated with the low adherence identified by the questionnaires, the profiles of patients with low and high adherence were analyzed. We considered high adherence as negative responses to all questions and low adherence as two or more positive responses in the MGT and in the score of problems identified by the BMQ regimen screen. There were sociodemographic and clinical aspects in regards to blood pressure levels and greater prevalence of CRI among patients identified with low adherence by the regimen screen, but not among patients with low adherence identified by the MGT (Table 3). This indicates a nexus of low adherence and clinical outcome that is only being

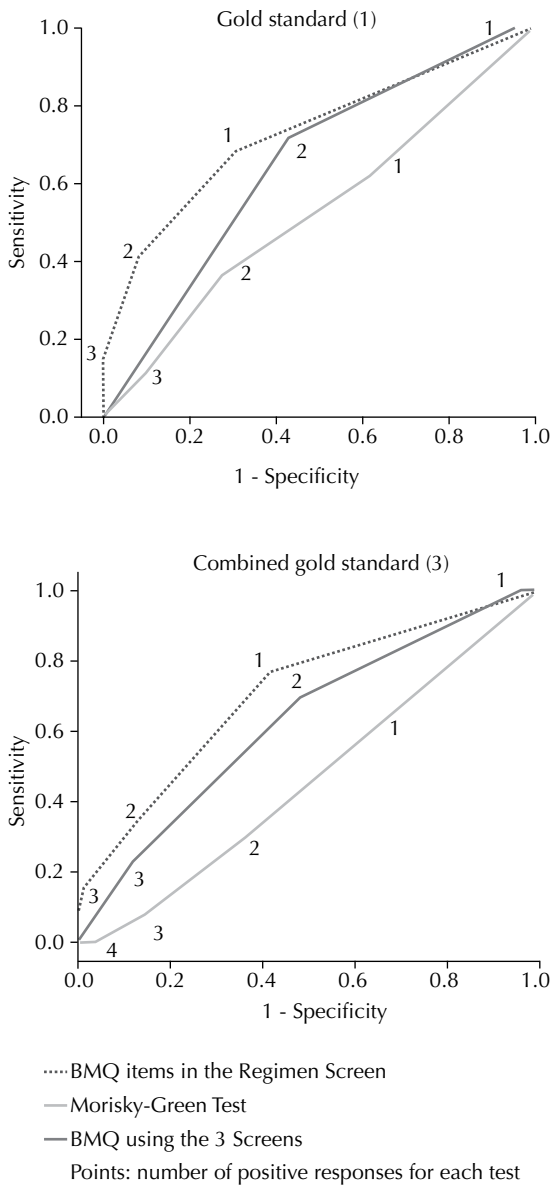

Figure. Performance of the tests according to the gold standard of uncontrolled arterial pressure (1) and the combined gold standard (3, uncontrolled arterial pressure + insufficient uptake of antihypertensive medication). Porto Alegre, Southern Brazil, 2010.

Table 2. Performance of the questionnaires according to the number of positive responses in the Morisky-Green Test and the Brief Medication Questionnaire in comparison to the three gold standards utilized. Porto Alegre, Southern Brazil, 2010.

Performance	Gold standard 1		Gold standard 2		Gold standard 3	
	Se%	Sp%	Se%	Sp%	Se%	Sp%
Morisky-Green Test						
Adherent (no positive responses)	100	0	100	0	100	0
Moderate Adherence (1 positive response)	61.1	38.7	61.8	34.9	61.5	35.7
Moderate Adherence (2 positive responses)	36.8	72.0	35.3	63.5	30.8	63.1
Low Adherence (3 positive responses)	10.5	90.9	11.8	85.7	0	85.7
Low Adherence (4 positive responses)	3.2	98.2	5.9	98.4	0	96.4
Brief Medication Questionnaire						
Adherent (no positive response)	100	0	100	0	100	0
Probable adherence (positive response in 1 screen)	100	3.6	97.1	3.2	100	3.6
Probable low adherence (positive response in 2 screens)	71.6	56.8	47.1	47.6	69.0	52.4
Low adherence (positive response in 3 screens)	17.9	90.0	23.5	92.1	23.0	88.1
BMQ Regimen Screen						
Adherent (no positive responses)	100	0	100	0	100	0
Probable adherence (1 positive response)	68.4	69.4	50.0	55.6	77.0	58.3
Probable low adherence (2 positive responses)	41.1	91.9	23.5	84.1	38.5	84.5
Low adherence (>3 positive responses)	14.7	100	0.60	98.4	15.4	98.8

Se=sensitivity; Sp=specificity; gold standard 1: uncontrolled arterial pressure >140/90mmHg; gold standard 2: insufficient use of medications from the basic health unit pharmacy <80%; gold standard 3: combination of gold standards 1 and 2

measured by the BMQ. Hypertensive people with low adherence per the BMQ regimen screen presented a greater average number of medications than those with high adherence. A medication usage pattern was not identified among patients with low adherence as identified by MGT. These differences are compatible with the low correlation between BMQ and MGT (r=0.28; p<0.001). The two methods did not present agreement (r= – 0.14, p=0.56). We identified a lower percentage of patients with self-perceived good or very good health among patients with low adherence as identified by both tools. There were no significant differences between the questionnaires in regards to expenditures on medications, type of medication utilized, number of daily doses and other characteristics.

Logistic regression analysis was performed to assess confounding by the factors that were associated in univariate analysis to low adherence in one of the screening tests with $p < 0.1$: presence of controlled or uncontrolled hypertension, perception of health dichotomized in good/very good and fair/poor/very poor, CRI present or not and number of antihypertensives used. For the MGT, self-perceived health was associated with adherence as measured by the prevalence ratio (PR) of 2.57 (95%CI 1.18;2.80). For the BMQ, good adherence was associated with good control of blood pressure with an POR of 13.13(95%CI 5.03;34.29) and self-perception of good/very good health with an PR of 4.02 (95%CI 1.55;10.43).

DISCUSSION

Reliability as evaluated by the analysis of internal consistency is ideal when the Cronbach α coefficient is greater than 0.7, but acceptable when above 0.6.[7] Both questionnaires were correlated to the sum of their items, meaning that, within each questionnaire, the items measure the same concept. The MGT presented greater internal consistency than the BMQ, although lower temporal stability.

The analysis of BMQ showed that the regimen screen performed better than the other screens and the MGT for the identification of low adherence among people with uncontrolled hypertension. This finding is similar to the original study performed in the USA, which used a more reliable gold standard (MEMS) than the insufficient acquisition of medications and uncontrolled blood pressure, although it was obtained in a smaller sample of patients (43 vs 206). We did not encounter studies evaluating BMQ in relation to control of blood pressure. In the present study, the BMQ regimen screen presented lower performance than in the original study – sensitivity of 80% vs 77% and specificity of 100% vs 58.3% for the combined gold standard. This may be due to differences in the sample, culture, the gold standards and in the system that records acquisition of medications. Furthermore, in addition to the adaptations during Portuguese translations of the BMQ, a simplification was introduced in regards to dosage. Nonetheless, we cannot affirm that the validation using this adaptation

Table 3. Characteristics of hypertensive patients according to level of adherence in the Morisky-Green Test and Brief Medication Questionnaire. Porto Alegre, Southern Brazil, 2010.

Variable	MGT					BMQ				
	n=80 High adherence		n=66 Low Adherence (≥ 2 positive responses)		p	n=107 High adherence		n=48 Low Adherence (≥ 2 positive responses)		p*
	n	%	n	%		n	%	n	%	
Sociodemographic										
Age	70.0 (SD 11.4)		63.4 (SD 13.4)		0,00	66.0 (SD 13.5)		66.0 (SD 14.0)		0.99
Male sex	67	36.0	6	30.0	0.80	37	34.6	17	35.4	1.00
White	69	86.2	51	77.3	0.19	88	82.2	37	77.4	0.51
Years of education	8.0 (SD 4.0)		7.8 (SD 4.5)		0.68	8.8 (SD 4.6)		7.8 (SD 4.8)		0..22
Married/partner	36	45.0	27	40.0	0.73	49	45.8	18	37.5	0.38
Retired	33	41.2	22	33.3	0.39	39	36.4	17	35.4	1.00
Monthly household income R$	1931 (SD 1611.2)		1530 (SD 993.7)		0.05	1882.3 (SD 1634.4)		1795 (SD 1537)		0.45
Classes D and E	2	2.5	8	12.1	0.12	4	3.7	5	10.4	0.43
Affiliated with basic health unit	70	87.5	50	75.8	0.08	93	86.9	41	85.4	0.80
Health insurance	19	23.8	15	22.7	1.0	27	25.2	12	25.0	1.00
Comorbidities										
Cardiovascular disease	26	32.5	20	30.3	0.86	36	33.6	16	33.3	1.00
Chronic renal insufficiency	16	20.0	16	25.0	0.55	21	19.8	20	42.6	0.01
Obesity	32	40.0	26	39.4	1.00	45	42.1	19	39.6	0.86
Diabetes	19	23.8	24	36.4	0.10	30	28	16	33.3	0.57
Common mental disorders	9	11.2	15	22.7	0.07	21	19.6	5	10.4	0.17
Dyslipidemia	47	58.8	32	48.5	0.28	58	54.2	25	52.1	0.86
Cardiovascular risk factors										
Sedentarism	33	41.3	27	40.9	0.51	43	40.2	20	41.7	0.50
Tobacco use	7	8.9	6	9.1	1.0	16	15.0	4	8.3	0.31
Blood pressure										
Mean systolic BP	136.4 (SD 22.2)		134.9 (SD 16.1)		0.64	128.8 (SD 17.8)		148.4 (SD 20.1)		0.001
Mean diastolic BP	82.3 (SD 13.7)		83.7 (SD 13.1)		0.55	80.3 (SD 12.0)		88.2 (SD 14.8)		0.001
Uncontrolled BP	37	46.2	35	53.0	0.51	30	28.0	39	81.2	0.001
Perceived health										
Very good or good	65	81,2	42	63,0	0,02	85	79,4)	28	58,3	0,001
Mean number of AHT	2.3 (SD 0.9)		1.9 (SD 1.1)		0.18	2.1 (SD 0.9)		2.5 (SD 1.1)		0.06
Average daily doses (mean+SD)	2.8 (SD 1.1)		2.9 (SD 1.1)		0.84	2.9 (SD 1.1)		3.0 (SD 1.0)		0.60
Average medication expenditures (mean+SD)	45.3 (SD 64.9)		48.5 (SD 98.3)		0.13	44.4 6(SD 3.6)		62.8 (SD 113.7)		0.42

* Tests utilized: chi-square (dichotomous variables); t-Test (continuous variables with a parametric distribution) and Mann-Whitney (continuous variables with a non-parametric distribution); uncontrolled AP: ≥ 140/90 mmHg; Classes D and E: economic classification criteria in Brazil 2008; R$: reais; AHT: antihypertensives

influenced the different performance in comparison to the original BMQ.[23]

The MGT presented variable performance in previous studies, with a sensitivity of 43%[16] to 73.5%[19] and specificity of 81% to 45.3%. The association identified for BMQ between low adherence and the effects of treatment (blood pressure and presence of CRI) was absent for the MGT in the present study and in other studies.[17,22] This finding reinforces the impression that the BMQ can discriminate between people with uncontrolled hypertension who do and do not take medications. This characteristic can make it useful to differentiate between low adherence and inadequate prescription, which is a frequent clinical dilemma.

The lack of correlation of the MGT with clinical outcomes motivated Morisky to broaden the questionnaire, adding

four more questions. Using this new instrument, which has not yet been validated in Portuguese, Morisky identified an association between low adherence and uncontrolled blood pressure in 67.2%, p<0.001,[15] approximating our finding with the BMQ regimen screen (81.2%; p<0.001). In addition, the format of questions on the recall of medication usage, in the BMQ regimen screen, may facilitate its use in clinical practice.

The study presents some limitations. The lack of an appropriate gold standard and the multiple determinants of adherence complicate the analysis of results. There is no consensus on a gold standard method to evaluate adherence.[6] Direct methods are used (serum measures of medications or metabolites) which are onerous and difficult to execute in the case of multiple medications, as is the case with hypertension. Indirect methods include measurement of medication dispensing, pill counts, questionnaires and clinical response to the medications, although indirect methods are more subject to measurement bias. Studies show low to moderate correlation between the methods, which can be attributed to the fact they measure different dimensions of the same construct, to different cutoff values for non-adherence, to limitations of the methods or to difficulty in controlling the subjective factors related to the patient.[8] Therefore, the selection of a way to evaluate adherence should consider the available resources in the health services and the strategies utilized and the strategies selected should follow the basic psychometric norms of reliability and validity.[10] Finally, since no strategy is considered excellent, a multi-method approach has been uses in studies and in clinical practice.[6,10,11]

We could not evaluate the acquisition of medications for all patients, since half of patients utilized medication not available in our pharmacy. These findings relative to the availability of antihypertensives were similar to the findings of Bertoldi et al in regards to medication utilized for acute and chronic illnesses, which showed that only 51% of patients receive prescribed medication from the public system.[3] Due to this limitation we evaluated less patients using gold standards 2 and 3, which may have influenced the results. The use of gold standard 2 was possible due to pharmacy information systems, which presents limitations in comparison to MEMS but have a satisfactory correlation with pill counts as shown by Steiner[21] (r=0.68; p=0.001).

An inherent bias in the cross-sectional study design is the bias of reverse causality, since we evaluated exposure and outcomes at the same period and lost temporality[18]. This bias may have occurred in the present study when considering patients who needed to purchase antihypertensives and who more often presented with CRI and elevated blood pressure levels. The significance of this finding may be related to greater gravity of the disease, inadequate treatment or low treatment adherence. Likewise, we found a smaller percentage of patients with good or very good self-perceived health among those with low adherence identified by the two questionnaires. It was not possible to establish if this association, described by DiMatteo in a meta-analysis,[7] was caused by low adherence or resulted from perception of poor health.

Another limitation is selection bias due to the large number of losses, which may have occurred due to: incorrect information received or compiled, patients enrolled in a unit to receive medications but affiliated with other services and a population resistant to the regionalization of health services. The patients encountered showed a high percentage of affiliation with the health service, which may differ from the patients not encountered and limits the findings to patients that access the service. This study also did not evaluate adherence to non-pharmaceutical treatment, which may be a confounding factor. Nonetheless, the variable for level of physical activity and the obesity percentage can be indirect measures to evaluate adherence to non-pharmaceutical treatment, which were not associated to adherence in our study.

In the BMQ regimen screen, we found 48.1% of patients with low adherence. The clinical profile of these patients (higher blood pressure, greater prevalence of CRI and worse self-perceived health) is insufficient to identify low adherence; therefore a more objective method to evaluate adherence is needed, potentially using the BMQ regimen screen which was strongly associated with control of blood pressure. From the point of view of program planning in public health, such evaluation can indicate which patients should receive educational reinforcement, pharmaceutical support and multidisciplinary care and which require adjustment of therapeutic regimens.

REFERENCES

1. Alves LC, Rodrigues RN. Determinantes da autopercepção de saúde entre idosos do Município de São Paulo, Brasil. *Rev Panam Salud Publica*. 2005;17(5-6):333-41. DOI:10.1590/S1020-49892005000500005

2. Benedetti TRB, Antunes PC, Rodriguez-Añez CR, Mazo GZ, Petroski EL. Reprodutibilidade e validade do Questionário Internacional de Atividade Física (IPAQ) em homens idosos. *Rev Bras Med Esporte*. 2007;13(1):11-6. DOI:10.1590/S1517-86922007000100004

3. Bertoldi AD, Barros AJ, Wagner A, Ross-Degnan D, Hallal PC. Medicine access and utilization in a population covered by primary health care in Brazil. *Health Policy*. 2009;89(3):295-302. DOI:10.1016/j.healthpol.2008.07.001

4. Bloch KV, Melo AN, Nogueira AR. Prevalência da adesão ao tratamento anti-hipertensivo em hipertensos resistentes e validação de três métodos indiretos de avaliação da adesão. *Cad Saude Publica*. 2008;24(12):2979-84. DOI:10.1590/S0102-311X2008001200030

5. Cockcroft DW, Gault MH. Prediction of creatinine clearance from serum creatinine. *Nephron*. 1976;16(1):31-41.

6. DiMatteo MR, Giordani PJ, Lepper HS, Croghan TW. Patient adherence and medical treatment outcomes: a meta-analysis. *Med Care*. 2002;40(9):794-811. DOI:10.1097/01.MLR.0000024612.61915.2D

7. Fachel JM, Camey SA. Avaliação psicométrica: qualidade das medidas e o entendimento dos dados, in Cunha JA, org. Psicodiagnóstico. Artmed Editora.2000: Porto Alegre. p.158-70.

8. Garber MC, Nau DP, Erickson SR, Aikens JE, Lawrence JB. The concordance of self-report with other measures of medication adherence: a summary of the literature. *Med Care*. 2004;42(7):649-52.

9. Harzheim E, Starfield B, Rajmil L, Álvarez-Dardet C, Stein AT. Consistência interna e confiabilidade da versão em português do Instrumento de Avaliação da Atenção Primária (PCATool-Brasil) para serviços de saúde infantil. *Cad Saude Publica*. 2006;22(8):1649-59. DOI:10.1590/S0102-311X2006000800013

10. Hawkshead J, Krousel-Wood MA. Techniques for measuring medication adherence in hypertensive patients in outpatient settings: advantages and limitations. *Dis Manag Health Outcomes*. 2007;15:109-18.

11. Krousel-Wood MA, Muntner P, Islam T, Morisky DE, Webber LS. Barriers to and determinants of medication adherence in hypertension management: perspective of the cohort study of medication adherence among older adults. *Med Clin North Am*. 2009;93(3):753-69. DOI:10.1016/j.mcna.2009.02.007

12. Kuller LH. Prevention of coronary heart disease and the National Cholesterol Education Program. *Circulation*. 2006;113(5):598-600. DOI:10.1161/CIRCULATIONAHA.105.604595

13. Leite SN, Vasconcellos MPC. Adesão à terapêutica medicamentosa: elementos para a discussão de conceitos e pressupostos adotados na literatura. *Cienc Saude Coletiva.* 2003;8(3)775-82. DOI:10.1590/S1413-81232003000300011

14. Makdisse M, Nascimento Neto R, Chagas ACP, Brasil D, Borges JL, Oliveira A, et al. Versão em português, adaptação transcultural e validação do Questionário de Claudicação de Edimburgo. *Arq Bras Cardiol*. 2007;88(5):501-6. DOI:10.1590/S0066-782X2007000500001

15. Morisky DE, Ang A, Krousel-Wood M, Ward HJ. Predictive validity of a medication adherence measure in an outpatient setting. *J Clin Hypertens (Greenwich)*. 2008;10(5):348-54. DOI:10.1111/j.1751-7176.2008.07572.x

16. Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. *Med Care*. 1986;24(1):67-74.

17. Prado Jr JC, Kupek E, Mion Jr D. Validity of four indirect methods to measure adherence in primary care hypertensives. *J Hum Hypertens*. 2007;21(7):579-84. DOI:10.1038/sj.jhh.1002196

18. Rothman KJ, Greenland S. Modern epidemiology. 2. ed. Philadelphia: Lippincott-Raven; 1998.

19. Santa Helena ET, Nemes MIB, Eluf-Neto J. Desenvolvimento e validação de questionário multidimensional para medir não-adesão ao tratamento com medicamentos. *Rev Saude Publica*. 2008;42(4):764-7. DOI:10.1590/S0034-89102008000400025

20. Santos KOB, Araújo TM, Oliveira NF. Estrutura fatorial e consistência interna do *Self-Reporting Questionnaire* (SRQ-20) em população urbana. *Cad Saude Publica*. 2009;25(1):214-22. DOI:10.1590/S0102-311X2009000100023

21. Steiner JF, Prochazka AV. The assessment of refill compliance using pharmacy records: methods, validity, and applications. *J Clin Epidemiol*. 1997;50(1):105-16.

22. Strelec MAAM, Pierin AMG, Mion Jr D. The influence of patient's consciousness regarding high blood pressure and patient's attitude in face of disease controlling medicine intake. *Arq Bras Cardiol*. 2003;81(4):349-54. DOI:10.1590/S0066-782X2003001200002

23. Svarstad BL, Chewning BA, Sleath BL, Claesson C. The Brief Medication Questionnaire: a tool for screening patient adherence and barriers to adherence. *Patient Educ Couns*. 1999;37(2):113-24.

24. Vasan RS, Larson MG, Leip EP, Evans JC, O'Donnell CJ, Kannel WB, et al. Impact of high-normal blood pressure on the risk of cardiovascular disease. *N Engl J Med*. 2001;345(18):1291-7. DOI:10.1056/NEJMoa003417

25. Wang YR, Alexander GC, Stafford RS. Outpatient hypertension treatment, treatment intensification, and control in Western Europe and the United States. *Arch Intern Med*. 2007;167(2):141-7. DOI:10.1001/archinte.167.2.141

26. Zeller A, Schroeder K, Peters TJ. Electronic pillboxes (MEMS) to assess the relationship between medication adherence and blood pressure control in primary care. *Scand J Prim Health Care*. 2007;25(4):202-7. DOI:10.1080/02813430701651954

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ANNEX. Portuguese version of the Brief Medication Questionnaire.

1) Quais medicações que você usou na ÚLTIMA SEMANA?
Entrevistador: Para cada medicação anote as respostas no quadro abaixo:
Se o entrevistado não souber responder ou se recusar a responder coloque NR

NA ÚLTIMA SEMANA					
a) Nome da medicação e dosagem	b) Quantos dias você tomou esse remédio	c) Quantas vezes por dia você tomou esse remédio	d) Quantos comprimidos você tomou em cada vez	e) Quantas vezes você esqueceu de tomar algum comprimido	f) Como essa medicação funciona para você 1 = Funciona Bem 2 = Funciona Regular 3 = Não funciona bem

2) Alguma das suas medicações causa problemas para você? (0) Não (1) Sim
a) Se o entrevistado respondeu SIM, por favor, liste os nomes das medicações e quanto elas o incomodam

	Quanto essa medicação incomodou você?				
Medicação	Muito	Um pouco	Muito pouco	Nunca	De que forma você é incomodado por ela?

3) Agora, citarei uma lista de problemas que as pessoas, às vezes, têm com seus medicamentos.

Quanto é difícil para você:	Muito difícil	Um pouco difícil	Não muito difícil	Comentário (Qual medicamento)
Abrir ou fechar a embalagem				
Ler o que está escrito na embalagem				
Lembrar de tomar todo remédio				
Conseguir o medicamento				
Tomar tantos comprimidos ao mesmo tempo				

Escore de problemas encontrados pelo BMQ

DR – REGIME (questões 1a-1e)	1 = sim	0 = não
DR1. O R falhou em listar (espontaneamente) os medicamentos prescritos no relato inicial?	1	0
DR2. O R interrompeu a terapia devido ao atraso na dispensação da medicação ou outro motivo?	1	0
DR3. O R relatou alguma falha de dias ou de doses?	1	0
DR4. O R reduziu ou omitiu doses de algum medicamento?	1	0
DR5. O R tomou alguma dose extra ou medicação a mais do que o prescrito?	1	0
DR6. O R respondeu que "não sabia" a alguma das perguntas?	1	0
DR7. O R se recusou a responder a alguma das questões?	1	0
NOTA: ESCORE ≥ 1 INDICA POTENCIAL NÃO ADESÃO soma:		*Tregime*
CRENÇAS		
DC1. O R relatou "não funciona bem" ou "não sei" na resposta 1g?	1	0
DC2. O R nomeou as medicações que o incomodam?	1	0
NOTA: ESCORE ≥ 1 INDICA RASTREAMENTO POSITIVO PARA BARREIRAS DE CRENÇAS soma:		*Tcrencas*
RECORDAÇÃO		
DRE1. O R recebe um esquema de múltiplas doses de medicamentos (2 ou mais vezes/dia)?	1	0
DRE2. O R relata "muita dificuldade" ou "alguma dificuldade"em responder a 3c?	1	0
NOTA: ESCORE ≥ 1 INDICA ESCORE POSITIVO PARA BARREIRAS DE RECORDAÇÃO soma:		*Trecord*

R = respondente NR = não respondente