Int J Clin Pharm (2011) 33:642–649
DOI 10.1007/s11096-011-9518-x

RESEARCH ARTICLE

Effect of a 36-month pharmaceutical care program on pharmacotherapy adherence in elderly diabetic and hypertensive patients

Paulo Roque Obreli-Neto · Camilo Molino Guidoni · André de Oliveira Baldoni · Diogo Pilger · Joice Mara Cruciol-Souza · Walderez Penteado Gaeti-Franco · Roberto Kenji Nakamura Cuman

Received: 13 December 2010 / Accepted: 22 April 2011 / Published online: 5 May 2011

Abstract *Objective*: The primary objective of this study was to evaluate the effect of a pharmaceutical care program on pharmacotherapy adherence in elderly diabetic and hypertensive patients. The clinical outcomes of this pharmacotherapy adherence approach were the secondary objective of the study. *Setting*: Public Primary Health Care Unit in a municipality in the Brazilian State of Sao Paulo. *Method*: A 36-month randomized, controlled, prospective clinical trial was carried out with 200 patients divided into two groups: control (n = 100) and intervention (n = 100). The control group received the usual care offered by the Primary Health Care Unit (medical and nurse consultancies). The patients randomized into the intervention group received pharmaceutical care intervention besides the usual care offered. Main outcome measure: Pharmacotherapy adherence (Morisky-Green test translated into Portuguese and computerized dispensed medication history) and clinical measurements (blood pressure, fasting glucose, A1C hemoglobin, triglycerides and total cholesterol) were evaluated at the baseline and up to 36 months. A P value <0.05 was considered statistically significant. *Results*: A total of 97 patients from the intervention group and 97 patients from the control group completed the study (n = 194). Significant improvements in the pharmacotherapy adherence were verified for the intervention group according to the Morisky-Green test (50.5% of adherent patients at baseline vs. 83.5% of adherent patients after 36 months; $P < 0.001$) and the computerized dispensed medication history (52.6% of adherent patients at baseline vs. 83.5% of adherent patients after 36 months; $P < 0.001$); no significant changes were verified in the control group. Significant improvements in the number of patients reaching adequate values for their blood pressure (26.8% at baseline vs. 86.6% after 36-months; $P < 0.001$), fasting glucose (29.9% at baseline vs. 70.1% after 36 months; $P < 0.001$), A1C hemoglobin (3.3% at baseline vs. 63.3% after 36 months; $P < 0.001$), triglycerides (47.4% at baseline vs. 74.2% after 36 months; $P < 0.001$) and total cholesterol (59.8% at baseline vs. 80.4% after 36 months; $P = 0.002$) were verified in the intervention group, but remained unchanged in the control group. *Conclusion*: These results indicated the effectiveness of pharmaceutical care in improving pharmacotherapy adherence, with positive effects in the clinical outcomes of the patients studied.

Keywords Brazil · Clinical trial · Diabetes · Elderly · Hypertension · Medication adherence · Pharmaceutical care · Public health

P. R. Obreli-Neto · W. P. Gaeti-Franco · R. K. N. Cuman (✉)
Department of Pharmacology and Therapeutics, State University of Maringá, Avenue Colombo 5790, Maringá, PR 87020-290, Brazil
e-mail: paulorobreli@yahoo.com.br

C. M. Guidoni · A. de Oliveira Baldoni
Department of Pharmaceutical Science, University of Sao Paulo, Ribeirao Preto, Avenida do Café, Ribeirão Preto, SP 14040-903, Brazil

D. Pilger
Faculty of Pharmacy, Departamento do Medicamento, Federal University of Bahia, Rua Barão do Jeremoabo 147, Salvador, BA 40170-115, Brazil

J. M. Cruciol-Souza
Department of Pharmaceutical Sciences, State University of Londrina, Avenue Robert Koch 60, Londrina, PR 86038-350, Brazil

Impact of findings on practice

- Pharmacists as members of the healthcare team are able to help improving adherence to pharmacotherapy in elderly diabetic and hypertensive patients.
- Patients adherence to pharmacotherapy can be improved by complex interventions based on pharmaceutical care principles.
- Improved adherence to pharmacotherapy due to a pharmaceutical care program can be associated with better clinical outcomes such as reduced levels of blood pressure, fasting glucose, A1C hemoglobin, triglycerides and total cholesterol in elderly patients with hypertension and/or diabetes.

Introduction

Diabetes mellitus and hypertension are currently major public health problems. The prevalence of diabetes mellitus was estimated at more than 285 million individuals throughout the world in 2010, while the prevalence of hypertension was predicted to reach more than 1.56 billion individuals in 2025, most of the cases involving elderly people [1, 2]. Earlier studies showed that an estimated 27.0–49.0% of diabetes and/or hypertensive patients do not take their medication as prescribed and are said to be non-adherent [3, 4]. Patient adherence to pharmacotherapy is a complex but important factor in achieving positive clinical outcomes for these diseases [4, 5]. Non-adherence carries a huge economical burden. An estimated yearly expenditure of hundreds of billions of US dollars can be attributed to the non-adherence to pharmacotherapy [6].

Barriers to pharmacotherapy adherence are numerous. The major barriers include complex therapeutic plans, difficulty in understanding medical prescriptions, treatment of asymptomatic diseases, socioeconomic aspects, concerns and beliefs [7, 8]. Besides taking an elevated number of drugs, elderly patients present impairments of their physical and cognitive activities, which increase the risk of non-adherence to the pharmacotherapy [8].

There is a need to explore alternative strategies to address this public health problem, especially for chronic health problems, which need more complex interventions like combinations of more convenient care, information, reminders, self-monitoring, reinforcement, counseling, family therapy, psychological therapy, crisis intervention, manual telephone follow-up and supportive care [9].

The pharmacist can act as a member of the healthcare team in the patient care process by way of pharmaceutical care, which is defined by Hepler and Strand (1990) as "the responsible provision of drug therapy for the purpose of achieving definite outcomes that improve a patient's quality of life" [10]. Previous studies indicated a positive effect of pharmaceutical care in pharmacotherapy adherence in diabetic and/or hypertensive patients, via the combination of complex interventions such as more convenient care, information, reminders, self-monitoring, reinforcement and counseling [11–13]. However, to the authors' knowledge, randomized, controlled, prospective clinical trials of long duration evaluating the effectiveness of pharmaceutical care in the pharmacotherapy adherence developed in developing countries such as Brazil, Argentina, Chile and Mexico, amongst others, are scarce.

Previous pharmaceutical care studies developed in developing countries have involved small samples [13], were nonrandomized [14, 15], were of small duration [13–15] and did not report pharmacotherapy adherence rates [14–16]. It has been suggested that rigorously designed pharmaceutical care studies addressing pharmacotherapy adherence are of paramount importance [11, 12].

Aim of the study

The primary objective of this study was to evaluate the effects of a 36-month pharmaceutical care program on pharmacotherapy adherence in elderly diabetic and hypertensive patients in a Brazilian Public Primary Health Care Unit (PHCU). The clinical outcomes of this pharmacotherapy adherence approach were the secondary objective of the study.

Method

Type of study and setting

A randomized, controlled, longitudinal, prospective clinical trial was carried out from October-2006 to October-2009 in a Brazilian public PHCU located in the municipality of Salto Grande, Sao Paulo State. In the Brazilian public health system, PHCUs are responsible for providing basic health services such as the promotion of health education, disease prevention and surveys of disease spread. The professionals who provide this service include family physicians and nurses, while the pharmacists work mainly in administrative services (such as the acquisition and inventory control of drugs), with little clinical activity directed at the patient. This study was approved by the Research Ethical Committee of the State University of Maringa, Brazil (CAAE 0182/09).

Study subjects

Patients ≥60 years of age, with a diagnosis of diabetes and/or hypertension (according to the Brazilian national consensus [17, 18]), under drug treatment for diabetes and/or hypertension, participating regularly in activities offered at the primary health care unit (medical and nursing consultancies), with up-to-date results for their routine physical and laboratory tests (no more than 30 days prior to the baseline measurements), were eligible for recruitment. Patients were excluded from the study if they had been diagnosed with dementia and/or had a history of previous cerebrovascular accidents.

Sample size

A total of 397 patients was identified for inclusion in the study. A sample size of patients was indicated to carry out a study with a margin error of 5% and confidence interval of 95%. Based on these data, to ensure sufficient statistical power and to account for 'drop-outs' during the study, a target sample size of 200 patients was assumed. Eligible patients who were willing to participate in the study (oral and written consent), were randomized into two proportional groups: control group (n = 100 patients) and intervention group (n = 100 patients).

Randomization

Two researchers (JV and GS) interviewed the patients and consulted their medical records in order to structure the groups. These researchers were blinded to patient's study status and played no role in the delivery of the interventions. According to this data collection, the patients were stratified into six strata:

1. Illiterate patients or with incomplete elementary school level, monthly family income ≤US$ 329.5, systolic blood pressure (SBP) <140 mmHg and/or fasting glucose <6.1 mmol/L.
2. Patients with no literacy or incomplete elementary school level, monthly family income ≤US$ 329.5, SBP >140 mmHg and fasting glucose >6.1 mmol/L.
3. Patients with complete elementary school level, monthly family income ≤US$ 329.5, SBP <140 mmHg and/or fasting glucose <6.1 mmol/L.
4. Patients with complete elementary school level, monthly family income ≤US$ 329.5, SBP >140 mmHg and fasting glucose >6.1 mmol/L.
5. Patients with complete undergraduate university level, monthly family income ≥US$ 329.5, SBP <140 mmHg and/or fasting glucose <6.1 mmol/L.
6. Patients with complete undergraduate university level, monthly family income ≥US$ 329.5, SBP >140 mmHg and fasting glucose >6.1 mmol/L.

A proportional stratified random sampling was carried out to guarantee that the groups were matched as closely as possible with the socioeconomic and clinical characteristics of the patients.

Description of interventions

Patients enrolled in the control group received the usual care offered in the public primary health care unit, consisting of appointments with physicians (every 3 months) and nurses (every month). The procedures were registered in the patient records and could consist of alterations in the prescribed drugs, requests for laboratory exams, general information about patient health and referrals to specialists. They received their prescription services without any pharmaceutical care approach.

Patients randomized into the intervention group, besides the usual care offered, also received pharmaceutical care intervention. The pharmaceutical care intervention was composed of individual follow-up attendances (according to the Pharmacotherapy Workup developed at the University of Minnesota, United States of America [19]) and educative group activities. The Pharmacotherapy Workup was carried out by four previously trained pharmacists (training lasted 20 h, and considered the Pharmacotherapy Workup process), with a frequency of visits of once every 6 months (this schedule was adopted so as not to disturb the routine activities of the pharmacist staff of the public primary health care unit). During the Pharmacotherapy Workup, interventions aimed at guaranteeing a high rate of adherence to the pharmacotherapy were taken. These interventions included assessment of non-adherence problem, discussions with the patients about the role of medication in their health status (active participation of the patients in choosing their drug treatment), suggestions to the physicians concerning new drug regimens (taking into account the patient's medication experience), orientation with respect to the correct use of drugs (including the method for insulin administration) and the confection of special package that provides a visual reminder that a medication was taken.

The pharmaceutical care program was developed individually, respecting the patients' individual needs and knowledge of his/her clinical conditions and drug therapy. Data concerning the reason for the encounter, the patient's demographics, pharmacotherapy history, patient's medication experience and other clinical information were elicited during the assessment, and registered in the patient's medical records. After assessing if all the patient's

drug-related needs were being met and if any drug therapy problems were present, the pharmacists elaborated individual care plans for the patients (patients participated actively in the elaboration of the care plan). In the follow-up evaluation, the patient's outcomes in relation to the individual desired goals of the therapy were evaluated, and the patients were reassessed to determine if any new drug therapy problems had developed. All decisions made in pharmaceutical care practice were documented in the patient's medical record. The medical records were accessed by the physicians and nurses during their attendances to promote a multidisciplinary approach. Educative group activities were carried out once every 6 months with groups of 20 patients under the supervision of a pharmacist. These activities discussed themes such as adherence, dangers of self-medication and correct storage of medicines.

Adherence assessment

Adherence was assessed by two researchers (PON and RC) at the baseline and after 36 months of follow-up, using two different methods: the Morisky-Green test translated into Portuguese [3] and the computerized dispensed medication history [11]. These researchers were blinded to the group allocation of the patients.

The Morisky-Green test translated into Portuguese is a validated self-reporting tool for adherence assessment, that consists of four direct questions [3, 20]:

1. Do you ever forget to take your medicine?
2. Are you careless at times about taking your medicine?
3. When you feel better, do you sometimes stop taking your medicine?
4. Sometimes if you feel worse when you take the medicine, do you stop taking it?

The patients were considered adherent to the pharmacotherapy when they gave the right answer to the four questions, and were considered non-adherent to the pharmacotherapy when they gave the right answer to three or less questions [3, 20].

The computerized dispensed medication history involves the estimation of the medication use of each patient, by analyzing the periodicity of prescription pickups during the 6 months before the measure. The quantity of prescribed and dispensed drugs for this period is calculated. Patients with a quantity of dispensed medications within 80–115% of the prescribed medications are considered adherent, and patients with other values are considered non-adherent [11].

Clinical outcomes

Routine physical and laboratory exams were assessed at the baseline and after 36 months of follow-up, by two blinded researchers (GD and FS), in both groups. The goals for these exams comprised (1) blood pressure <140/90 mmHg (patients with no diagnosis of diabetes) and <130/80 mmHg (patients with a diagnosis of diabetes), (2) fasting glucose <6.1 mmol/L, (3) A1C hemoglobin <7.0%, (4) triglycerides <1.7 mmol/L and (5) total cholesterol <5.2 mmol/L.

Data analyzes

The effect of pharmaceutical care on pharmacotherapy adherence and the clinical outcomes was determined by comparing the baseline versus final results (after 36 months of follow-up) for the intervention and control groups. The data were analyzed using Statistica package version 7. The normal distribution of the data was assessed using the Kolmogorov–Smirnov test and quantile–quantile plots, before selection of the statistical tests. Chi-square tests were used for categorical variables, and independent sample t-student tests were used for quantitative variables. A P value of <0.05 was considered to be statistically significant.

Results

Study sample

Of the 200 patients recruited, a total of 194 individuals completed the study (97 patients in each group) (Fig. 1). The study population consisted of poorly educated individuals with a low family income. No significant differences in the socioeconomic and clinical characteristics of the patients were observed between the control and intervention groups (Table 1).

Adherence assessment

A high rate of non-adherent patients was observed in both groups at the baseline. The intervention group showed a significant increase in pharmacotherapy adherence, while the control group showed no significant changes. No significant difference was verified between the results of the two adherence assessment tools used (Table 2).

Clinical outcomes

Most of the patients in both groups showed an inadequate clinical status at the baseline. A significant improvement in the number of patients presenting adequate exam results was verified in the intervention group after 36 months of follow-up, while no significant changes were observed in the control group (Table 3).

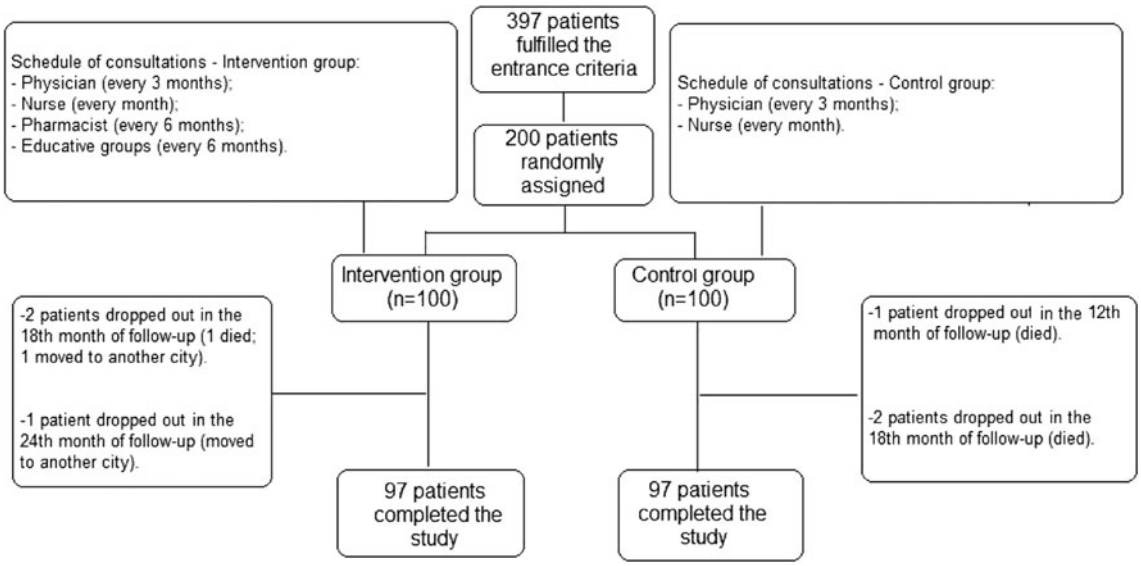

Fig. 1 Flowchart of patients in the study

Table 1 Characteristics of the study participants at the baseline, October 2006

Characteristic	Intervention group n = 97	Control group n = 97	*P* value
Female sex, n (%)	61 (62.9)	60 (61.8)	0.882
Age, mean (SD) [95%CI] (years)	65.3 (5.8) [64.1:66.4]	65.3 (5.7) [64.1:66.4]	0.990
Incomplete elementary school, n (%)	76 (78.4)	75 (77.4)	0.926
Lives with spouse and/or son, n (%)	75 (77.3)	77 (79.4)	0.878
Monthly family income, mean (SD) [95%CI], US$	314.9 (99.1) [294.6:335.6]	317.7 (101.8) [296.6:338.9]	0.320
Number of drugs for chronic use, mean (SD) [95%CI]	3.3 (1.7) [3.0:3.6]	3,3 (1.7) [3.0:3.7]	0.174
MRCI, mean (SD) [95%CI]	13.0 (5.7) [11.9:14.2]	13.1 (5.7) [11.9:14.2]	0.808
Number of diseases, mean (SD) [95%CI]	2.4 (1.3) [2.1:2.7]	2.4 (1.3) [2.1:2.7]	0.986
SBP, mean (SD) [95%CI] (mmHg)	156.7 (21.8) [152.3:161.1]	155.9 (20.8) [151.7:160.1]	0.788
DBP, mean (SD) [95%CI] (mmHg)	106.6 (17.7) [103.0:110.2]	108.7 (16.9) [105.5:112.3]	0.363
Fasting glucose, mean (SD) [95%CI] (mmol/L)	7.4 (3.0) [6.8:8.0]	7.4 (3.0) [6.8:8.1]	0.932
A1C[a] hemoglobin, mean (SD) [95%CI], (%)	7.7 (0.5) [7.6:7.9]	7.7 (0.5) [7.5:7.9]	0.691
Triglycerides, mean (SD) [95%CI] (mmol/L)	2.3 (1.5) [2.0:2.6]	2.3 (1.5) [2.0:2.6]	0.977
Total cholesterol, mean (SD) [95%CI] (mmol/L)	5.2 (0.9)[5.1:5.4]	5.2 (0.9) [5.0:5.4]	0.915

The χ^2 test and independent sample t-student test were used as appropriate. *P* value of <0.05 was considered to be statistically significant

SBP systolic blood pressure, *DBP* diastolic blood pressure, *MRCI* medication regimen complexity index [26], *SD* standard deviation

[a] Only patients with a diagnosis of diabetes carried out this exam

Discussion

To our knowledge, this is the first controlled, longitudinal, prospective clinical trial developed in a PHCU environment in a developing country, to assess the effect of pharmaceutical care on pharmacotherapy adherence and its association with clinical outcomes. In order to assess the effect of an intervention on pharmacotherapy adherence, long duration studies are better than short duration ones, since the patients are exposed to everyday living factors for a longer period. The results indicated that the pharmaceutical care program improved pharmacotherapy adherence over a 36-month period, with a positive correlation on the clinical outcomes. By adopting strategies focused on the patient and working together with other health professionals in the process of care, the pharmacists were able to provide a better support for these patients.

The strategies to improve adherence were targeted to specific risk factors and causes identified during the patient assessment. Multicomponent interventions, including external cognitive supports involving education strategies (patient education and counseling) and behavioral component focused

Table 2 Adherence rates of the study participants, October 2006–October 2009

Adherence	Intervention group n = 97			Control group n = 97		
	Baseline n (%)	After 36 months n (%)	*P* value	Baseline n (%)	After 36 months n (%)	*P* value
Adherence according to the Morisky-Green test						
Non-adherent	48 (49.5)	16 (16.5)	<0.001*	50 (51.5)	54 (55.7)	0.565
Adherent	49 (50.5)	81 (83.5)		47 (48.5)	43 (44.3)	
Adherence according to the computerized dispensed medication history						
Non-adherent	46 (47.4)	16 (16.5)	<0.001*	51 (47.4)	55 (56.7)	0.564
Adherent	51 (52.6)	81 (83.5)		46 (52.6)	42 (43.3)	

The χ^2 test was used

* *P* value of <0.05 was considered to be statistically significant

Table 3 Study participants reaching clinical outcomes, October 2006–October 2009

Variable	Intervention group n = 97			Control group n = 97		
	Baseline n (%)	After 36 months n (%)	*P* value	Baseline n (%)	After 36 months n (%)	*P* value
Blood pressure <140/90 or 130/80 (mmHg[a])	26 (26.8)	84 (86.6)	<0.001*	26 (26.8)	30 (30.9)	0.526
Fasting glucose <6.1 (mmol/L[c])	29 (29.9)	68 (70.1)	<0.001*	30 (30.9)	27 (27.8)	0.636
A1C[b] hemoglobin <7.0%[c]	1 (3.3)	19 (63.3)	<0.001*	1 (3.3)	1 (3.3)	1.000
Triglycerides <1.7 (mmol/L[c])	46 (47.4)	72 (74.2)	<0.001*	45 (46.4)	49 (50.5)	0.566
Total cholesterol <5.2 (mmol/L[c])	58 (59.8)	78 (80.4)	0.002*	62 (63.9)	62 (63.9)	1.000

The χ^2 test was used

* *P* value of <0,05 was considered to be statistically significant

[a] <140/90 mmHg for patients with no diagnosis of diabetes and <130/80 mmHg for patients with a diagnosis of diabetes

[b] Only patient with a diagnosis of diabetes carried out this exam

[c] According to the reference results for the exams

on the mechanism of medication delivery (blister packs), were tailored to the individual needs of each patient. The present pharmaceutical care program encouraged patients to assume an active role in their own treatment plans (promote self-efficacy), empowered patients and family members to become informed medication consumers, encouraged patients to develop a list of short-term and long-term goals of the drug therapy (to stimulate long-term adherence), provided medication instructions several times and in different formats (verbal and written), promoted convenience through reminder packaging, and conducted regular follow-up attendances to assess adherence rates and to motivate the patient.

The study design provided evidence on its global impact on adherence and clinical outcomes in a longer period than previous studies [11–13], but cannot distinguish the individual impact of each pharmaceutical care components. Previous studies based on single intervention (behavioral, educational) has only a marginal and nondurable effect on medication adherence [21, 22]. The effectiveness of the pharmaceutical care program on improving pharmacotherapy adherence is consistent with previous studies that indicated better adherence rates with multicomponent interventions tailored to the individual needs of each patient, than single interventions [21–23]. Based on the present results and consistent with recommendations of others [24, 25], the strategy of addressing underlying reasons for non-adherence, educating patients, providing serial follow-up, and promoting convenience through reminder packaging showed efficacy in improving and maintaining long-term adherence (36 months).

Adherence assessment

Some studies have reported noncompliance with the treatment as one of the most prevalent drug-related problems [13, 27]. A significant improvement in the pharmacotherapy adherence of the patients located in the intervention group was verified ($P < 0.001$). Discussions with the patients about the role of medications in their health status, suggestions to the physicians concerning new drug regimens taking into account the patient's medication experience and the confection of special package that

provides a visual reminder that a medication was taken were effective in increasing pharmacotherapy adherence.

The changes observed in the present study were more significant than verified in earlier studies. These variations in the results can be attributed to different baseline adherence rates of the patients enrolled in the studies, different study durations and different characteristics of the health systems where the studies were developed (availability of medications, availability of medical and nursing consultation and others). The adherence (self-reported) of the diabetic patients was 51.3% at baseline and 78.6% after a 12-month pharmaceutical care program ($P < 0.05$) in a study developed by Al Mazroui et al. in the United Arab Emirates [28]. Krass et al. [11] observed a statistical trend towards an increase in the proportion of adherent patients within the group submitted to pharmacists' diabetes care services in Australia during a 9 month period (41% at baseline vs. 52% post intervention; $P = 0.15$), according to the Brief Medication Questionnaire (BMQ), with no difference detected according to the computerized dispensed medication history (50% at baseline vs. 52% post intervention; $P = 0.70$). A 9-month community pharmacy-based hypertension medication therapy management (MTM) program, developed in the United States of America, promoted a non statistically significant increase in the mean adherence rates (80.5% at baseline vs. 87.5% post intervention; P value 0.07), according to the computerized dispensed medication history [12]. Sá Borges et al. [13] verified an improvement in the mean adherence score (according to the Morisky-Green test) of 2.8–3.9 ($P < 0.05$) in diabetic patients submitted to a 12-month pharmaceutical care program developed in the Brazilian public health system.

Clinical outcomes

The improvements in adherence promoted by pharmaceutical care programs were associated with better clinical outcomes for the diabetic and hypertensive patients [13]. A positive correlation between pharmacotherapy adherence and adequate clinical outcomes was verified in the present study. The number of patients enrolled in the intervention group reaching adequate clinical outcomes increased significantly after 36 months of pharmaceutical care program. This can be attributed to the pharmacists applying a pharmaceutical care strategy which involved identifying, resolving and preventing drug-related problems [29]. Such effectiveness in the management of drug-related problems is statistically related with the control of cardiovascular risk factors, quality of life and health expenditure [30].

There is considerable variability in the results published regarding the correlation between improvement in adherence and better clinical outcomes, which may be due to several factors. Al Mazroui et al. [28], in a study developed in the United Arab Emirates, also verified better clinical outcomes (body mass index, blood pressure, fasting glucose, A1C hemoglobin, triglycerides, total cholesterol, serum HDL-C and serum LDL-C; $P < 0.05$) after an improvement in pharmacotherapy adherence promoted by a 12-month pharmaceutical care program. A significant improvement in clinical outcomes (16.0% of patients reaching blood pressure goals at baseline vs. 48.0% of patients reaching blood pressure goals after a 9-month pharmaceutical care intervention program; P value <0.05) was also verified by Planas et al. in a study developed in the United States of America [12]. Significant reductions in the mean values for fasting glycemia (10.0 mmol/L at baseline vs. 7.3 mmol/L after a 12-month pharmaceutical care program, $P < 0.05$) and A1C hemoglobin (8.9% at baseline vs. 7.9% after a 12-month pharmaceutical care program, $P < 0.05$) were verified by Sá Borges et al., in a study developed in Brazil [13]. Different study participant characteristics (different baseline clinical status), different study duration and different health care settings where the studies were developed influenced the observed changes in the values.

Kicklighter et al. [31] found that blood pressure control was not maintained at an adequate level in most of the patients, after discontinuation of a pharmaceutical care program, suggesting that adherence interventions work whilst in place, but once removed, patient behaviors with respect to the taking of medicines returns to the pre-intervention level. These results show the need for a systematic and continuous approach to the management of pharmacotherapy adherence in chronic health conditions.

Limitations

The present study had some limitations. The absence of a gold standard method to measure adherence [32] complicated assessment of the interventions provided. Indirect methods are useful in daily practice (cheap, fast and easy to apply), but tend to overestimate adherence [32]. The present authors decided to use two indirect methods concomitantly to reduce this bias. Only the diabetic patients carried out the A1C hemoglobin test in the health system setting analyzed, which reduced the sample size for this parameter and may have produced a bias in the study. The present study did not evaluate formal measures of cognitive functions. The study design cannot distinguish the individual impact of each pharmaceutical care component on the adherence. The study was only carried out in one PHCU, thus in order to generalize the results, future multicenter studies with larger sample populations would naturally be needed.

Conclusion

The results obtained indicated the effectiveness of pharmaceutical care on improving pharmacotherapy adherence in elderly diabetic and/or hypertensive patients attended in this Brazilian public PHCU. Such better adherence rates resulted in a positive effect on the clinical outcomes of the patients. These results suggest that the introduction of the pharmacist into the healthcare team could promote better clinical results and reduce public health expenditure.

Acknowledgments The authors would like to thank the pharmacists and researchers for their assistance during the research.

Funding None.

Conflicts of interest The authors have no conflicts of interest to declare.

References

1. International Diabetes Federation. Diabetes Atlas. 4th ed. Brussels: International Diabetes Federation; 2009. ISBN-13: 978-2-930229-71-3. Available: http://www.diabetesatlas.org/content/diabetes.
2. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: analysis of worldwide data. Lancet. 2005;365(9455):217–23.
3. Bloch KV, Melo AN, Nogueira AR. Prevalence of anti-hypertensive treatment adherence in patients with resistant hypertension and validation of three indirect methods for assessing treatment adherence. Cad Saude Publica. 2008;24(12):2979–84.
4. Krapek K, King K, Warren SS, George KG, Caputo DA, Mihelich K, et al. Medication adherence and associated hemoglobin A1c in type 2 diabetes. Ann Pharmacother. 2004;38(9):1357–62.
5. Prado JC, Kupek E, Mion D. Validity of four indirect methods to measure adherence in primary care hypertensives. J Hum Hypertens. 2007;21(7):579–84.
6. DiMatteo MR. Evidence-based strategies to foster adherence and improve patient outcomes. JAAPA. 2004;17(11):18–21.
7. Odegard OS, Gray SL. Barriers to medication adherence in poorly controlled diabetes mellitus. Diabetes Educ. 2008;34(4):692–7.
8. Osterberg L, Blaschke T. Adherence to medication. N Engl J Med. 2005;353(5):487–97.
9. Haynes RB, Ackloo E, Sahota N, McDonald HP, Yao X. Interventions for enhancing medication adherence. Cochrane Database Syst Rev. 2008;(2):CD000011.
10. Hepler CD, Strand LM. Opportunities and responsibilities in pharmaceutical care. Am J Hosp Pharm. 1990;47(3):533–43.
11. Krass I, Taylor SJ, Smith C, Armour CL. Impact on medication use and adherence of Australian pharmacists' diabetes care services. J Am Pharm Assoc. 2005;45(1):33–40.
12. Planas LG, Crosby KM, Mitchell KD, Farmer KC. Evaluation of a hypertension medication therapy management program in patients with diabetes. J Am Pharm Assoc. 2009;49(2):164–70.
13. Sá-Borges AP, Guidoni CM, Ferreira LD, Freitas O, Pereira LRL. The pharmaceutical care of patients with type 2 diabetes. Pharm World Sci. 2010;32(6):730–6.
14. Lyra-Júnior DP, Marcellini PS, Pelá IR. Effect of pharmaceutical care intervention on blood pressure of elderly outpatients with hypertension. Braz J Pharm Sci. 2008;44(3):451–7.
15. Obreli-Neto PR, Cuman RKN. Pharmaceutical care program for the rational use of drugs in the elderly users of a Basic Health Unit in the Sao Paulo State, Brazil. Lat Am J Pharm. 2010;29(3):333–9.
16. Correr CJ, Pontarolo R, Wiens A, Rossignoli P, Melchiors AC, Radominski R, et al. Economic evaluation of pharmacotherapeutic follow-up in type 2 diabetes mellitus patients in community pharmacies. Arq Bras Endocrinol Metabol. 2009;53(7):825–33.
17. Brazilian Society of Cardiology, Brazilian Society of Hypertension, Brazilian Society of Nephrology. V Brazilian guidelines on hypertension. Arq Bras Cardiol. 2007;89(3):24–79.
18. Brazilian Society of Diabetes. Brazilian Society of Diabetes' Guidelines 2009. Rio de Janeiro, RJ: Diagraphic Editora; 2009.
19. Strand LM, Cipolle RJ, Morley PC, Frakes MJ. The impact of pharmaceutical care practice on the practitioner and the patient in the ambulatory practice setting: twenty-five years of experience. Curr Pharm Des. 2004;10(31):3987–4001.
20. Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of self-reported measure of medication adherence. Med Care. 1986;24(1):67–74.
21. Peterson AM, Takiya L, Finley R. Meta-analysis of trials of interventions to improve medication adherence. Am J Health Syst Pharm. 2003;60(7):657–65.
22. Takiya L, Peterson AM, Finley R. Meta-analysis of interventions for medication adherence to antihypertensives. Ann Pharmacother. 2004;38(10):1617–24.
23. Roter DL, Hall JA, Merisca R, Nordstrom B, Cretin D, Svarstad B. Effectiveness of interventions to improve patient compliance: a meta-analysis. Med Care. 1998;36(8):1138–61.
24. Becker MH, Maiman LA. Strategies for enhancing patient compliance. J Community Health. 1980;6(2):113–35.
25. Lee LK, Grace KA, Taylor JA. Effect of a pharmacy care program on medication adherence and persistence, blood pressure, and low-density lipoprotein cholesterol: a randomized controlled trial. JAMA. 2006;296(21):2563–71.
26. George J, Phun YT, Bailey MJ, Kong DC, Stewart K. Development and validation of the medication regimen complexity index. Ann Pharmacother. 2004;38(9):1369–76.
27. Lyra-Júnior DP, Kheir N, Abriata JP, Rocha CE, Santos CB, Pela IR. Impact of pharmaceutical care interventions in the identification and resolution of drug-related problems and on quality of life in a group of elderly outpatients in Ribeirào Preto (SP), Brazil. Ther Clin Risk Manag. 2007;3(6):989–98.
28. Al Mazroui NR, Kamal MM, Ghabash NM, Yacout TA, Kole PL, McElnay JC. Influence of pharmaceutical care on health outcomes in patients with Type 2 diabetes mellitus. Br J Clin Pharmacol. 2009;67(5):547–57.
29. Cipolle RJ, Strand LM, Morley PC. Pharmaceutical care practice: the clinician's guide. New York, NY: The McGraw-Hill Companies; 2004. ISBN: 10: 0-07-136259-2.
30. Niquille A, Bugnon O. Relationship between drug-related problems and health outcomes: a cross-sectional study among cardiovascular patients. Pharm World Sci. 2010;32(4):512–9.
31. Kicklighter CE, Nelson KM, Humphries TL, Delate T. An evaluation of a clinical pharmacy-directed intervention on blood pressure control. Pharm Practice. 2006;4(3):110–6.
32. Brawley LR, Culos-Reed SN. Studying adherence to therapeutics regimens: overview, theories, recommendations. Control Clin Trials. 2000;21(5):156–63.