


Continuity of Care and the Control of High Blood Pressure at Colombian Primary Care Services

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Lena Barrera, MD, PhD^{1,2} , Diana Oviedo, Msc¹, Alvaro Silva, MD^{1,3}, Diego Tovar, Msc⁴ , and Fabián Méndez, PhD²

Abstract

Continuity of care (COC) has been associated with lower mortality and hospitalizations and higher high blood pressure (HBP) control rates. This evidence mainly came from high income countries. We aimed to identify conditions associated with controlled HBP, particularly COC, in primary care services (PCSs) affiliated to two health insurances in Colombia, a low-median income country. A longitudinal observational study was carried out using clinical records of hypertensive adults >18 years with ≥4 clinic visits attending a contributive and a subsidized PCS in Cali (Colombia) between 2013 and 2014. Subsidized PCSs were for unemployment people and those at low socio-economic position and contributive for formal workers. COC was measured using the Bice and Boxerman index. Logistic regression models were performed to quantify the relation between COC and controlled HBP (blood pressure <140/90 mmHg). Between 2013 and 2014, among 8797 hypertensive people identified, 1358 were included: 935 (68.8%) and 423 (31.1%) from the contributive and subsidized PCSs, respectively. 856 (62.3%) were women and had a mean age of 67.7 years (SD 11.7). All people were on antihypertensive treatment. Over the study period, 522 (38.4%) people had controlled HBP, 410 (43.9%) in the contributive and 112 (26.5%) in subsidized PCSs. An increase in 1 unit of the COC index is associated with a 161% higher probability of having HBP controlled (OR, 2.61; 95% CI, 1.25–5.44). The odds of having controlled HBP increased as the number of visits rose; for example, people at the fourth visit had a 34% (OR, 1.34; 95% CI, 1.08–1.66) higher probability of reaching the target. Continuity of care was positively associated with controlled HBP. The strengthening of COC can improve the observed low HBP control rates and reduce health inequalities.

Keywords

hypertension, primary health care, continuity of patient care, Colombia

¹School of Medicine, Prevention and Control of Chronic Diseases Group, PRECEC, Faculty of Health, Universidad Del Valle, Cali, Colombia

²School of Public Health, Prevention and Control of Chronic Diseases Group, PRECEC, Faculty of Health, Universidad Del Valle, Cali, Colombia

³Caja de Compensación Familiar Del Valle Del Cauca-Comfandi, Cali, Colombia

⁴School of Statistics, Prevention and Control of Chronic Diseases Group, PRECEC, Faculty of Health, Universidad Del Valle, Cali, Colombia

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Corresponding Author:

Lena Barrera, MD, PhD, Department of Internal Medicine, Faculty of Health, Universidad del Valle-Campus San Fernando, Calle 4 B No, 36-00, Edificio 100, Piso 1, Oficina 117, Cali 0057, Colombia.

Email: lena.i.barrera@correounivalle.edu.co



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What do we already know about this topic?

The continuity of care (COC) as regular care for people with chronic conditions by the same health team has been associated with better health outcomes such as higher probability of achieving targets, lower hospitalizations, lower mortality, and patient satisfaction.

How does your research contribute to the field?

Like previous analysis, we found a positive association between COC and the probability of having high blood pressure (HBP) controlled in primary care services from a low–middle income country. Lower COC and HBP control rates have been found in the plans for unemployed people and those in lower socio-economic status than that for formal workers.

What are your research's implications toward theory, practice, or policy?

The COC needs to be strengthened for people with chronic conditions such as HBP at primary care services regardless of the health system or type of health provider. Also, health providers should facilitate procedures to grantee the continuity of care. Increasing COC has the potential of reducing inequalities between systems.

Introduction

High blood pressure (HBP) is the global leading cardiovascular risk factor. Worldwide, in 2017, HBP accounted for 10.4 million deaths mainly due to ischemic heart disease, hemorrhagic stroke, and ischemic stroke.¹ For adults ≥ 18 years of age, in 2015, the world standardized prevalence of HBP, blood pressure (BP) $\geq 140/90$ mmHg, was 24.1% for men and 20.1% for women.² In Colombia, a low-middle income country (LMIC), the global prevalence of HBP estimated by the National Health Survey in 2007 was 22.8%,³ and for those aged 60 years and older, the 2015 SABE survey reported a prevalence of 51.4% for men and 57.7% for women.⁴

Lowering BP is directly correlated with reductions in HBP-related cardiovascular mortality and morbidity.⁵ Although the percentage of people with controlled HBP (BP $< 140/90$ mmHg) has reached a level of 50% or more in high-income countries (HICs), the control of HBP in LMICs is still far from being acceptable, with percentages below 20%.^{6,7} In 2014, the High Cost Account (HCA), a national register of people with chronic conditions like HBP, revealed that among 2,827,129 people with HBP, 56.3% had controlled HBP using a target of BP $< 150/90$ mmHg BP for those aged 60 years and older and BP $< 140/90$ mmHg for the younger.⁸ By contrast, in a sample of Colombian hypertensive people, the PURE study revealed that only 37.1% of those on antihypertensive treatment had BP $< 140/90$ mmHg.⁹

The control of HBP in people mainly relies on primary care services (PCSs)¹⁰; therefore, access to and the performance of PCSs are determinant factors to improve the control of HBP.^{11–14} An essential attribute of PCS performance is the continuity of care (COC) defining as receiving repeated health care from the same physician. Patients form a beneficial therapeutic relationship if treated by the same doctor over time leading to better patient satisfaction, more patient-centered interventions, and also increase in positive health outcomes.¹⁵ The COC has been associated with achieving

controlled HBP and lowering both cardiovascular mortality and visits to emergency services.¹⁶ Some evidence has shown that COC reduced between 2% and 25% the risk of hospitalization^{17,18} and increased the likelihood of achieving of blood pressure control targets and also the quality of life of hypertensive people.^{19,20} The associations have been consistent despite of differences between health systems across the world,^{16,17} although the impact may vary regarding PCS coverage and performance.²¹

In Colombia, primary health care is mainly provided through two health insurance plans, contributive and subsidized. Unemployed people and those in the lowest socio-economic position are covered by the subsidized plan while formal workers, individuals with capacity to pay, and their dependents are covered with the contributive plan. A small percentage of the population receives healthcare from special plans.²² The contributive is a private plan mainly financed by workers and employs contributions, and the subsidized is funded by the government means of general taxes. The special plans covered army forces, university teachers, and workers from the National Company for Oil Exploration (ECOPETROL).²³ For all health plans, a national regulation to provide healthcare for people with HBP was established in 2000,²⁴ and the first Colombian national clinical guidelines for the management of HBP were launched in 2013.²⁵ The national guideline defines HBP as having systolic blood pressure (SBP) ≥ 140 mmHg and/or diastolic blood pressure (DBP) ≥ 90 mmHg for adults ≥ 18 years of age and controlled HBP as BP below 140/90 mmHg for hypertensive people.^{24,25} Some reports have shown differences in health outcomes between health insurances. For example, older people from the contributive system used preventive measures more frequently than those from subsidized system in the 2015 SABE survey.^{26,27} Therefore, we aimed to identify conditions associated with achieving controlled HBP, particularly COC among hypertensive individuals attending two PCSs affiliated to contributive and subsidized plans in Cali, the third largest city of Colombia.

Methods

This is a retrospective longitudinal analysis of hypertensive people attending two PCSs belonged to the subsidized and contributive plans in Cali (Colombia) between 2013 and 2014. Ethical approval was obtained from ethical committees at both PCSs and the University of Valle with the number 06-014 in 2014.

The subsidized PCS was located in the East Cali and provided healthcare to people living nearby; nearly 67% belonged to low socio-economic status in 2014.²⁸ The contributive PCS was at southeast of Cali and provided healthcare to affiliates regardless of their residential zone. Both PCSs provide healthcare to hypertensive people based on the national regulations²⁴; and the contributive PCSs also added a family physician, as a team leader, and a program addressing renal protection.

In brief, the national guidelines established that for all hypertensive patients, the health providers should offer two annual medical visits with a general physician; the measurement of lipids, kidney function, and glycemia and electrocardiogram at the diagnosis; and access to first line antihypertensive medications without audit. Over the follow-up, the number of medical visits and the laboratory tests depended on the cardiovascular risk with at least one annual check by internal medicine specialist. The clinical checks can be carried out by professional and/or assistant nurses for those at low cardiovascular risk and controlled HBP. Hypertensive people at high cardiovascular risk and/or with comorbidities should be sent to internal medicine specialist at least three times a year.^{24,25}

Study Population

We included individuals >18 years of age with HBP registered with one of the following codes from the International Classification of Diseases (ICD v. 10): I10X, I11.0, I11.9, I12.0, I12.9, I13.0, I13.1, I13.2, I13.9, I15.0, I15.1, I15.2, I15.8, or I15.9²⁹ and had more than four visits with general practitioner between January 1, 2013 and December 31, 2014 in the database provided by each PCS. A 50% of controlled HBP rate was expected according to the 2014 National Kidney Chronic Disease report.⁸ We estimated the total number of people needed to identify factors associated with controlled HBP considering an odds ratio (OR) of 1.2³⁰ leading to a sample of 1351 people who were distributed into one-third for the subsidized and two-thirds for contributive PCSs according to the population registered with each PCS.

Data Extraction

Each PCS provided the database of people with HBP attending between January 1, 2013, and December 31, 2014. For each individual, a minimum of 4 and a maximum of 6

registers were included as the national guide established a minimum of 2 clinical visits per year for hypertensive people.²⁴ Data from all medical visits were included for those who had 4, 5, and 6 medical visits. For those with more than 6 medical visits, we ran an algorithm to randomly select the medical visits from which the data were extracted. Data were extracted chronologically from the PCS records following the calendar date. Information from the initial and the last medical visit identified over the study period was always extracted. A maximum of 6 visits was included for each patient, as it reflected the national guideline for the follow-up of individuals with hypertension. The administrative unit at each PCS provided the registers and the dataset of hypertensive patients to the researchers.

Variables

The primary outcome was controlled HPB defined as BP <140/90 mmHg registered at any time during the study period.^{8,25} The covariables were demographic characteristics, physiological variables, HBP-related conditions, non-cardiovascular comorbidities, diabetes, and other cardiovascular risk factors such as obesity as body mass index ≥ 30 , dyslipidemia, and smoking. In both PCSs, all variables were collected from the registers which were filled by the general physician during each medical visit. The socio-economic stratum was adjudicated by the researchers based on the stratum mode of the patient's neighborhood defined by the Administrative Office of the municipality of Cali.³¹ For those with 6 or more clinical visits, the interval time between visits was calculated among the included records. Pregnant women were excluded from the analysis.

Continuity of care (COC) was defined as having been seen by the same physician throughout the included visits during the study period and was estimated based on the index developed by Bice and Boxerman.³² The COC index was calculated according to the equation (1) where n_j is the number of visits to the same physician and n is the total number of visits during the observed period. The expected values of the COC range between 0 when the physician varies at each visit to 1 when the physician did not vary

$$COC = \frac{\sum_{j=1}^s n_j^2 - n}{n(n-1)} \quad (1)$$

Statistical Analysis

A descriptive analysis was carried out by calculating percentages for categorical variables and mean and standard deviation for quantitative variables. Two multilevel logistic models were performed to estimate the association between having controlled HBP and independent variables. Thus, a cross-sectional model using the BP recorded at the last visit as the outcome and a longitudinal analysis using all BP

measurements in each visit as the outcome, taking each subject as a random effect in the first level, and the PCSs for the second hierarchical level were performed. As the guideline recommended more regular medical visits for those with uncontrolled BP, we considered and analyzed the population by number of visits. The first strata were those with the minimal visits established in the guideline.^{24,25} Then, the population was divided into 3 groups according to the total number of clinical visits they had registered in the data set provided by each PCS such as those with 4, 5, or 6 visits and more. The control variables added to the model were age, BMI, sex, diabetes, and having any HPB-related condition, such as stroke, heart failure, coronary heart disease, or impaired kidney function.³³ For the longitudinal model, a total of 6.6% of BMI value was inputted from the last identifiable measurement to complete missing data. As aging is associated with limitations in achieving blood pressure targets due to physical changes and medical attitudes to intervene this population, we explore the interaction between age and medical visits over the period.³⁴ All models were adjusted for the total individual follow-up days and diabetes. Data were analyzed using STATA (version 14 2014, StataCorp LP).

Results

Between 2013 and 2014, we identified 3652 people with HBP among 22,456 attendances at the subsidized PCS. A total of 1968 (53.8%) with less than 4 medical visits were excluded. After, we randomly selected 592 (35.1%) people according to

the sample size estimation. Then, we excluded 168 (28%) people, based on inclusion criteria, leaving 423 (72%) people for the analysis. Among 5145 registered people with diagnosis of HBP from the contributive PCS, we randomly excluded 2744 (53.3%), as the initial dataset did not contain information about the number of clinic visits per individual. From the remaining 1262 people, we excluded 327 (25.9%) based on inclusion criteria, leaving 935 (75%) for the analysis (see Figure 1).

The included population had a mean age of 67.7 (SD 11.7) years, and 856 (62.3%) were women. Those from the subsidized PCS were slightly older than people from the contributive PCS with a mean age of 68.5 (SD 11.9) and 67.4 (SD 11.6), respectively. All people receiving care in the subsidized PCS were at low socio-economic status compared with only 30.9% in the contributive PCS. People from the contributive PCS had more clinic visits than those in the subsidized PCS, and globally, those with BP \geq 140/90 mmHg had lower length between medical visits over the period (see Table 1).

Among the included population, 72% (n =1036) did not have any HBP-related condition. Impaired kidney function (IKF) was the most common HBP-related condition, with 143 (10.5%) individuals, followed by chronic peripheral arterial disease (91; 6.7%), coronary heart disease (86; 6.3%), stroke (64; 4.7%), and heart failure (51; 3.7%). A higher proportion of men suffered from HBP-related diseases compared with women in both PCSs; however, a higher proportion of women in the subsidized were found with these conditions than that in the contributive PCS. Similarly, people with IKF were more frequently identified among those visiting the

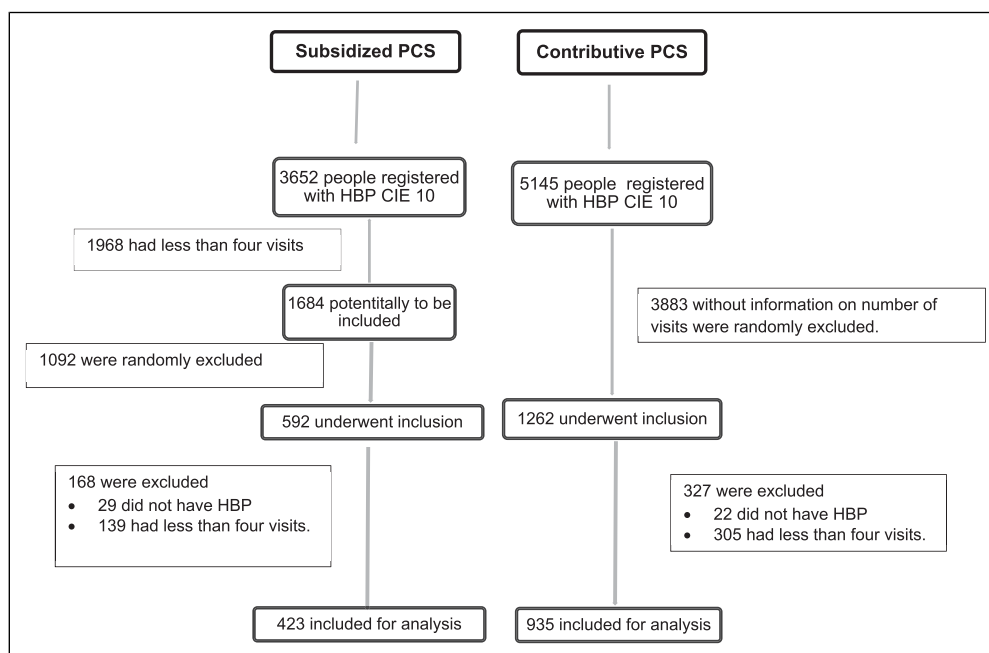


Figure 1. Flow diagram of the selection of included population.

Table 1. Characteristics of Included Population, N = 1358.

Characteristics	Contributive PCS N = 935		Subsidized PCS N = 423	
	<60 years	≥60 years	<60 years	≥60 years
Age (years) (SD) ^a	52.6 (6.7)	71.8 (8.8)	52.2 (5.5)	73.4 (8.2)
n (%)	259 (27.7)	676 (73.2)	114 (25.9)	309 (73.1)
Female, N (%)	148 (69.2)	386 (53.5)	80 (80.0)	232 (71.8)
Male, N (%)	66 (30.8)	335 (46.5)	20 (20.0)	91 (28.2)
Socio-economic strata, N (%)				
Low	75 (35.0)	214 (29.7)	100 (100.0)	322 (99.7)
Middle	130 (60.7)	470 (65.2)	0 (.0)	0 (.0)
High	7 (3.3)	15 (2.1)	0 (.0)	0 (.0)
Unknown	2 (.9)	22 (3.1)	0 (.0)	1 (.3)
Baseline clinic characteristic				
Number of people by total number of included visits N (%)				
Four visits	38 (17.8)	62 (8.6)	51 (51.0)	117 (36.2)
Five visits	40 (18.7)	104 (14.4)	23 (23.0)	85 (26.3)
Six visits	136 (63.6)	555 (77.0)	26 (26.0)	121 (37.5)
Mean time between visits in days (SD) ^a				
Four visits	89.27 (39.69)	103.35 (39.56)	111.84 (29.49)	119.76 (27.07)
Five visits	89.70 (25.04)	98.12 (27.97)	104.44 (17.18)	102.08 (23.31)
Six visits	94.88 (19.29)	97.89 (15.71)	92.98 (10.84)	93.00 (15.49)
Mean time between visits in days (SD) ^a				
Blood pressure ≥140/90 mmHg	85.14 (28.99)	91.18 (28.18)	103.90 (26.21)	103.51 (25.17)
Four visits	69.56 (40.72)	97.86 (54.36)	108.46 (30.36)	116.92 (28.15)
Five visits	75.08 (28.97)	72.48 (33.81)	98.73 (19.40)	100.59 (22.63)
Six visits ^b	92.83 (21.81)	93.18 (20.15)	93.56 (10.95)	93.80 (18.60)
Blood pressure <140/90 mmHg	98.54 (20.54)	99.97 (18.24)	106.10 (24.64)	104.79 (24.89)
Four visits	98.54 (20.54)	99.97 (18.24)	106.10 (24.64)	104.79 (24.89)
Five visits	102.95 (34.81)	103.25 (34.31)	115.12 (30.54)	120.11 (25.93)
Six visits ^b	97.98 (16.55)	98.67 (14.28)	93.94 (9.88)	92.00 (13.91)
Blood pressure <140/90 mmHg, N (%) ^a	186 (71.81)	502 (74.26)	80 (70.18)	193 (62.46)

^aAt baseline.^bThe interval time was measured between selected records. See text.

subsidized PCS than those from the contributive PCS. In both PCSs, people aged 60 years and older were more likely to have HBP-related conditions (see [Table 2](#)).

For 144 (11.4%) people, we did not identify any of the 4 cardiovascular risk factors analyzed. Dyslipidemia was the most common cardiovascular risk factor in both PCSs. A higher proportion of people with dyslipidemia, obesity, and diabetes were found in the contributive PCS compared to the subsidized PCS. In contrast, smoking was the most common cardiovascular risk factor reported in those from the subsidized PCS. In both PCSs, dyslipidemia and diabetes were more commonly found in older people, but smoking and obesity were more common in younger people. Men exhibited more cardiovascular risk factors than women, except for obesity (see [Table 2](#)).

Between 2013 and 2014, we recorded data from 6, 5, and 4 clinic visits for 838 (61.7%), 252 (18.5%), and 268 (19.7%) hypertensive people, respectively. While 691 (73.9%) people from the contributive PCS had 6 clinic visits, only 147

(34.8%) from the subsidized PCS had that number of visits. Over the study period, regardless of the total visits recorded, the proportion of people with controlled HBP was higher in the contributive (46.6%) as compared with the subsidized PCS (33.3%). Similarly, the frequency of clinic visits with the same physician was higher in the contributive PCS than it was in the subsidized PCS, COC .27 vs .10. Almost 100% of patients were on antihypertensive treatment in both PCSs. There were no differences in being on antihypertensive treatment between older (≥60 years) and younger (<60 years) patients, between sexes, or among those diagnosed with any HBP-related conditions ([Table 3](#)).

The odds of controlled HBP decreased 5% for every increase in one unit of BMI (odds ratio [OR], .95; 95% confidence interval [CI], .92–.98) using the last BP as an outcome. Identical results were observed if all BP measures were used (OR, .96; 95% CI .94–.98). Similarly, for every year increase in age, the odds of having controlled HBP dropped by 2% (OR, .98; 95% CI .97–.99) though this

Table 2. Clinical Characteristics of the Population, n = 1358.

Clinical characteristics	Contributive PCS, n = 935				Subsidized PCS, n = 423			
	Male		Female		Male		Female	
	<60 years	≥60 years	<60 years	≥60 years	<60 years	≥60 years	<60 years	≥60 years
HBP-related chronic diseases								
Coronary heart disease (N-%)	4 (6.1)	36 (10.8)	2 (1.4)	18 (4.7)	2 (10.0)	4 (4.4)	1 (1.3)	19 (8.2)
Stroke (N-%)	2 (3.0)	20 (5.9)	3 (2.0)	18 (4.7)	1 (5.0)	3 (3.3)	3 (3.8)	14 (6.0)
Heart failure (N-%)	1 (1.5)	13 (3.9)	2 (1.4)	8 (2.1)	1 (5.0)	6 (6.6)	2 (2.5)	18 (7.8)
Chronic peripheral artery disease (N-%)	5 (7.7)	48 (14.3)	1 (.7)	16 (4.2)	0 (0)	0 (0)	2 (2.5)	19 (8.2)
Impaired kidney function (N-%)	5 (7.7)	59 (17.6)	4 (2.7)	20 (5.2)	2 (10.0)	27 (29.7)	2 (2.5)	24 (10.3)
Cardiovascular risk factors								
Diabetes mellitus (N-%)	34 (51.5)	217 (64.8)	48 (32.4)	154 (39.9)	5 (25.0)	39 (42.9)	35 (43.8)	109 (46.9)
Dyslipidemia (N-%)	52 (80.0)	273 (81.5)	110 (74.3)	327 (84.9)	14 (70.0)	57 (62.6)	50 (62.5)	146 (62.9)
Obesity (N-%) ^a	28 (43.1)	111 (33.1)	70 (47.3)	143 (37.1)	8 (40.0)	4 (4.4)	49 (61.3)	25 (10.8)
Body mass index mean (SD)	29.5 (5.16)		27.3 (4.65)			28.79 (5.66)		26.97 (4.72)
Smoking (N-%)	5 (7.7)	12 (3.6)	3 (2.0)	6 (1.6)	0 (.0)	6 (6.6)	4 (5.0)	11 (4.7)
Chronic diseases non-related to HBP								
Thyroid diseases (N-%)	2 (3.1)	72 (21.5)	22 (14.9)	109 (28.3)	3 (15.0)	7 (7.7)	7 (8.8)	39 (16.8)
COPD (N-%)	0 (.0)	19 (5.7)	0 (.0)	8 (2.1)	0 (.0)	5 (5.5)	2 (2.5)	14 (6.0)

Note. COPD = chronic obstructive pulmonary Disease; HBP = high blood pressure; SD = standard deviation.

^aBMI ≥ 30.

association became slightly weaker in the longitudinal model (OR, 1.00; 95% CI .98–1.01). Additionally, having any HBP-related condition was associated with lower odds of having controlled HBP over the study period (OR, .77; 95% CI .61–.99), but this effect was not identified in the cross-sectional model. There was no significant association between sex and the probability of having controlled HBP.

Table 4

An increase in 1 unit in the COC results in almost 3-fold higher odds of having HBP controlled (OR, 2.61; 95% CI, 1.25–5.44). Similarly, the probability of controlled HBP increased by 52% (OR, 1.52; 95% CI, 1.28–1.80) at each visit with the same physician in the longitudinal model. Then, those who received healthcare by the same physician were more likely to have controlled HBP. The odds of having controlled HBP increased as the number of visits rose; for example, people at the fourth visit had a 34% (OR, 1.34; 95% CI, 1.08–1.66) higher probability of reaching the target, compared to those at the first visit. However, there was an interaction effect between each clinical visit and age. For every year increase in age, there was no variation in the probability of having HBP controlled across the clinic visits. Also, for those at the sixth clinic visit, a one-year increase in age reduced the probability of control by 3% (OR, .97; 95% CI, .95–.99) compared to those at the first clinic visit registered. For the cross-sectional analysis, there was no difference in the risk of having controlled HBP between those with 5 or 6 clinic visits compared to those with 4 clinic visits. A positive association between increases in the total of follow-up days and controlled HBP was found in the longitudinal model (see Table 4).

Discussion

In this analysis of hypertensive people being regularly treated in the Colombian contributive and subsidized PCSs, we found that hypertensive people were mainly women aged 60 years and over; individuals attending the subsidized PCS were at lower socio-economic status than those at the contributive PCS. Over the study period, 38.4% of hypertensive people had controlled HBP, 46.6% at the contributive and 33.3% at the subsidized PCSs. Better COC scores were associated with higher odds of having controlled HBP over the period. The probability of reaching the BP target also increased at each visit, but this effect was modified by age.

Despite of being under equal regulations, the percentages of hypertensive people with controlled HBP were 46.6% and 33.3% for the contributive and subsidized PCSs, respectively, over the study period. Similarly, the PURE study, which analyzed a sample of hypertensive people from twelve Colombian states, reported that people at lowest income and with lower education had poor control rates in comparison with those in opposite categories, 14% vs 22%.⁹ The subsidized insurance is for those at lower socio-economic conditions.²² The 2015 SABE survey also found that among people aged 60 years and older, the rate of controlled HBP was 44% and 54% in those in the subsidized and the contributive insurance, respectively.⁴ There has been reported that people in the subsidized insurance are less likely to use preventive services and claim medicines.^{27,35,36} These data may reflect that access barriers to medicines and other interventions in the subsidized insurance could account for the lower blood pressure control rates in this population.

Table 3. Performance of Services for Hypertensive People, N = 1358.

	Contributive PCS, N = 935			Subsidized PCS, N = 453		
	People with 4 visits	People with 5 visits	People with 6 visits	People with 4 visits	People with 5 visits	People with 6 visits
Number of people in each category (N-%)	100 (10.7)	144 (15.4)	691 (73.9)	168 (39.7)	108 (25.5)	147 (34.8)
People on antihypertensive treatment (N-%)	100 (100.0)	144 (100.0)	691 (100.0)	168 (100.0)	107 (99.1)	147 (100.0)
People with blood pressure <140/90 mmHg in the last visit (N-%)	83 (83.0)	126 (87.5)	595 (86.1)	119 (70.8)	77 (72.0)	110 (74.8)
People with blood pressure <140/90 mmHg over the study period (N-%)	52 (51.49)	76 (53.15)	308 (44.57)	68 (40.48)	37 (34.26)	36 (24.49)
Time between first and last visit						
Median (days) 25%—75% quartile	424 (273–519)	495 (403.5–580)	608 (550v650)	461 (393–550)	544 (451–590.5)	570 (518–617)
Continuity of Care Index (COC)						
Median (range)	.17 (.00–1.00)	.30 (.00–1.00)	.26 (.07–.67)	.17 (.00–.17)	.10 (.00–.30)	.07 (.00–.27)
Global median (10%–90% quartiles)	.27 (.07–.67)			.10 (.00–.27)		

Note. N = number; % = percentage.

Table 4. Conditions Associated with Blood Pressure Below 140/90 mmHg, N = 1321^a.

Characteristics	Having blood pressure <140/90 mmHg			
	Cross-sectional analysis ^{b,c}		Longitudinal analysis ^{b,d}	
	Odds ratio ^b [CI] ^e	P value	Odds ratio ^b [CI] ^e	P value
Individual				
Age ^f	.98 (95% CI .97–.99)	.042	1.00 (95% CI .98–1.01)	.998
Sex	1.07 (95% CI .77–1.49)	.662	.94 (95% CI .76–1.18)	.642
BMI	.95 (95% CI .92–.98)	.003	.96 (95% CI .94–.98)	.001
Having any related HBP condition ^g	.98 (95% CI .69–1.40)	.948	.77 (95% CI .61–.99)	.044
Primary care performance				
Continuity of care				
COC	2.61 (95% CI 1.25–5.44)	.010	NA	
Being attended by the same physician at the next clinic visit			1.52 (95% CI 1.28–1.80)	<.001
Patients-visit group ^h				
Five visits	1.27 (95% CI .79–2.03)	.318	NA	
Six visits	1.32 (95% CI .85–2.05)	.207	NA	
People at each chronological visit recorded ⁱ				
Second visit	NA		1.12 (95% CI .91–1.39)	.260
Third visit	NA		1.17 (95% CI .94–1.44)	.141
Fourth visit	NA		1.34 (95% CI 1.08–1.66)	.006
Fifth visit	NA		1.50 (95% CI 1.18–1.89)	.001
Sixth visit	NA		2.25 (95% CI 1.71–2.96)	<.001
Interaction effect				
Clinic visit in chronological order ^b age				
Second visit	NA		.99 (95% CI .98–1.01)	.904
Third visit	NA		.98 (95% CI .97–1.00)	.231
Fourth visit	NA		.99 (95% CI .97–1.01)	.588
Fifth visit	NA		.98 (95% CI .97–1.00)	.290
Sixth visit	NA		.97 (95% CI .95–.99)	.027
Total days between the first and the last clinic register over the study period ^d	1.00 (95% CI .99–1.00)	.587	1.001 (95% CI 1.000–1.002)	<.001
Diabetes	.95 (95% CI .76–1.20)	.684	1.010 (95% CI .822–1.240)	.928

Note. N = number

^aOnly people with all variables with valid values. Body mass index (BMI)

^bAdjusted for diabetes.

^cOutcome recorded from the last visit

^dOutcome recorded over the study period.

^eCI:Confidence interval

^fCentered age = 67.9 years

^gHaving at least one of the following HBP-related conditions: heart failure, coronary heart disease, impaired kidney function, or stroke

^hPeople were classified by the total of number visits included as: those with 4, 5, or 6 registers.

ⁱFor everyone, the first and last register corresponded to the first and last medical visit identified chronologically during the study period

We confirmed the positive association between the COC and having controlled HBP and reduction in hypertension related-diseases mortality and morbidity.^{13,16} For each visit at which people were treated by the same physician, the probability of being in control increased almost 3-fold. Consistently, the COC has been associated with lower mortality rates and better HBP control across different health systems.^{16,37} Studies from the USA, the United Kingdom, France, and China have found that those who had been attended by the same general practitioner had up to 34% higher probability of achieving the BP target.³⁷ Noteworthy, a lower

COC index was identified in the subsidized in relation to contributive PCS which could also explain the lower blood pressure targets in the former. Additionally, the median COC for those with 6 visits was lower compared with data reported in countries like Korea and China with .77 and .74, respectively,^{13,14} so the analyzed PCSs have space to improve their performance. From the patient's perspective, familiarity, empathy, and trust in the general practitioner are mechanisms that explained the COC. And, the increasing knowledge about the patients, empathy, and stronger responsibility are GP conditions which support the pathways of COC.¹⁵ In

addition to this, in Colombia, the GPs are assigned to the called primary care programs for chronic diseases for long periods of time at PCSs which could contribute to the positive observed association.

We selected a sample of hypertensive people who met the minimal follow-up for people with HBP established in the national guidelines. Among the selected sample, people at the contributive insurance had more regular checkups than those at the subsidized insurance. Also, the lengths between visits were lower for those with BP $\geq 140/90$ at the first visit. The integration of family physicians into the HBP program could contribute to strength the follow-up and then the achievement of HBP control targets. Family physicians providing clinical orientation and preventive strategies have been resulted in higher control rates and reduction in cardiovascular hypertension-related mortality.^{12,38} The program at the contributive PCS has also included a strategy focused on renal kidney prevention which includes a nephrologist consultant providing orientations to the primary group. Consistently, the integration between consultants and PCSs has been associated with higher recognition of renal function impairment and the achievement of blood pressure targets.³⁹ It is noticeable that people were at similar cardiovascular risk in both PCSs and markedly differences in interventions could not be expected.

Finally, the probability of having HBP controlled increased at each contact with the service mainly after the third visit. This result confirmed that the achievement of HBP control demands more than one clinical visit and a constant follow-up.¹² In Chinese people with hypertension, Zuo et al. recently reported that having 4 to 6 appointments over 1 year follow-up increased the probability of achieving BP control by 62% in comparison with having one to three.⁴⁰ Similarly, Mahmood et al. found that those adherent to the regular appointments are more likely to have controlled BP.⁴¹ The continuous monitoring offered by community health workers, physicians, pharmacist, or other members of health team integrated into PCSs has resulted in SBP reductions up to 19 mmHg.^{12,42} Therefore, the European Society of Hypertension guidelines have recommended a monthly follow-up until achieving the BP target.⁴³ However, the data showed that older people can be less likely to have HBP controlled at the sixth visit. The lack of having received care by the same physician and poor adherence to interventions could account for that finding. Also aging has been associated with poor HBP control even in experimental conditions.^{44,45}

Limitations and Strengths

Few studies have been carried out outside the HIC, so the current analysis added evidence on the positive impact of COC on individual health in LMIC. Leniz J and Gulliford M using data from the Chilean National Health Survey found that COC was neither associated with better HBP control nor with access to hypertensive medications. However, the

measurement of COC was based on questions about awareness of general practitioner reported by people with HBP, and only 28% (258) of them were classified as having COC.²¹ Our analysis used the Bice and Boxerman index which is a standard measurement to calculate COC.³² Consistently, the higher the index, the better the health outcomes such as lower hospitalization rates, higher HBP control rates, and quality of life regardless of health system.^{14,16} Although the COC does not capture the quality of relationship between general practitioner and patient, our data allowed for identifying the general practitioner with a code so we can be confident that COC was accurately measured. Also, we restricted the analysis to those who adhered to the national guidelines in terms of medical visits over a limited period of 2 years. Therefore, we reduced the potential divergence between patient's reports and data.⁴⁶

We found a lower percentage of hypertensive people reaching the BP target (42.8%) over the study period compared to that reported by the HCA, 56.3%. This register used a higher target (BP $<150/90$ mmHg) for older people which can account for that difference.⁸ However, evidence has shown a reduction in cardiovascular mortality particularly stroke in adults over 60 years who attained systolic BP levels between 130 and 140 mm compared to those with higher levels.^{47,48} Additionally, we found lower HBP control rates in the subsidized than in the contributive insurance. These differences need more exploration because patient adherence and the use of non-pharmacological interventions were not assessed in the current analysis. Also, we used secondary data which are not collected for research purposes. However, our sample was formed with people who have been followed up over 2 years in both PCSs, and only 6.6% of registers had missing value in the BMI variable. Complementary, the sample only included data from those with regular medical visits such as people with more than 4 medical visits over the period because we did not measure patient-adherence. Attending medical appointments regularly has been associated with higher adherence to interventions and better BP control.^{49,50} Finally, the rates of HBP control were consistent to that reported by the PURE and the CARMELA surveys, 37.1% and 30.6%, respectively.^{9,51}

The probability of having BP controlled increased at each medical visit and more significantly after the third visit. The visits were not related with the date of hypertension diagnosis, but most patients were over 60 years so they could have the diagnosis for more than years. Although there are variations in medications recommended by the national guideline, we considered that the higher probability of having HBP controlled after the third visit could also be explained by the COC strengthened by the guideline. Our data showed that all patients were on antihypertensive medication over the study period, and it is known that the reduction in BP levels due to medications is similar regardless of antihypertensive class.⁵² An intensification in treatment could be possible, but it is also related to COC.

In conclusion, in 2 PCSs from an LMIC, nearly 40% of hypertensive people have controlled HBP over 2 years of follow-up. The COC and regular visits to the PCSs increased the probability of achieving the HBP target. The strengthening of the follow-up for hypertensive patients regardless of insurance plan can improve the current HPB control rates. Moreover, increasing COC has the potential of reducing inequalities in health outcomes.

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ORCID iDs

Lena Barrera  <https://orcid.org/0000-0001-9179-7796>

Diego Tovar  <https://orcid.org/0000-0003-3490-9899>

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