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Gaps in hypertension care and control: a population-based study in low-income urban Medellin, Colombia

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Abstract

OBJECTIVES To assess hypertension prevalence and the extent and associated factors of hypertension diagnosis, follow-up, treatment and control gaps in low-income urban Medellin, Colombia.
METHODS We randomly sampled 1873 adults aged 35 or older. Unaware hypertensive individuals were defined as those without previous diagnosis whose average blood pressure was equal to or above 140/90 mmHg. For aware hypertensive patients, control was delimited as average blood pressure below 140/90 if under 59 years old or diabetic, and as less than 150/90 otherwise. We used logistic regression to identify care gap-associated factors.
RESULTS Hypertension prevalence was 43.5% (95% CI 41.2–45.7). We found 28.2% aware and 15.3% unaware hypertensive individuals, which corresponds to a 35.1% (95% CI 31.9–38.5) underdiagnosis. This gap was determined by age, sex, education and lifestyle factors. 14.4% (95% CI 11.6–17.6) of aware hypertensive patients presented a follow-up gap, 93.4% (95% CI 90.9–95.2) were prescribed antihypertensive drugs, but 38.9% (95% CI 34.7–43.3) were not compliant. The latter was strongly associated with follow-up. The hypertension control gap in aware hypertensive patients, 39.0% (95% CI: 34.9–43.2), was associated with being older, having diabetes, weakly adhering to pharmacological treatment and receiving poor non-pharmacological advice. Overall, 60.4% (95% CI 57.0–63.8) of aware and unaware hypertensive participants had either diagnosed but uncontrolled or undiagnosed hypertension.
CONCLUSIONS We found high hypertension prevalence coupled with, from an international perspective, encouraging awareness and control figures. Still, there remains ample room for improvement. Our findings can assist in designing integrated primary healthcare measures that further strengthen equitable and effective access to hypertension care and control.

keywords chronic diseases, hypertension awareness, hypertension control, cascade of hypertension care, health care gaps, primary health care, Latin America, Colombia

Sustainable Development Goals: Good Health and Wellbeing, Reduced Inequalities

Introduction

Globally, uncontrolled hypertension (HTN) is the leading underlying risk factor for attributable deaths, accounting for 10.8 million (19.2%) of the yearly worldwide mortality [1]. HTN has been associated with around 65% of deaths due to stroke and 50% of deaths due to ischaemic heart disease[2]. In the last decades, the main impact of uncontrolled HTN has shifted from high-income countries (HICs) to low- and middle-income countries (LMICs) [3]. Almost three-quarters of the affected – more than one billion adults – now live in developing countries. Cardiovascular diseases mainly affect the middle-aged working population and generate premature mortality and disability that hamper economic growth and social development [4].

HTN requires lifelong care, but problem awareness, access to treatment and successful control are

compromised in LMICs [2], where health services are often designed to provide above all curative treatment for acute diseases. Globally, only 10% of people suffering from chronic conditions are treated appropriately [5]. Care for non-communicable diseases is, apart from a few exceptions [6], often reduced to belated management, in specialised settings, of exacerbations or complications.

In a cross-sectional study conducted between 2003 and 2009 in 3 HICs, 10 middle-income countries (MICs) and 4 low-income countries (LICs) [7], the overall age- and sex-standardised HTN prevalence in adults aged 35 to 70 years was 40.8% and awareness of the condition 46.5%. Of the aware individuals, 87.5% were treated with antihypertensive medication but only 32.5% of the treated patients had controlled blood pressure (BP). Not surprisingly, LICs performed significantly worse than MICs and HICs. In the Colombian sites included in this multicentre study, the overall HTN prevalence was 37.5% and HTN awareness 51.9%. Among the aware individuals, 77.5% were treated with antihypertensive medication, but only 37.1% of the treated patients had controlled BP [8].

A review that included population-based studies from 90 countries worldwide [9] estimated, for 2010, an overall standardised HTN prevalence of 31.1% in adults aged 20 years or older. Of the affected, 46.5% were aware of their status, and 36.9% reported treatment with antihypertensive medication, but only 13.8% had controlled BP. The corresponding outcome figures were, again, substantially lower for LMICs than for HICs. A 2019 review focusing on LMICs [10] pooled individual-level HTN data on persons aged 15 years and older from 44 countries and found 17.5% prevalence. Of the hypertensive individuals, 39.2% were aware of their condition, 29.9% received pharmacological treatment, and barely 10% attained controlled BP. The included Latin American and the Caribbean countries generally performed better than predicted by their per capita gross domestic product.

The studies mentioned above provide information on HTN control internationally and on variations among populations. However, only the most recent one explored the causes of the observed gaps in the cascade from HTN detection to control. Most studies that identify patient- and provider-related barriers to HTN care have been carried out in HICs [11] and collected information at the health facility level. The evidence on the determinants of gaps in the HTN care process in LMICs is scarce and, after over a decade, an updated and more in-depth assessment of HTN care at the population level would be welcome for Colombia, a country that has experienced profound market-oriented health system changes where cost-containment mechanisms imposed by health insurance companies often hamper timely access to care, especially for the chronically ill [12].

The present study aims to determine the prevalence of HTN in the population aged 35 years or older in low-income urban Medellin and at estimating the magnitude of the diagnosis, follow-up, treatment and control gaps in the HTN continuum of care and identifying associated factors.

Methods

Study setting

Colombia is a MIC with a 2016 per-capita gross domestic product of (current) US$ 5870 [13]. The healthcare system has two insurance schemes [14]. The contributory one is compulsory for formally employed workers, pensioners and part of the self-employed. The State finances the subsidised scheme, which covers people that cannot afford contributions. An array of health insurance companies contract healthcare provision for their affiliates with private clinics and autonomous public hospitals. Under both insurance schemes, affiliates and their dependents are entitled to benefits comprising a standardised healthcare package.

As detailed previously [15], the study was conducted in 2016 in the Santa Cruz Commune, located in the north-east of Medellin, the second-largest industrialised city of Colombia. Santa Cruz is one of the most deprived of the city's 16 communes [16] and had 111 452 inhabitants (53% women and 47% men) in 2015 [17]. Almost 55% of the commune's population are insured under the contributory scheme and 44% under the subsidised scheme; 1% have no insurance cover [18]. Santa Cruz commune was purposively selected for being urban and having a low-income population, making it akin to the environments most Colombians are currently living in. It represents the national health system's functioning and the major primary healthcare provider in the area is committed to improving HTN control activities based on the research results.

Sampling

We used cluster sampling. To estimate the HTN prevalence with 2% precision, allowing for an alpha error of 5% and assuming *a priori* – in line with national figures [19] – an 18% prevalence, 1.5 adults over 35 years per household [17,20], a design effect of 1.5 and 25% non-response, we needed to include a total of 1380 households. The municipality's Planning Office provided the total population size of the commune's 11

neighbourhoods and maps and lists of addresses. To select households, we subdivided all neighbourhoods into clusters of 15 contiguous premises. We randomly sampled 92 clusters, including in each neighbourhood a number of clusters proportional to its population size. Trained professional surveyors made up to two repeat visits to every selected premise to include in the study all identified household members aged 35 years or older.

Data collection

Participants were interviewed using a structured questionnaire designed to provide information on sociodemographic characteristics, health-seeking behaviour, lifestyle habits and health problems. Most variables measured during the survey were assessed by self-report. Participants referring to a previous diagnosis of HTN were asked about follow-up care, prescription of antihypertensive pharmacological and non-pharmacological treatment and treatment adherence. The use of antihypertensive drugs was verified by presentation of the packages. To determine levels of adherence to pharmacological treatment, we applied Morisky's four-item Medication Adherence Questionnaire [21]. BP was measured three times for all participants, from the right arm in a sitting posture, using a digital manometer, following international recommendations for standardised BP measurement in population surveys [22,23].

Data analysis

Data were double entered in a Microsoft Excel 2010 database and analysed using the Statistical Package for Social Sciences (SPSS) V.23 (SPSS Inc., Chicago, IL, USA). We developed checks for data entry with built-in filters and logical constraints.

In the final analysis, the main measured variables were dichotomised. Grouping becomes clear from the reported results, except for: post-primary education (yes: university, technical college or secondary school / no: primary school or below); remunerated occupation (yes: formal or informal worker, self-employed / no: housewife, student, unemployed and pensioner); smoking (yes: current habit / no: never or abandoned); alcohol consumption (yes: monthly, weekly or every day / no: annually or not at all); physical activity (yes: every day or at least twice a week / no: once a week or not at all); if aware of being hypertensive, received all indications of non-pharmacological treatment (yes: if during the last appointment it was recommended to reduce salt and fat intake, increase physical activity, not to smoke, limit alcohol consumption, and control weight / No: at least one of the listed items was not indicated); if prescribed pharmacological treatment, adherence (yes: negative to all four Medication Adherence Questionnaire items / no: positive to one or more items).

We defined as Aware Hypertensive (AH) individuals self-reporting a previous diagnosis of HTN and as Unaware Hypertensive (UH) those individuals without a previous diagnosis of HTN but presenting an average BP measurement equal to or higher than 140/90 mmHg. Stage 1 HTN was defined as blood pressure values of 140-159 mmHg systolic and/or 90–99 mmHg diastolic, and stage 2 HTN or above as blood pressure values ≥160 mmHg systolic and/or ≥100 mmHg diastolic [24]. Controlled HTN was defined as an average BP measurement less than 140/90 mm Hg for AH patients between 35 and 59 years old or for diabetic patients regardless of age, and less than 150/90 mm Hg for AH patients aged 60 years or older [25].

The dependent variables were the four main outcome gaps in HTN care and control (Box 1). For each outcome, associations with patient, provider and health system variables were explored. *P*-values less than 0.05 (two-tailed) were considered significant. For systolic and diastolic BP, means and standard deviations were calculated. We calculated proportions, differences in proportions, and odds ratios with their 95% confidence interval (CI) for categorical variables. Adjusted odds ratios and their 95% CI were obtained with multivariate logistic regression. Potential predictors for each gap were included in separate models that were built using step-by-step selection. All the models included the variables sex and age. Other variables were included in order of statistical significance, or when they acted as a confounder. Interactions between variables were explored.

Ethical aspects

This study was approved by the Ethics Committee of Metrosalud E.S.E in Colombia on 10 December 2015; approval reference 1400/5.2. All participants provided written informed consent. All surveyors were able to identify and refer to the nearest health centre participants with stage 2 HTN or above, or those reporting acute health complications or symptoms. Stage 1 HTN participants without diagnosis, follow-up or treatment were referred for care to the provider corresponding to the patients' health insurance company.

Results

Of the 1380 sampled premises, 47 were commercial buildings, 31 households refused to participate and 214

Box 1 Main Gaps in hypertension care and control – definitions.

Gap	Numerator	Denominator
Diagnosis gap	Number of Unaware Hypertensive individuals[1]	Number of Unaware Hypertensive individuals plus Number of Aware Hypertensive individuals[2]
Follow-up gap	Number of Aware Hypertensive individuals who did not attend a follow-up consultation during the last year	Number of Aware Hypertensive individuals
Pharmacological treatment gap	Number of Aware Hypertensive individuals who received a prescription but – either do not take the drugs – or are non-adherent	Number of Aware Hypertensive individuals who received a prescription for antihypertensive medication
Control gap	Number of Aware Hypertensive individuals who did not manifest controlled hypertension[3]	Number of Aware Hypertensive individuals

[1]Unaware Hypertensive individual: participant not reporting a previous diagnosis of HTN but presenting an average BP measurement higher than 140/90 mmHg in the survey. [2]Aware Hypertensive individual: participant reporting a previous diagnosis of HTN. [3]Controlled hypertension: see text for precise definition.

did not have any member aged 35 years or older. Hence, 1088 households were included, totalling 1937 eligible individuals, of whom 1880 eventually participated. After eliminating 7 questionnaires with incomplete data, information on 1873 individuals was analysed.

Among them, 814 (43.5%, 95% CI 41.2–45.7) were hypertensive (Table 1): 528 (28.2%, 95% CI 26.2–30.3) were aware hypertensive patients, and 286 (15.3%, 95% CI 13.7–17.0) were unaware hypertensive individuals; 28.6% of the AH and 6.6% of the UH reported a diagnosis of diabetes. The mean systolic and diastolic BP ± standard deviation in the overall study sample was 126.5 ± 18.1 and 80.3 ± 11.5 mmHg; in the AH patients it was 136.1 ± 20.0 and 82.2 ± 12.9 mmHg; in the UH participants 143 ± 13.1 and 93.3 ± 9.8 mmHg; and among the non-hypertensive individuals 117.3 ± 11.2 and 75.9 ± 7.7 mmHg. A 41.3% (95% CI 37.2–45.5) of the AH participants was ≥65 years old, and women predominated. Among the AH, 23.9% (95% CI 20.4–27.7) presented stage 1 and 15.1% (95% CI 12.3–18.5) stage 2 or above HTN. The UH stratum was younger – only 26.6% (95% CI 21.8–32.0) were ≥65 years old – and had equal proportions of men and women. Among the UH, we detected 76.6% (95% CI 71.3–81.1) stage 1 and 23.4% (95% CI 18.9–28.7) stage 2 or above HTN. Surprisingly, a high proportion of the UH (72.7%) reported that their BP had been measured during the last year.

In the overall study population, 286 individuals with HTN (15.3%, 95% CI 13.7–17.0) had not been previously diagnosed, and the diagnosis gap among the 814 participants with HTN was 35.1% (95% CI 31.9–38.5). In multivariate analysis (Table 2), this gap was significantly higher among men, participants under 65, people living alone, smokers, individuals reporting physical inactivity and persons with post-primary education. Furthermore, it was nearly six times higher in participants not reporting diabetes. Still, among diabetic patients with an elevated BP reading, 11.2% also presented a diagnosis gap. We found no interaction effects.

Among 528 AH, 76 (14.4%, 95% CI 11.6–17.6) did not attend a follow-up consultation during the previous year (Table 3). The follow-up gap was significantly higher among men, individuals with a remunerated occupation, people insured under the subsidised scheme or not covered by any health insurance, and, substantially so, in participants referring alcohol consumption and in persons not reporting diabetes. There were no interaction effects.

A total of 493 AH patients (93.4%, 95% CI 90.9–95.2) had received a prescription for antihypertensive drugs (Table 4). Of them, 192 (38.9%, 95% CI 34.7–43.3) had a pharmacological treatment gap, which was significantly and positively, albeit rather weakly, associated with post-primary education and alcohol consumption. It was also nearly three times more frequent among patients who had not attended a follow-up consultation during the last year.

Among the 528 AH, 206 (39.0%, 95% CI: 34.9–43.2) had uncontrolled HTN (Table 5). In multivariate

Table 1 Characteristics of study participants by hypertension-related subgroups. Santa Cruz Commune, Medellin, Colombia. 2016

	Aware hypertensive		Unaware hypertensive		Non-hypertensive		Total	
Characteristics	*n*	%(95% CI)	*n*	%(95% CI)	*n*	%(95% CI)	*n*	%(95% CI)
ALL	528	28.2 (26.2–30.3)	286	15.3 (13.7–17.0)	1059	56.5 (54.3–58.8)	1873	100.0
Sex								
Female	369	69.9 (65.9–73.7)	142	49.7 (43.9–55.4)	637	60.2 (57.2–63.1)	1148	61.3 (59.1–63.5)
Male	159	30.1 (26.3–34.1)	144	50.3 (44.6–56.1)	422	39.8 (36.9–42.8)	725	38.7 (36.5–40.9)
Age								
≤49 years	98	18.6 (15.4–22.0)	90	31.5 (26.3–37.0)	615	58.1 (55.1–61.0)	803	42.9 (40.6–45.1)
50–64 years	212	40.2 (36.0–44.4)	120	42.0 (36.3–47.7)	316	29.8 (27.1–32.6)	648	34.6 (32.5–36.8)
65–79 years	161	30.5 (26.7–34.5)	54	18.9 (14.7–23.7)	103	9.7 (8.1–11.6)	318	17.0 (15.3–18.7)
≥80 years	57	10.8 (8.4–13.7)	22	7.7 (5.0–11.2)	25	2.4 (1.6–3.4)	104	5.6 (4.6–6.7)
Skin colour								
Mestizo or white	501	94.9 (92.8–96.5)	275	96.2 (93.4–97.9)	1021	96.4 (95.2–97.4)	1797	95.9 (95.0–96.8)
Black	27	5.1 (3.5–7.2)	11	3.8 (2.1–6.6)	38	3.6 (2.6–4.8)	76	4.1 (3.2–5.0)
Living alone								
Yes	36	6.8 (4.9–9.2)	26	9.1 (6.2–12.8)	44	4.2 (3.1–5.5)	106	5.7 (4.7–6.8)
No	492	93.2 (90.8–95.1)	260	90.9 (87.2–93.8)	1015	95.8 (94.5–96.9)	1767	94.3 (93.2–95.3)
Post-primary education								
Yes	136	25.8 (22.2–29.6)	136	47.6 (41.8–53.3)	530	50.0 (47.0–53.1)	802	42.8 (40.6–45.1)
No	392	74.2 (70.4–77.8)	150	52.4 (46.7–58.2)	529	50.0 (46.9–53.0)	1071	57.2 (54.9–59.4)
Remunerated occupation								
Yes	156	29.5 (25.8–33.5)	150	52.4 (46.7–58.2)	576	54.4 (51.4–57.4)	882	47.1 (44.8–49.4)
No	372	70.5 (66.5–74.2)	136	47.6 (41.8–53.3)	483	45.6 (42.6–48.6)	991	52.9 (50.6–55.2)
Health insurance scheme								
Subsidised/Uncovered	262	49.6 (45.4–53.9)	148	51.7 (46.0–57.5)	477	45.0 (42.1–48.0)	887	47.4 (45.1–49.6)
Contributory	266	50.4 (46.1–54.6)	138	48.3 (42.5–54.0)	582	55.0 (52.0–57.9)	986	52.6 (50.4–54.9)
Smoking								
Yes	62	11.7 (9.2–14.7)	71	24.8 (20.1–30.1)	241	22.8 (20.3–25.4)	374	20.0 (18.2–21.8)
No	466	88.3 (85.3–90.8)	215	75.2 (69.9–79.9)	818	77.2 (74.6–79.7)	1499	80.0 (78.2–81.8)
Alcohol consumption								
Yes	55	10.4 (8.0–13.2)	63	22.0 (17.5–27.1)	165	15.6 (13.5–17.9)	283	15.1 (13.5–16.8)
No	473	89.6 (86.8–92.0)	223	78.0 (72.9–82.5)	894	84.4 (82.1–86.5)	1590	84.9 (83.2–86.5)
Physical activity								
Yes	152	28.8 (25.0–32.8)	49	17.1 (13.1–21.8)	200	18.9 (16.6–21.3)	401	21.4 (19.6–23.3)
No	376	71.2 (67.2–75.0)	237	82.9 (78.2–86.9)	859	81.1 (78.7–83.4)	1472	78.6 (76.7–80.4)
Diabetes								
Yes	151	28.6 (24.9–32.6)	19	6.6 (4.2–10.0)	58	5.5 (4.2–7.0)	228	12.2 (10.8–13.7)
No	377	71.4 (67.4–75.1)	267	93.4 (90.0–95.8)	1001	94.5 (93.0–95.8)	1645	87.8 (86.3–89.2)
Felt need of health care during the last year								
Yes	431	81.6 (78.2–84.8)	164	57.3 (51.6–63.0)	608	57.4 (54.4–60.4)	1203	64.2 (62.0–66.4)
No	97	18.4 (15.2–21.8)	122	42.7 (37.0–48.4)	451	42.6 (39.6–45.6)	670	35.8 (33.6–38.0)
Last BP measurement								
≥1 year/No BP measurement	13	2.5 (1.4–4.1)	78	27.3 (22.4–32.6)	235	22.2 (19.8–24.8)	326	17.4 (15.7–19.2)
<1 year	515	97.5 (95.9–98.6)	208	72.7 (67.4–77.6)	824	77.8 (75.2–80.2)	1547	82.6 (80.8–84.3)

BP, blood pressure; CI, confidence interval.

analysis, this control gap was significantly more frequent in individuals aged 65 years or older, in persons reporting diabetes, in participants who had not received all recommendations for non-pharmacological treatment, and in patients with a pharmacological treatment gap. We did not find interactions, in particular not between sex and age and the other independent determinants in the model.

Finally, considering the overall surveyed population, 492 individuals had either diagnosed but uncontrolled (n = 206) or undiagnosed HTN (n = 286), that is 26.3% (95% CI 24.3–28.3) of all study participants or

Table 2 Factors associated with a hypertension diagnosis gap in 814 hypertensive adults aged 35 years or older. Santa Cruz Commune, Medellin, Colombia. 2016

Characteristics	*n*	*N*	% (95% CI)	% difference (95% CI)	Crude OR (95% CI)	Adjusted OR (95% CI)
ALL	286	814	35.1 (31.9–38.5)	–	–	–
Sex						
Male	144	303	47.5 (41.9–53.1)	19.7 (12.8–26.5)	2.35 (1.75–3.17)	1.94 (1.40–2.70)
Female	142	511	27.8 (24.0–31.8)			
Age						
<65 years	210	520	40.4 (36.2–44.6)	14.5 (7.8–20.8)	1.94 (1.42–2.66)	1.71 (1.21–2.43)
≥65 years	76	294	25.9 (21.1–31.1)			
Skin colour						
Mestizo or white	275	776	35.4 (32.1–38.9)	6.5 (−9.7–18.9)	1.35 (0.66–2.76)	
Black	11	38	28.9 (16.5–44.5)			
Living alone						
Yes	26	62	41.9 (30.3–54.4)	7.4 (−4.5–20.2)	1.37 (0.81–2.31)	2.0 (1.09–3.66)
No	260	752	34.6 (31.2–38.0)			
Post-primary education						
Yes	136	272	50.0 (44.1–55.9)	22.3 (15.2–29.3)	2.61 (1.93–3.54)	2.36 (1.68–3.31)
No	150	542	27.7 (24.0–31.6)			
Remunerated occupation						
Yes	150	306	49.0 (43.4–54.6)	22.2 (15.4–28.9)	2.63 (1.95–3.54)	
No	136	508	26.8 (23.1–30.7)			
Health insurance scheme						
Subsidised/Uncovered	148	410	36.1 (31.6–40.8)	1.9 (−4.7–8.4)	1.09 (0.82–1.45)	
Contributory	138	404	34.2 (29.7–38.9)			
Smoking						
Yes	71	133	53.4 (44.9–61.7)	21.8 (12.6–30.8)	2.48 (1.70–3.62)	2.41 (1.59–3.66)
No	215	681	31.6 (28.2–35.1)			
Alcohol consumption						
Yes	63	118	53.4 (44.4–62.2)	21.3 (11.7–30.8)	2.43 (1.64–3.61)	
No	223	696	32.0 (28.7–35.6)			
Physical activity						
No	237	613	38.7 (34.9–42.6)	14.3 (6.8–20.9)	1.95 (1.36–2.80)	2.20 (1.47–3.28)
Yes	49	201	24.4 (18.8–30.7)			
Diabetes						
No	267	644	41.5 (37.7–45.3)	30.3 (23.5–35.7)	5.63 (3.41–9.3)	5.84 (3.45–9.89)
Yes	19	170	11.2 (7.1–16.6)			

CI, confidence interval; OR, odds ratio.

60.4% (95% CI 57.0–63.8) of the 814 participants with HTN.

Discussion

This study in a low-income urban area of Medellin, Colombia, found a HTN prevalence of 43.5%, the sum of 28.2% of aware hypertensive patients and 15.3% of unaware hypertensive individuals, corresponding to an HTN diagnosis gap of 35.1%. Overall, 60.4% of participants with HTN had either diagnosed but uncontrolled or undiagnosed HTN. Of the individuals that were unaware of their condition, 72.7% reported a BP measurement in the previous year and 23.4% presented stage 2 or worse HTN. The diagnosis gap was positively associated with being male, under 65, living alone, having post-primary education, smoking and reporting physical inactivity. Among the AH, we found a follow-up gap of 14.4%, positively related to being male, having a paid occupation, being uninsured or affiliated to the subsidised health insurance scheme and reporting alcohol consumption. Of the AH, 93.4% were prescribed antihypertensive drugs. However, 38.9% did not take them or were not adherent to the prescribed treatment, to which post-primary education, alcohol consumption and having a follow-up gap contributed. The HTN control gap in AH was 39.0%, positively associated with being 65 or older and reporting diabetes; and negatively associated with

Table 3 Factors associated with a hypertension follow-up gap in 528 adults aged 35 years or older with previous diagnosis of hypertension. Santa Cruz Commune, Medellin, Colombia. 2016

Characteristics	*n*	*N*	% (95% CI)	% difference (95% CI)	Crude OR (95% CI)	Adjusted OR (95% CI)
ALL	76	528	14.4 (11.6–17.6)	–	–	–
Sex						
Male	37	159	23.3 (17.2–30.3)	12.7 (5.7–20.3)	2.57 (1.56–4.21)	1.82 (1.03–3.22)
Female	39	369	10.6 (7.7–14.0)			
Age						
<65 years	45	310	14.5 (10.9–18.8)	0.3 (−6.1–6.1)	1.02 (0.62–1.68)	1.14 (0.66–1.98)
≥65 years	31	218	14.2 (10.1–19.3)			
Skin colour						
Black	8	27	29.6 (15.1–48.2)	16.1 (7.5–34.8)	2.68 (1.13–6.37)	
Mestizo or white	68	501	13.6 (10.8–16.8)			
Living alone						
No	74	492	15.0 (12.1–18.4)	9.5 (−3.5–14.7)	3.01 (0.71–12.80)	
Yes	2	36	5.6 (1.2–16.6)			
Post-primary education						
Yes	29	136	21.3 (15.1–28.8)	9.3 (2.2–17.4)	1.99 (1.19–3.32)	
No	47	392	12.0 (9.1–15.5)			
Remunerated Occupation						
Yes	37	156	23.7 (17.6–30.8)	13.2 (6.1 −20.9)	2.65 (1.62–4.36)	1.83 (1.02–3.31)
No	39	372	10.5 (7.7–13.9)			
Health insurance scheme						
Subsidised/Uncovered	45	262	17.2 (13.0–22.1)	5.5 (−0.6–11.5)	1.57 (0.96–2.57)	1.97 (1.16–3.36)
Contributory	31	266	11.7 (8.2–15.9)			
Smoking						
Yes	16	62	25.8 (16.2–37.6)	12.9 (3.6–25.4)	2.35 (1.25–4.42)	
No	60	466	12.9 (10.1–16.1)			
Alcohol consumption						
Yes	21	55	38.2 (26.2–51.4)	26.6 (14.7–40.0)	4.69 (2.54–8.66)	3.30 (1.70–6.43)
No	55	473	11.6 (9.0–14.7)			
Physical activity						
No	60	376	16.0 (12.5–19.9)	5.4 (−1.4–11.0)	1.61 (0.90–2.90)	
Yes	16	152	10.5 (6.4–16.1)			
Diabetes						
No	65	377	17.2 (13.7–21.3)	10.0 (3.5–15.1)	2.65 (1.36–5.18)	2.56 (1.28–5.13)
Yes	11	151	7.3 (3.9–12.3)			

CI, confidence interval; OR, odds ratio.

receiving proper non-pharmacological advice and having pharmacological treatment prescribed and adhere to it.

The study has some limitations. We sampled participants in a low-income urban environment, akin to the one half of the Colombian population is currently living in. Still, our results may not represent the situation in upper-class urban zones or underserved rural areas. A previous study in Colombia [8] registered a high HTN prevalence among adults but large variability within the country. Regarding data collection, comorbidities were self-reported, without confirmation in clinical records or through diagnostic tests. The use of self-report scales for measuring medication adherence also has potential limitations, related to patients' willingness to disclose information [26]. Furthermore, the 4-item Morisky Test [21] only addresses barriers to medication-taking without assessing self-efficacy [26,27]. Nevertheless, this tool has a reasonable specificity for identifying non-adherent behaviour in hypertensive patients [28]. As for smoking and alcohol consumption, we only recorded the habit's presence, without measuring consumption levels. Finally, the duration of HTN and diet-related factors or lipid profile, which could be associated with HTN control, were not considered. The study's major strength is providing previously unavailable population-based evidence on the magnitude of care gaps in Colombia at the different HTN control cascade steps and identifying associated factors.

Our findings are compatible with the estimates from the Colombian sample contained in an international study [7] that found, in 2013, an overall HTN prevalence

Table 4 Factors associated with a pharmacological treatment gap in 493 adults aged 35 years or older with previous diagnosis of hypertension and prescription for anti-hypertensive medication. Santa Cruz Commune, Medellin, Colombia. 2016

Characteristics	*n*	*N*	% (95% CI)	% difference (95% CI)	Crude OR (95% CI)	Adjusted OR (95% CI)
ALL	192	493	38.9 (34.7–43.3)	–	–	–
Sex						
Female	134	344	39.0 (33.9–44.2)	0.0 (−9.5–9.1)	1.00 (0.67–1.48)	1.25 (0.82–1.91)
Male	58	149	38.9 (31.4–46.9)			
Age						
<65 years	118	291	40.5 (35.0–46.3)	3.9 (−4.9–12.4)	1.18 (0.81–1.71)	1.03 (0.70–1.51)
≥65 years	74	202	36.6 (30.2–43.4)			
Skin colour						
Black	12	24	50.0 (31.0–69.0)	11.6 (−4.8–28.0)	1.61 (0.71–3.65)	
Mestizo or white	180	469	38.4 (34.1–42.8)			
Living alone						
No	186	461	40.3 (35.9–44.9)	21.6 (4.5–32.4)	2.93 (1.18–7.26)	
Yes	6	32	18.8 (8.2–34.6)			
Post-primary education						
Yes	64	129	49.6 (41.1–58.2)	14.4 (4.5–24.2)	1.81 (1.21–2.73)	1.59 (1.04–2.43)
No	128	364	35.2 (30.4–40.2)			
Remunerated Occupation						
Yes	66	146	45.2 (37.3–53.3)	8.9 (0.6–18.4)	1.45 (0.98–2.14)	
No	126	347	36.3 (31.4–41.5)			
Health insurance scheme						
Contributory	97	247	39.3 (33.3–45.5)	0.7 (−8.0–9.2)	1.03 (0.72–1.48)	
Subsidised/Uncovered	95	246	38.6 (32.7–44.8)			
Smoking						
Yes	26	59	44.1 (31.9–56.8)	5.8 (−6.9–19.2)	1.27 (0.73–2.20)	
No	166	434	38.2 (33.8–42.9)			
Alcohol consumption						
Yes	29	50	58.0 (44.2–70.9)	21.2 (6.8–34.2)	2.37 (1.31–4.30)	1.90 (0.99–3.60)
No	163	443	36.8 (32.4–41.4)			
Physical activity						
No	141	347	40.6 (35.6–45.9)	5.7 (−3.8–14.6)	1.27 (0.85–1.91)	
Yes	51	146	34.9 (27.6–42.9)			
Diabetes						
No	142	349	40.7 (35.6–45.9)	6.0 (−3.6–14.9)	1.29 (0.86–1.93)	
Yes	50	144	34.7 (27.3–42.7)			
Follow-up gap						
Yes	38	61	62.3 (49.8–73.7)	26.6 (13.3–38.4)	2.98 (1.71–5.19)	2.62 (1.47–4.67)
No	154	432	35.6 (31.2–40.2)			

CI, confidence interval; OR, odds ratio.

of 37.5% among individuals aged 35 to 70 years. However, the proportion of AH, 16.9%, was lower and that of UH individuals, 20.6%, was higher than in the present study. In contrast, the 2007 Colombian National Health Survey [29] estimated the overall HTN prevalence in the population aged 18 to 69 years as 8.8%. Since then, no studies were conducted on HTN prevalence in a representative national sample. Our results corroborate that the prevalence among adults has been rising throughout the recent decades, as it did in the rest of Latin America [30–32] but also suggest that the diagnosis gap may have decreased, at least in urban areas.

The diagnosis gap is higher among younger people, as was recently also reported for an array of LMICs [7,9] as well as HICs [33]. Younger individuals tend to be healthier and usually have particularly low HTN awareness. The higher diagnostic and follow-up gaps we observed in men were also reported before [7–10] and could be related to gender disparities in healthcare use. In Colombia, overall healthcare utilisation is 59% higher among women than men [34]. Women making more medical visits than men were a critical factor determining gender discrepancies in HTN awareness among young adults in the United States [35]. The gender differences in

Table 5 Hypertension control gap and associated factors in 528 adults aged 35 years or older with previous diagnosis of hypertension. Santa Cruz Commune, Medellin, Colombia. 2016

Characteristics	*n*	*N*	% (95% CI)	% difference (95% CI)	Crude OR (95% CI)	Adjusted OR (95% CI)
ALL	206	528	39.0 (34.9–43.2)	–	–	–
Sex						
Male	71	159	44.7 (37.1–52.4)	8.1 (−1.0–17.2)	1.40 (0.96–2.04)	1.43 (0.97–2.12)
Female	135	369	36.6 (31.8–41.6)			
Age						
≥65 years	99	218	45.4 (38.9–52.0)	10.9 (2.4–19.3)	1.58 (1.11–2.25)	1.67 (1.16–2.40)
<65 years	107	310	34.5 (29.4–39.9)			
Skin colour						
Black	13	27	48.1 (30.3–66.4)	9.6 (−6.3–26.3)	1.48 (0.68–3.22)	
Mestizo or white	193	501	38.5 (34.3–42.8)			
Living alone						
Yes	17	36	47.2 (31.7–63.2)	8.8 (−6.2–24.5)	1.43 (0.74–2.83)	
No	189	492	38.4 (34.2–42.8)			
Post-primary education						
No	160	392	40.8 (36.0–45.7)	7.0 (−2.6–15.9)	1.35 (0.90–2.03)	
Yes	46	136	33.8 (26.3–42.0)			
Remunerated Occupation						
Yes	61	156	39.1 (31.7–46.9)	0,1 (−8.9–9.3)	1.00 (0.68–1.47)	
No	145	372	39.0 (34.1–44.0)			
Health insurance scheme						
Contributory	105	266	39.5 (33.7–45.4)	0.9 (−7.4–9.2)	1.04 (0.73–1.47)	
Subsidised/Uncovered	101	262	38.5 (32.8–44.5)			
Smoking						
Yes	27	62	43.5 (31.7–55.9)	5.1 (−7.2–18.2)	1.24 (0.72–2.11)	
No	179	466	38.4 (34.1–42.9)			
Alcohol consumption						
No	186	473	39.3 (35.0–43.8)	3.0 (−11.0–15.2)	1.13 (0.63–2.02)	
Yes	20	55	36.4 (24.6–49.5)			
Physical activity						
No	152	376	40.4 (35.6–45.4)	4.9 (−4.4–13.6)	1.23 (0.83–1.82)	
Yes	54	152	35.5 (28.2–43.4)			
Diabetes						
Yes	70	151	46.4 (38.5–54.3)	10.3 (1.0–19.5)	1.53 (1.04–2.24)	1.71 (1.15–2.55)
No	136	377	36.1 (31.3–41.0)			
Received all indications of non-pharmacological treatment						
No	153	363	42.1 (37.1–47.3)	10.0 (1.0–18.4)	1.54 (1.04–2.27)	1.54 (1.03–2.28)
Yes	53	165	32.1 (25.4–39.5)			
Last BP measurement						
≥1 year/No BP measurement	6	13	46.2 (22.1–71.7)	7.3 (xx–16.7)	1.35 (0.45–4.07)	
<1 year	200	515	38.8 (34.7–43.1)			
Follow-up gap						
Yes	36	76	47.4 (36.4–58.5)	9.8 (−2.0–21.7)	1.49 (0.92–2.43)	
No	170	452	37.6 (33.2–42.1)			
Pharmacological treatment†						
No	105	227	46.3 (39.9–52.8)	12.7 (4.2–21.0)	1.70 (1.20–2.43)	1.79 (1.24–2.58)
Yes	101	301	33.6 (28.4–39.0)			

CI, confidence interval; OR, odds ratio; BP, Blood Pressure.
†No: no pharmacological treatment prescribed or prescribed but patient does not take the drugs or is not adherent; Yes: pharmacological treatment prescribed and patient is adherent

healthcare use can be the result of sociocultural representations of masculinity that require men to be sturdy, which limits care seeking [35,36]. Individuals of productive age face time-constraints and work schedule conflicts, which can explain higher gaps in the employed, but indirectly also contribute to gender divergences since the employment rate in Colombia is some 40% higher in men than in women [37].

In our results, diagnosis and/or follow-up gaps were further associated with living alone and an unhealthy lifestyle (smoking, alcohol consumption and physical inactivity). These factors, related to an overall lack of self-care and self-care practices, are well-known determinants of HTN prevention and control [38,39]. Post-primary education contributing to higher gaps may seem surprising, but the evidence on its role is conflicting and mediated by many contextual factors. In one of the previously cited reviews [7], a higher education was associated with higher case identification, but only in LICs and in younger hypertensive individuals; in another review [10] the association was positive in LICs but weak or non-existent in upper MICs and even negative in some of the included European and Eastern Mediterranean MICs. Specifically for Colombia, a previous study [8] reported, someway in line with our findings, that lower educational attainment was not associated with less HTN awareness.

Having been diagnosed with diabetes reduces, as can be expected, the risk of HTN diagnosis gap. Notwithstanding, the finding that over 10% of persons with diabetes have undiagnosed HTN is disturbing. The same holds for UH individuals in general, a quarter of whom presented stage 2 or worse HTN. Lack of BP screening has been documented as one of the most common barriers for detecting HTN worldwide [2,39]. Nevertheless, almost three-quarters of the UH in our study reported a BP measurement in the last year. To what extent remaining undiagnosed can be attributed to BP fluctuations and short-term BP variability [39,40], measurement error or non-adherence to clinical protocols or health personnel inertia for taking action remains to be established. At any rate, these findings point towards lost opportunities for HTN diagnosis at the health service level.

The HTN control gap, in its turn, is positively associated with age and with being diabetic. The former is in line with previous reports [39, 41, 42]. The latter is unfortunate, given the importance of BP control in diabetic patients [43]. It is of note that for these patients we defined controlled HTN stringently, as an average BP measurement less than 140/90 mm Hg regardless of age. Clinicians' possible variable use of criteria in the daily practice may have contributed to our findings. The control gap is strongly negatively associated with having received full recommendations for non-pharmacological treatment and having pharmacological treatment prescribed and adhering to it. HTN drugs are prescribed for nearly all diagnosed patients. Nevertheless, the frequency of non-compliance, the almost 40% pharmacological treatment gap, is large and strongly related to the follow-up gap and to education and the lifestyle factors discussed above. The association with education has been described before in Colombia [8]. A qualitative study [44] documented that hypertensive patients under pharmacological treatment reported a lack of information regarding their medical condition, had a poor understanding of the prescribed treatment regime and expressed a desire for better communication and a more trusting relationship with their doctors. Treatment being conducive to HTN control is not surprising. Our findings also shed light on the reported low adherence to non-pharmacological treatment in Colombia [45] and indicate weaknesses in providing advice and a lack of an effective approach to educate and support patients' self-care.

The prevalence of HTN control among all aware hypertensive patients (61.0%) and among those prescribed antihypertensive medication (58.2%) found in this study is higher than the figures reported in four cities of the Southern Cone of Latin America, where only 33.4% of all aware hypertensive patients and 43.3% of those under treatment achieved control [31]. It is also higher than previously reported results from observations well over a decade ago in 11 communities in Colombia [8], where, among those receiving treatment, only 40.8% of the urban and 31.8% of the rural residents achieved BP control. The global result of 35.5% control reported for aware patients in the Latin American countries represented in a large 2016 review including 90 countries worldwide [9] is also lower than the control level in our study. Taking a different perspective, the 20.9% control in all individuals with HTN in ten Latin American countries [10], and 45.0% and 28.8% control in Costa Rica and Brazil, the two best-performing countries, can be contrasted with the 39.6% control in all HTN participants included in our study.

The HTN control rate in aware patients in our study also compares favourably to the findings of a 2019 secondary analysis of data on people aged 40–79 extracted from the latest national surveys in 12 HICs [33]. The best performing ones, Canada and Germany, attained 50–58% control for women and 48–69% for men, respectively, in aware subjects, and figures as low as 26% for women and 17% for men were reported in other countries. Notwithstanding, the diagnosis gap in the two aforementioned countries was some 13% to 20% lower than in our study, leading to a smaller overall HTN

control gap in the total HTN population. Still, Medellin's HTN diagnosis gap is close to and in two instances even lower than the figures reported for many of the other HIC. The bigger difference in control between HICs and LMICs is generally related to the extent of the HTN diagnosis gap, which uses to be much higher in LICs [2]. Our results in metropolitan Colombia, an upper-middle-income country, suggest that that difference is getting narrower. Whether this reflects the population's increased apprehension of the severity of HTN as a health problem or improved health system performance, or both, remains to be elucidated.

HTN care and control at the population level depend on the health system and are considered a correlate measure of how well it functions [46]. We can point at three features of the Colombia's healthcare model that hamper optimal performance. First, the lack of an integrated and prevention-oriented primary healthcare approach, with passive healthcare strategies and facilities that are mainly geared to, available for and utilised by individuals presenting disease symptoms. Second, besides the possible diagnosis inertia referred to above, there is a problem with quality and continuity of care. Third, in line with the global health agenda [47], the medicalisation of HTN treatment, despite scientific evidence widely supporting the positive effects of sustained lifestyle modifications on BP control [48], is problematic.

Conclusions

This study found a high HTN prevalence in adults aged 35 years or older in Medellin, Colombia. The observed treatment and control figures are encouraging, which reflects current coverage gains of the Colombian health system. Still, there remains ample room for improvement. One in three hypertensive individuals is not aware of their condition – including 10% of the diabetic patients – and almost 40% of the diagnosed patients are not successfully controlled. We documented the magnitude of care gaps occurring at the different steps of the HTN control cascade and identified associated factors thereof. Our findings can assist in setting priorities for comprehensive primary health care interventions and contribute to guiding the deployment of integrated activities that should further strengthen equitable and effective access to HTN care and control.

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References

1. Abbafati C, Machado DB, Cislaghi B *et al*. Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet* 2020: **396**: 1223–1249.
2. Ibrahim MM, Damasceno A. Hypertension in developing countries. *Lancet* 2012: **380**: 611–619.
3. Zhou B, Bentham J, Di Cesare M *et al*. Worldwide trends in blood pressure from 1975 to 2015: a pooled analysis of 1479 population-based measurement studies with 19·1 million participants. *Lancet* 2017: **389**: 37–55.
4. De Maio FG. Understanding chronic non-communicable diseases in Latin America: towards an equity-based research agenda. *Global Health*. 2011: **7**: 36.
5. Pan American Health Organization. Innovative Care for Chronic Conditions. Organizing and Delivering High Quality Care for Chronic Noncommunicable Diseases in the Americas. Washington D.C.; 2013. (Available from: https://www.paho.org/hq/dmdocuments/2013/PAHO-Innovate-Care-2013-Eng.pdf) [21 Oct 2020]
6. Londoño Agudelo E, Rodríguez Salvá A, Díaz Piñera A *et al*. Assessment of hypertension management and control: a registry-based observational study in two municipalities in Cuba. *BMC Cardiovasc Disord*. 2019: **19**: 29.
7. Chow CK, Teo KK, Rangarajan S *et al*. Prevalence, awareness, treatment, and control of hypertension in rural and urban communities in high-, middle-, and low-income countries. *JAMA* 2013: **310**: 959–968.
8. Camacho PA, Gomez-Arbelaez D, Molina DI *et al*. Social disparities explain differences in hypertension prevalence, detection and control in Colombia. *J Hypertens*. 2016: **34**: 2344–2352.
9. Mills KT, Bundy JD, Kelly TN *et al*. Global disparities of hypertension prevalence and control. *Circulation* 2016: **134**: 441–450.
10. Geldsetzer P, Manne-Goehler J, Marcus ME *et al*. The state of hypertension care in 44 low-income and middle-income countries: a cross-sectional study of nationally representative individual-level data from 1·1 million adults. *Lancet* 2019: **394**: 652–662.
11. Khatib R, Schwalm J-D, Yusuf S *et al*. Patient and healthcare provider barriers to hypertension awareness, treatment and follow up: a systematic review and meta-analysis of qualitative and quantitative studies. *PLoS One* 2014: **9**: e84238.
12. Abadia CE, Oviedo DG. Bureaucratic Itineraries in Colombia. A theoretical and methodological tool to assess

managed-care health care systems. *Soc Sci Med*. 2009: **68**: 1153–1160.
13. The World Bank Data. (Available from: https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=CO) [23 Oct 2020]
14. Congreso de la República de Colombia. Ley Número 100 de 1993. Por la cual se crea el sistema de seguridad social integral y se dictan otras disposiciones. Colombia; 1993. (Available from: https://www.minsalud.gov.co/sites/rid/Lists/BibliotecaDigital/RIDE/DE/DIJ/ley-100-de-1993.pdf) [23 Oct 2020]
15. Londoño Agudelo E, García Fariñas A, Pérez Ospina V *et al*. Out-of-pocket expenditure for hypertension care: a population-based study in low-income urban Medellin, Colombia. *Glob Health Action* 2020: **13**: 1806527.
16. Proantioquia y demás instituciones privadas que conforman la iniciativa "Medellín Cómo Vamos." Informe de Calidad de Vida de Medellín, 2017. Medellín, Colombia; 2018. (Available from: https://www.medellincomovamos.org/download/documento-informe-de-calidad-de-vida-de-medellin-2017/) [25 Oct 2020]
17. Alcaldía de Medellín. Perfil sociodemográfico por barrio. Comuna 2 Santa Cruz 2005-2015. Medellín, Colombia; 2011. (Available from: https://www.medellin.gov.co/irj/go/km/docs/wpccontent/Sites/Subportal%20del%20Ciudadano/Planeaci%C3%B3n%20Municipal/Secciones/Indicadores%20y%20Estad%C3%ADsticas/Documentos/Proyecciones%20de%20poblaci%C3%B3n%202005%20-%202015/Resumen%20perfil%20Barrios%20por%20Comuna/Perfil%20Demografico%20Barrios_Comuna_02Final.pdf) [25 Oct 2020]
18. Alcaldía de Medellín. Secretaría de Salud. Indicadores Básicos. Situación de Salud en Medellín 2015. Medellín, Colombia; 2015. (Available from: https://www.medellin.gov.co/irj/go/km/docs/pccdesign/SubportaldelCiudadano_2/PlandeDesarrollo_0_19/IndicadoresyEstadsticas/Shared Content/Librosdeindicadores/indicadores2015.pdf) [26 Oct 2020]
19. Ministerio de Salud y Protección Social. Análisis de Situación de Salud. Colombia, 2013. Bogotá, D.C., Colombia; 2014. (Available from: https://www.minsalud.gov.co/sites/rid/Lists/BibliotecaDigital/RIDE/VS/ED/PSP/ASIS 24022014.pdf) [28 Oct 2020]
20. Alcaldía de Medellín. Perfil Demográfico 2016 - 2020. Medellín, Colombia; 2015. (Available from: https://www.medellin.gov.co/irj/go/km/docs/pccdesign/SubportaldelCiudadano_2/PlandeDesarrollo_0_17/IndicadoresyEstadsticas/SharedContent/Documentos/ProyeccionPoblacion2016-2020/Perfil Demográfico2016-2020TotalMedellin.pdf). [28 Oct 2020]
21. Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. *Med Care*. 1986: **24**: 67–74.
22. Luepker RV, Evans A, McKeigue P, Reddy KS. Cardiovascular survey methods. Geneva, Switzerland; 2004. (Available from: https://apps.who.int/iris/bitstream/handle/10665/42569/9241545763_eng.pdf?sequence=1) [03 Nov 2020]
23. Tolonen H EHES Manual Part B. Fieldwork Procedures. Helsinki; 2016. (Available from: http://www.julkari.fi/bitstream/handle/10024/131503/URN_ISBN_978-952-302-701-5.pdf?sequence=1&isAllowed=y) [03 Nov 2020]
24. Chobanian AV, Bakris GL, Black HR *et al*. Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. *Hypertension* 2003: **42**: 1206–1252.
25. James PA, Oparil S, Carter BL *et al*. Evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8). *JAMA* 2014: **311**: 507–520.
26. Culig J, Leppée M. From Morisky to Hill-bone; self-reports scales for measuring adherence to medication. *Coll Antropol*. 2014: **38**: 55–62.
27. Lam WY, Fresco P. Medication adherence measures: an overview. *Biomed Res Int* 2015: **2015**: 1–12.
28. Ben AJ, Neumann CR, Mengue SS. The Brief Medication Questionnaire and Morisky-Green test to evaluate medication adherence. *Rev Saude Publica*. 2012: **46**: 279–289.
29. Rodríguez J, Ruiz F, Peñaloza E *et al*. Encuesta Nacional de Salud 2007. Resultados Nacionales. Bogotá, Colombia. 2009. (Available from: https://www.minsalud.gov.co/sites/rid/Lists/BibliotecaDigital/RIDE/VS/ED/GCFI/ENCUESTA NACIONAL.pdf) [04 Nov 2020]
30. Ordunez P, Martinez R, Niebylski ML, Campbell NR. Hypertension prevention and control in Latin America and the Caribbean. *J Clin Hypertens* 2015: **17**: 499–502.
31. Rubinstein AL, Irazola VE, Calandrelli M *et al*. Prevalence, awareness, treatment, and control of hypertension in the Southern Cone of Latin America. *Am J Hypertens* 2016: **29**: 1343.
32. Ruilope LM, Chagas ACP, Brandão AA *et al*. Hipertensión en América Latina: perspectivas actuales de las tendencias y características. *Hipertens y Riesgo Vasc* 2017: **34**: 50–56.
33. Zhou B, Danaei G, Stevens GA *et al*. Long-term and recent trends in hypertension awareness, treatment, and control in 12 high-income countries: an analysis of 123 nationally representative surveys. *Lancet* 2019: **394**: 639–651.
34. Gobierno de Colombia. Ministerio de Salud y Protección Social. Analisis De Situación De Salud (ASIS) Colombia, 2017. 2018. (Available from: https://www.minsalud.gov.co/sites/rid/Lists/BibliotecaDigital/RIDE/VS/ED/PSP/asis-nacional-2017.pdf) [12 Nov 2020]
35. Everett B, Zajacova A. Gender differences in hypertension and hypertension awareness among young adults. *Biodemography Soc Biol*. 2015: **61**: 1–17.
36. Ofman D, Silvia PG, Iris C, Cófreces P, Stefani D. Estudio de las representaciones sociales de la hipertensión arterial según género. *Liberabit*. 2015: **21**: 59–70.
37. Ministerio de Salud de Colombia y Profamilia. Encuesta Nacional de Demografía y Salud. Tomo 1. Bogotá, Colombia; 2015. (Available from: https://dhsprogram.com/pubs/pdf/FR334/FR334.pdf) [12 Nov 2020]

38. Slama M, Susic D, Frohlich ED. Prevention of hypertension. *Curr Opin Cardiol* 2002: **17**: 531–536.
39. Olsen MH, Angell SY, Asma S *et al*. A call to action and a lifecourse strategy to address the global burden of raised blood pressure on current and future generations: the Lancet Commission on hypertension. *Lancet* 2016: **388**: 2665–2712.
40. Chadachan VM, Ye MT, Tay JC, Subramaniam K, Setia S. Understanding short-term blood-pressure-variability phenotypes: from concept to clinical practice. *Int J Gen Med* 2018: **11**: 241–254.
41. Nelson SAE, Dresser GK, Vandervoort MK *et al*. Barriers to blood pressure control: a STITCH substudy. *J Clin Hypertens*. 2011: **13**: 73–80.
42. Chowdhury EK, Owen A, Krum H *et al*. Barriers to achieving blood pressure treatment targets in elderly hypertensive individuals. *J Hum Hypertens* 2013: **27**: 545–551.
43. Grossman A, Grossman E. Blood pressure control in type 2 diabetic patients. *Cardiovasc Diabetol* 2017: **16**: 3.
44. Legido-Quigley H, Camacho Lopez PA, Balabanova D *et al*. Patients' knowledge, attitudes, behaviour and health care experiences on the prevention, detection, management and control of hypertension in colombia: a qualitative study. *PLoS One* 2015: **10**: e0122112.
45. Rodríguez-López MR, Varela MT, Rincón-Hoyos VMM, Caicedo DM, Méndez FGO. Prevalencia y factores asociados a la adherencia al tratamiento no farmacológico en pacientes con hipertensión y diabetes en servicios de baja complejidad. *Rev Fac Nac Salud Pública* 2015: **33**: 192–199.
46. Nulu S. Neglected chronic disease: the WHO framework on non-communicable diseases and implications for the global poor. Glob. *Public Health* 2017: **12**: 396–415.
47. Clark J. Medicalization of global health 1: Has the global health agenda become too medicalized? *Glob Health Action*. 2014: **7**(SUPP.1): 23998.
48. Hedayati SS, Elsayed EF, Reilly RF. Non-pharmacological aspects of blood pressure management: what are the data? *Kidney Int* 2011: **79**: 1061–1070.

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