RESEARCH ARTICLE

Change in the criteria for hypertension based on a Peruvian population: a study based on the recent American Heart Association/American College of Cardiology guidelines

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Abstract

Introduction: The American Heart Association/American College of Cardiology has published new guidelines for hypertension in 2017. These guidelines change the criteria to classify patients with hypertension. There has not yet been a study that analyzes the consequences of these changes in developing countries. The objective of our study was to characterize changes in the classification of hypertension with the new guidelines among Peruvian patients and to determine the factors associated with being newly diagnosed as hypertensive.

Methods: An analytical cross-sectional investigation was carried out, which was based on the secondary analysis of the data of hypertension. We compared certain variables including using antihypertensive medication, region, and other sociodemographic characteristics. We performed a descriptive analysis of the variables shown as frequency and percentage. P values that were less than 0.05 were considered statistically significant, obtained using a multivariate analysis.

Results: Of the 5,615 patients in this cohort, with the old criteria 4,915 (87.5%) did not have the diagnosis of hypertension; however, with the new criteria 1,415 (25%) will be diagnosed with hypertension. 467 (9%)
of patients who were not taking medications and 85 (32%) of patients who were taking medications will switch from having high-normal blood pressure to grade 1 hypertension, with the new guideline. The recent diagnosis of hypertension was associated with sex (p <0.001), age (p <0.001), being overweight (p <0.001), physical activity (p = 0.010), smoking (p = 0.031), and a history of diabetes mellitus (p <0.001). When adjusted for pharmacotherapy, only sex (p <0.001), age (p <0.001), being overweight (p <0.001), and physical activity (p = 0.001) remained statistically significant.

**Conclusions:** The new criteria increased the percentage of patients that now will be classified with hypertension. This should be accompanied by effective politics in education, surveillance, and adequate treatment of the health care system.

**Keywords**
hypertension, diagnosis, multicentric, Peru, guidelines
**Introduction**

Multiple reports have shown that hypertension (HTN) remains one of the most important chronic diseases,\(^1\)–\(^3\) despite the fact that there are increasingly better diagnostic and treatment methods.\(^4\) The current worldwide prevalence is 30%, according to different regional studies.\(^5\) Worldwide, a greater morbimortality have been reported due to the same diseases or pathologies derived from it.\(^6\)–\(^8\) Multiple institutions have expressed their concern to generate changes that have a positive impact on the control of this disease.\(^9\)

In November 2017, the American Heart Association (AHA) in conjunction with the American College of Cardiology (ACC) made one of the most important changes of the last decades in this subject.\(^10\) In these changes, the cut-off point for the diagnosis of hypertension is reduced, which generates a new global panorama for the diagnosis, treatment, and overall control of HTN.\(^11\) This has not yet been evaluated in prospective studies in developing countries, but it is important to determine how much the changes that have been established can affect the populations so that efforts to analyze data that can give an idea of the change that may occur. The aims of this study are to characterize changes in the classification of hypertension with the new guidelines among Peruvian patients and to determine the factors associated with being newly classed as hypertensive.

**Methods**

**Study design**

An analytical cross-sectional investigation was carried out, which was based on the secondary analysis of the data; this is because the primary data was used to describe and find associations of chronic pathologies and others related to blood pressure in various populations of Peru.\(^12,13\)

**Population and sample**

The population studied were patients who attended the outpatient clinic of hospitals in 10 Peruvian cities: belonging to the coast; Piura (29 meters above sea level (masl)), Chiclayo (29 masl), Lima (101 masl); to the mountains: Huánuco (1894 masl), Huancayo (3249 masl), Cajamarca (2720 masl), Cusco (3399 masl), Puno (3827 masl), and Cerro de Pasco (4338 masl) and to the jungle; Loreto (104 masl). These cities are of the three natural regions (coast, mountains, and jungle) and are the most important/large in the whole territory (north, center, and south). A non-random sampling was taken, for which all the patients who had systolic and diastolic blood pressure measurements in the primary base were included. Subjects were not excluded because they all had the information required for the analysis.

We included patients of major age who agreed to participate in the study and signed the informed medical consent, excluding those who had acute symptoms that alter the hemodynamic balance (fever, diarrhea, vomiting), pregnancy, any anatomical defects or surgical procedures that could potentially interfere with the proper access to blood flow to the upper arm, patients that lived less than half a year in the city where the clinic was located, and patients who had not adequately answered major questions or answered in repetitive patterns.

**Variables**

The main variable was the diagnosis of hypertension, this was obtained according to the two categorizations (the old and the new guidelines criteria).\(^5,10\) This was based on the measurements of systolic and diastolic blood pressure, reporting elevated once or twice, which was performed in the primary population. These primary measurements were made in triage and outpatient settings of public hospitals located in the host cities. They were performed by trained medical students, who used calibrated equipment and who were guided by international recommendations for blood pressure measurements.\(^14\)

The secondary variables were those that used antihypertensive medication (according to the antihypertensive medication intake on the day the patient went to perform their medical consultation), gender (male or female), age (taken quantitatively according to the years completed), being overweight or obese (according to the body mass index, taking weight and height was also done at the time of the survey and with triage teams), physical activity (taken as yes or no, according to the self-report of the patients), smoking (taken as yes or no, according to the self-report of the patients), diabetes mellitus (according to the diagnosis of a medical professional), and the natural region where they lived (Coast: Lima, Piura, Chiclayo; Mountain: Cajamarca, Huánuco, Huancayo, Cerro de Pasco, Cusco, Puno and the jungle: Loreto).

**Data analysis**

The first step was to make the selection of the data that would be used for the study, for which a process of selection and purification of the information that had the primary base was carried out. Then we proceeded to build a database in Microsoft Excel. After that, the data was transferred to the STATA program v.12.1 (Stata Corp, Texas, USA).
Descriptive statistics were generated, for which a chart of the diagnosis of hypertension was made according to having two, one or no high blood pressure and taking into account the diagnostic criteria (the previous or the current one generated by the AHA/ACC guidelines). After that, two tables were generated (one for systolic pressures and the other for diastolic ones) where the percentages of the old and new HTA categories can be seen; These tables were divided according to whether the patients had taken antihypertensive medication the same morning they were interviewed.

Finally, a bivariate and multivariate analysis table was prepared, in which the outcome variable would be the new hypertensive being, defined as those that were not hypertensive with the prior criteria but that now became so; this variable was contrasted versus gender, age, being overweight, the report of regular physical activity, smoking, history of diabetes mellitus, region and adjusted by the one who uses antihypertensive medication. To obtain the crude prevalence ratios (cPR), adjusted prevalence ratios (aPR), 95% confidence interval (CI), and p-value, the generalized linear models were used, with the Poisson family, the log link function, and robust models. P-values that were less than 0.05 were considered statistically significant.

**Ethics**

Research ethics principles were followed. Patient identification data was never used, and the primary project was approved by an IRB; endorsed by the Peruvian Institute of Health - National Hospital San Bartolome (N °: 2845-DG-OADI-N ° 822-HONADOMANI-SB-2014). The ethical principles of data use were respected.

**Results**

All patients in the study were eligible and provided informed consent. Using the 2017 AHA/ACC BP guidelines criteria, from the 5,615 patients in this study, 3,724 (66.3%) will not have a diagnosis of hypertension, 476 (8.5%) will continue to have hypertension and 1,415 (25.2%) will be newly diagnosed with hypertension. Figure 1 showed that before the new guidelines 6% and 2% of the patients had HT due to one (SBP or DBP) or two (SBP and DBP) elevated blood pressures, respectively. With the new criteria, the numbers of hypertensive patients will increase to 24% and 10% for having one or two elevated BP, respectively. This means a 300% increase in hypertensive patients in this cohort.

In this study, following the prior guidelines, 4,915 (87.5%) patients were non-hypertensive. Of them, 94.5% were classified as normal BP. With the new classification, this percentage will decrease to 71.13%. More details are shown in Figure 2.

The 8.7% (467) of the patients that didn’t receive pharmacological treatment and 31.8% (85) of the patients that were using medication change from having a normal-high systolic blood pressure to have HT stage 1. The majority of

![Figure 1. Comparison of percentage pre and post blood pressure the new guidelines criteria changes in a Peruvian population. HT: Hypertension.](image)
the patients with no treatment (87.9%) switch from having blood pressure normal to normal-high. This change was less dramatic in the patients that received antihypertensive medication, only 45.7% stay in the non-hypertensive range (Table 1).

The 22.8% (1,218) of the patients that were not receiving medication and 34.1% (81) of the patients that were receiving medication switched from having normal high diastolic pressure to have stage 1 HT with the new guidelines (Table 2).

The ones that were on medication received at least one antihypertensive pill in the morning of the clinical visit.

**Table 1.** Difference in the category of systolic blood pressure pre and post new guidelines by pharmacological treatment in a Peruvian population (n = 5615).

| Old classification | New classification (New guidelines) | Normal | Elevated | HT 1 | HT 2 | HT Crisis |
|--------------------|------------------------------------|--------|----------|------|------|-----------|
| No Pharmacological treatment (p value < 0.001) | **Optimal** | 3972 (74.3%) | | | | |
| | **Normal** | 727 (13.6%) | | | | |
| | **Normal high** | | 467 (8.7%) | | | |
| | **HT 1** | | | 138 (2.6%) | | |
| | **HT 2** | | | 38 (0.7%) | | |
| | **HT 3** | | | | 6 (0.1%) | |
| With Pharmacological treatment (p value < 0.001) | **Optimal** | 95 (35.6%) | | | | |
| | **Normal** | 27 (10.1%) | | | | |
| | **Normal high** | | 85 (31.8%) | | | |
| | **HT 1** | | | 44 (16.4%) | | |
| | **HT 2** | | | 10 (3.8%) | | |
| | **HT 3** | | | | 6 (2.3%) | |

**Figure 2.** Comparison of frequency new HT diagnosis in patients that were not hypertensive with the old guidelines in a Peruvian population. HT: Hypertension.
Bivariate model showed that being newly diagnosed with hypertension was associated with gender (p<0.001), age (p<0.001), being overweight (p<0.001), physical activity (p=0.010), smoking (p=0.031), and history of diabetes mellitus (p<0.001) when it was adjusted by region and pharmacological treatment. In the multivariate analysis, we found that age (p<0.001) and being overweight (p<0.001) increased the risk of being diagnosed with hypertension using the new guidelines criteria. In contrast, females (p<0.001) and intense physical activity (p<0.001) were associated with less risk. All of these variables were adjusted for smoking, history of diabetes mellitus, region, and pharmacological treatment (Table 3).

**Discussion**

In general, in our cohort following the 2017 ACC/AHA criteria, the patients were four times more likely to be newly diagnosed with hypertension than following the prior guidelines. This new classification has a cut off of 130/80 compared to 140/90. The ones that were on medication received at least one antihypertensive pill in the morning of the clinical visit.

### Table 2. Difference in the category of diastolic blood pressure pre and post new guidelines by pharmacological treatment in a Peruvian population (n = 5615).

| Old classification | New classification (New guidelines) | Normal/high | HT 1 | HT 2 |
|--------------------|------------------------------------|-------------|------|------|
| **No Pharmacological treatment (p value < 0.001)** | | | | |
| Optimal            | 3831 (71.6%)                       | | | |
| Normal             | 954 (17.9%)                        | 264 (4.9%)  | 240 (4.5%) |
| Normal high        |                                    | | | |
| HT 1               |                                    | | | |
| HT 2               |                                    | | | |
| HT 3               |                                    | | | |
| **With Pharmacological treatment (p value < 0.001)** | | | | |
| Optimal            | 119 (44.6%)                        | | | |
| Normal             | 69 (25.8%)                         | | | |
| Normal high        | 22 (8.3%)                          | | | |

The ones that were on medication received at least one antihypertensive pill in the morning of the clinical visit.

Bivariate model showed that being newly diagnosed with hypertension was associated with gender (p<0.001), age (p<0.001), being overweight (p<0.001), physical activity (p=0.010), smoking (p=0.031), and history of diabetes mellitus (p<0.001) when it was adjusted by region and pharmacological treatment. In the multivariate analysis, we found that age (p<0.001) and being overweight (p<0.001) increased the risk of being diagnosed with hypertension using the new guidelines criteria. In contrast, females (p<0.001) and intense physical activity (p<0.001) were associated with less risk. All of these variables were adjusted for smoking, history of diabetes mellitus, region, and pharmacological treatment (Table 3).

### Table 3. Bivariate and multivariate analysis with socio-pathological characteristics associate with a newly diagnosed of hypertension in a Peruvian population (N = 5280).

| Variables  | Bivariate model | Multivariate model |
|------------|-----------------|-------------------|
|            | cPR (CI95%)     | P value | aPR (CI95%) | P value |
| Female     | 0.83 (0.77-0.89)| <0.001 | 0.85 (0.80-0.90)| <0.001 |
| Age*       | 1.01 (1.00-1.01)| <0.001 | 1.01 (1.00-1.01)| <0.001 |
| Overweight | 1.34 (1.30-1.38)| <0.001 | 1.26 (1.24-1.28)| <0.001 |
| Physical activity | 0.86 (0.77-0.97)| 0.010 | 0.89 (0.83-0.95)| 0.001 |
| Smoking    | 1.19 (1.01-1.39)| 0.031 | 1.12 (1.00-1.26)| 0.051 |
| Diabetes mellitus | 1.26 (1.12-1.41)| <0.001 | 1.12 (0.98-1.28)| 0.084 |
| Region     |                 |        |                |        |
| Coast      | Comparison category | | Comparison category | |
| Mountain   | 0.94 (0.84-1.04)| 0.250 | 0.98 (0.90-1.07)| 0.699 |
| Jungle     | 0.81 (0.61-1.07)| 0.143 | 0.77 (0.58-1.01)| 0.057 |

Result variable was the new diagnosis of hypertension (following the new changes of the 2017 ACC/AHA guidelines), cPR (crude prevalence ratio), aPR (adjusted prevalence ratio), CI 95% (95% confidence interval) p value obtain with a linear model, with Poisson, function de enlace, gross and adjusted model by pharmacotherapy *Quantitative variable (age in years).
with the prior cut off of 140/90.\textsuperscript{15} This will bring a lot of burden to the Peruvian health system and other countries from the region because this increase in hypertensive patients has to be in accordance with new policies, acquisition of a bigger number of diagnostic equipment, increase of antihypertensive medications, increase on lifestyle modification, and increase of education to the newly diagnosed.\textsuperscript{16} Some of this change has been in place in some regions\textsuperscript{17} with the goal of preventing this disease but now they need to be evaluated faster by the health authorities for an immediate implementation.

One to two out of 10 patients that were not taking any antihypertensive medication switched from being non-hypertensive to being newly diagnosed hypertensive, following the systolic and diastolic new criteria. This new percentage should be captured by the health care system and education to this population should be given immediately. This creates a big problem because, in the past, this population believed that they didn’t have elevated blood pressure.\textsuperscript{15} The recruitment process of the newly diagnosed hypertensive patients should be very strict and accurate. New diagnostic techniques and treatment should be implemented.\textsuperscript{15}

In the group of patients that were already using antihypertensive medication, three out of 10 patients went from being treated and having the blood pressure normal to be not adequately treated (blood pressure not at goal). All of this new data is very important because pharmacological treatment has new goals in each group of patients.\textsuperscript{18} With these new guidelines, groups that in the past were under control now can be poorly treated or not in control.\textsuperscript{19}

The changes in the percentage of frequency for the new guidelines have had a high impact, of which it is recommended to study the possible new impacts of this change, with the groups that now enter the criteria of hypertension and how they influence other cardiological risks.

Studies in the US have determined a change in the prevalence of arterial hypertension, with an increase in prevalence from 13.7\%\textsuperscript{20} to 30.4\%\textsuperscript{21} considering the JNC7 guidelines and the new ACC/AHA guidelines.

This is a topic that each Peruvian region should address because it will generate a new surveillance system, prevention intervention, and treatments in patients that were already diagnosed with hypertension. We are predicting that there will be a short-term increase in the expenditure of the healthcare system\textsuperscript{22,23} but this event will improve the public health system in the long term. There is a lot of good evidence that showed that investing in prevention strategies produce direct and indirect saving.\textsuperscript{4,22}

We also found that older males classed as overweight and with poor physical activity have higher risks in becoming hypertensive with these new guidelines. These risk factors have been demonstrated before in other studies.\textsuperscript{24,25} The decision-making personnel should conduct surveillance of these risk factors and other specific ones for each specific population.

One of the limitations of this study includes information bias because this study was not designed for these specific goals. Another limitation is that the results cannot be extrapolated to all the Peruvian population due to the type of sampling that was done in the study. Despite all these limitations, this research is very important because it was done on a large cohort of Peruvian patients that participated to understand the physiological measures of blood pressure and other chronic comorbidities. This study showed the burden that this new change will cause on the healthcare of similar populations.

Conclusions

Our conclusions are that with the 2017 AHA/ACC criteria, there will be more than a 300\% increase in newly diagnosed hypertensive patients. This increase is less dramatic in patients that didn’t have the disease using the prior guidelines but required special attention in patients that already had the disease and were treated with antihypertensive medication. Gender, age, being overweight and poor physical activity were associated with the new diagnosis of hypertension.

Consent statement
Written informed consent for publication of the patients’ details and/or their images was obtained from the patients.

Data availability
Underlying data
Zenodo: Change criteria hypertension Peru, data. https://doi.org/10.5281/zenodo.4567767.26

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