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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 [version 1; peer review: 2 approved with reservations]

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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%)

Open Peer Review

Approval Status

	1	2
version 1
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1. José Fernando Gómez Montes , Universidad de Caldas, Manizales, Colombia		
2. Saman Khalesi , Central Queensland University, Rockhampton, Australia		
Any reports and responses or comments on the article can be found at the end of the article.		

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

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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), Huancaayo (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, Huanuco, Huancaayo, 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.

Figure 2. Comparison of frequency new HT diagnosis in patients that were not hypertensive with the old guidelines in a Peruvian population. HT: Hypertension.

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).

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%)

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%)	
Normal high		264 (4.9%)	
HT 1			240 (4.5%)
HT 2			52 (1.0%)
HT 3			7 (0.1%)
With Pharmacological treatment (p value < 0.001)			
Optimal	119 (44.6%)		
Normal		69 (25.8%)	
Normal high		22 (8.3%)	
HT 1			43 (16.1%)
HT 2			11 (4.1%)
HT 3			3 (1.1%)

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).

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

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 140/90.¹⁵ 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.¹⁶ Some of this change has been in place in some regions¹⁷ 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.¹⁵ The recruitment process of the newly diagnosed hypertensive patients should be very strict and accurate. New diagnostic techniques and treatment should be implemented.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.¹⁸ With these new guidelines, groups that in the past were under control now can be poorly treated or not in control.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 cardiometabolic risks.

Studies in the US have determined a change in the prevalence of arterial hypertension, with an increase in prevalence from 13.7%²⁰ to 30.4%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^{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.^{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.^{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

This data are available under the terms of the [Creative Commons Attribution 4.0 International license](#) (CC-BY 4.0).

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Saman Khalesi

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Abstract

- The methods section needs clarification on how the authors identified “the factors associated with being newly diagnosed...” - what “multivariate analysis” was used as there are many types.
- *Results section:*
If the significant p-value is defined in the methods, what is the use of reporting p values in the results? Instead, I suggest reporting coefficients (aPR etc.) or risk/likelihood which provides a better understanding of the modelling.
- *Conclusion section:*
I believe it should read as effective policies in education instead of “politics in education”.

Introduction

- I am not sure I follow the significance of the study, “...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” - what do the authors mean by the last part? Isn't the aim of the study to focus on the Peruvian population to call for interventions and policies to help prevent and manage HTN in this population? If so, please consider changing the abstract to also reflect this.
- What is the significance of identifying factors associated with being newly diagnosed? I think this also goes back to interventions and policies targeting the at-risk population. The significance of the study needs rewording.

Methods

- I don't think the second half of the “study design” section adds anything to this paper, what is the use of knowing what the primary data was used for?
- “Non-random sampling” does this refer to selective sampling? What was the reason of excluding patients who lived less than half a year in the city?

- I don't think the first sentence of data analysis is required, instead better explanation of the GLM could help.

Results

- Please include the characteristics of the participants. Some sections need rewording, for example, "This means a 300% increase in hypertensive patients in this cohort" - maybe change to "This means a 300% increase in hypertensive diagnosis using the 2017... guidelines".

Conclusion.

- "This increase is less dramatic in patients that didn't have the disease using the prior guidelines..." - I'm not sure what results this conclusion refers to. If anything, it should suggest the findings to be more dramatic for this cohort

I highly recommend proof-reading the manuscript before the next submission as some sentences and paragraphs need rewording/restructuring.

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

No

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Hypertension, epidemiology, health behaviour

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 27 September 2021

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José Fernando Gómez Montes

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This is a cross-sectional study based on the secondary analysis of the data from patient surveys in health facilities in the 10 cities of Peru. The aim "To examine the impact of the new 2017 ACC/AHA hypertension guideline on the prevalence of hypertension and their factors associated. The topic of the manuscript is appropriate for the Journal. It could be of interest to investigators and clinicians. However, several essential revisions are necessary

Major compulsory revisions

First question... why authors no included in the introduction or discussion section an identical paper published in Spanish in Rev Med Chile in 2019:

- Hernández-Vásquez A, Rojas-Roque C, Santero M, Ruiz-Maza JC, Casas-Bendezú M, Miranda JJ. ¿Qué representa cambiar el umbral diagnóstico de la hipertensión arterial? Guías ACC/AHA 2017 y su aplicación en Perú [Changes in the prevalence of hypertension in Peru using the new guideline of the American College of Cardiology]. Rev Med Chil. 2019 ¹

Regarding Guidelines ACC/AHA 2017 authors mentioned "This has not yet been evaluated in prospective studies in developing countries", however, several papers in low and middle income countries (LMICs) have been published. Please check at least these papers:

- Kibria GMA, Swasey K, Kc A, Mirbolouk M, Sakib MN, Sharmeen A, Chadni MJ, Stafford KA. Estimated Change in Prevalence of Hypertension in Nepal Following Application of the 2017 ACC/AHA Guideline. JAMA Netw Open. 2018 Jul 6;1(3):e180606. doi: 10.1001/jamanetworkopen.2018.0606. PMID: 30646022; PMCID: PMC6324293. ²
- Rahman MA, Halder HR, Yadav UN, Mistry SK. Prevalence of and factors associated with hypertension according to JNC 7 and ACC/AHA 2017 guidelines in Bangladesh. Sci Rep. 2021 Jul 29;11(1):15420. doi: 10.1038/s41598-021-94947-2. PMID: 34326418; PMCID: PMC8322062. ³
- Kibria GMA, Swasey K, Choudhury A, Burrowes V, Stafford KA, Uddin SMI, Mirbolouk M, Sharmeen A, Kc A, Mitra DK. The new 2017 ACC/AHA guideline for classification of hypertension: changes in prevalence of hypertension among adults in Bangladesh. J Hum Hypertens. 2018 Sep;32(8-9):608-616. doi: 10.1038/s41371-018-0080-z. Epub 2018 Jun 13. PMID: 29899377; PMCID: PMC6487869. ⁴
- Li D, Zeng X, Huang Y, Lei H, Li G, Zhang N, Huang W. Increased Risk of Hypertension in Young Adults in Southwest China: Impact of the 2017 ACC/AHA High Blood Pressure

Guideline. Curr Hypertens Rep. 2019 Feb 28;21(3):21. doi: 10.1007/s11906-019-0926-y. PMID: 30820764.⁵

Why authors non included a table to show characteristics of participants?. This is strongly recommended.

The discussion section should include comments and comparisons with the papers cited above. Moreover, a comment comparative with Mejia and cols. (2017) paper is desirable. More information is needed in the discussion section about findings in other LMICs.

Minor essential revisions:

Title:

The title is accurate and sufficiently descriptive of the content.

Abstract:

Abstract: Must be changed, due there are at least 5 papers with the same aim in LMICs. Secondary analysis of the data of hypertension is no clear for the reader. Please revise.

Introduction:

Another concern about this paper is why it is a prospective study mentioned in the introduction section, however, in study design "an analytical cross-sectional" is referred to? Please clarify this confusion.

Material and methods:

Please clarify why the study referenced as 12 is based in primary analysis?. More information about what was exactly his aim, more than only "find associations of chronic pathologies related with blood pressure".

Why the data based referenced as primary analysis included only data of the 894 patients with hypertension, while this research for secondary analysis mentioned 5.615 participants? Please clarify this situation.

"Subjects were not excluded because they all had the information required" should be interpreted as missing data were included?. Please clarify this important bias in this paper.

Variables description should be more clear, for example, Physical activity, what tools were used? How blood pressure was taken?. Please check Kibria y cols. (2018). Definition of hypertension should be mentioned in the material section for more understanding of readers. Only cut-off levels are commented in the discussion section

Results:

Information is clearly provided.

Discussion

Please check above.

References:

There were 26 and all are appropriate, however, non important references about the topic in LMICs were included. Check above.

Tables and figures:

Three tables and two figures are shown. All are well presented. However, an initial table with sample description is recommended.

Thanks for letting me review this manuscript.
This could be a nice paper.

Level of interest: An article whose findings are important to those with closely related research interests.

Quality of written English: Well.

Statistical review: No.

Declaration of competing interests:

I declare that I have no competing interests.

References

1. Hernández-Vásquez A, Rojas-Roque C, Santero M, Ruiz-Maza J, et al.: ¿Qué representa cambiar el umbral diagnóstico de la hipertensión arterial? Guías ACC/AHA 2017 y su aplicación en Perú. *Revista médica de Chile*. 2019; **147** (5): 545-556 [Publisher Full Text](#)
2. Kibria G, Swasey K, KC A, Mirbolouk M, et al.: Estimated Change in Prevalence of Hypertension in Nepal Following Application of the 2017 ACC/AHA Guideline. *JAMA Network Open*. 2018; **1** (3). [Publisher Full Text](#)
3. Rahman M, Halder H, Yadav U, Mistry S: Prevalence of and factors associated with hypertension according to JNC 7 and ACC/AHA 2017 guidelines in Bangladesh. *Scientific Reports*. 2021; **11** (1). [Publisher Full Text](#)
4. Kibria G, Swasey K, Choudhury A, Burrowes V, et al.: The new 2017 ACC/AHA guideline for classification of hypertension: changes in prevalence of hypertension among adults in Bangladesh. *Journal of Human Hypertension*. 2018; **32** (8-9): 608-616 [Publisher Full Text](#)
5. Li D, Zeng X, Huang Y, Lei H, et al.: Increased Risk of Hypertension in Young Adults in Southwest China: Impact of the 2017 ACC/AHA High Blood Pressure Guideline. *Current Hypertension Reports*. 2019; **21** (3). [Publisher Full Text](#)

Is the work clearly and accurately presented and does it cite the current literature?

No

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: geriatric medicine. internal medicine. falls. epidemiology.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

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