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## May measurement month 2017 campaign screening results from Venezuela: an analysis of blood pressure, abdominal circumference and body mass index.

Rafael Hernández-Hernández<sup>1</sup>, José Andrés Octavio-Seijas<sup>2</sup>, Jesús López-Rivera<sup>3</sup>, Igor Morr<sup>2</sup>, Antonieta P. Costantini-Olmos<sup>4</sup>, Mónica L. Gúzman-Franolic<sup>4</sup>, Egle Silvea<sup>5</sup>, Amanda Duín<sup>1</sup>, José Marval<sup>6</sup>, Nedina Coromoto Méndez-Amaya<sup>6</sup>, José Félix Ruíz-Lugo<sup>6</sup>, Dámaso Vásquez<sup>6</sup>, Carlos Ignacio Ponte-Negrete<sup>7</sup>, Thomas Beaney<sup>8</sup>, Elsa Kobeissi<sup>8,9</sup>, Neil R Poulter<sup>8</sup> and the investigators of Venezuela MMM-17 blood pressure campaign (listed at the end).

<sup>1</sup>Hypertension and Cardiovascular Risk Factors Clinic, School of Medicine, Universidad Centro Occidental Lisandro Alvarado, Barquisimeto, Venezuela.

<sup>2</sup>Department of Experimental Cardiology. Tropical Medicine Institute, Universidad Central de Venezuela, Caracas, Venezuela.

<sup>3</sup>Hypertension Unit, General Hospital, San Cristóbal, Venezuela.

<sup>4</sup>FARMATODO pharmacy group, Caracas, Venezuela.

<sup>5</sup>Instituto de Investigaciones de Enfermedades Cardiovasculares de LUZ. Universidad del Zulia, Maracaibo, Venezuela.

<sup>6</sup>Venezuelan Society of Cardiology and Venezuelan Society of Hypertension.

<sup>7</sup>Caribbean Cardiologic Unit. Venezuelan Foundation of Preventive Cardiology.

<sup>8</sup>Imperial Clinical Trials Unit, Imperial College London, Stadium House, London, UK.

<sup>9</sup>Conflict Medicine Program, Global Health Institute, American University of Beirut, Beirut, Lebanon.

**Key words:** hypertension; body mass index; abdominal circumference.

**Abstract.** The present study had the purpose of evaluating the proportion of subjects with hypertension, treatment, control rates, and the relationship between blood pressure (BP) with body mass index and abdominal circumference in a cross-sectional study, as part of a worldwide study designed by International Society of Hypertension, performed during May 2017. After the protocol's approval by the local Ethical Committee, 64 sites were included from eight Venezuelan regions. A short questionnaire was completed for each participant, including knowledge of taking antihypertensive treatment, diabetes, previous

myocardial infarction or stroke, alcohol intake, and smoking. BP was measured in the sitting position three times after resting for 5 minutes, one minute apart, using mainly oscillometric devices. Height, weight and abdominal circumference were measured. Data analyses were performed by the MMM central team. 21644 individuals were screened. After multiple imputations, 10584 individuals [48.9% (50.7% male; 47.7% female)] had hypertension. Of subjects not receiving antihypertensive medication, 1538 (12.2%) were hypertensives. Of hypertensive individuals receiving antihypertensive medication, 2974 (32.9%) had uncontrolled BP. 15.6% of our sample had obesity according to their body mass index; 43.8% of women and 20.7% of men had abdominal obesity. BP was positively correlated with BMI and abdominal circumference. In this largest BP screening carried out in Venezuela, 48.9% of the individuals had elevated BP and 12.2% did not know that they had hypertension, and in one third of those with hypertension on treatment, BP was not controlled. 15.6% had obesity by BMI, and 35.1% abdominal obesity. Screening such as the MMM17 can evaluate the association between hypertension and obesity and therefore may help to inform control programs.

**Campana de Medición del mes de mayo-2017: un análisis de los resultados de la presión arterial, circunferencia abdominal e índice de masa corporal en Venezuela.**

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**Palabras clave:** hipertensión; índice de masa corporal; circunferencia abdominal.

**Resumen.** Se realizó el presente estudio con el objetivo de evaluar la proporción de sujetos con hipertensión, tratamiento, tasas de control y la relación entre la presión arterial (PA) con el índice de masa corporal y la circunferencia abdominal en un estudio transversal, como parte de un estudio mundial diseñado por la Sociedad Internacional de Hipertensión, realizada durante mayo de 2017. Luego de la aprobación del protocolo por el Comité de Ética local, se incluyeron 64 sitios de ocho regiones venezolanas. Se completó un breve cuestionario para cada participante, que incluye el conocimiento de tomar tratamiento antihipertensivo, diabetes, infarto de miocardio o accidente cerebrovascular previo, consumo de alcohol y tabaquismo. La PA se midió en posición sentada tres veces después de descansar durante 5 minutos, con un minuto de diferencia, utilizando principalmente dispositivos oscilométricos. Se midieron la talla, el peso y la circunferencia abdominal. Los análisis de datos fueron realizados por el equipo central de MMM. Se evaluaron 21644 personas. Después de múltiples imputaciones, 10584 individuos [48,9% (50,7% hombres; 47,7% mujeres)] tenían hipertensión. De los sujetos que no recibieron medicación antihipertensiva, 1538 (12,2%) eran hipertensos. De las personas hipertensas que recibieron medicamentos antihipertensivos, 2974 (32,9%) tenían BP no controlada. El 15,6% de nuestra muestra tenía obesidad según su índice de masa corporal; el 43,8% de las mujeres y el 20,7% de los hombres tenían obesidad abdominal. La PA se correlacionó positivamente con el IMC y la circunferencia

abdominal. En esta encuesta de detección de la PA más grande realizada en Venezuela, el 48,9% de los individuos tenían presión arterial elevada y el 12,2% desconocían tener hipertensión, y en un tercio de aquellos con hipertensión en tratamiento, la PA no estaba controlada. El 15,6% tenía obesidad por IMC y el 35,1% obesidad abdominal. Los exámenes de detección como el MMM17 pueden estimar la prevalencia de hipertensión y obesidad y pueden ayudar a evaluar los programas de control.

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## INTRODUCTION

Hypertension is considered the single most preventable cause of premature death (1) and is the biggest contributor to the global burden of disease (2), and to mortality, leading to 10.4 million deaths every year worldwide. In Latin America almost 1 million cardiovascular deaths occur annually, with coronary heart disease, stroke, and hypertension as the primary cause of death (3). Cardiovascular mortality in Latin America increases every year due to aging of the population, and importantly, for the epidemiological transition, with changes in the way of living, including increased consumption of processed foods with high salt, fat, and sugar content, accompanying low levels of physical activity, and smoking (4). Cardiovascular diseases are the first cause of deaths in Venezuela, mainly coronary artery disease, stroke, heart failure, and hypertension reported as primary cause of death (3,5). On the other hand, cardiovascular diseases have hypertension in common as a primary risk factor, also, for renal disease; they are frequently accompanied by other risk factors, such as obesity, diabetes mellitus, lipid abnormalities, smoking, and low physical activity.

In fact, hypertension is the risk factor most strongly associated with the first myocardial infarction in Latin American countries (6). Furthermore, the end-organ damage (e.g., renal failure, stroke or pe-

ripheral vascular disease) associated with hypertension emphasizes the importance of prevention, detection and control efforts worldwide (7,8). Epidemiological information in Latin America is mainly focused on the prevalence of hypertension and few such studies, in different areas of Latin America, are available. Among these studies, the Cardiovascular Risk Factor Multiple Evaluation in Latin America (CARMELA) study (9,10), a representative, multicentre observational study including 11550 individuals of both sexes, aged 25–64, from seven large cities: Barquisimeto (Venezuela), Bogotá (Colombia), Buenos Aires (Argentina), Lima (Peru), Mexico (Mexico), Quito (Ecuador) and Santiago de Chile (Chile), showed a hypertension prevalence range between 11.7 and 29.8%. In 2008, when CARMELA was carried out, Barquisimeto (Venezuela) had the second largest prevalence of hypertension in Latin America, and the highest prevalence of any lipid abnormalities (81%), diabetes (6%), obesity measured by body mass index (25.1%), abdominal obesity (29.2%); metabolic syndrome (25.8%) and smoking (25.0%).

Since 2000, but more so in the last few years, Venezuela has had important changes in the political, economic and social systems, and it is important to know the impact of such changes in the prevalence of hypertension, and other cardiovascular factors, such as obesity, diabetes and the degree of blood pressure control in hypertensive patients.

The aim of this study was to evaluate the proportion of subjects with hypertension, treatment and control rates, and the relationship between blood pressure (BP) and body mass index and abdominal circumference in a cross-sectional study, as a part of the study design by the International Society of Hypertension; carried out during month of May 2017.

## METHODS

### Study Design

The MMM cross-sectional survey was designed by the International Society of Hypertension to be carried out in about 100 countries (11). Target participants were volunteer adults ( $\geq 18$  years) who ideally had not had their blood pressures measured in the previous year; however this was not an exclusion to participation.

In Venezuela the final protocol was approved by the Ethical Committee of the School of Medicine of the Centro-Occidental Lisandro Alvarado University and was performed in universities, health centres and mainly in a chain of pharmacies (Farmatodo) located in several important towns of Venezuela. There was a national leader and a local coordinator in each region. Voluntary staff were pharmacists, nurses, medical and nursing students and physicians. Local campaigns to incentivise participation from the public were carried out using social media communications.

A short questionnaire, which included knowledge of taking antihypertensive treatment; suffering from diabetes, previous myocardial infarction or stroke; frequency of alcohol intake, and current smoking was completed for each participant; following this, physical measurements were carried out; including blood pressure, height, weight and abdominal circumference. Data were entered on paper forms and later transferred to spread sheets for analysis.

Blood pressure was measured in the sitting position three times after resting for at

least 5 minutes, one minute apart. Recording was carried out mainly, but not limited to, the left arm, using validated oscillometric devices of different brands, mainly from Omron Healthcare. Manual sphygmomanometers were used in about 1% of readings. Blood pressure was calculated from the mean of the second and third readings, and hypertension was defined as a systolic blood pressure of at least 140 mm Hg and/or a diastolic blood pressure of at least 90 mm Hg. Participants receiving antihypertensive treatment were also assumed to have hypertension. Among those on antihypertensive treatment, controlled blood pressure was defined as a blood pressure of less than 140/90 mmHg.

Abdominal circumference was measured at the level of the umbilicus, with the subjects standing and breathing normally; normal values were defined  $< 102$  cm in males and  $< 88$  in females (12); also, height and weight was measure, and body mass index was calculated. The WHO Classification of body mass index was used (13).

### Data handling and statistical analysis

Data cleaning was done locally and centrally by the MMM project team. Data from 21644 individual from Venezuela were divided into eight regions.

Blood pressures were recorded, and crude analyses were done using the mean of the second and third blood pressure readings, available in 97.9% of subjects. Using only those individuals with all three readings we compared mean blood pressures and the proportion of participants with hypertension using different combinations of the three readings. For further analyses, multiple imputation was used to impute the mean of the second and third reading where this was missing, based on the available reading, along with age, sex (with an interaction between age and sex) and use of antihypertensive medication. Both systolic and diastolic components were included within the imputation models.

Mean blood pressures were standardised for age and sex according to the WHO world age-standard population along with an assumed sex ratio of 1:1 (13).

Linear regression models were run separately for systolic and diastolic blood pressures. In all models, the association of blood pressure was adjusted for age and sex (with an interaction term) and antihypertensive medication. Complete details of statistical analyses have been published in WWW17 worldwide results (11).

## RESULTS

The number of participants included from Venezuela was 21644 subjects with a mean age of 53.2 years (SD: 15.64), more women were included (62.8%), the self-reported ethnicity was predominantly mixed (62.4%) follow by white (30.4%) ethnicity. The whole group of general characteristics of the sample is in Table I. Table II presents the distribution for age group and sex and distribution of sample for the eight Venezuela regions.

BP was measured three times in 97.9% of subjects, the average blood pressure in first, second and third reading was on average: 126.8/76.1 mmHg; 124.5/74.9 mmHg and 123.8/75.8 mmHg respectively; for analysis the average of 2<sup>nd</sup> and 3<sup>rd</sup> reading was used for different calculations.

### Blood pressure and age

Based on a linear regression model, the association between age and sex with systolic and diastolic BP in subjects who were not receiving antihypertensive treatment (12303 subjects) showed a linear increase, with the mean systolic blood pressure in women exceeding the mean systolic blood pressure in men at 80-85 years of age. For diastolic blood pressure, the relationship showed an inverted U shape, with highest levels at age 55-60 years, and with blood pressure in women lower than in men until aged 80-85 (Fig. 1).

The percentages of subjects with elevated blood pressure ( $\geq 140/\geq 90$  mmHg) by sex and age group are shown in Fig. 2. Overall, 48.9% (50.7% of male and 47.7% of female) have elevated blood pressure; and the proportion of hypertension increases with age.

### Blood pressure by Venezuelan regions

Mean systolic and diastolic blood pressure by region are shown in Table III. The proportion of subjects with elevated blood pressure ( $\geq 140/\geq 90$  mmHg) by region and age group in Table IV; there is variation in both blood pressure and hypertension in different regions, with hypertension being higher in the capital region (54%), and the lower in the eastern region with 41.0% for both sexes.

### Physical measurements and risk factors and their relationship with blood pressure

Body mass index was calculated for all participants and according to age groups; 4.8% of subjects are defined as underweight; 46.5% as normal; 32.0% overweight and 15.6% obese in the female population; and 3.1%; 42.4%; 36.9% and 16.8% respectively among men (Table V).

Abdominal circumference defined as high ( $\geq 88$  cm in female and  $\geq 102$  cm in male) was present in 43.8% of women and 20.7% of men; and hypertension was more frequent in participants with higher waist circumference in males and females (Table VI). In comparison to a desirable abdominal circumference, systolic and diastolic blood pressure are higher by 4.2/3.1 mmHg in female and 5.6/4.3 mmHg in male with high abdominal circumference, which was statistically significant in both cases ( $p > 0.001$ ). After adjustment for age and sex, significantly higher systolic and diastolic blood pressures were apparent in subjects who were receiving antihypertensive drug treatment. Only systolic blood pressure was higher for subjects with self-reported diabetes, previ-

**TABLE I**  
PARTICIPANTS MAIN CHARACTERISTICS IN VENEZUELA

Participant Characteristics		Total	Percentage
Sex			
	Female	13584	62.8
	Male	8040	37.2
	Unknown	20	0.09
	Total	21644	100
Age (years)	Mean (SD)	53.2 (15.64)	
Ethnicity			
	White	6571	30.4
	Black	871	4.02
	Mixed	13508	62.4
	Other	694	3.2
On hypertensive medication		9046	41.8
Diabetes Mellitus		2325	10.7
Previous Myocardial Infarction		776	3.6
Previous Stroke		597	2.8
Pregnant	yes	264	1.95
Current Smoker		2115	9.8
Alcohol Intake			
	Never/rarely	20751	95.9
	Once or more per week	890	4.1
Body Mass Index (Kg/m <sup>2</sup> )	Mean (SD)	25.47 (4.68)	
Abdominal Circumference (cm)			
	Female (Mean – SD-)	86.9 (12.63)	
	Male (Mean – SD-)	93.2 (13.34)	
BP Measurement arm			
	Right	5574	25.8
	Left	16067	74.2

ous myocardial infarction or stroke. Alcohol intake and current smoking showed little effect on BP; meanwhile pregnancy was associated with lower systolic and diastolic blood pressure (Fig. 3).

#### Hypertension control

A group of 1526 subjects (14.4%) not receiving antihypertensive therapy were found to have elevated blood pressure ( $\geq 140/\geq 90$  mmHg). 9046 subjects (58.2%) were on anti-

hypertensive drug therapy; 30.0% of females and 38.5% of males were not controlled (BP  $\geq 140 / \geq 90$  mmHg). Table VII shows blood pressure control by age group and sex.

#### DISCUSSION

This study was part of the worldwide MMM17 campaign initiated by the International Society of Hypertension, and was a synchronised, standardised and multinational-

**TABLE II**  
NUMBER OF SUBJECTS BY SEX AND AGE IN 8 VENEZUELAN REGIONS.

	Female	Male	Unknown	Total
<b>By Age Group</b>				
< 24	660	335	1	996
25-34	1312	816	1	2129
35-44	1869	1151	2	3022
45-54	2867	1649	4	4520
55-64	3466	1938	5	5409
65-74	2388	1464	2	3854
>74	995	665	3	1663
Unknown	27	22	2	51
Total	13584	8040	20	21644
<b>By Venezuelan Region*</b>				
	Female	Male		Total
Andes	2101	1408	-	3509
Capital	4179	2318	-	6497
Central	1957	1129	-	3086
Central-Western	1385	702	-	2087
Eastern	1103	634	-	1737
Island	817	443	-	1260
Southern	246	217	-	463
Western	1385	1072	-	2457
Total **	13173	7923		21096

\*Regions: Andes: Táchira and Mérida States; Capital: Federal District, Guarenas, Los Téques. Central Western: Lara and Yaracuy States; Island: Porlamar City. Eastern: Anzoátegui, Sucre and Monagas States; Sothern: Barinas State; Western: Zulia and Falcón States.

\*\* 548 subjects were not classified by regions.

al BP screening campaign and cardiovascular factors and events (11). In our case, most subjects were screened at the pharmacy level, < 2% from health centres or universities; unlike the global MMM17 study (11) 97.9% of subjects had three BP readings recorded, mainly in the left arm, using validated oscillometric devices. Abdominal circumference was also recorded, which was not collected globally.

However, in view of the convenience sampling it is inappropriate to compare the prevalence of hypertension observed previously in Venezuela, in representative studies, but the association of blood pressure in 21644 subjects gives an idea of comparative

prevalence with other countries participating in the worldwide campaign; as well as between different Venezuelan regions. Also, the relations of blood pressure in subjects with obesity (either body mass index classification or central obesity by abdominal circumference), reported diabetes, previous cardiovascular diseases, alcohol intake, and smoking are valid.

Subjects found with high blood pressure ( $\geq 140/\geq 90$  mmHg) whether they remained on treatment, were recommended to visit their physician for proper clinical evaluation or treatment adjustment if necessary. For all participants, general recommendations on cardiovascular health were given.

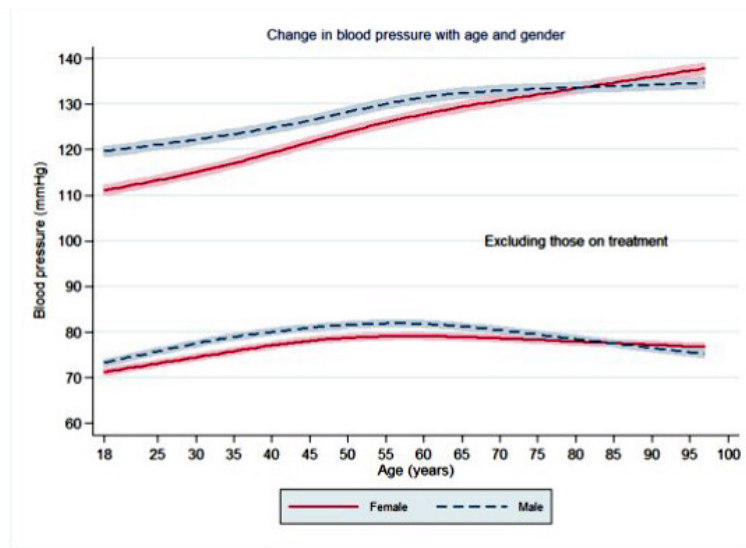


Fig. 1. Change in blood pressure with age and gender.

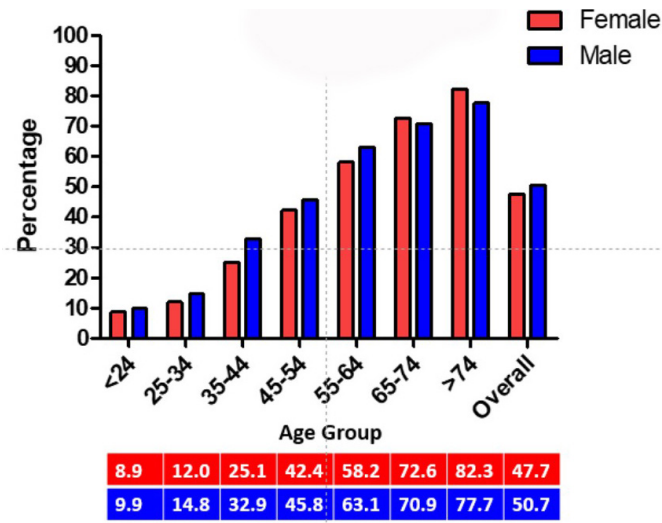


Fig. 2. Defined according to ESC/ESC and LASH guidelines (7,8).

This study included a sample of 21644 subjects, being the largest study carried out in Venezuela until now. The second largest study was carried out in 15000 subjects >18 year of age, back in the 1990s in one single city (Barquisimeto – central-western region) (14) which showed a prevalence of hypertension in 23.6% (27.75% male and 21.39% female); another large study was carried out in Maracaibo (Western region) in 7424 subjects with a prevalence of hypertension in

39.2% (45.2% in male and 28.9% in female) (15). The Cardiovascular Multiple Risk Factor Evaluation Study (CARMELA study), included a sample of 1848 subjects from Barquisimeto (Venezuela) as part a Latin American study major cities. The CARMELA study includes an evaluation of physical measurement of BP, weight, height, abdominal circumference, lipid levels, glucose level and carotid intima media thickness and plaques, in subjects 25 to 64 years old (9,10). In CAR-



**TABLE III**  
MEAN CRUDE SYSTOLIC AND DIASTOLIC BP BY REGION IN VENEZUELA, AND AGE AND SEX STANDARDISED ON SUBJECTS NOT ON ANTIHYPERTENSIVE TREATMENT AND ON ANTIHYPERTENSIVE TREATMENT.

Venezuela Region	Diastolic (mmHg)	SE	Systolic (mmHg)	SE
Southern	76.6	0.477	131.3	0.813
Western	74.6	0.216	127.7	0.373
Andes	75.5	0.272	127.7	0.493
Capital	74.4	0.136	124.0	0.240
Central	75.6	0.194	122.7	0.345
Island	74.1	0.304	121.8	0.561
Central-Western	74.2	0.239	121.6	0.419
Eastern	73.6	0.275	120.9	0.450
Mean Total Crude (before imputation)	74.9	0.076	124.2	0.133
Mean Total Age and Sex Standardised	73.7	0.095	120.5	0.139
Mean Total Age and Sex Standardised, excluding subjects on treatment	72.4	0.100	117.7	0.145
Mean Total Age and Sex Standardised, in subjects on treatment	78.4*	0.356	129.8*	0.576

\* $p < 0.0001$  versus subjects not on treatment.  
SE: standard error.

MELA, the prevalence of hypertension, in Venezuela was 24.7% (27.5% male and 22.9% female), the second highest prevalence after Buenos Aires with 29% in subjects 25 to 64 years old. Other studies in Venezuela with broad age groups and not representative samples, found a prevalence of 34% (16).

In the present study, the percentage of people in Venezuela with hypertension was 48.9% (50.7% male; 47.7% female), with variations for different Venezuelan regions indicating an apparent increment in prevalence compared to previous studies in Venezuela; which may be genuine or due to bias in terms of more participation of hypertensive patients receiving medication, than would be expected, comparing to the overall MMM17 report, where percentage was 34.9% worldwide (80 countries) and 41.0% in the Americas region (11). The proportion of patients with hypertension of those not receiving treatment was 12.4% in

Venezuela, comparing to 17.3% globally and 14.4% in the Americas; the percentage of subjects receiving treatment but with uncontrolled blood pressure was 33.1% in our study comparing to 46.3% globally and 38.6% for the Americas (11). This indicates a smaller proportion of individuals not receiving treatment and smaller proportion with uncontrolled hypertensive group receiving treatment, in relation to both worldwide and Americas data. Also, females older than 65 years and males 24 to 54 years were more likely to be uncontrolled. Those results are consistent with CARMELA study which reported 28.2% of those treated with antihypertensive medication but not controlled (17). On the other hand, percentage of hypertension in Venezuelan regions goes from 54.0% in the capital region to 41.0% to the eastern region; which is consistent with cardiovascular mortality rates reported in that regions in Venezuela (5,18).

**TABLE IV**  
 PERCENTAGE OF SUBJECTS WITH HYPERTENSION BY GROUP-AGE AND SEX IN VENEZUELAN  
 REGIONS ACCORDING TO ESH/ESC AND LASH GUIDELINES (7,8).

Region/Sex	<24	25-34	35-44	45-54	55-64	65-74	>74	Overall
Andes								
Female	7.8	8.5	28.1	43.7	55.8	73.1	82.4	48.7
Male	12.2	17.9	34.7	48.3	64.4	75.1	73.1	53.8
Capital								
Female	4.2	9.7	26.7	43.9	59.1	74.9	83.0	53.7
Male	10.6	12.0	32.4	47.1	61.9	72.0	80.6	54.7
Central								
Female	4.0	9.7	26.7	43.9	59.1	74.9	83.0	53.7
Male	8.0	20.9	33.5	46.1	59.2	64.9	76.2	45.8
Central-western								
Female	10.0	11.4	21.3	48.3	53.2	75.5	79.5	44.8
Male	15.2	6.0	30.0	47.0	63.6	66.4	65.9	46.7
Eastern								
Female	4.7	11.5	20.6	34.6	61.3	70.3	87.8	39.4
Male	4.3	14.5	29.2	40.9	57.6	78.6	78.6	44.6
Island								
Female	16.3	5.9	25.8	42.3	62.1	62.2	86.0	45.9
Male	0.0	15.2	35.2	34.5	65.7	64.9	89.7	47.0
Southern								
Female	0.0	16.1	36.5	40.7	55.2	58.6	100.0	43.1
Male	33.3	18.2	20.8	37.5	53.4	84.0	64.3	46.1
Western								
Female	6.6	21.6	29.3	46.2	65.5	78.2	81.2	51.7
Male	15.2	16.4	38.6	52.2	72.8	70.7	87.3	55.4

\* Regions: Andes: Táchira ad Mérida States; Capital: Federal District, Guarenas, Los Téques; Central: Aragua and Carabobo States; Central-Western: Lara and Yaracuy States; Island: Porlamar City; Eastern: Anzoátegui, Sucre and Monagas States; Southern: Barinas State; Western: Zulia and Falcón States.

\*\*548 subjects not classified by regions.

In 2017 the American Heart Association (AHA)/American College of Cardiology (ACC) changed the criteria to define hypertension with a cut-off values of  $\geq 130/80$  mmHg (19), instead the approved for all guidelines until that year ( $\geq 140/90$  mmHg), founded in a particular way of measure BP in the office and mainly on one study results (SPRINT) (20). Our study did not analyse

upon the AHA/ACC guideline, because it was designed previously of that guideline, but above all, we follow ESC/ESH, LASH, and Venezuelan guidelines which maintained the criteria  $\geq 140/90$  mmHg (1,7,8, 21), also the way as BP was measured was those follow by most of the clinical or epidemiological studies in Venezuela and worldwide, allowing comparison among previous studies.

**TABLE V**  
 CLASSIFICATION OF BODY MASS INDEX BY SEX AND AGE-GROUP IN VENEZUELA;  
 ABSOLUTE NUMBERS AND PERCENTAGES

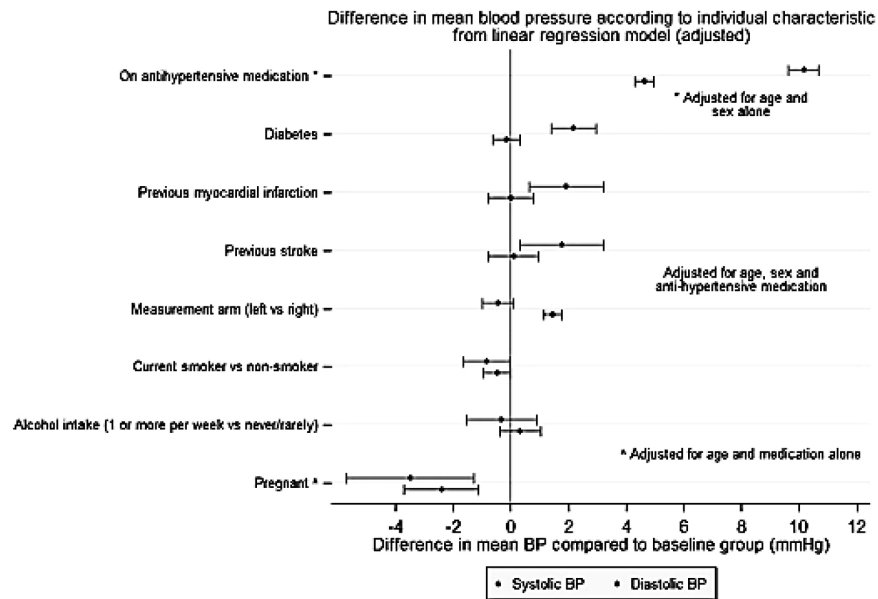
	Age Group								
	<24	25-34	35-44	45-54	55-64	65-74	>74	Unknown	Total
<b>FEMALE</b>									
<b>BODY MASS INDEX</b>									
Underweight	80	85	79	94	117	123	77	3	658
%	12.1	6.5	4.2	3.3	3.4	5.2	7.7	11.1	4.8
Normal	410	701	864	1195	1508	1111	523	9	6321
%	62.1	53.4	46.2	41.7	43.5	46.5	52.6	33.3	46.5
Overweight	126	345	583	1014	1171	800	295	10	4344
%	19.1	26.3	31.2	35.4	33.8	33.5	29.6	37.0	32.0
Obesity Grade 1	32	120	228	393	498	282	74	3	1630
%	4.8	9.1	12.2	13.7	14.4	11.8	7.4	11.1	12.0
Obesity grade 2	9	35	72	107	112	47	12	0	394
%	1.4	2.7	3.9	3.7	3.2	2.0	1.2	0.0	2.9
Obesity grade 3	1	10	19	30	22	11	3	0	96
%	0.2	0.8	1.0	1.0	0.6	0.5	0.3	0.0	0.7
Unknown	2	16	24	34	38	14	11	2	141
Total	660	1312	1869	2867	3466	2388	995	27	13584
<b>MALE</b>									
<b>BODY MASS INDEX</b>									
Underweight	28	33	17	31	53	52	38	1	253
%	8.4	4.0	1.5	1.9	2.7	3.6	5.7	4.5	3.1
Normal	227	364	381	566	762	723	378	9	3410
%	67.8	44.6	33.1	34.3	39.3	39.4	56.8	40.9	42.4
Overweight	55	284	447	671	794	513	198	8	2970
%	16.4	34.8	38.8	40.7	41.0	35.0	29.8	36.4	36.9
Obesity Grade 1	19	105	215	293	258	142	39	4	1075
%	5.7	12.9	18.7	17.8	13.3	9.7	5.9	18.2	13.4
Obesity grade 2	2	20	63	59	53	23	5	0	225
%	0.6	2.5	5.5	3.6	2.7	1.6	0.8	0.0	2.8
Obesity grade 3	0	5	16	17	8	1	2	0	49
%	0.0	0.6	1.4	1.0	0.4	0.1	0.3	0.0	0.6
Unknown	4	5	12	12	10	10	5	0	58
Total	335	816	1151	1649	1938	1464	665	22	8040

**TABLE VI**  
 ABDOMINAL CIRCUMFERENCE IN FEMALE AND MALE (ABSOLUTE NUMBERS AND PERCENTAGE),  
 WITH AND WITHOUT HYPERTENSION.

	Waist Circumference		
	Desirable*	High**	Total
<b>FEMALE</b>			
Participants without hypertension (n)	5949	4140	10089
%	85.4	76.2	81.4
Participants with hypertension (n)	1020	1290	2310
%	14.6	23.8	18.6
Total	6969	5430	12399
%	56.2	43.8	100
<b>MALE</b>			
Participants without hypertension (n)	4549	1007	5556
%	76.9	65.3	74.5
Participants with hypertension (n)	1370	536	1.906
%	23.1	34.7	25.5
Total	5919	1543	7462
%	79.3	20.7	100

\*Desirable: <88 cm in female; <102 cm in male.

\*\*High: ≥88cm in female; ≥102 cm in male.



**Fig. 3.** Difference in blood pressure according to individual characteristic from linear adjusted regression model.

**TABLE VII**  
BLOOD PRESSURE CONTROLLED (<140/<90 MMHG\*) ACCORDING TO SEX AND AGE GROUP  
IN SUBJECT ON ANTIHYPERTENSIVE DRUG TREATMENT.

	Age group							Total
	<24	25-34	35-44	45-54	55-64	65-74	>74	
<b>WOMEN</b>								
Hypertension controlled	31	88	250	712	1,299	1,104	475	3,959
%	75.6	77.2	71.4	70.1	72.5	69.5	63.1	70.0
Hypertension not controlled	10	26	100	304	492	485	278	1,695
%	24.4	22.8	28.6	29.9	27.5	30.5	36.9	30.0
Total	41	114	350	1016	1791	1589	753	5654
<b>MEN</b>								
Hypertension controlled	15	37	166	322	622	560	287	2,009
%	78.9	57.8	68.3	58.0	61.1	61.3	63.2	61.5
Hypertension not controlled	4	27	77	233	396	354	167	1,258
%	21.1	42.2	31.7	42.0	38.9	38.7	36.8	38.5
Total	19	64	243	555	1018	914	454	3267

\*According to ESH/ESC and LASH Guidelines (7,8).

Note: from the whole group 141 females and 58 males did not record age; 20 individuals did not record sex.

However, a recent publication of one Venezuelan study (EVESCAM) carried out between 2014 and 2017, in 4454 subjects (22) was re-analysed following criteria of JNC-7 (cut-off  $\geq 140/90$  mmHg) and AHA/ACC guidelines (23); and they found a crude prevalence of hypertension of 47.4% for JNC-7 criteria and 60.4% for AHA/ACC criteria; and the prevalence standardized for age and sex, in 37.9% (men) and 36.3% (women) for JNC-7 and 55.4% (men) and 49.0% (women) for AHA/ACC criteria. Our results shown higher percentage of hypertension standardized by age and sex, using the same cut off ( $\geq 140/90$  mmHg) which may be due to higher age in our study (50.2 y vs. 53.2 y). Prevalence calculated over AHA/ACC guidelines may overestimate the situation. However, usage of AHA/ACC criteria is open to discussion worldwide.

In the present study, body mass index was in average 25.5 (SD 4.68) kg/m<sup>2</sup>; underweight subjects represent 3.9% (female:

4.8%; male: 3.1%); normal weight: 44.4%; overweight: 34.4% and obesity in 16.2% (female: 15.6%; male: 16.8). Blood pressure increase in obese subjects with reference to underweight individuals was 11.4/7.5 mmHg higher (SBP/DBP  $p < 0.0001$ ); (Table VI). Central obesity measured throughout abdominal circumference was on average for females 86.9 (SD 12.63) cm and males 93.2 (SD 13.34) cm; 43.8% of women had an abdominal circumference over 88 cm; and 20.7% of men, over 102 cm, indicating abdominal obesity. Blood pressure was 4.2/3.1 mmHg (SBP/DBP) higher in females and 5.6/4.3 mmHg higher among underweight subjects.

The CARMELA study reported the average BMI for Venezuela was 27 Kg/m<sup>2</sup> (male: 26.9 Kg/m<sup>2</sup>, female 27 Kg/m<sup>2</sup>); underweight 2% (female: 2.1%; male: 1.7%); normal weight 36.8%, overweight 36.2%; obesity 25.1% (female: 26.1%; male: 23.6%); central obesity in 29.2% (24). Another study carried

out in the west region of Venezuela (Maracaibo), in 2012, reported an average BMI of 28.25 Kg/m<sup>2</sup>, with a prevalence of obesity of 33.3% (female: 32.4%; male: 34.2%) (25). Presuming these are comparable, those studies indicate an apparent progressive loss of average body mass index in the Venezuelan population since 2008. Loss of weight for the population could cause lowering of blood pressure or produce an apparent better control of blood pressure (26). Caraballo-Arias in 2015 reported important changes in the economic and job situation and in health in Venezuela since 2006 which might explain weight loss in the Venezuelan population (27). Also, another publication made observations about the economic crisis and migration of scientific and health personal from Venezuela (28), which importantly affects the health care system for the attention of patients with hypertension and cardiovascular diseases.

Subjects in our study reported to having diabetes was 10.7% in contrast with other studies showing 7.7% (range 6% to 14.9%) in several Venezuelan regions (29) and 6.4% (Central-Western region), including fasting glucose determination (30). The percentage of diabetes seems to be consistent with those studies, however population based representative samples are required to confirm the prevalence.

Adjusting for age, sex and antihypertensive treatment; both systolic and diastolic BP was significantly higher for individuals receiving antihypertensive treatment; systolic BP was significantly higher in individuals with a previous history of diabetes, stroke and myocardial infarction. Alcohol intake and smoking did not significantly change BP. The proportion of participants reporting either alcohol intake or smoking were low, and lower than previous reports (10,14,15); this situation may be as consequence of the current economic situation in Venezuela. Pregnant women tended to have lower systolic and diastolic BP, as expected.

This study has the advantage of being the largest study of this type carried out in Venezuela to detect hypertension associated with obesity and other risk factors; it can give an idea of the cardiovascular risk factors in the country; and can also help to identify unknown subjects with the disease; however this is not a representative sample and their values cannot be used as prevalence; which require appropriate epidemiological design studies. However, using the same methodology in different years and regions could help to identify tendencies and comparisons.

In conclusion, this largest cross-sectional survey in Venezuela allows us to state:

- Systolic and diastolic blood pressure increases with age; it is higher in young men and elderly women; and tend to be higher in obese, either classified by body mass index or abdominal circumference.
- The percentage of current hypertension for Venezuela, in a comparative way, was higher than worldwide and the America Continent (48.9% vs 34.9% and 41.0% respectively).
- Treated hypertensive subjects tend to have higher systolic and diastolic than not treated and not hypertensive subjects.
- Obesity, previous myocardial infarction or stroke, and diabetes affect mainly the systolic blood pressure.
- One third of hypertensives who reported to be taking treatment were not controlled - mainly elderly women and young men, but these values were lower than among the world-wide and American continent data.
- The economic crisis in Venezuela may have influenced the rate of obesity, diabetes, alcohol intake, smoking and also on blood pressure control.

#### **Investigators of Venezuela MMM-17 blood pressure campaign**

Rebeca Arrage; Gloria Alvarado; Maria Gracia Alvarado; Adonis Diomar Álvarez; Daana Arnaud; Gracia Asbati; Peggy Asuaje;

María De Los Ángeles Avendaño; Karliany Barrios; Sebastián Bracho; María Laura Boschetti Saer; Luis Blanco; Marilú Bermúdez; Juan Carlos Camacho Duin; Noe Alexander Campos; Korint Carrillo; Mary Carmen Castellón; Mary Francis Carrión; Carla Maria Cotonne Di Mauro; Maryolga Cova; Kira Nathaly Cuenca Camejo; Andreina Fernández; Loyda Fonseca; María Antonieta Gámez; Rigmarí García; Fernando González; Daysi De Gouveia; Angeli Hernández; Petra Luisa Hernandez; Bertulio Izarra; Maria De Lourdes Natera; Ines Padrón; Julio Palacios; Lisbeth Pereira; Yalí Pereira; Gabriela Pérez; Nilda Pietrobono; Sandra Porreca; Maryoritza Puente; Renne Ramirez; Ilsa Ramos; Yuli Rawik; Carmen Ríos; María Rimer; Fanny Rojas; Luisa Rondón; Maria Carolina Messina; Meybi Montilla; Gilda Noguera; Sergio Sanchez; Alfonso Sulbarán, Danila Sbrizzi; Samantha Valentina, Astrid Varela; Zoyla Elizabeth Vega; Luis Zambrano; Rubén Zambrano.

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