

Teide volcano Tenerife, Canary Islands. Spain. 2016

CURSO DE LA ELEVACIÓN DE LA TENSIÓN ARTERIAL DEL NIÑO Y ADOLESCENTE.

M. Moya

INTERÉS DE LA EVALUACIÓN DE LA T ARTERIAL EN LA EDAD PEDIÁTRICA

1. HTA afecta a 1000 millones de adultos en el mundo y la HTAS es creciente en > 60 años.

SPRINT Reseach Group, NEJM 2015.

2. HTA entre 67 factores de riesgo de muerte es el más importante ajustado a cualquier edad.

Lim SS Lancet 2013.

3. 'Blood pressure tracks from childhood into adulthood'

Mayo Clinic. Patient Care & Info 2015

ELEVACIÓN DE LA TENSIÓN ARTERIAL. CONCEPTOS

1. Hipertensión primaria en la niñez: es una elevación persistente de la T. arterial por encima del percentil 95 (o de un umbral cuantitativo) sin que se pueda identificar una causa.

Bucher BS Curr Hypertens Rep 2013.

2. **Prehipertensión:** elevación de la presión (S 120-139; D 89-99 mm Hg) no llegando a los umbrales de HTA.

La pre-HTA seguirá su curso a HTA a menos que cambie el estilo de vida.



THOMAS SYDENHAM XVII

‘A man is as old as his arteries’

Ateromatosis (atherosclerosis): depósito o placa de lípidos, colesterol...en la pared arterial. Su ruptura → oclusión, embolismo...

Arteriosclerosis (arterial stiffness): endurecimiento patológico (Lobstein 1833) y pérdida de la elasticidad. Nuevo concepto Early Vascular Ageing (P Nilsson 2009)

* Estimada por la velocidad de la onda de pulso ($> 10\text{m/s}$), ultrafast echo...

* Velocidad onda de pulso (PWV) medida en niños normo e hipertensos. (Bercu BB, J Pediatr 1979; Weberruss H, BMC Obesity 2016)

Intima-media thickness and arterial function in obese children

Weberruss H et al. BMC Obesity 2016; 3:2. doi 10.1186/ s40608

- Carotid IMT: US B-Mode
- Common Carotid Distensibility: US M-Mode
 - Arterial compliance
 - Elastic modulus
 - Stiffness index
 - Local pulse wave velocity

In conclusion: Obese children have stiffer arteries than controls. BMI > influenced negatively the above arterial stiffness parameters

HIPERTENSION Y VENTRÍCULO IZQUIERDO

- Huang J. et al. Changzhou People's Hospital

Hipertensión primaria:

Los pacientes presentan un índice de masa ventricular izquierda(>110 g/m²) y una función sistólica deteriorada con respecto al grupo control.

Medicine 2016; 95(2): 1-9

US STRUCTURAL MEASUREMENT AND LEFT VENTRICULAR FUNCTION IN OBESE CHILDREN. HUSJ



US TELESYSTOLIC/DIASTOLIC MEASUREMENTS AND LEFT VENTRICULAR FUNCTION IN OBESE CHILDREN (n=101) AND CONTROLS (n=38)

	OB	CONTR	P<
IV septum thickness (mm)	9.1	7.4	0.05
LV ED mm	43.3	39.4	0.05
LV mass height related (g)	38.5	32.8	0.05

HTA. FACTORES DE RIESGO

1. Generales (~Adulto)

- Consumo de sodio: 90% de niños (4-14 a) ingieren más de 1,5 g/d, DRI
CDC MMWR, Jan 2016
- Nivel socioeconómico: La T. arterial decrece con cada punto de incremento en la educación materna.
Apolonor study Eur J Pediatr 2015
- Riesgo cardiometabólico y severidad de la obesidad pediátrica
Skinner AC NEJM 2015
- Determinantes genéticos: polimorfismos del gen de MMP-9; -3 que degradan la elastina. Yasmin CM, Vascular Biology (2006) 2011

2. Específicos

HTA. FACTORES DE RIESGO

1. Generales (~Adulto)

2. Específicos

- Origen fetal: Rev sistemática de experimentación animal.

 - Subnutrición materna general Presión S >

 - Subnutrición materna general y proteica S y D >

 - van Abeelen AF. J Hypertension 2012

- Ganancia de peso postnatal

 - 0-6 m de vida IMC cada 1 Z-score implica 0,81 mm Hg (%95 IC; .15, 1.46)

 - 2-3 a de vida “ “ “ 1.61 mm Hg (%95 IC; 1.95-2.89)

Perng W. Hypertension AHA,2016

RIGIDEZ ARTERIAL Y OBESIDAD

Chicos y adolescentes obesos presentan circulación hiperkinética y vasodilatación (lo contrario de la rigidez arterial), pero:

disfunción endotelial (NO < ...)



remodelación de arteriolas



resistencia vascular (MMP-9; -3) >



HIPERTENSIÓN (rigidez arterial)

ESTUDIOS DE TA EN NIÑOS



No existe la concienciación debida

Efecto 'bata blanca' >

Frecuentes errores en la técnica



CRITERIO DE EVALUACIÓN DE LA T. A. ELEVADA EN N & A

Working Group on High Blood Pressure in C & A (Pediatrics 2004)

Los límites para TAS y D están referidos al género y a la altura (en lugar de la edad) y vienen referidos como percentiles 50, 90, 95 y >95.

Prehipertension: TAS ó D 90 y 95 centil

Hipertension: TAS ó D > 95 centil

(Requiere comprobar cada caso en 4 tablas)

A

Table 1. Blood-Pressure Thresholds Indicating the Need for Further Evaluation, Intervention, or Both.*

Years of Age	Boys		Girls		Boys and Girls	
	SBP	DBP	SBP	DBP	SBP	DBP
	mmHg				mmHg	
3	100	59	100	61	≥100	>60
4	102	62	101	64	≥100	>60
5	104	65	103	66	≥100	>60
6	105	68			≥105	>70
7	106	70			≥105	>70
8	107	71			≥105	>70
9	109	72	110	72	≥110	>75
10	111	73	112	73	≥110	>75
11	113	74	114	74	≥110	>75
12	115	74	116	75	≥115	>75
13	117	75	117	76	≥115	>75
14	120	75	119	77	≥115	>75
15	120	76	120	78	≥120	>80
16	120	78	120	78	≥120	>80
17	120	80	120	78	≥120	>80
≥18	120	80	120	80	≥120	>80

Ingelfinger JR.
NEJM 2014;370:2316-2325

BP TRACKING THROUGHOUT CHILDHOOD TO CHILDHOOD

24-h mean SBP tracks better than
casual readings.

O'sullivan JJ. J Hypertens 2000

Blood Pressure in Schoolchildren and Adolescents and its Variation according to Nutritional Status Evaluation: An Early Preventive Key for Obesity Comorbidities

Bosch VM, Moya M*, Espejo MP, Gutierrez J and Meca J

University of Murcia and University Miguel Hernández, Alicante, Spain

Table 1: Anthropometric data from 1347 children and adolescents according to age and gender (m ± SD).

AGE (Y)	BOYS				GIRLS			
	N	Weight (kg)	Height (cm)	BMI-Zs	N	Weight (Kg)	Height (cm)	BMI-Zs
6	48	26 ± 4.8	121.1 ± 5.1	0.959 ± 0.884	39	23.2 ± 4.1	118.1 ± 7.1	0.481 ± 0.970
7	74	29 ± 6.2	126.8 ± 5.2	0.874 ± 0.830	57	27.4 ± 6.2	123.4 ± 5.7	0.770 ± 0.865
8	67	32.6 ± 6.8	132.5 ± 6.5	0.860 ± 0.866	39	30.8 ± 6.2	130.6 ± 6.6	0.455 ± 1.56
9	51							0.05 ± 0.905
10	61							0.47 ± 1.22
11	62							0.94 ± 0.994
12	57							0.18 ± 0.931
13	62	56.9 ± 11	160.7 ± 8.6	0.771 ± 0.766	52	53.7 ± 9.8	156.2 ± 6.7	0.647 ± 0.862
14	79	59.6 ± 11.4	167 ± 6.6	0.375 ± 0.933	41	54.7 ± 6.6	159.3 ± 5.6	0.474 ± 0.547
15	58	63.7 ± 11.5	169.2 ± 6.7	0.447 ± 0.797	45	56.4 ± 9	159.6 ± 5.7	0.395 ± 0.769
16	33	67.2 ± 11.3	172.9 ± 6.8	0.322 ± 0.874	44	58 ± 7.1	161.8 ± 6.2	0.332 ± 0.637
17	55	69.4 ± 10.7	173.9 ± 6.2	0.282 ± 0.899	59	59 ± 110.6	161.6 ± 6.5	0.273 ± 0.701
18	26	71.9 ± 11.4	175.7 ± 8.3	0.193 ± 0.841	39	58.9 ± 8.5	161.7 ± 5.6	0.139 ± 0.868

**Datos muestrales y antropométricos:
1347 escolares (614 chicas) de 6-18 años**

Table 3: Nutritional status of the whole sample according to the BMI- Z score [15] with the absolute number and percentage for underweight, normal weight, overweight and obese.

	<p style="text-align: center;">NUTRITIONAL STATUS SUMMARY (1347 KIDS)</p> <p>Underweight 3.1 %</p> <p>Normal weight 67.8 %</p> <p>Overweight 17.6 %</p> <p>Obese 11.5 %</p>			
Underweight < -1 SD				
Normal weight -1 SD to +1 SD				
Overweight +1 SD to +2 SD				
Obese > +2SD	65 (21.6%)	32 (13.4%)	44 (10.2%)	18 (4.8%)
ALL	301 (100%)	238 (100%)	430 (100%)	375 (100%)

Blood Pressure in Schoolchildren and Adolescents and its Variation according to Nutritional Status Evaluation: An Early Preventive Key for Obesity Comorbidities

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Table 2; Systolic (SBP) and Diastolic Blood Pressure (DBP) of the whole sample (n= 1347) according to gender (m ± SD). The last two columns in each subgroup refer to the blood pressure values > 90th centile in children and adolescents whose height was on the 5th centile, i.e. the worst condition thus indicating further evaluation.

AGE (Y)	BOYS				GIRLS			
	SBP mmHg	DBP mmHg	SBP(P90)* mmHg	DBP(P90)* mmHg	SBP mmHg	DBP mmHg	SBP(P90)* mmHg	DBP(P90)* mmHg
6	104 ± 10	55 ± 14	105	68	102 ± 10	50 ± 14	104	68
7	104 ± 9							59
8	104 ± 10							71
9	109 ± 10							72
10	111 ± 10							73
11	113 ± 11							74
12	114 ± 10							75
13	123 ± 11							76
14	123 ± 10							77
15	125 ± 12							78
16	125 ± 11	61 ± 14	120	78	113 ± 8	63 ± 12	120	78
17	128 ± 12	62 ± 13	120	80	118 ± 9	64 ± 12	120	78
18	131 ± 13	67 ± 13	120	80	119 ± 11	68 ± 11	120	80

PREVALENCE OF PREHYPERTENSION (> 90 CENTILE)
 In the whole sample n= 1347 236 (15.7 %) for SBP
 88 (5.5 %) for DBP
 Overweight & obese n= 386 77 (20.0 %) for SBP
 35 (8.2 %) for DBP

* Kaelber, Pickett [24]

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6	104 ± 10	55 ± 14	105	68	102 ± 10	50 ± 14	104	68
7	104 ± 9							59
8	104 ± 10							71
9	109 ± 10							72
10	111 ± 10							73
11	113 ± 11							74
12	114 ± 10							75
13	123 ± 11							76
14	123 ± 10							77
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Blood Pressure in Schoolchildren and Adolescents as a Nutritional Status Evaluation: An Early Preventive Key for

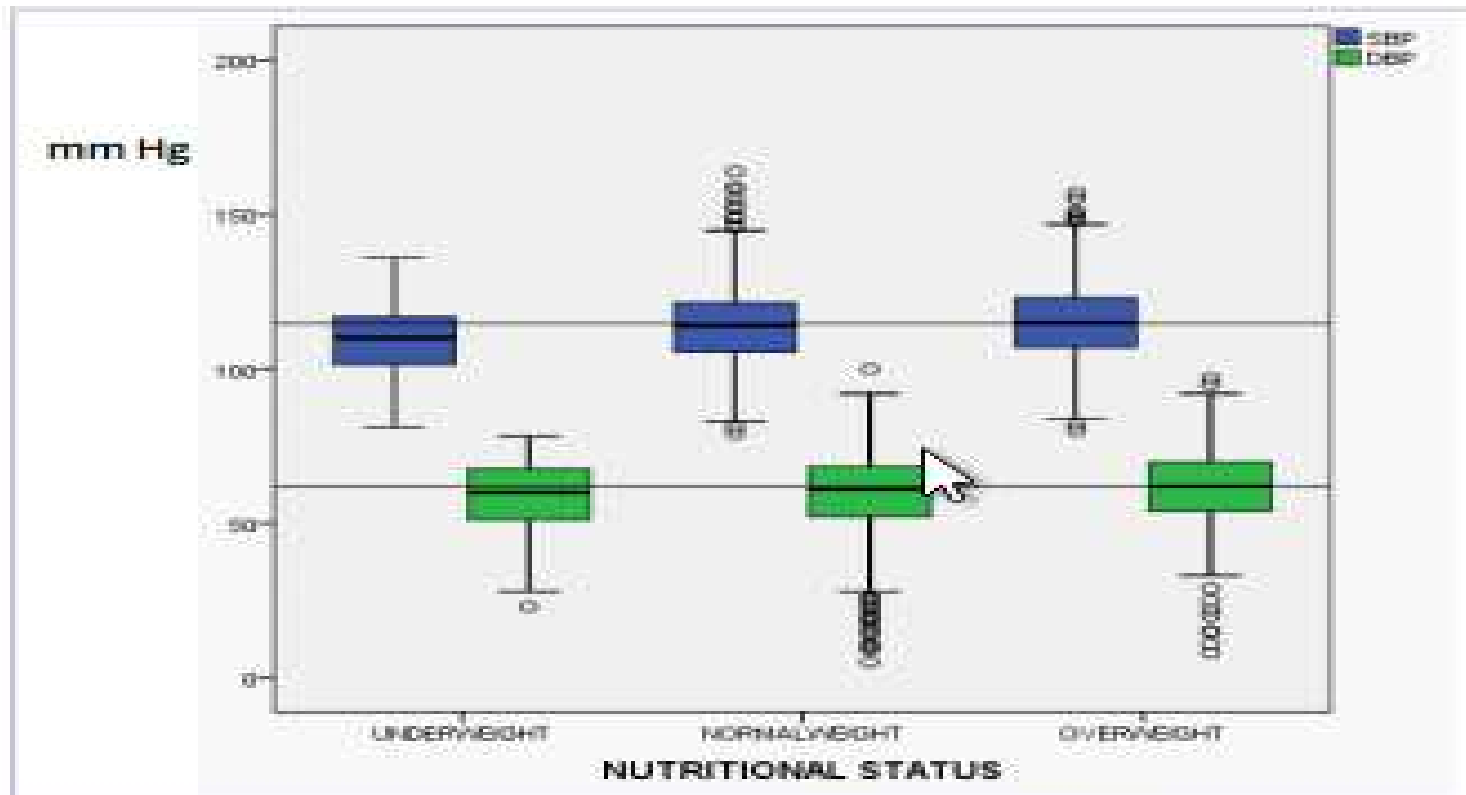


Figure 1: Whole sample box plot for SBP and DBP according to the nutritional status: Underweight, normal weight and overweight (comprises overweight and obese).

REGRESIÓN MÚLTIPLE

Table 4: Multiple regression analysis (Enter method) for SBP and DBP as dependent variables.

SBP				DBP			
Model	Beta	t	p	Model	Beta	t	p
(Constant)		26.142	0.000	(Constant)		9.408	0.000
Age	0.409	11.176	0.000	Age	0.189	4.192	0.000
Gender	-0.105	-4.586	0.000	Gender	0.119	4.161	0.000
Waist C.	0.272	6.426	0.000	Waist C.	0.137	2.608	0.009
BMI-Zs	0.000	0.002	0.998	BMI-Zs	0.022	0.480	0.631

Gender: 1-Male; 2-Female; Beta: standardized coefficient; t: Individual regression coefficient

BP TRACKING FROM CHILDHOOD TO ADULTHOOD

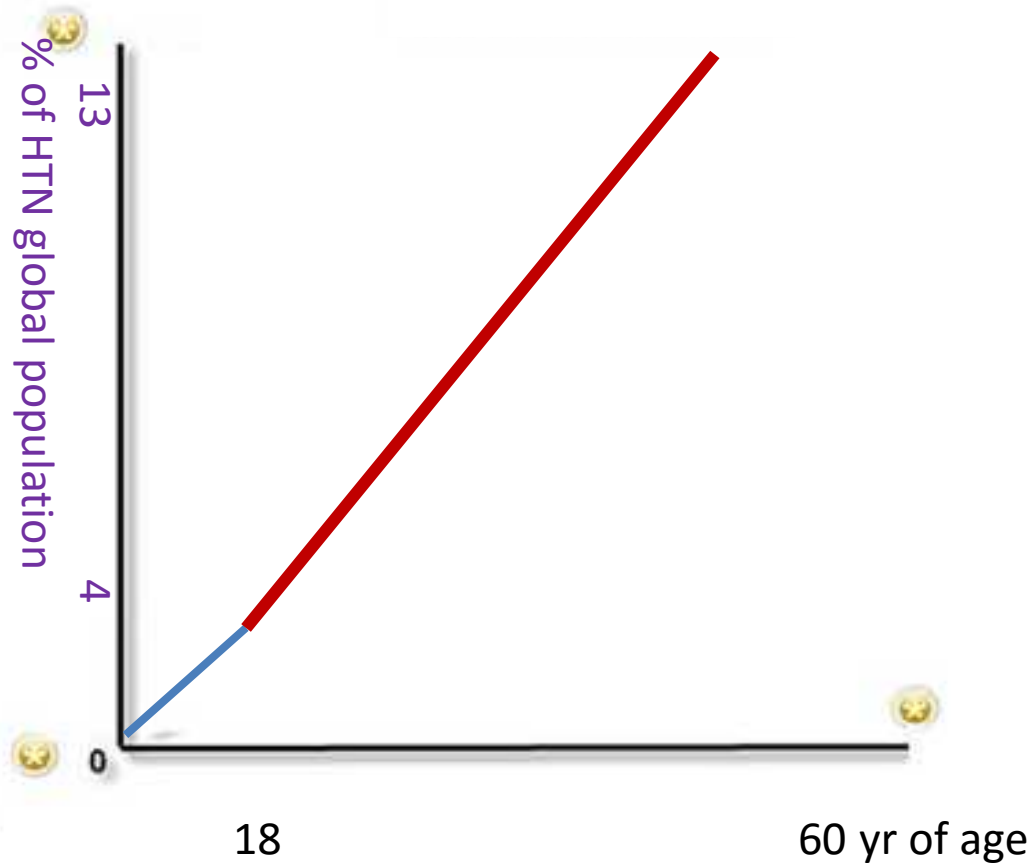
- Adult obesity has an increased risk for diabetes, hypertension, NAFLD...
- Hypertension is the most important CVD risk factor
- Childhood EBP (associated or not to obesity) tracks to adulthood

HTN TRACKING FROM CHILDHOOD

Basic Facts in Pediatric Ages

- Childhood EBP (associated or not to obesity) tracks to adulthood
- Pediatric HTN is closely related to BMI >
- BMI going down but SBP remains raised
- Prevention of obesity is not yet achieved
But could imply prevention of HTN

TRACKING FACTORS



- 1 BMI
- 2 Vegetables & fruits
- 3 Physical activity
- 4 Cardiorespiratory fitness
- 5 Alcohol consumption
- 6 Smoking
- 7 Socioeconomic status

Kelly RK, J Pediatr 2015

BP TRACKING not systematic review

Author Journal Year Follow-up(yr) N° patients

Parker FD Pediatrics 2016 3 101606

Kelly RK J Pediatr 2015 20 798

Kagura J BMC Pediatr 2015 20 3273

Lee MH Yousey Med J 2014 24 266

Johnson W Arterioscler 2014 60 1300

Miersch A Pediatr N 2013 6 13260

Toschke A Acta Pediatr 2010 10 27820

Li Z Hyperten R 2009 15 547

Berenson GS Am J Med 1989 Retrospective after CVD deaths

SUMMARY OF BP TRACKING not systematic review

Support for BP Tracking:

- 148870 children & adolescents
- 19.8 yr follow-up (3-60 yr)

Not in Favor


- Chiolerio A. JAMA Pediatr 2013. Review
- Lloyd LJ. Int J Obes 2010. Review

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Table 5: Different prevalence rates of nutritional status for the same population when evaluated through different methods: CDC- Zs; CDC (LMS) - Zs [15] and IOTF-Cole curves [16].

	BOYS (n = 734)			GIRLS (n= 613)		
	BMI zs CDC	BMI zs LMS CDC	IOTF	BMI zs CDC	BMI zs LMS CDC	IOTF
Under weight	2.9	3.7	1.9	3.4	5.7	3.1
Normal weight	65.1	59.7	63.6	71.7	64.5	67.9
Over weight	17	30.4	24.9	16.8	27.4	22.8
Obese	14.9	6.1	9.5	8.1	2.4	6.2
ALL	100			100		



Crump C et al. Low stress resilience in adolescence is linked to HTN in adulthood.
Heart 2016:

- Suecia, 1,5 millones de A. incorporados entre 1969-97 y estudiados en 2012
- La baja resistencia al stress es un riesgo de HTA: HR 1,43; IC 95% 1,40- 1,46

MUCHAS GRACIAS

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