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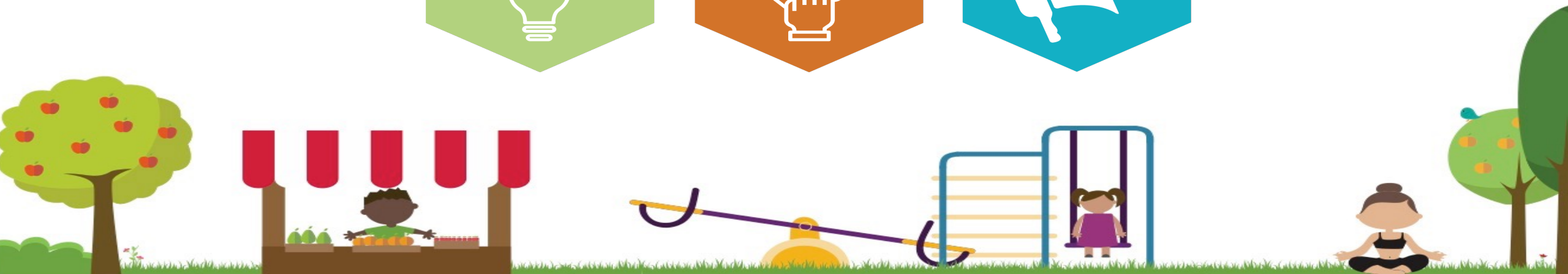

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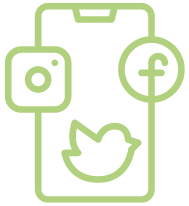

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Epidemiology, Human Genetics, and Environmental Sciences

Youth/Child Cardiovascular and Environmental Health: Perspectives from South America

Sept. 6, 2023
11 AM-12 PM CST

SPEAKER

Augusto César Ferreira De Moraes, PhD, MSc Augusto.DeMoraes@uth.tmc.edu
Assistant Professor, Epidemiology, Human Genetics & Environmental Sciences
UTHealth Houston School of Public Health in Austin

UTHealth
The University of Texas Health Science Center at Houston
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👨🏽‍⚕️ No conflict of interest to declare.

👨🏽‍⚕️The views and opinions expressed in this webinar are mine and do not necessarily reflect the views or positions of any entities I represent.

Austin, Sep 5th, 2023.

Summary

① Cardiovascular Health Epidemiology;

A. Prevalence in South America

B. Associations with Lifestyle and Environmental Factors

② Cardiovascular Health in Pediatrics

A. Methods to Evaluate

③ SAYCARE Study

④ Future and Challenges

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Cardiovascular Epidemiology

MORTALITY

- Cardiovascular Disease
  - 48.3% ➔ MALE
  - 51.7% ➔ FEMALE

- Cancer
  - 13% ➔ MALE
  - 11% ➔ FEMALE

Seshasai SR, et al. *N Engl J Med;* 2022.

Roger VL, et al. *Circulation*, 2022.

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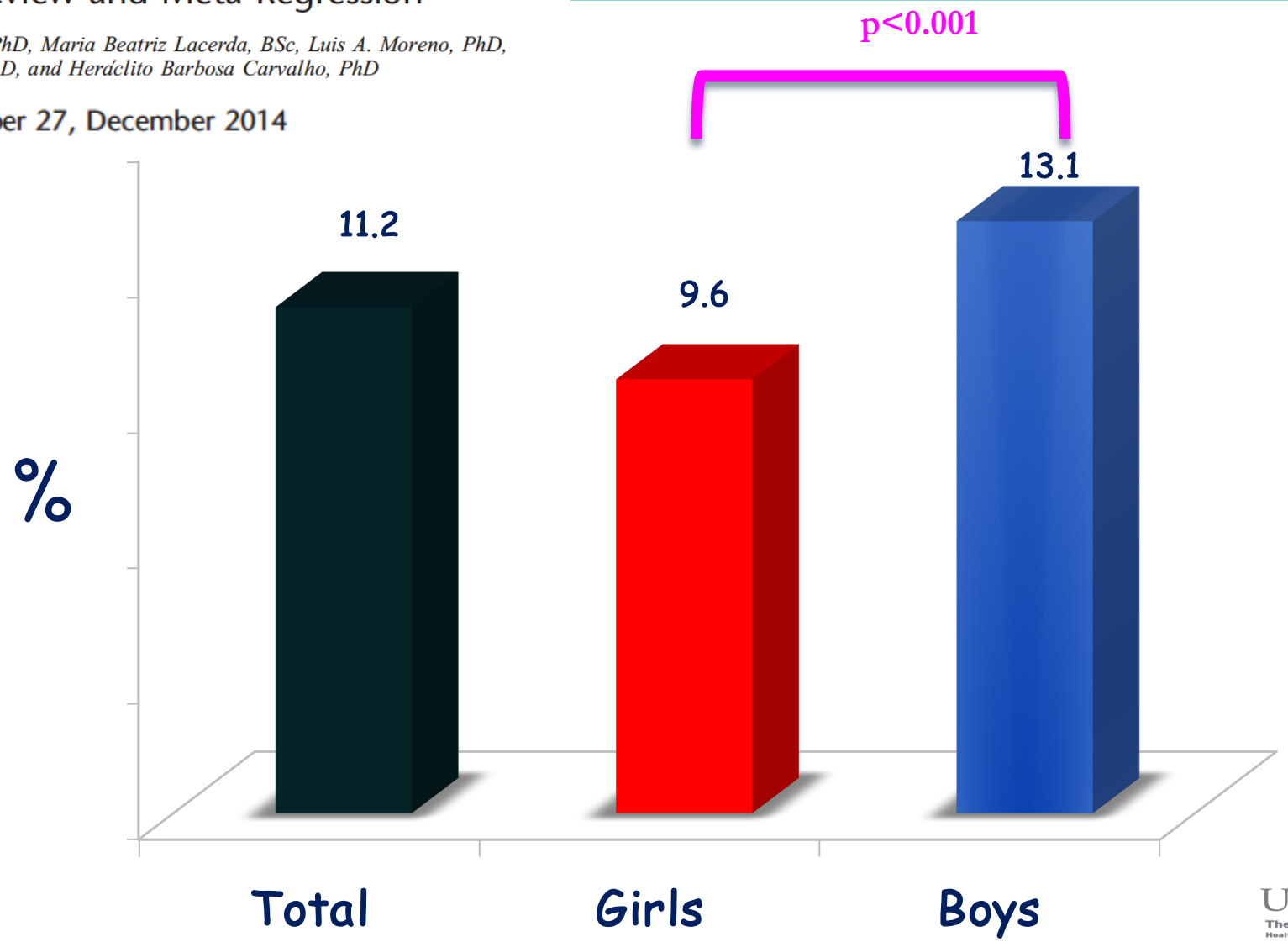
Cardiovascular Epidemiology

Prevalence of High Blood Pressure in 122,053 Adolescents: A Systematic Review and Meta-Regression

Augusto César Ferreira de Moraes, PhD, Maria Beatriz Lacerda, BSc, Luis A. Moreno, PhD, Bernardo L. Horta, PhD, and Heráclito Barbosa Carvalho, PhD

Medicine • Volume 93, Number 27, December 2014



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Prevalence of High Blood Pressure in 122,053 Adolescents: A Systematic Review and Meta-Regression

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Medicine • Volume 93, Number 27, December 2014

META-REGRESSION

Independents Variables	Boys Adjusted Model	Total Adjusted Model
Characteristic of countries		
Higher income	Ref	Ref
Low-and-middle income	1.66 (0.44 ; 2.88)	0.23 (0.76 ; 1.23)
Method of measured BP		
Sphygmomanometer	Ref	Ref
Digital monitor	0.72 (0.67 ; 0.77)	-0.09 (-0.17 ; -0.02)

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Cardiovascular Epidemiology

Journal of Human Hypertension (2013), 1–4
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www.nature.com/jhh

ORIGINAL ARTICLE

Prevalence of cardiovascular risk factors among Latin American adolescents: a multilevel analysis

ACF de Moraes[1,2,3,4,5], C Musso[6], MN Graffigna[6], J Soutelo[6], M Migliano[6], HB Carvalho[2,8] and G Berg[6,7,8]

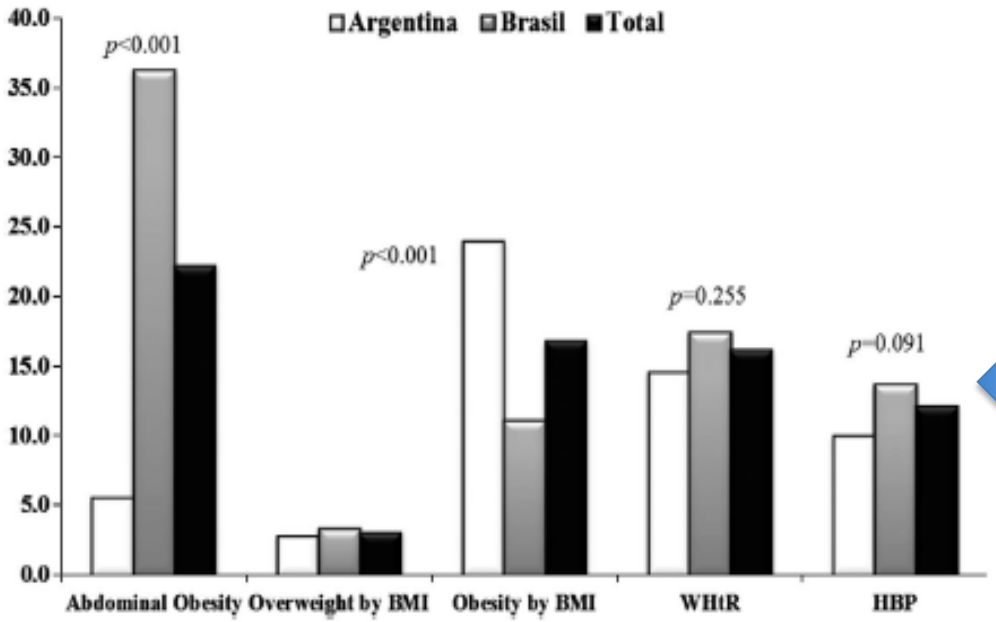

Figure 1. Prevalence of cardiovascular risk factors according to country for girls.

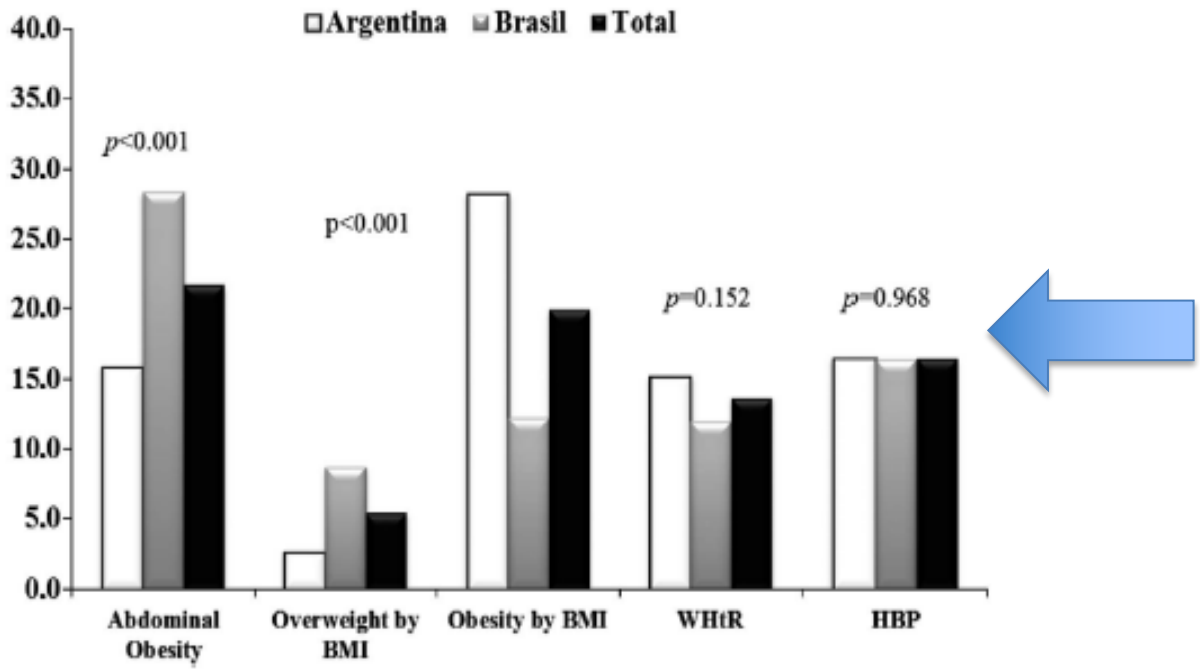

Figure 2. Prevalence of cardiovascular risk factors according to country for boys.

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Association with Lifestyle behavior

OPEN ACCESS Freely available online

PLOS ONE

Independent and Combined Effects of Physical Activity and Sedentary Behavior on Blood Pressure in Adolescents: Gender Differences in Two Cross-Sectional Studies

Augusto César Ferreira de Moraes[1,2,3,19]*, Heráclito Barbosa Carvalho[1], Juan Pablo Rey-López[1,3], Luis Gracia-Marco[3,16], Laurent Beghin[5,17], Anthony Kafatos[6], David Jiménez-Pavón[3,7], Dénes Molnar[8], Stefaan De Henauw[9], Yannis Manios[10], Kurt Widhalm[11], Jonatan R. Ruiz[7,12], Francisco B. Ortega[7,12], Michael Sjöström[12], Angela Polito[13], Raquel Pedrero-Chamizo[14], Ascensión Marcos[15], Frederic Gottrand[5,17], Luis A. Moreno[3,4,18]

OBJECTIVE: To examine the independent and combined association of PA and SB on both systolic (SBP) and diastolic blood pressure (DBP) in adolescents from two observational studies.

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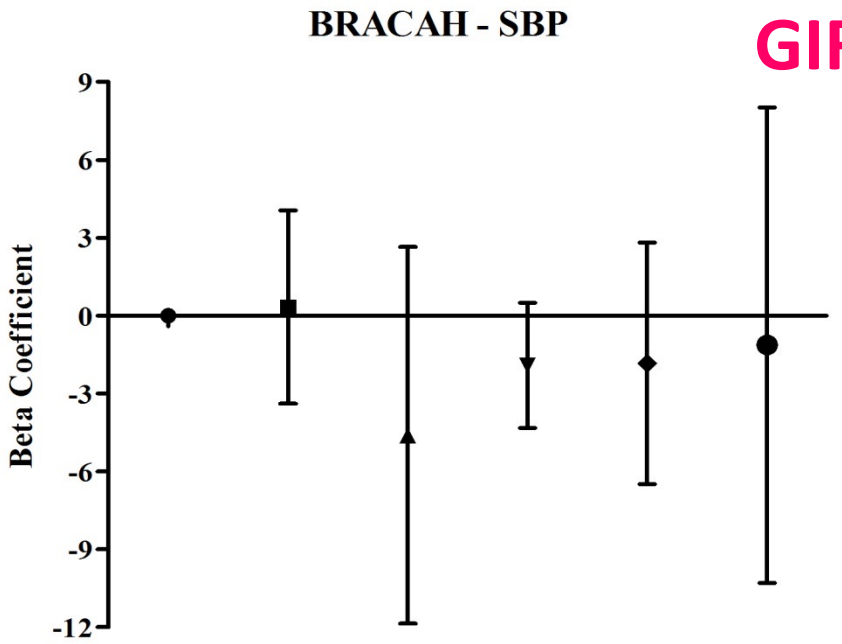
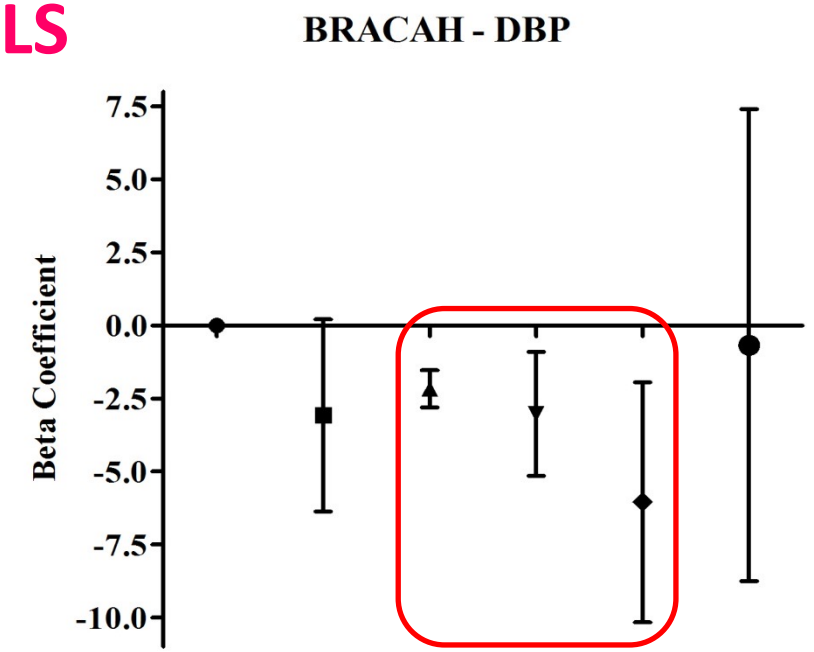
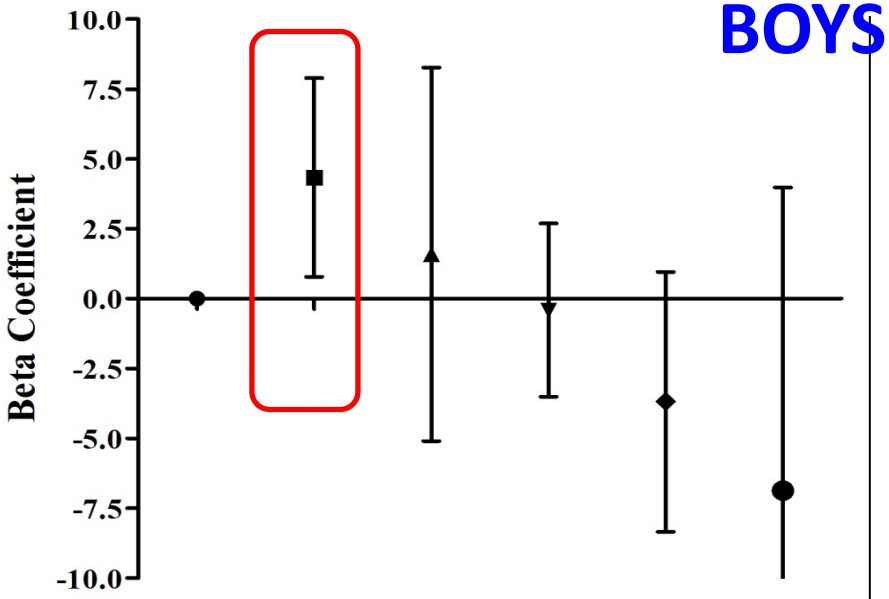
Association with Lifestyle behavior

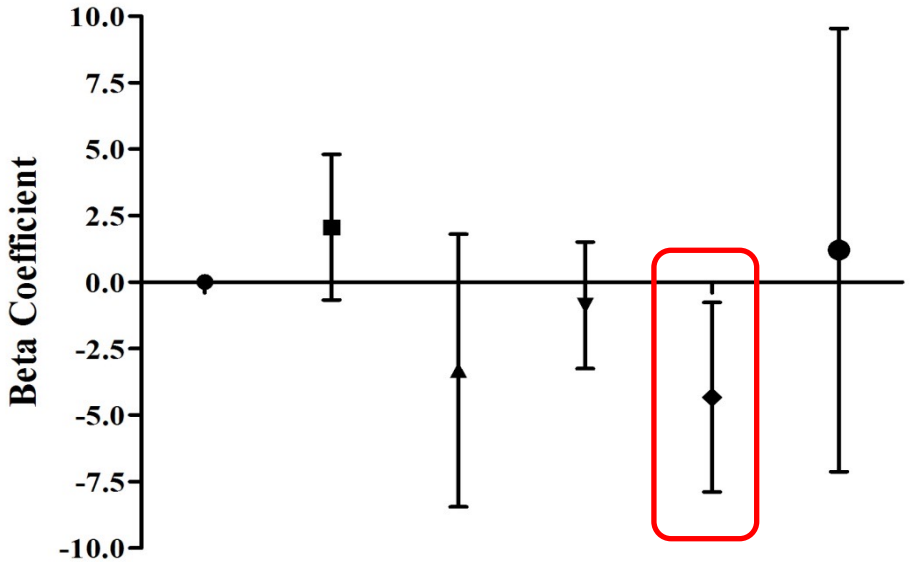


GIRLS



BOYS





- ● < 60 min/d + > 4 h/d
- ■ < 60 min/d + 2 - 4 h/d
- ▲ < 60 min/d + < 2 h/d

- ▼ ≥ 60 min/d + > 4 h/d
- ◆ ≥ 60 min/d + 2 - 4 h/d
- ● ≥ 60 min/d + < 2 h/d

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Your zip code is more important than your gene code.

Ana Diez-Roux, MD, PhD

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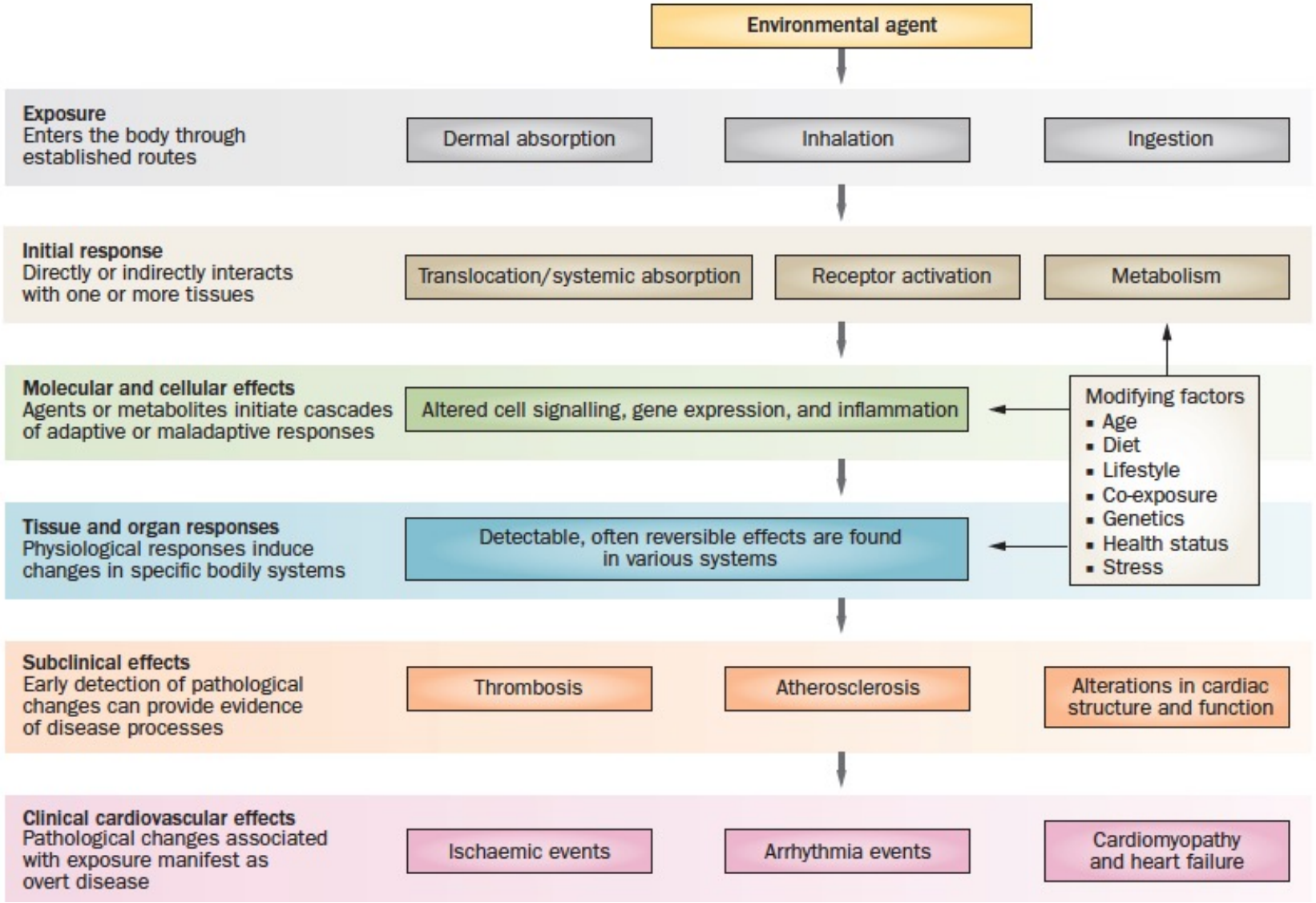
Framework



Cosselman, K. E. et al. Nat. Rev. Cardiol. 12, 627–642 (2015)

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Association with Environmental Factors

Direct observations

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Association with Environmental Factors

Direct observations

Air pollutant	No. of estimates	Sample size	Countries spanned	I^2	P egger	SBP (mmHg) with 95% CI
Short-term effects						
PM10	3	195634	2	95.99%	0.796	0.267(0.033,0.501)
Long-term effects						
NO2	6	15408	9	43.09%	0.160	0.754(0.541,0.968)
PM2.5	7	66102	9	0.00%	0.353	1.809(0.962,2.655)
PM10	8	137865	10	91.50%	0.380	0.526(0.095,0.958)

Huang M, et al. J Am Heart Assoc. 2021 May 18;10(10):e017734

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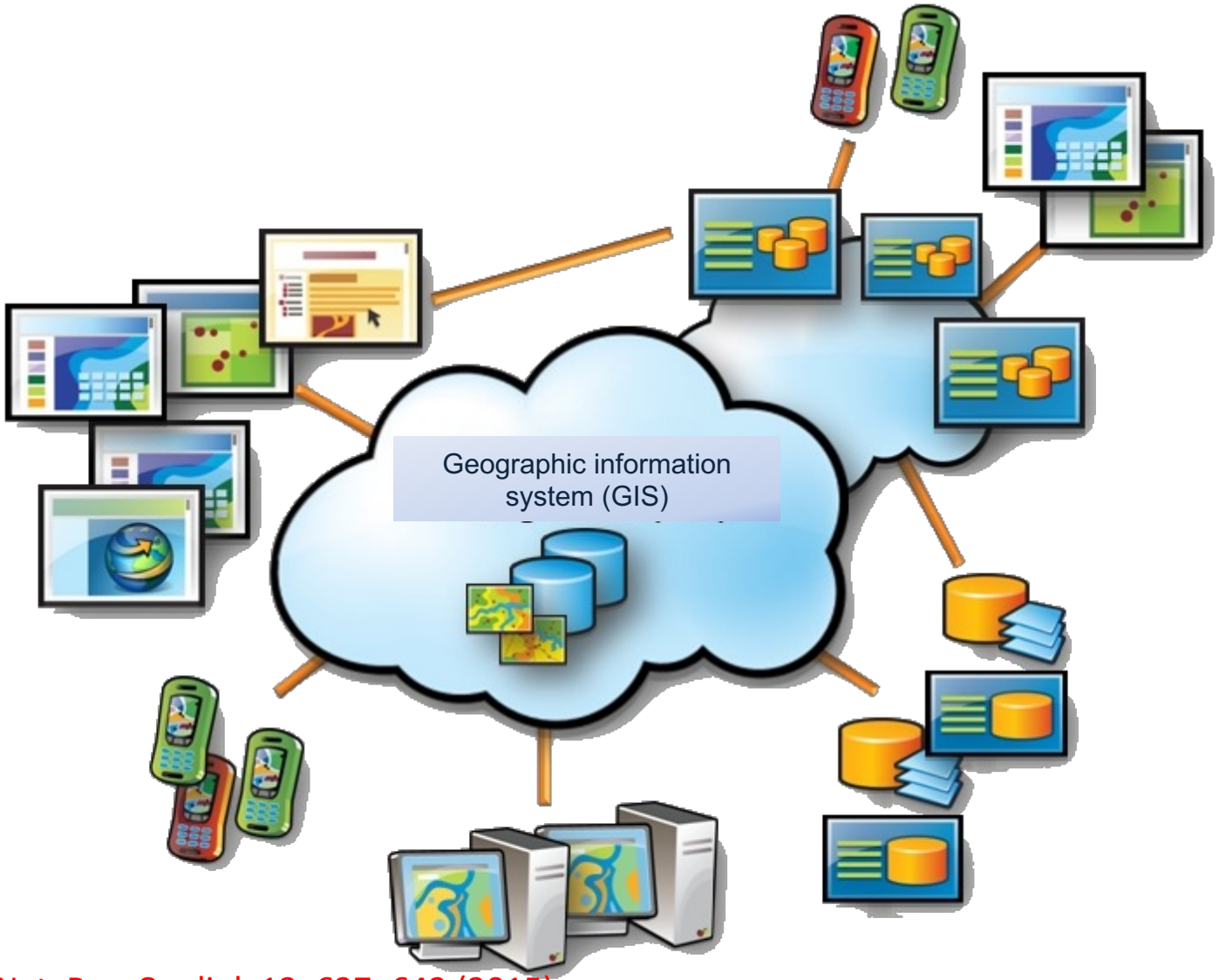
Association with Environmental Factors

◇ GIS



Cosselman, K. E. et al. Nat. Rev. Cardiol. 12, 627–642 (2015)

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Association with Environmental Factors

- **GIS**

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Association with Environmental Factors

Questionnaire

Characteristics of the school food environment associated with hypertension and obesity in Brazilian adolescents: a multilevel analysis of the Study of Cardiovascular Risks in Adolescents (ERICA)

Table 3 Association between contextual and individual characteristics of the school food environment and hypertension in school-going adolescents aged 12–17 years. Study of Cardiovascular Risks in Adolescents (ERICA), Brazil, 2013–2014

	Crude analysis		Model 1		Model 2		Model 3	
Characteristic	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
Contextual level								
Offer of meals prepared on the school premises								
No	Ref.							
Yes	1·07	0·81, 1·42						
Sale of foods at school								
No	Ref.							
Yes	0·91	0·63, 1·31						
Advertisement of industrialized foods at school								
No	Ref.		Ref.					
Yes	0·66*	0·43, 1·03	0·69	0·45, 1·06				
Sale of food in the school's immediate vicinity								
No	Ref.		Ref.				Ref.	
Yes	0·70**	0·53, 0·93	0·70**	0·51, 0·95			0·67**	0·48, 0·95
Individual level								
Consumption of meals prepared on the school premises								
No	Ref.				Ref.		Ref.	
Yes	0·81**	0·71, 0·93			0·80**	0·70, 0·92	0·79**	0·69, 0·92
Purchase of foods at the school cafeteria								
No	Ref.				Ref.		Ref.	
Yes	1·33***	1·15, 1·55			1·28**	1·11, 1·48	1·29**	1·11, 1·49

Gonçalves VSS, et al. PubHealth Nutr (2020)

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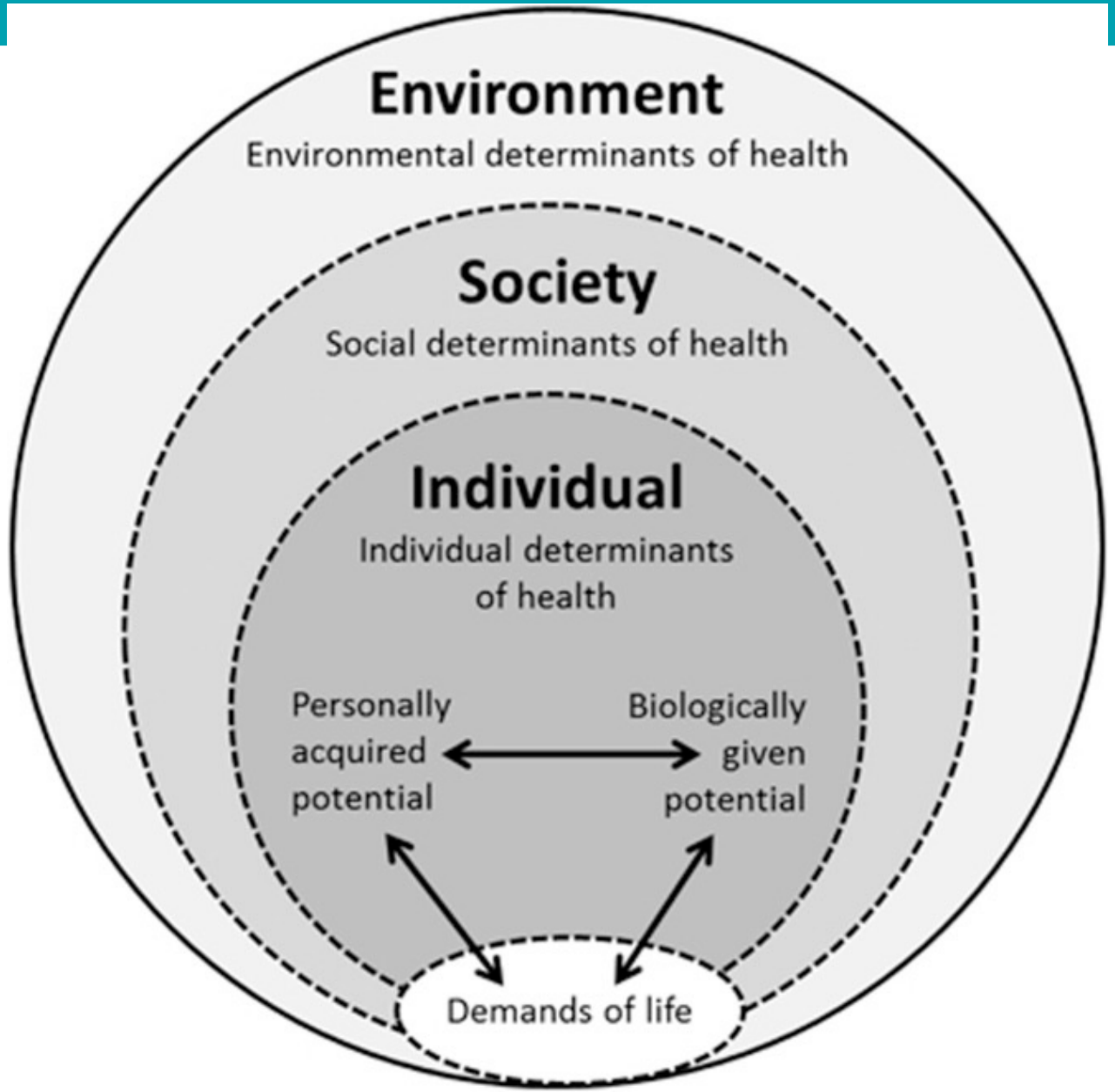
Environmental & CVH ➔ Challenges



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Aim

1) To estimate the Prevalence of Life Essential 8 ® proposed by AHA;

2) To identify the mediator/modifier effects of environmental, socioeconomic, and behavioral variables on the longitudinal pattern of this outcome.

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① New frontiers in pediatric nutritional and cardiovascular health: methods development to assess the double burden of malnutrition in low-in-middle income countries - SAYCARE cohort study;

YCARE Research Group
Youth/Child cArdiovascular Risk and Environmental Research Group

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① New frontiers in pediatric nutritional and cardiovascular health: methods development to assess the double burden of malnutrition in low-in-middle income countries - SAYCARE cohort study;

2019

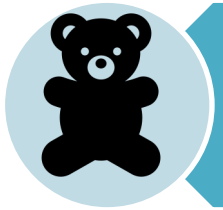
6 schools
188 children

2021

2 schools
149 children

2022

6 schools
199 children



536 children

YCARE Research Group
Youth/Child cArdiovascular Risk and Environmental Research Group

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Research projects in development

- **Mainly Outcome**
  - ✓ Life's Essential 8® (score and definitions)

AHA PRESIDENTIAL ADVISORY *Lloyd-Jones DM, et al. Circulation, 2022.*

Life's Essential 8: Updating and Enhancing the American Heart Association's Construct of Cardiovascular Health: A Presidential Advisory From the American Heart Association

Donald M. Lloyd-Jones, MD, ScM, FAHA, Chair; Norrina B. Allen, PhD, MPH, FAHA; Cheryl A.M. Anderson, PhD, MPH, MS, FAHA; Terrie Black, DNP, MBA, CRRN, FAHA; LaPrincess C. Brewer, MD, MPH; Randi E. Foraker, PhD, MA, FAHA; Michael A. Grandner, PhD, MTR, FAHA; Helen Lavretsky, MD, MS; Amanda Marma Perak, MD, MS, FAHA; Garima Sharma, MD; Wayne Rosamond, PhD, MS, FAHA; on behalf of the American Heart Association

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Measurement Methods

- **Health behaviors**
  - Physical activity moderate-vigorous intensity
  - Sleep Time
  - Health Eating Pattern
  - Smoking Behavior

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Measurement Methods

◇ Health behaviors

- Physical activity moderate-vigorous intensity:

Points	Minutes
100	≥420
90	360–419
80	300–359
60	240–299
40	120–239
20	1–119
0	0

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Measurement Methods

◇ Health behaviors

😴 Sleep Time

- 🛏 Age 6 to 12 years, 9 to 12 hours;
- 🛏 Age 13 to 18 years, 8 to 10 hours.

Points	Level
100	Age-appropriate optimal range
90	<1 h above optimal range
70	<1 h below optimal range
40	1–<2 h below or ≥1 h above optimal
20	2–<3 h below optimal range
0	≥3 h below optimal range

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Measurement Methods

◇Health behaviors

Health Eating Pattern: DASH(Dietary Approaches to Stop Hypertension)

Component	Foods (NHANES 24 hour recall)	Scoring Criteria	Note
Fruits	All fruits and fruit juices	Quintile 1: 1 point Quintile 2: 2 points Quintile 3: 3 points Quintile 4: 4 points Quintile 5: 5 points	Higher score represents more ideal intake Quintile 1 is lowest consumption and Quintile 5 is highest consumption
Vegetables	All vegetables except potatoes and legumes		
Nuts and Legumes	Nuts and peanut butter, dried beans, peas, tofu		
Whole Grains	Brown rice, dark breads, cooked cereal, whole grain cereal, other grains, popcorn, wheat germ, bran		
Low-fat Dairy	Skim milk, yogurt, cottage cheese		
Sodium	Sum of sodium content of all foods reported as consumed	Quintile 1: 5 points Quintile 2: 4 points Quintile 3: 3 points Quintile 4: 2 points Quintile 5: 1 point	Reverse scoring as higher quintiles represent less ideal intake Quintile 1 is lowest consumption and Quintile 5 is highest consumption
Red and Processed Meats	Beef, pork, lamb, deli meats, organ meats, hot dogs, bacon		
Sweetened beverages	Carbonated and noncarbonated sweetened beverages		

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Measurement Methods

◇ Health behaviors

- Health Eating Pattern: DASH(Dietary Approaches to Stop Hypertension)

Quantiles of DASH-style diet adherence or HEI-2015 (population) or MEPA (individuals)*; ages 2–19 y (see Supplemental Material for younger ages)

Scoring (population):

Points	Quantile
100	≥95th percentile (top/ideal diet)
80	75th–94th percentile
50	50th–74th percentile
25	25th–49th percentile
0	1st–24th percentile (bottom/least ideal quartile)

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Measurement Methods

◇ Health behaviors

Smoking Behavior

Scoring:

Points	Status
100	Never tried
50	Tried any nicotine product, but >30 d ago
25	Currently using inhaled NDS
0	Current combustible use (any within 30 d)

Subtract 20 points (unless score is 0) for living with active indoor smoker in home

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Measurement Methods

◇ Health factors

- Body mass index (kg/m^2)
- Blood pressure
- Blood lipids
- Blood glucose

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Measurement Methods

◇ Health factors

⚖ Body mass index (kg/m^2)

- BMI percentiles for age and sex

Points	Level
100	5th–<85th percentile
70	85th–<95th percentile
30	95th percentile–<120% of the 95th percentile
15	120% of the 95th percentile–<140% of the 95th percentile
0	≥140% of the 95th percentile

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Measurement Methods

◇ Health factors

Blood pressure

Metric: Systolic and diastolic BP (mmHg) percentiles for age through 12 y. For age ≥13 y, use adult scoring. Screening should start no later than age 3 y and earlier per clinician discretion

Scoring:

Points	Level
100	Optimal (<90th percentile)
75	Elevated (≥90th–<95th percentile or ≥120/80 mmHg to <95th percentile, whichever is lower)
50	Stage 1 hypertension (≥95th–<95th percentile+12 mmHg, or 130/80 to 139/89 mm Hg, whichever is lower)
25	Stage 2 hypertension (≥95th percentile+12 mmHg, or ≥140/90 mmHg, whichever is lower)
0	Systolic BP ≥160 or ≥95th percentile+30 mmHg systolic BP, whichever is lower; and/or diastolic BP ≥100 or ≥95th percentile+20 mmHg diastolic BP

Subtract 20 points if treated level

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Measurement Methods

◇Health factors

Blood pressure

TABLE 3. BP Levels for Boys by Age and Height Percentile

Age, y	BP Percentile	SBP, mm Hg							DBP, mm Hg						
		Percentile of Height							Percentile of Height						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
1	50th	80	81	83	85	87	88	89	34	35	36	37	38	39	39
	90th	94	95	97	99	100	102	103	49	50	51	52	53	53	54
	95th	98	99	101	103	104	106	106	54	54	55	56	57	58	58
	99th	105	106	108	110	112	113	114	61	62	63	64	65	66	66
2	50th	84	85	87	88	90	92	92	39	40	41	42	43	44	44
	90th	97	99	100	102	104	105	106	54	55	56	57	58	58	59
	95th	101	102	104	106	108	109	110	59	59	60	61	62	63	63
	99th	109	110	111	113	115	117	117	66	67	68	69	70	71	71
3	50th	86	87	89	91	93	94	95	44	44	45	46	47	48	48
	90th	100	101	103	105	107	108	109	59	59	60	61	62	63	63
	95th	104	105	107	109	110	112	113	63	63	64	65	66	67	67
	99th	111	112	114	116	118	119	120	71	71	72	73	74	75	75
4	50th	88	89	91	93	95	96	97	47	48	49	50	51	51	52
	90th	102	103	105	107	109	110	111	62	63	64	65	66	66	67
	95th	106	107	109	111	112	114	115	66	67	68	69	70	71	71
	99th	113	114	116	118	120	121	122	74	75	76	77	78	78	79
5	50th	90	91	93	95	96	98	98	50	51	52	53	54	55	55
	90th	104	105	106	108	110	111	112	65	66	67	68	69	69	70
	95th	108	109	110	112	114	115	116	69	70	71	72	73	74	74
	99th	115	116	118	120	121	123	123	77	78	79	80	81	81	82
6	50th	91	92	94	96	98	99	100	53	53	54	55	56	57	57
	90th	105	106	108	110	111	113	113	68	68	69	70	71	72	72
	95th	109	110	112	114	115	117	117	72	72	73	74	75	76	76
	99th	116	117	119	121	123	124	125	80	80	81	82	83	84	84

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Measurement Methods

◇ Health factors

Blood lipids

Metric: Non–HDL cholesterol (mg/dL), starting no later than age 9–11 y and earlier per clinician discretion

Scoring:

Points	Level
100	<100
60	100–119
40	120–144
20	145–189
0	≥190

If drug-treated level, subtract 20 points

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Measurement Methods

◇Health factors

Blood glucose

Metric: FBG (mg/dL) or HbA1c (%), symptom-based screening at any age or risk-based screening starting at age ≥10 y of age or onset of puberty per clinician discretion

Scoring:

Points	Level
100	No history of diabetes and FBG <100 (or HbA1c < 5.7)
60	No diabetes and FBG 100–125 (or HbA1c 5.7–6.4) (prediabetes)
40	Diabetes with HbA1c <7.0
30	Diabetes with HbA1c 7.0–7.9
20	Diabetes with HbA1c 8.0–8.9
10	Diabetes with Hb A1c 9.0–9.9
0	Diabetes with HbA1c ≥10.0

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SAYCARE Cardiovascular Epidemiology

Table. Sociodemographic, behavioral, and clinical characteristics by biological sex, SAYCARE Study.

VARIABLES	Female n= 268			Male n= 246		
	Mean or %	(CI 95%)		Mean or %	(CI 95%)	
Age (years)	6.9	(6.9;	7.1)	7.0	(6.8;	7.1)
Physical activity (≥ 60 minutes of moderate or vigorous activity per week)	17.5	(14.3;	21.4)	19.3	(16.2;	22.9)
Mediterranean food pattern (0-16 points)	**4.9**	**(4.7**	**5.1)**	**5.3**	**(5.2**	**5.5)**
Sleep health (9-11 hours a night)	49.4	(44.8;	54.1)	49.2	(45.0;	53.3)
Body Mass Index (BMI) (kg/m2)	18.70	(18.30;	19.11)	18.57	(18.26;	18.87)
Non-HDL cholesterol (mg/dL)	158.68	(155.75;	161.62)	156.58	(154.16;	159.00)
Fasting blood glucose (mg/dL)	5.15	(5.12;	5.18)	5.16	(5.12;	5.19)
Systolic Blood Pressure (mm Hg)	**102.4**	**(101.4;**	**103.3)**	**103.8**	**(102.8;**	**104.7)**
Diastolic blood pressure (mm Hg)	60.4	(59.5;	61.1)	60.0	(59.3;	60.7)
Health Behaviors 1 (0-100 points)	**65.1**	**(63.3**	**66.8)**	**67.5**	**(66.1**	**68.9)**
Health Factors 2 (0-100 points)	**73.7**	**(72.6**	**74.8)**	**76.1**	**(75.3**	**76.9)**
Cardiovascular Health - overall 3 (0-100 points)	**71.0**	**(70.0**	**72.0)**	**73.6**	**(72.8**	**74.4)**
Cardiovascular Health - Categories						
Low CVH (0 to 49)	2.7	(1.6;	4.8)	1.1	(0.5;	2.5)
Moderate CVH (50 to 79)	70.6	(66.2;	74.7)	64.9	(60.8;	68.9)
High CVH (Score 80 to 100)	**26.7**	**(22.7;**	**31.0)**	**34.0**	**(30.1;**	**38.1)**

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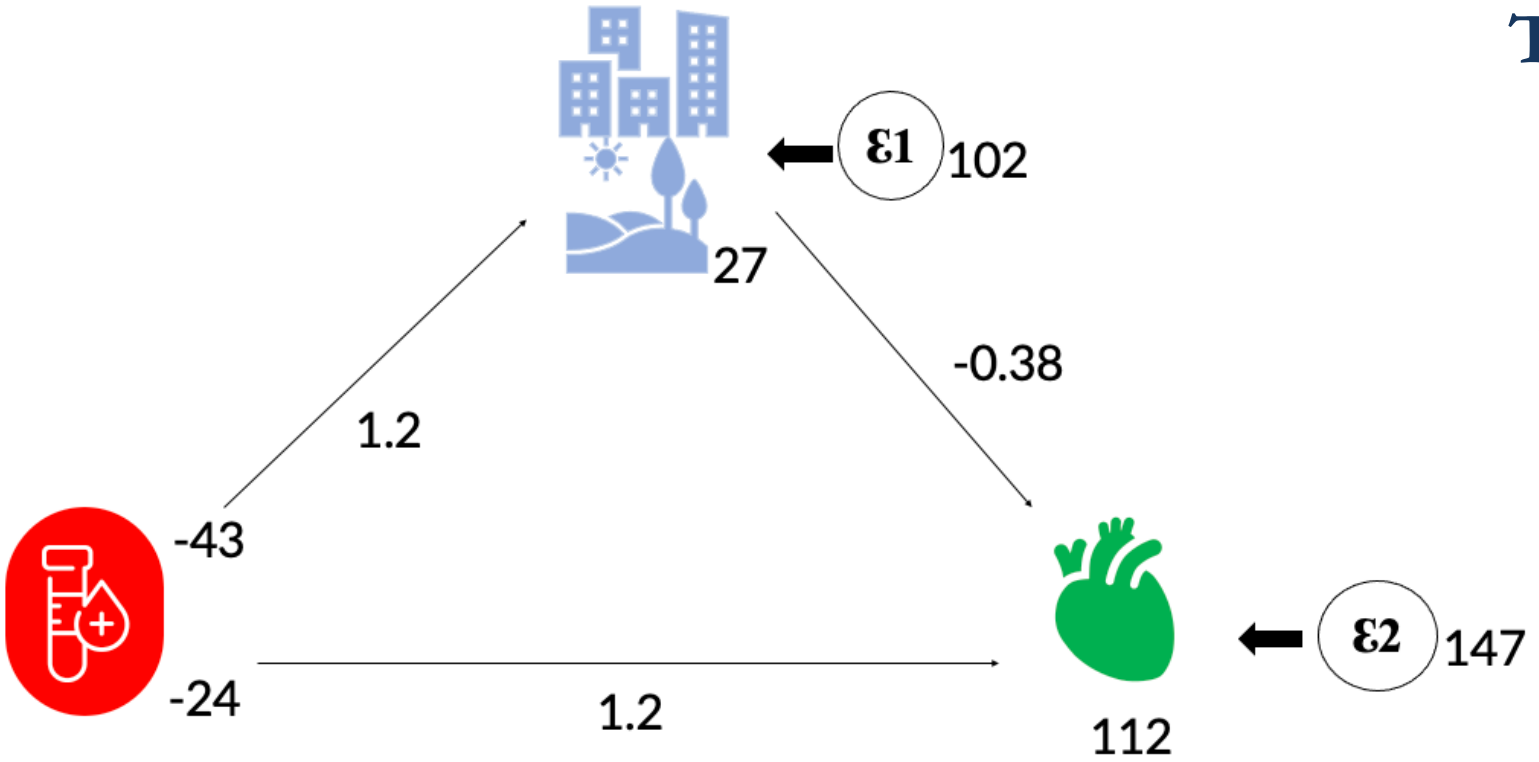
SAYCARE Cardiovascular Epidemiology



Multiple mediation analyzes of the association between serum iron and overall cardiovascular health mediated by environmental factors in children, SAYCARE Study.

The result indicates that these environmental factors are mediating, or influencing, up to 12.9% of the association between serum iron and cardiovascular health.

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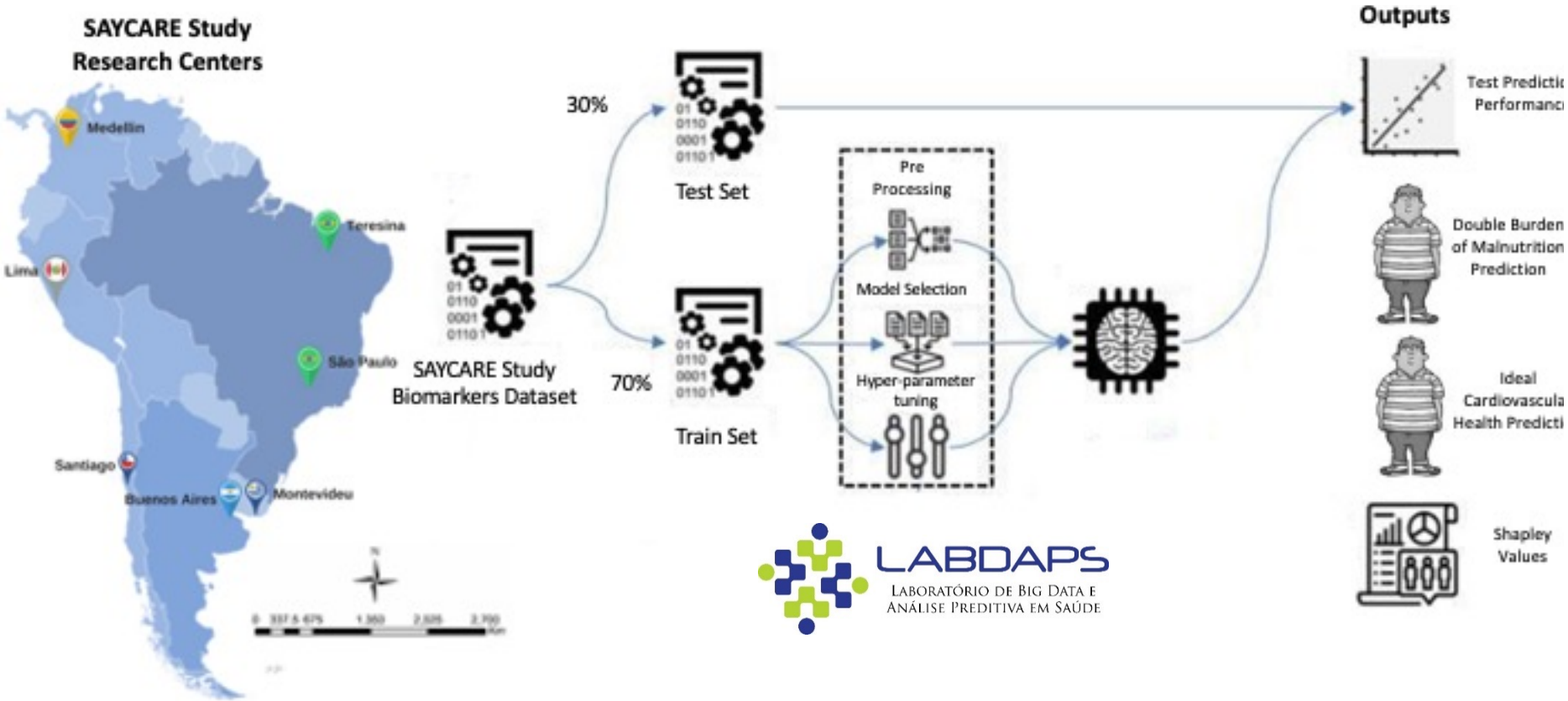
Future & Challenges

Machine learning applications for an early prediction of the double burden of malnutrition and markers of ideal cardiovascular health



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Collaboration with FSPUSP

LABDAPS
LABORATÓRIO DE BIG DATA E ANÁLISE PREDITIVA EM SAÚDE

Dr. Alexandre Chiavegatto Filho

Dr. Tiago Almeida de Oliveira

Mateus Silva Rocha

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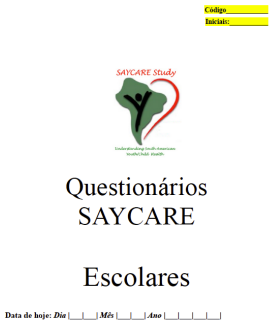
Predictors



- Biological Sex
- Sedentary Behavior and Time
- Sleep Time and Quality
- Food intake, food preferences and choices
- Bike Paths and Side Walks
- Mother Weight

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Exposures

- Socioeconomic status
- Parental education level
- Active Commuting by Bike
- Soft drink and Water drink

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Machine Learning Approach

- We propose to test the predictive performance of algorithms for structured data (using the one-versus-all) multiclass classification method: **random forest, quadratic discriminant analysis, extra trees classifier, light gradient boosting machine, catboost, gradient boosting trees, extreme gradient, boosting, k-nearest neighbours, decision trees and ada boost.**

- We will use area under receiver operating characteristic (AUROC) to compare predictive performance across different machine learning classification techniques. Plotting the False Positive Rate (FPR) on the x-axis against the True Positive Rate (TPR) on the y-axis yields the AUROC.

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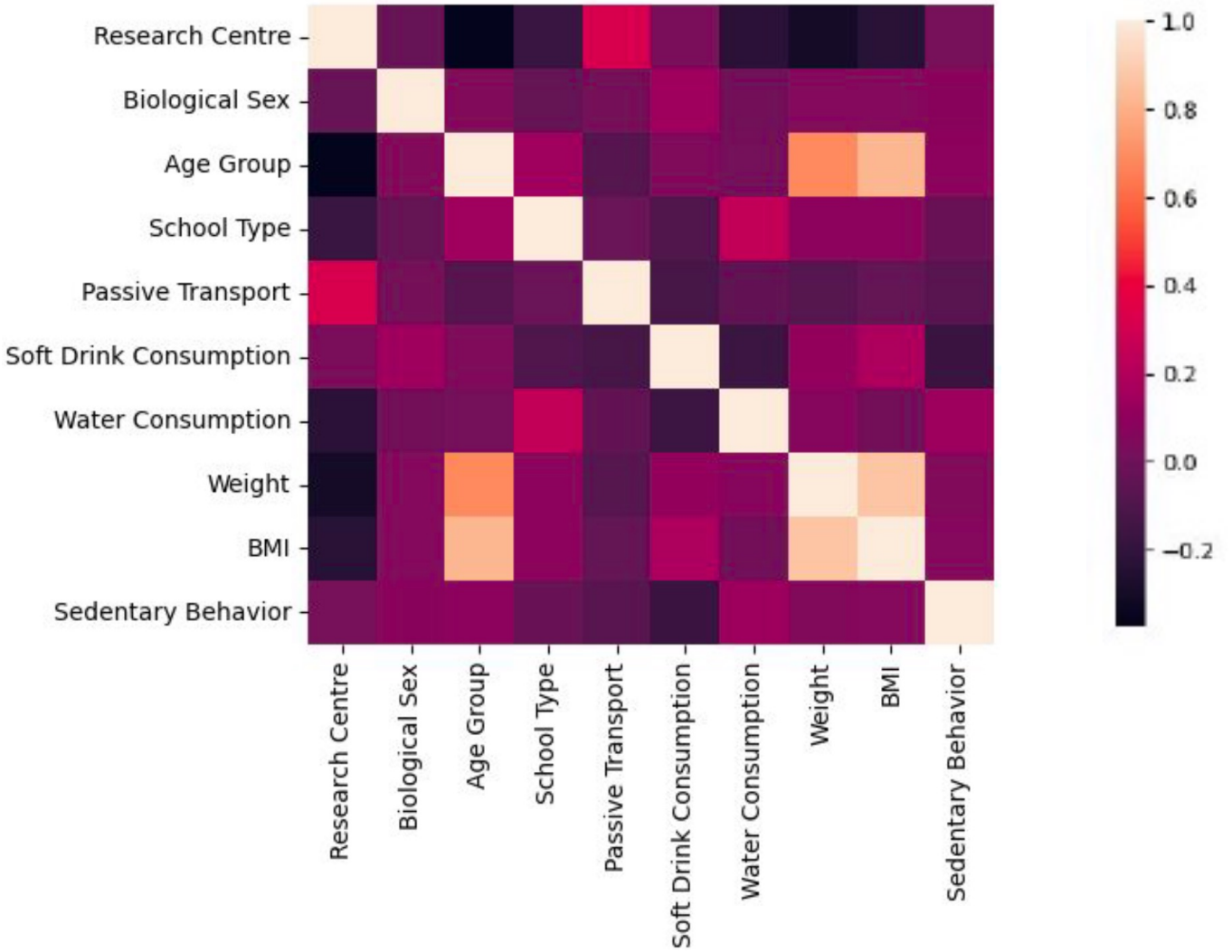
Machine Learning Approach



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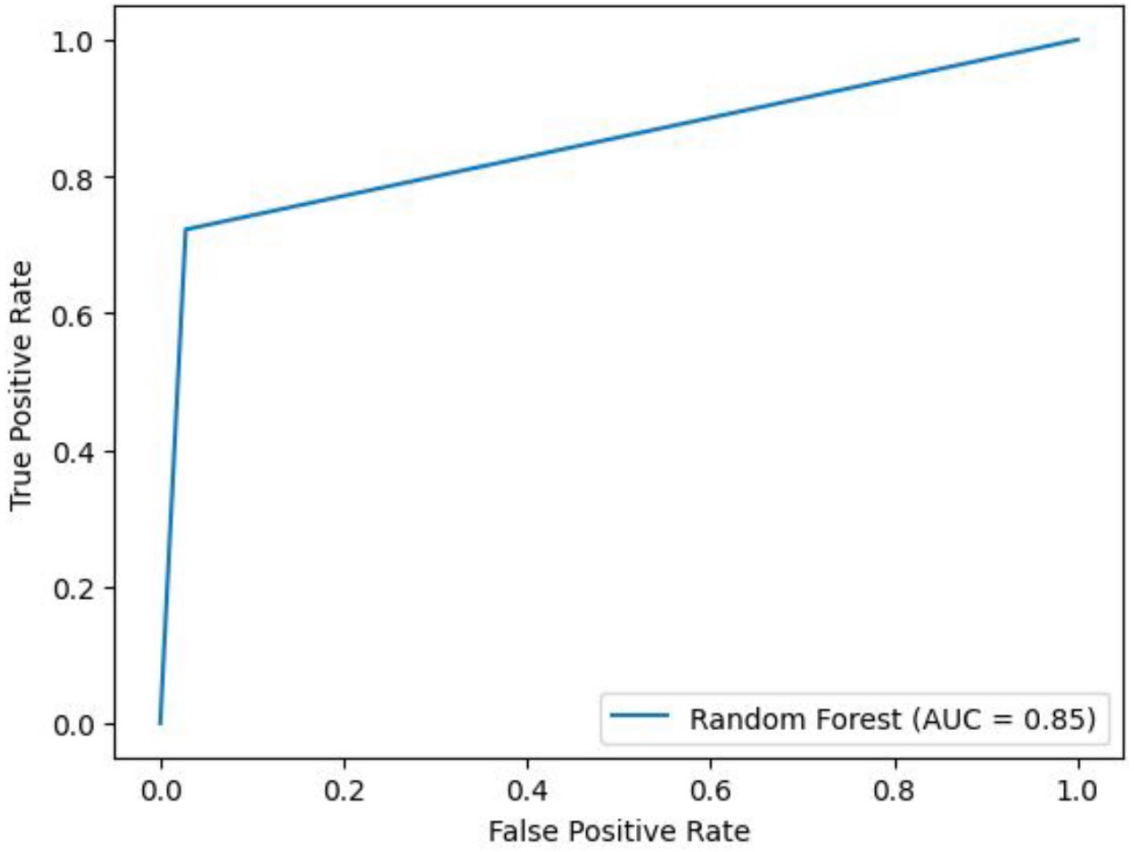
Machine Learning Approach

	Analysis		
Models	**Precision**	**Recall**	**F1**
Random Forest	0,92	0,92	0,91
KNN	0,69	0,76	0,72
SVM	0,81	0,81	0,75
LGBM	0,89	0,89	0,89
XGB	0,91	0,91	0,91



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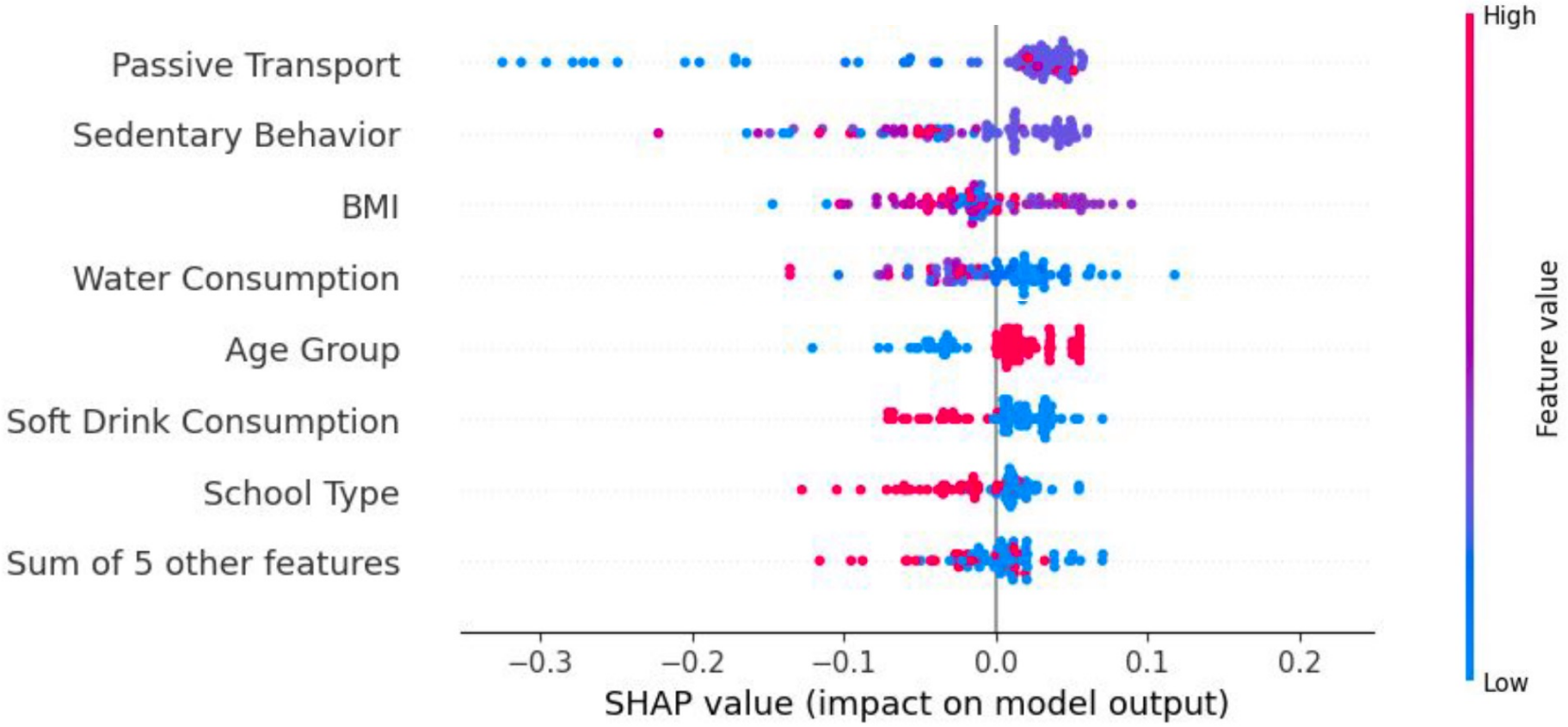
Machine Learning Approach



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Conclusion

- The worldwide prevalence of HBP is high (>10%) in adolescents and is higher in developing countries; methodology influences its prevalence;

- The performance of ≥ 60 min of physical activity per day helps to control blood pressure and reduces the effects of sedentary behavior and genes associated with elevated blood pressure;

- AHA classification “Life Essential 8®” is useful for measuring Cardiovascular health in the pediatric population;

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Conclusion

- Latin American children present moderate Cardiovascular health based on LE8®;
- Environmental factors mediate the association between iron serum profile and LE8®;
- Machine Learning approach is useful for predicting LE8® in the South American pediatric population without clinical information

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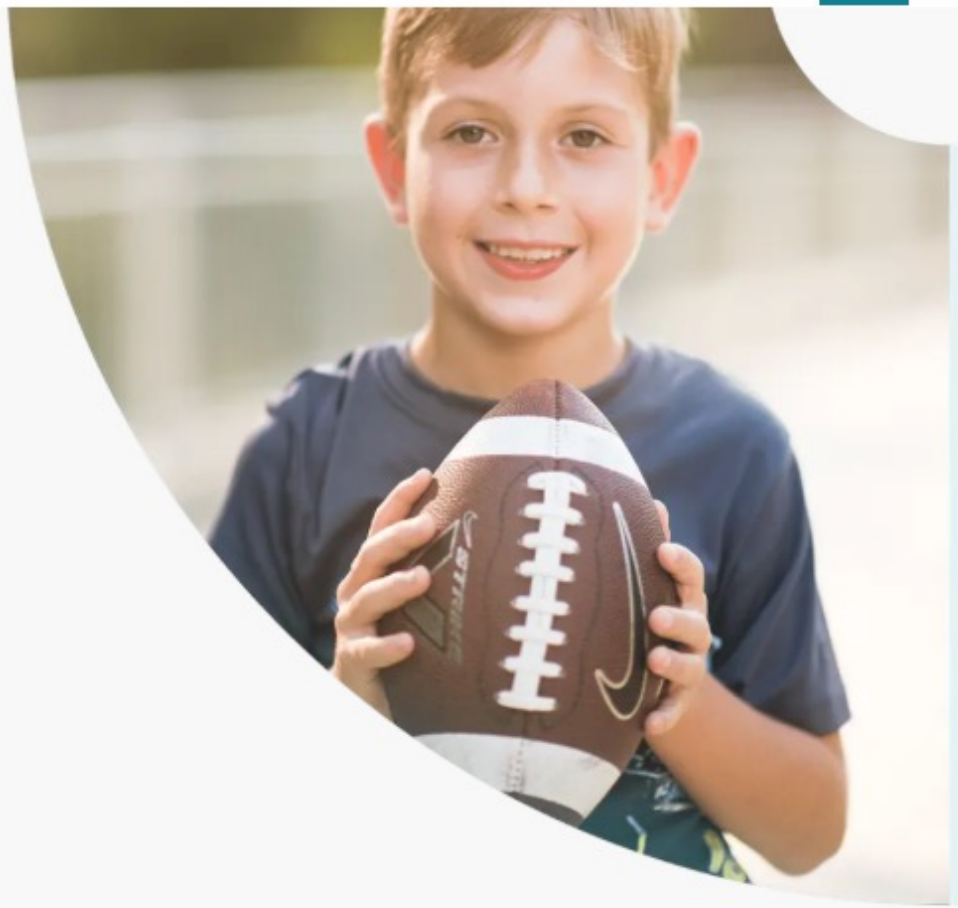

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