DATA 608 Final Project Proposal Percentile of Blood Pressure in Children and Adolescents

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Background

- Hypertension standards for adult are well known for a few decades. However, we are still lack of golden standards for children and adolescence because their blood pressure change according to their gender, age and height. Because of the development of a large national database on normative BP levels throughout childhood, the ability to identify children who have abnormally elevated BP has improved.

- Big data such as National Health and Nutrition Examination Survey (NHANES) have been added to the childhood BP database, and the BP data have been reexamined. The blood pressure are categorized in 50th, 90th, 95th, and 99th percentiles by gender, age, and height.

- Hypertension in children and adolescents continues to be defined as systolic BP (SBP) and/or diastolic BP (DBP) ≥95th percentile. BP between the 90th and 95th percentile in childhood had been designated “high normal.” To be consistent with the Seventh Report of the Joint National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7), this level of BP will now be termed “prehypertensive” and is an indication for lifestyle modifications.

- So it is important to have a completed percentile blood pressure data in children and adolescent. However, Interpreting blood pressure measurements for children is complicated by the need to account for a constantly changing body size. It is time-consuming to calculate and/or do data entry, yet assessment of blood pressure percentiles is medically recommended from the age of 3 onward because 75% of cases of pediatric hypertension and 90% of cases of prehypertension in children from 3 to 18 years of age go undetected. So I am going to develop an shiny BP perentiles app reads a child’s systolic and diastolic blood pressure percentiles normalized by age, sex, and height

DATABASE

LMS Parameter DATABASE for Height (CDC)

https://www.cdc.gov/growthcharts/percentile_data_files.htm

	Sex <int>	Agemos <dbl>	L <dbl>	M <dbl>	S <dbl>	P3 <dbl>	P5 <dbl>	P10 <dbl>	P25 <dbl>
1	1	24.0	0.9415240	86.45220	0.04032153	79.91084	80.72977	81.99171	84.10289
2	1	24.5	1.0072081	86.86161	0.04039563	80.26037	81.08868	82.36401	84.49471
3	1	25.5	0.8372514	87.65247	0.04057753	81.00529	81.83445	83.11387	85.25888
4	1	26.5	0.6814930	88.42326	0.04072312	81.73416	82.56406	83.84716	86.00517
5	1	27.5	0.5387797	89.17549	0.04083319	82.44846	83.27899	84.56534	86.73507
6	1	28.5	0.4076972	89.91041	0.04090906	83.14945	83.98045	85.26962	87.44977

6 rows | 1-10 of 14 columns

P3 <dbl>	P5 <dbl>	P10 <dbl>	P25 <dbl>	P50 <dbl>	P75 <dbl>	P90 <dbl>	P95 <dbl>	P97 <dbl>
79.91084	80.72977	81.99171	84.10289	86.45220	88.80525	90.92619	92.19688	93.02265
80.26037	81.08868	82.36401	84.49471	86.86161	89.22805	91.35753	92.63177	93.45923
81.00529	81.83445	83.11387	85.25888	87.65247	90.05675	92.22966	93.53407	94.38278
81.73416	82.56406	83.84716	86.00517	88.42326	90.86260	93.07608	94.40885	95.27762
82.44846	83.27899	84.56534	86.73507	89.17549	91.64711	93.89827	95.25754	96.14512
83.14945	83.98045	85.26962	87.44977	89.91041	92.41159	94.69757	96.08149	96.98663

6 rows | 7-15 of 14 columns

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summary(h)
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      Sex          Agemos            L                 M               S          
 Min.   :1.0   Min.   : 24.0   Min.   :-0.3909   Min.   : 84.98   Min.   :0.03964  
 1st Qu.:1.0   1st Qu.: 77.5   1st Qu.: 0.4165   1st Qu.:118.22   1st Qu.:0.04077  
 Median :1.5   Median :132.0   Median : 0.9025   Median :143.71   Median :0.04378  
 Mean   :1.5   Mean   :132.0   Mean   : 0.8085   Mean   :140.12   Mean   :0.04405  
 3rd Qu.:2.0   3rd Qu.:186.5   3rd Qu.: 1.1725   3rd Qu.:162.95   3rd Qu.:0.04663  
 Max.   :2.0   Max.   :240.0   Max.   : 2.2358   Max.   :176.85   Max.   :0.05056  
       P3               P5              P10              P25              P50        
 Min.   : 78.44   Min.   : 79.26   Min.   : 80.52   Min.   : 82.64   Min.   : 84.98  
 1st Qu.:108.50   1st Qu.:109.71   1st Qu.:111.57   1st Qu.:114.71   1st Qu.:118.22  
 Median :130.59   Median :132.22   Median :134.68   Median :138.93   Median :143.71  
 Mean   :128.58   Mean   :130.02   Mean   :132.24   Mean   :135.96   Mean   :140.12  
 3rd Qu.:150.67   3rd Qu.:152.21   3rd Qu.:154.59   3rd Qu.:158.56   3rd Qu.:162.95  
 Max.   :163.33   Max.   :165.04   Max.   :167.66   Max.   :172.02   Max.   :176.85  
      P75              P90              P95              P97        
 Min.   : 87.31   Min.   : 89.41   Min.   : 90.66   Min.   : 91.48  
 1st Qu.:121.77   1st Qu.:125.00   1st Qu.:127.02   1st Qu.:128.37  
 Median :148.56   Median :152.98   Median :155.66   Median :157.40  
 Mean   :144.29   Mean   :148.06   Mean   :150.32   Mean   :151.79  
 3rd Qu.:167.36   3rd Qu.:171.30   3rd Qu.:173.67   3rd Qu.:175.21  
 Max.   :181.65   Max.   :185.96   Max.   :188.53   Max.   :190.19  
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```{r}
boxplot(h,xlab="variables")
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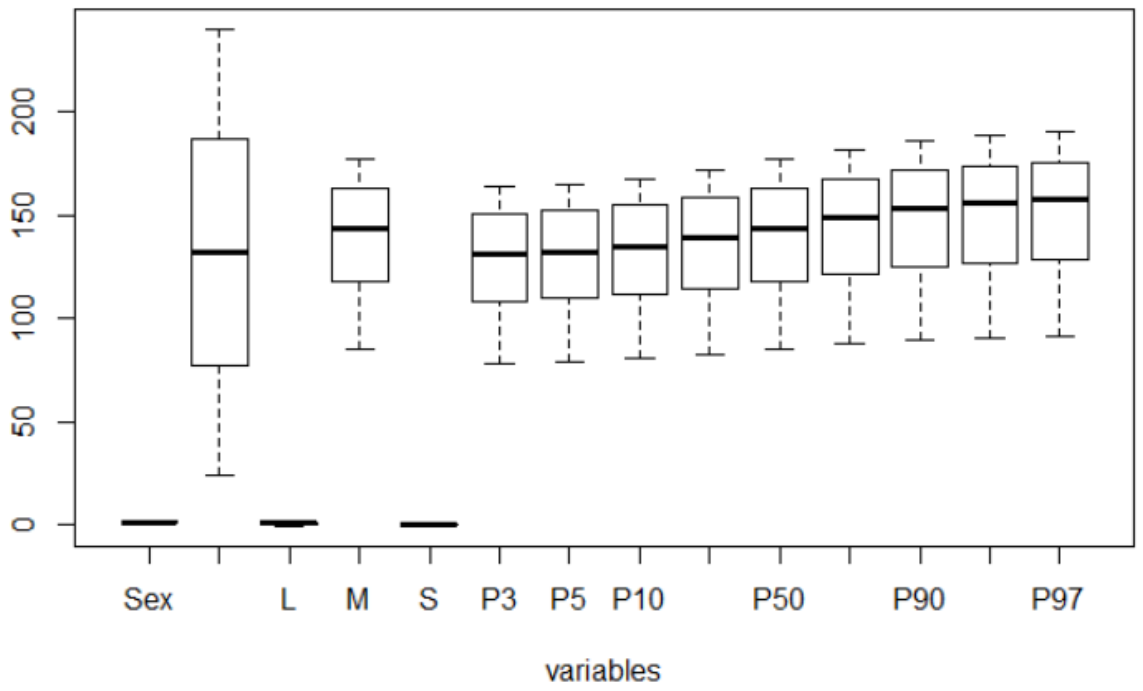
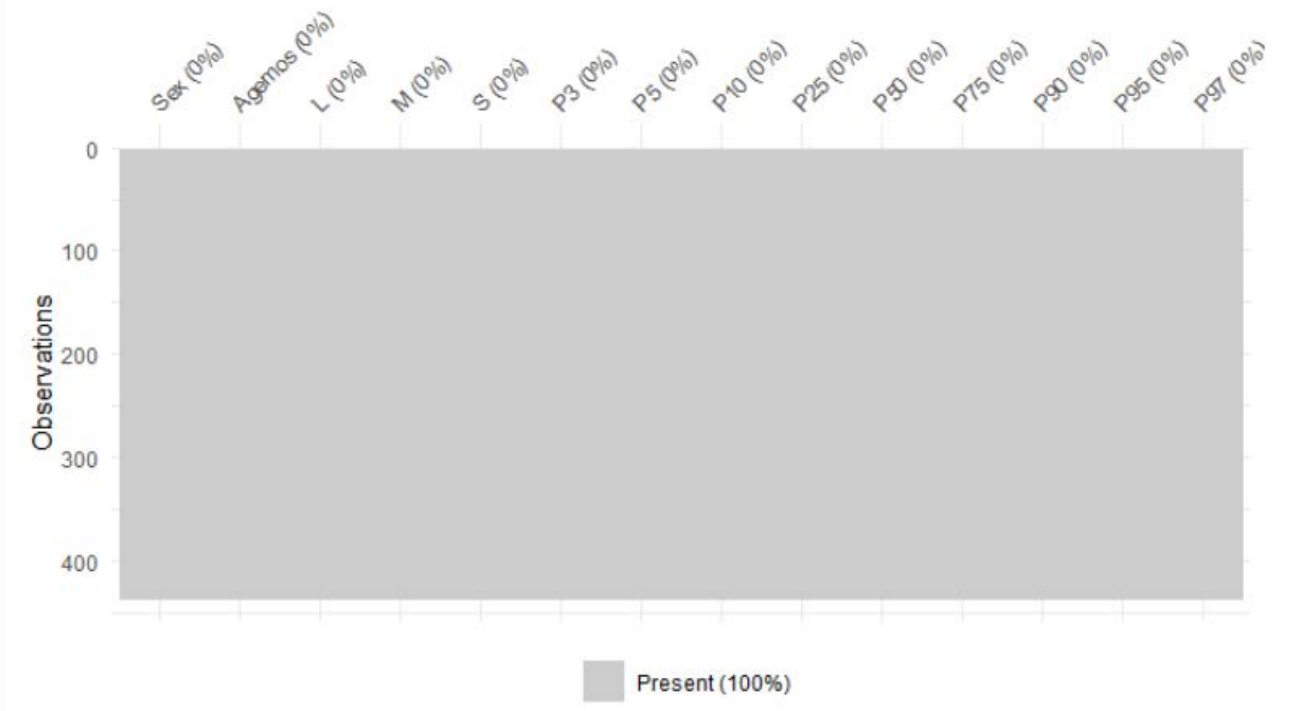


No Missing Data

```{r}
vis_miss(h)
```



no missing data

regression coefficients model from blood pressure regression model (JNC-7)

	Gender <fctr>	BPvar <fctr>	alpha <dbl>	B1 <dbl>	B2 <dbl>	B3 <dbl>	B4 <dbl>	G1 <dbl>	G2 <dbl>
1	Male	Sys	102.19768	1.82416	0.12776	0.00249	-0.00135	2.73157	-0.19618
2	Female	Sys	102.01027	1.94397	0.00598	-0.00789	-0.00059	2.03526	0.02534
3	Male	Dia	61.01217	0.68314	-0.09835	0.01711	0.00045	1.46993	-0.07849
4	Female	Dia	60.50510	1.01301	0.01157	0.00424	-0.00137	1.16641	0.12795

4 rows | 1-10 of 12 columns

G3 <dbl>	G4 <dbl>	SD <dbl>
-0.04659	0.00947	10.7128
-0.01884	0.00121	10.4855
-0.03144	0.00967	11.6032
-0.03869	-0.00079	10.9573

Analysis

- According to the Centers for Disease Control and Prevention (CDC) website (https://www.cdc.gov/growthcharts/percentile_data_files.htm)
- In 2000, CDC)released a new set of childhood growth charts for the United States. These charts included a set of smoothed percentiles along with LMS (lambda-mu-sigma) parameters to allow the calculation of other percentiles or standard deviation scores. These parameters resemble the LMS parameters derived using Cole's LMS method. Similarities in the terminology mask differences in the methods used. This brief commentary is intended to clarify these differences.

- These files contain the L, M, and S parameters needed to generate exact percentiles and z-scores along with the percentile values for the 3rd, 5th, 10th, 25th, 50th, 75th, 90th, 95th, and 97th percentiles by sex (1=male; 2=female) and single month of age.

- Z scores, or standard deviation scores provide a quantitative measure of how far a child departs from the mean value of height or weight for age, expressed in units of standard deviations. This was of particular usefulness to describe children who fell well below or, in some cases, well above the outermost percentiles on the chart.

Formula to Obtain Z Score

To obtain the z-score (Z) and corresponding percentile for a given measurement (X), use the following equation:

$$Z = \frac{((X/M)^{**}L) - 1}{LS}, \quad L \neq 0$$

or

$$Z = \ln(X/M)/S, \quad L = 0$$

where X is the physical measurement (e.g. weight, length, head circumference, stature or calculated BMI value) and L, M and S are the values from the appropriate table corresponding to the age in months of the child (or length/stature). (X/M)**L means raising the quantity (X/M) to the Lth power.

LMS parameters to Calculate Height

The LMS parameters are the median (M), the generalized coefficient of variation (S), and the power in the Box-Cox transformation (L). To obtain the value (X) of a given physical measurement at a particular z-score or percentile, use the following equation:

$$X = M\,(1 + LSZ)^{**}(1/L),\ L \neq 0$$

Or

$$X = M \exp(SZ),\ L = 0$$

where the L, M, and S are the values from the appropriate table corresponding to the age in months of the child (** indicates an exponent, such that M(1+LSZ)**(1/L) means raising (1+LSZ) to the (1/L)th power and then multiplying the M; exp(X) is the exponentiation function, e to the power X). Z is the z-score that corresponds to the percentile. z-scores correspond exactly to percentiles, e.g., z-scores of -1.881, -1.645, -1.282, -0.674, 0, 0.674, 1.036, 1.282, 1.645, and 1.881 correspond to the 3rd, 5th, 10th, 25th, 50th, 75th, 85th, 90th, 95th, and 97th percentiles, respectively.

Regression Coefficients

TABLE B1. Regression Coefficients From Blood Pressure Regression Models

Variable Name	Symbol	Systolic BP		Diastolic BP5	
		Male	Female	Male	Female
Intercept	α	102.19768	102.01027	61.01217	60.50510
Age					
Age-10	β_1	1.82416	1.94397	0.68314	1.01301
(Age-10)^2	β_2	0.12776	0.00598	−0.09835	0.01157
(Age-10)^3	β_3	0.00249	−0.00789	0.01711	0.00424
(Age-10)^4	β_4	−0.00135	−0.00059	0.00045	−0.00137
Normalized height					
Zht	γ_1	2.73157	2.03526	1.46993	1.16641
Zht^2	γ_2	−0.19618	0.02534	−0.07849	0.12795
Zht^3	γ_3	−0.04659	−0.01884	−0.03144	−0.03869
Zht^4	γ_4	0.00947	0.00121	0.00967	−0.00079
Standard deviation	σ	10.7128	10.4855	11.6032	10.9573
ρ^*		0.4100	0.3824	0.2436	0.2598
n (persons)		32 161	31 066	24 057	23 443
n (visits)		42 074	41 017	29 182	28 794

The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents. Pediatrics, August 2004, VOLUME 114 / ISSUE Supplement

- Above table is regression coefficients model from blood pressure regression model using the Joint National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure 7(JNC-7) data.
- Based on LMS, Z score, regression coefficient (alpha, beta, gamma, sd) as well as gender. We are going to build a shiny app to provide the dynamic information of percentile of blood pressure according to age, height, gender .