Reference values for blood pressure in European children aged 2-11 years: results of the IDEFICS study

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Objective

- to provide oscillometric blood pressure reference values in European non-overweight school children participating in the IDEFICS study
- compare these values with those in the total IDEFICS population of children where also overweight and obese subjects are included
Methods:

participants

N=16,228
Children visited for the first time during the 2007-2008 survey

N=2,517
Children visited for the first time during the 2009-2010 survey

N=18,745
Overall sample

N=18,088
Excluded because missing blood pressure values

N=16,937
Children included in the present analysis

N=13,547
Non-overweight children

N=3,390
Overweight or obese children
### Characteristics of the sample

<table>
<thead>
<tr>
<th></th>
<th>Girls</th>
<th>Boys</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>ALL</td>
</tr>
<tr>
<td>(a) entire population</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>8399</td>
<td>8538</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>119 (13)</td>
<td>119 (13)</td>
</tr>
<tr>
<td>MMI (kg m⁻²)</td>
<td>16.5 (2.6)</td>
<td>16.5 (2.6)</td>
</tr>
<tr>
<td>Ow/Ob (%)</td>
<td>21.0</td>
<td>19.0</td>
</tr>
<tr>
<td>SBP (mm Hg)</td>
<td>101 (9)</td>
<td>101 (9)</td>
</tr>
<tr>
<td>DBP (mm Hg)</td>
<td>64 (6)</td>
<td>63 (7)</td>
</tr>
<tr>
<td>(b) non-overweight children only</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>6609</td>
<td>6938</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>117 (12)</td>
<td>118 (12)</td>
</tr>
<tr>
<td>MMI (kg m⁻²)</td>
<td>15.4 (1.3)</td>
<td>15.6 (1.2)</td>
</tr>
<tr>
<td>SBP (mm Hg)</td>
<td>100 (9)</td>
<td>100 (8)</td>
</tr>
<tr>
<td>DBP (mm Hg)</td>
<td>63 (6)</td>
<td>62 (6)</td>
</tr>
</tbody>
</table>
Methods:

**blood pressure measurement**

- Standardised method: IDEFICS survey manual and special training camps for survey staffs
- Oscillometric measurement with automated blood pressure and pulse meter: Welch Allyn 4200B-E2 Sphygmomanometer
- Right arm circumference was measured at standardised measurement points
- Cuff was chosen /using a table/ according to arm circumference
- Child relaxed and in sitting position
- 2 (-3) recordings. Mean value used
Methods:

Statistics

- Age- and height-specific systolic and diastolic pressure percentiles were calculated by GAMLSS, separately for boys and girls.

- Analysis:
  a) the entire population (n=16,937)
  b) the non-overweight children only (n=13,547).
## Results: percentile tables

### Table 2. Percentiles of systolic BP (mm Hg) in non-overweight children

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Ht (cm)</th>
<th>Percentiles for girls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2–3 (n=200)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>85</td>
<td></td>
<td></td>
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<tr>
<td>87</td>
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<tr>
<td>89</td>
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<td>92</td>
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<tr>
<td>94</td>
<td></td>
<td></td>
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<tr>
<td>97</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Height percentiles 3\textsuperscript{rd}, 10\textsuperscript{th}, 25\textsuperscript{th}, 50\textsuperscript{th}, 75\textsuperscript{th}, 90\textsuperscript{th}, 97\textsuperscript{th}
Results: percentile curves

SBP:
- higher in girls than in boys up to the age of 5 years; subsequently the trend was reversed, - the older the child, the greater the difference between sexes.

DBP:
- higher in girls than in boys at any age.
Results: sensitivity analysis

SBP:
- differences between sexes more pronounced at an older age and at the extremes of the distribution.
- Girls: greater differences (earlier maturation? Higher prevalence of obesity?)
- DBP: no sign. differences
Oscillometric devices:
Welch Allyn device validated
Easy to perform
Less observer bias
Less white coat impact
Often used in newborns and infants

Diastolic pressure differences vs ascultation?
Mean arterial pressure is measured: Syst- and Diastolic calculated
statistical work-up re the distribution of blood pressure values
Discussion

Pre-hypertension = 90th pct,
Hypertension = 95th pct or 120/80

• Repeted measurement x 3 required for clinical diagnosis
• Must be validated with askultation + mercury-manometer
• Ambulatory BP measurement
Figure 4. Least square means of BP tracking correlation coefficients for baseline age, adjusted for length of follow-up.

BP tracking correlation coefficients had an average of 0.38 for SBP and 0.28 for DBP, P<0.001.
Discussion

BMI and blood pressure

- The higher the BMI, the higher blood pressure, not physiologic
  - Insulin resistance effect on kidney circulation, sodium retention
- Blood pressure effects on adolescents with obesity:
  - Increased intimal wall thickness
  - Reduced cardiac vagal activity
  - Left ventricular hypertrophy
  - Smaller nocturnal fall in SBP
- Treat obesity! Maybe add pharmacological treatment?
Conclusions

- The present analysis provides updated reference values for blood pressure in children aged 2 to below 11 years
- To use for BP monitoring and planning population strategies for disease prevention.
Thank you for your attention

This presentation is based on the paper:


This work was done as part of the IDEFICS Study (www.idefics.eu). We gratefully acknowledge the financial support of the European Community within the Sixth RTD Framework Programme Contract No. 016181 (FOOD).

I highly acknowledge the work of Gianvincenzo Barba and Staffan Marild.