13. INVENT YOURSELF: BLOOD PRESSURE

Team Croatia
Reporter: Ana Ćenan
Study the accuracy of various methods to measure blood pressure. Propose an interesting study involving blood pressure and pulse.

“Study the accuracy of various methods to measure blood pressure and investigate the change in pulse and blood pressure caused by the change of body position.”
BLOOD PRESSURE (BP)

- The **pressure** which occurs on the **walls of the blood vessels** (arteries) during blood circulation

- Measured in millimeters of mercury – mmHg

- Vital sign

- **Normal** in a resting adult is **120/80 mmHg**
HEART RATE

- The **number** of **contractions** of the heart muscle per minute
- Varies depending on activity, sleep, anxiety, stress, illness
- The **normal** resting heart rate in adult is range from **60 to 100** beats per minute (bpm)
DEMONSTRATION OF THE PHENOMENON

- **Systolic** pressure - the **highest** arterial pressure
- **Diastolic** pressure - the **lowest** arterial pressure
HYPOTHESES

1. Upper arm BP monitor is the most accurate

2. Heart rate and BP differ between people who play sport and those who don’t

3. BMI has an effect on the blood pressure

4. BMI has an effect on the heart rate
MEASURING DEVICES

Omron M3 BP monitor

Omron wrist BP monitor

Riester Big Ben Round

Pulse oximeter
EXPERIMENT 1 - ACCURACY

- 30 students
- 14 years old
- physical activity
- 5 measurements with each BP measuring device
EXPERIMENT 2

- 49 students (14-15 years old)
- Omron M3 BP monitor
- measured 3 different position
- Divided to sports and non-sports
- Body mass index (BMI)
## RESULTS: EXPERIMENT 1

<table>
<thead>
<tr>
<th>BP measuring device</th>
<th>Accuracy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omron wrist BP monitor</td>
<td>95.3</td>
</tr>
<tr>
<td>Omron M3 BP monitor</td>
<td>91.1</td>
</tr>
<tr>
<td>Riester Big Ben Round</td>
<td>93.3</td>
</tr>
</tbody>
</table>
RESULTS: EXPERIMENT 2

- Students who did not play sports had lower blood pressure
RESULTS: EXPERIMENT 2

![Bar chart showing pulse (bpm) after different activities: laying down, getting up, and standing up, for those playing sports and not playing sports.](image)
RESULTS: EXPERIMENT 2
EFFECT OF BMI ON BLOOD PRESSURE

$y = 1.1287x + 92.046$
$R^2 = 0.0607$
RESULTS: EXPERIMENT 2

EFFECT OF BMI ON HEART RATE

\[ y = 0.0877x + 79.752 \]

\[ R^2 = 0.0001 \]
CONCLUSION

• The most accurate BP measuring device is Omron wrist BP monitor
• There is a significant difference between people who play sports and those who don’t
• BMI does not effect blood pressure and pulse
LITERATURE


THANK YOU!

Team Croatia
Report: Ana Ćenan
## Analysis of Variance

<table>
<thead>
<tr>
<th>Sum of squares within groups (SSW)</th>
<th>21500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sum of squares (SST)</td>
<td>22471</td>
</tr>
<tr>
<td>SUM of squares between groups</td>
<td>971</td>
</tr>
<tr>
<td>Final calculation</td>
<td></td>
</tr>
<tr>
<td>323,66666667</td>
<td></td>
</tr>
<tr>
<td>149,3055556</td>
<td></td>
</tr>
<tr>
<td>2,167813953</td>
<td></td>
</tr>
<tr>
<td>F(2,144)=2.17; p&lt;0.05</td>
<td></td>
</tr>
<tr>
<td>Doing sports</td>
<td>Gender</td>
</tr>
<tr>
<td>--------------</td>
<td>--------</td>
</tr>
<tr>
<td></td>
<td>Male</td>
</tr>
<tr>
<td>NO</td>
<td>16</td>
</tr>
<tr>
<td>YES</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Female</td>
</tr>
<tr>
<td>NO</td>
<td>6</td>
</tr>
<tr>
<td>YES</td>
<td>17</td>
</tr>
</tbody>
</table>
RESULTS: EXPERIMENT 2

- Significant difference in pulse measurements
- Females
STATISTICAL ANALYSIS: T-TEST

• $H_0$ – there is no difference between sports and non-sports group

• $H_A$ – there is a difference between sports and non-sports group

• Wilcoxon-Mann-Whitney sum rank test (non-parametric t-test)
• non-paired, two-sided
• significance level: 5%
Auscultatory Method

When the cuff is inflated so that it stops arterial blood flow, no sound can be heard through a stethoscope placed over the brachial artery distal to the cuff.

Korotkoff sounds are created by pulsatile blood flow through the compressed artery.

Blood flow is silent when the artery is no longer compressed.
# Blood Pressure Stages

<table>
<thead>
<tr>
<th>Blood Pressure Category</th>
<th>Systolic mm Hg (upper #)</th>
<th>Diastolic mm Hg (lower #)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low blood pressure (Hypotension)</td>
<td>less than 80</td>
<td>or</td>
</tr>
<tr>
<td>Normal</td>
<td>80-120</td>
<td>and</td>
</tr>
<tr>
<td>Prehypertension</td>
<td>120-139</td>
<td>or</td>
</tr>
<tr>
<td>High Blood Pressure (Hypertension Stage 1)</td>
<td>140-159</td>
<td>or</td>
</tr>
<tr>
<td>High Blood Pressure (Hypertension Stage 2)</td>
<td>160 or higher</td>
<td>or</td>
</tr>
<tr>
<td>High Blood Pressure Crisis</td>
<td>higher than 180</td>
<td>or</td>
</tr>
</tbody>
</table>

Source: American Heart Association
Diagram of human heart
CARDIAC CYCLE

- all four chambers of heart are in diastole

- atrial diastole - the atria is filling with blood

- ventricular diastole – the pressure in the ventricles drops below the pressure in the atria
  - valves opens

- atrial systole – the atria begin to contract

- ventricular systole – ventricles contract causing the pressure to rise which closes the valves
  - the pressure rises and aortic and pulmonary valve open forcing blood to the blood vessels