**Title: An investigation into whether heart rates are affected by height**

**Abstract:**

This research explores the relationship between height and heart rate across isometric and aerobic exercise. This is an important field of research because of spiralling increases in cardiovascular disease (CVD) deaths worldwide, and growing evidence that faster heart rates can be a predictor of future strokes and other cardiovascular conditions. This creates important questions about how early risk can be identified so people can do things to help prevent CVD. Through testing children age 9-11, this research seems to show an inverse relationship between height and heart rate. Although this research is limited in the number of participants and the longevity of the research, the results seem to tally with other research in the field. Although more research is needed, the body of evidence suggests that shorter people may need more and earlier intervention to help them prevent possible CVD.

**Introduction:**

CVD deaths worldwide are increasing to epidemic levels and the World Health Organisation says that it is the top cause of death globally (1). The British Heart Foundation emphasises that maintaining a healthy heart is important to avoid problems like CVD (2). It is useful to find out if you are at higher risk of CVD, because there are lifestyle changes that can help keep your heart healthy and reduce the risk. Exercise and healthy eating are known to help, but it is important to find out if other things can help to identify potential problems early. Faster heart rates are an indication that the heart needs to work harder; therefore differences in heart rates between similar people can be an early indicator of potential CVD problems like heart disease and stroke later in life (3). This research is interested in exploring links between height and heart rate in both isometric and aerobic exercise.

**Hypothesis**:

We would hypothesise that there is no difference in heart rate of taller and smaller people when exercising doing the plank and star jumps.

**Method:**

A group of 39 participants aged 9-11 years were measured against a 200cm ruler, and their height recorded in centimetres. Their age in months was recorded. All participants were taught how to take their carotid pulse by hand, and their resting pulse was noted. The plank, an isometric exercise involving supporting your body weight on your hands, was the first exercise. Participants were asked to sustain the plank for 30 seconds, then take their carotid pulse, which was recorded. The exercise was repeated to gain an average heart rate over the two planks. A rest break was given until participants’ pulse returned to their resting heart rate. Star jumps, an aerobic exercise involving rapidly contracting and releasing arms and legs whilst jumping, was the second exercise. Participants were asked to sustain continued star jumps for 30 seconds, then take their carotid pulse, which was recorded. The exercise was repeated to gain an average star jump pulse rate.

**Results:**

12 participants were able to fully complete both exercises and successfully measure their heart rate via the carotid pulse. The data was turned into a scatter graph for each type of exercise (see figure 1 and 2) and where possible a line of best fit drawn.

The test with isometric exercise (figure 1) seems to show minimal to no correlation between height and heart rate. However, the line of best fit on the test with aerobic star jumps (figure 2) indicates a weak negative correlation between height and heart rate.

**Discussion:**

The results suggest that the hypothesis has been partially disproved. There seem to be no difference in heart rate between taller and smaller people when planking. However, when star jumping there seems to be an inverse relationship between height and heart rate, suggesting smaller people have higher heart rates when completing aerobic exercise. This could suggest that smaller people may have a higher risk of CVD as they have a higher heart rate.

However, this study only researched children aged 9-11 years. At this stage of development children grow significantly, but current height gives little definite insight to final height as adults. This means any correlation shown in this research between height and heart rate could be inaccurate. However, other research in this area, like Dr. Smulyan shows that in adults: “short stature induces a faster heart rate” and therefore there is an inverse relationship between height and CVD (4). This supports the findings of my research, and suggests that though the data is taken from a limited age range it still is valid to conclude shorter people have faster heart rates.

One limitation of my research is the number of participants with full data. Of the original 39, only 12 were able to complete both exercises and successfully take their carotid pulse. This weakens the results because not enough participant data is included in the analysis. However, substantial research in Norway (5) supports my findings. This research included 13,266 people

followed for 14 years. It concludes that for every 5cm increase in height, the “age-adjusted risk

of stroke” was 25% lower in women and 18% lower in men. They noted that height was a significant factor in CVD, and smaller adults had higher heart rates. This study is more likely to be accurate because they have more data. Since their data supports the results from my limited participants, it suggests my research is valid and conclusions can be made.

Another limitation is my research measures ‘one moment in time’ and therefore only provides questionable data, as it cannot evaluate if this is an average day. People and heart rates change over time, and therefore my conclusions could be challenged. However, the longevity of the 14 year Norway research, and consistency of the height and heart rate relationship shown, supports my findings and therefore the conclusions can be more trusted.

If my research had more data, it would be interesting to look at impact of gender on the results. Other studies in this area show that females have a higher heart rate than males (6), so splitting by gender may have affected my results. This could be explored in future work.

The conclusion from my research that smaller people have higher heart rates is widely supported, suggesting that shorter height could be used as one risk factor for future CVD. However this is not universally supported. Research in the Nagasaki Islands (7) showed no correlation between height and heart rate. This suggests that an important factor that future research may consider is the impact of race and culture (for example diet) on heart rate.

ENDS

**Appendix 1 – Data table**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Participant** | **Height** | **Age** | **Pulse rate (bpm)** | | | **Pulse rate (bpm)** | | |
|  | **(cm)** | **(months)** | **Plank 1** | **Plank 2** | **Average** | **Star Jumps 1** | **Star Jumps 2** | **Average** |
| 1 | 175 | 131 | 92 | 85 | 89 | 108 | 97 | 103 |
| 2 | 147 | 127 | 106 | 80 | 93 | 120 | 102 | 111 |
| 3 | 147 | 133 | 102 | 112 | 107 | 108 | 124 | 116 |
| 4 | 145 | 126 | 80 | 84 | 82 | 102 | 116 | 109 |
| 5 | 150 | 132 | 108 | 108 | 108 | 111 | 112 | 112 |
| 6 | 167 | 133 | 99 | 104 | 102 | 105 | 107 | 106 |
| 7 | 158 | 132 | 84 | 89 | 87 | 116 | 121 | 119 |
| 8 | 172 | 134 | 93 | 98 | 96 | 99 | 101 | 100 |
| 9 | 163 | 131 | 101 | 105 | 103 | 112 | 115 | 114 |
| 10 | 162 | 127 | 87 | 92 | 90 | 104 | 103 | 104 |
| 11 | 179 | 135 | 93 | 102 | 98 | 100 | 101 | 101 |
| 12 | 159 | 126 | 102 | 107 | 105 | 103 | 104 | 104 |

**Bibliography:**

* British Heart Foundation, “Preventing Heart Disease”, <<https://www.bhf.org.uk/heart-health/preventing-heart-disease>>. [1st December, 2015]
* World Health Organisation, “Cardiovascular Diseases”, <<https://www.who.int/mediacentre/factsheets/fs317/en/>>. [1st December, 2015]
* Cleveland Clinic, “Busting 5 Myths About Blood Pressure and Heart Rate”, pub. online: <<http://health.clevelandclinic.org/2014/02/busting-5-myths-about-blood-pressure-and-heart-rate/>>. [1st December, 2015]
* Smulyan, Dr Harold, “Influence of Body Height on Pulsatile Arterial Hemodynamic Data”, pub. online: <[http://www.JACC.org](http://www.jacc.org/)> April 1998. [1st December, 2015]
* American Heart Association, “Body Height, Cardiovascular Risk Factors, and Risk of Stroke in Middle-aged Men and Women”, pub. online: <<http://m.circ.ahajournals.org/content/94/11/2877.full>> [1st December, 2015]
* McCarty, K, “Differences in Heart Rate According to Gender”, pub. online: <[http://www.livestrong.com/article/226511-difference-in-heart-rate-according-to-gender/#page=1 HYPERLINK "http://www.livestrong.com/article/226511-difference-in-heart-rate-according-to-gender/"> HYPERLINK "http://www.livestrong.com/article/226511-difference-in-heart-rate-according-to-gender/" August](http://www.livestrong.com/article/226511-difference-in-heart-rate-according-to-gender/) 2013 [1st December, 2015]
* Shimizu, Y and Nakazato, M, “Relationship between adult height and body weight and risk of carotid atherosclerosis assessed in terms of carotid intima-media thickness: The Nagasaki Islands study”, pub. online, Journal of Physiological Anthropology: <<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4177387/>> [1st December, 2015]