Methods for calculating Additional Height Index

Additional Height Index (AHI) is defined for each participant as

\[ AHI = \text{Height} - \text{Mid parental height} \pm \text{ADH} \]

where the – sign is used for males and the + sign is used for females.

and where we have defined expected/Average Deviated Height as

\[ \text{ADH} = (\text{Expected male height} - \text{Expected female height})/2 \]

We are aware that the difference in expected height between males and females can vary across time, culture and countries.

In the following we will explain three different methods for calculating AHI (method 1-3), which are really just variations of calculating ADH. Further, we show that the estimates of the associations of AHI with the health outcomes in the study asthma etc are independent of the particular choice of calculating AHI.

We are also aware that regression to the mean in height could affect AHI. In the current study we do not correct for the regression to the mean effect. In the following, however, we give an example of how to quantify the regression to the mean effect (method A1), and show that correcting for regression to the mean effect does not change the estimates of the associations of AHI with the health outcomes significantly.

Method 1) for calculating AHI

According to method 1) AHI is calculated as specified above and corresponds to the method used in the paper. However, the exact method of calculating ADH can be specified:

From our dataset we have calculated the Average of the Height of Male participants (AHM) and the Average of the Height of Female participants (AHF). To make these estimates more exact, ie to avoid the effect of statistical fluctuations of the height of the parents, we correct these estimates by the average of the mid parental height for the two groups, males and females. That is, we calculated the Average mid Parental Height for Male participants (APHM) and the Average mid Parental Height for Female participants (APHF). ie the estimated mean of the height difference between males and females were calculated as

\[ \text{ADH} = ((\text{AHM}-\text{APHM}) - (\text{AHF}-\text{APHF}))/2 \]

\[ = ((\text{AHM}-\text{APHM}) + (\text{APHF}-\text{AHF}))/2 \]

Ie the average that men are higher than their parents + the average that women are lower than their parents divided by two.
From our dataset we have ADH=5.84cm

AHM-APHM = 12.31cm

AHF-APHF = 0.63cm

**Method 2) for calculating AHI**

As mentioned above ADH can vary over time due to e.g. changes in the traditions for the upbringing of boys and girls. This may be relevant for in our study since we have participants from four age strata. Thus, we have calculated ADH for each age strata separately and four separate estimates of ADH were used in the formula for each of the four age groups (40, 50, 60 and 70 years).

In our dataset we have:

\[ ADH_{40} = 6.00\text{cm}, \ ADH_{50} = 6.05\text{cm}, \ ADH_{60} = 5.55\text{cm}, \ ADH_{70} = 6.14\text{cm} \]

**Method 3) for calculating AHI**

In Danish hospitals ADH is assumed to be 6.5cm. Hence an alternative method for calculating AHI is to assume ADH to be 6.5cm.

**Method A1) for calculating AHI**

This is like method 1) except that we make a correction for regression to the mean. If the parents of a participant were unusual high then we would expect this to be caused by several circumstances which not all are inherited to the participants. We would therefore expect a negative relationship between AHI and mid parental height. In figure 1 the AHI calculated via method 1) is plotted against mid parental height. The best fit line has a negative slope in correspondence with the regression to the mean effect. In figure 2 the points have been tilted (described below) such that the slope is zero and thereby the supposed regression to the mean effect has been removed. If we assume that the slope of the points in figure 1 is solely due to the regression to the mean effect then we can remove this effect by tilting the values of AHI for each participant according to this equation:

\[ AHI_4 = AHI_1 - \text{intercept} - \text{slope} \times \text{MidParentalHeight} \]

Where intercept and slope is from the best fit line in figure 1.
Figure 1 Scatterplot of AHI from method 1) and mid parental height. One blue circle for each participant. The best fit line could be caused by regression to the mean.

Figure 2 Scatterplot of AHI from method A1) and mid parental height. One blue circle for each participant. As the consequence of the construction method of AHI then the best fit line has zero slope.

Similar corrections of the AHI according to method 2) and 3) could also be done.
Results obtained with the different methods for calculating Additional Height Index

In this section, we present results of the regression analyses (corresponding to Figure 2 of the paper) when AHI is calculated by the methods 1), 2), 3), A1):

<table>
<thead>
<tr>
<th></th>
<th>Method 1) * OR per sd AHI</th>
<th>Method 2) OR per sd AHI</th>
<th>Method 3) OR per sd AHI</th>
<th>Method A1) OR per sd AHI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-allergic asthma</td>
<td>0.54 (0.38-0.77)</td>
<td>0.53 (0.37-0.76)</td>
<td>0.54 (0.38-0.77)</td>
<td>0.52 (0.36-0.75)</td>
</tr>
<tr>
<td>Non-allergic wheezing</td>
<td>0.69 (0.52-0.91)</td>
<td>0.69 (0.52-0.91)</td>
<td>0.69 (0.51-0.91)</td>
<td>0.69 (0.51-0.92)</td>
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<tr>
<td>Allergic rhinoconjuntivitis</td>
<td>1.05 (0.84-1.31)</td>
<td>1.04 (0.83-1.30)</td>
<td>1.05 (0.84-1.31)</td>
<td>1.01 (0.81-1.27)</td>
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<tr>
<td>Atopic dermatitis</td>
<td>1.10 (0.8-1.49)</td>
<td>1.10 (0.81-1.49)</td>
<td>1.10 (0.81-1.49)</td>
<td>1.02 (0.74-1.39)</td>
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<tr>
<td>Atopic sensitisation</td>
<td>1.02 (0.89-1.15)</td>
<td>1.02 (0.90-1.15)</td>
<td>1.02 (0.89-1.15)</td>
<td>1.02 (0.89-1.16)</td>
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<tr>
<td>IHD</td>
<td>0.91 (0.80-1.05)</td>
<td>0.91 (0.79-1.04)</td>
<td>0.91 (0.79-1.05)</td>
<td>0.92 (0.80-1.06)</td>
</tr>
<tr>
<td>IHD mortality</td>
<td>0.79 (0.61-1.03)</td>
<td>0.80 (0.61-1.04)</td>
<td>0.79 (0.61-1.03)</td>
<td>0.80 (0.61-1.05)</td>
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<tr>
<td>IHD or IHD mortality</td>
<td>0.89 (0.78-1.01)</td>
<td>0.89 (0.78-1.01)</td>
<td>0.89 (0.78-1.01)</td>
<td>0.89 (0.78-1.02)</td>
</tr>
</tbody>
</table>

*Corresponds exactly to results given in Figure 2

The estimates are adjusted for age, gender, body mass index, educational level, smoking status, alcohol consumption, physical activity during leisure time. The IHD models are additionally adjusted for serum levels of Triglycerides, LDL, and HDL, and for systolic blood pressure.