Predictive value of excess body weight in childhood and adolescence compared to body mass index and waist to height ratio

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The authors disclose any conflict of interest.

Background

Weight status in children is commonly defined using standard deviation scores of BMI (BMI-SDS; z-scores). However, this measure can be unreliable in certain situations, such as extreme obesity (1) and is not easy to understand for physicians or parents alike. Another measure quickly gaining acceptance is waist-to-height ratio (WHtR), and its predictive value is comparable to BMI(SDS) (2, 3). A cut-off-value ≥ 0.5 is associated with increased cardio-metabolic risk (4).

Excess body weight (EBW) is frequently used for adults, mainly in the context of bariatric surgery. However, an appropriate definition of EBW is not available for the paediatric population to date.

Objective

A simple definition for EBW in children/adolescents is introduced, which uses median weight as a function of height, age and gender as a robust reference point. The relationships between EBW, BMI-SDS, WHtR and metabolic parameters are examined.

Methods

Definition

\[ \text{EBW}(\%) = 100 \times \frac{\text{weight} - \text{median weight}^*}{\text{median weight}^*} \]

where median weight* takes into account height, age and gender.

The relationship between EBW, BMI-SDS, and WHtR and several anthropometric / metabolic parameters is compared using data from 14,362 children aged 11-18 taken from two sources:

1. APV data base, which collects data from German/Swiss/Austrian obesity outpatient centres (7,553 overweight/obese children) (5)
2. KiGGS survey, which is a representative sample of German children covering all weight ranges (6,809 children) (6).

Results

A) Characterization of study cohorts:

<table>
<thead>
<tr>
<th>Study</th>
<th>n</th>
<th>Median weight</th>
<th>BMI-SDS</th>
<th>WHtR</th>
</tr>
</thead>
<tbody>
<tr>
<td>APV</td>
<td>7,553</td>
<td>86.96</td>
<td>11.84</td>
<td>0.87</td>
</tr>
<tr>
<td>KiGGS</td>
<td>6,809</td>
<td>91.60</td>
<td>13.24</td>
<td>0.90</td>
</tr>
</tbody>
</table>

B) Correlation analyses:

- In both cohorts EBW correlates strongly with BMI-SDS (lin. corr. coeff. ≥ 0.93) and with WHtR (linear correlation coefficients ≥ 0.76).
- The relationships of all three measures with metabolic (triglycerides, HDL-cholesterol, fasting glucose) and clinical (systolic/diastolic blood pressure) parameters are quite similar.
- The strongest linear correlation can be found with HDL-cholesterol and systolic blood pressure.

EBW is a novel four-dimensional marker, comparing individual weight to a gender, age and height related ideal weight. BMI-SDS, WHtR and EBW have similar predictive values for metabolic comorbidities in the paediatric population. As EBW is valid even for extremely obese patients and is intuitive, it would make a very useful addition to existing anthropometric tools in paediatric obesity.

Conclusions

EBW is a novel four-dimensional marker, comparing individual weight to a gender, age and height related ideal weight. BMI-SDS, WHtR and EBW have similar predictive values for metabolic comorbidities in the paediatric population. As EBW is valid even for extremely obese patients and is intuitive, it would make a very useful addition to existing anthropometric tools in paediatric obesity.

Its ability to measure weight change should be examined.