New Criteria for Diagnosing Metabolic Syndrome in Teens

CME/CE

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Disclosures

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Criteria Developed Using Growth-Curve Modeling

Starting with the already validated cut-off points for 20-year-olds — based on the US National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP) and International Diabetes Federation (IDF) criteria for metabolic syndrome — Jolliffe and Janssen used data from surveys in around 3000 adolescents of each sex to perform growth-curve modeling, working backwards to age 12 years.

Dr. Janssen said they chose the NCEP ATP III and IDF criteria because of their clinically friendly nature.

Age- and sex-specific cut-off points for each metabolic syndrome component — blood pressure (BP), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C), and waist circumference (WC) — were used to generate age-related growth curves, similar to the ones used routinely by pediatricians. Tables were also constructed as an alternative to the growth curves.

Dr. Janssen stressed that fasting glucose should also be considered as one of the components of the metabolic syndrome, but this measurement was not included in the modeling "because it remains flat" throughout adolescence.

Table 1. Age-Specific Metabolic Syndrome Cut-off Points and Corresponding Percentiles for Males

<table>
<thead>
<tr>
<th>WC, cm</th>
<th>WC, cm</th>
<th>SBP, mm</th>
<th>DBP, mm</th>
<th>HDL-C</th>
<th>TG</th>
</tr>
</thead>
</table>

WC indicates waist circumference; NCEP ATP, US National Cholesterol Education Program Adult Treatment Panel III; IDF, International Diabetes Federation; SBP, systolic blood pressure; DBP, diastolic blood pressure; HDL-C, high-density lipoprotein cholesterol; and TG, triglycerides.

Metabolic syndrome cut-off point values represent the midpoint of a 1-year increment (ie, the values for age 12 years represent the values at age 12.5 years) and can be used for individuals within the 1-year age range (ie, 12.0 - 12.9 years). Criteria for ages 13, 15, 17, and 19 years can be found in tables in the article.

Metabolic syndrome defined as 3 of the 5 criteria (WC, BP, HDL-C, TG, and blood glucose).

Metabolic syndrome defined as having elevated WC and 2 of the remaining 4 criteria (BP, HDL-C, TG, and blood glucose).


### Table 2. Age-Specific Metabolic Syndrome Cut-off Points and Corresponding Percentiles for Females*

<table>
<thead>
<tr>
<th>Age, years †</th>
<th>(NCEP ATP, 92nd)‡</th>
<th>(IDF, 83rd)§</th>
<th>Hg (92nd)</th>
<th>Hg (97th)</th>
<th>mmol/L (26th)</th>
<th>mmol/L (89th)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>94.2</td>
<td>85.1</td>
<td>121</td>
<td>76</td>
<td>1.13</td>
<td>1.44</td>
</tr>
<tr>
<td>14</td>
<td>98.0</td>
<td>88.9</td>
<td>125</td>
<td>79</td>
<td>1.07</td>
<td>1.52</td>
</tr>
<tr>
<td>16</td>
<td>100.6</td>
<td>91.8</td>
<td>128</td>
<td>82</td>
<td>1.03</td>
<td>1.59</td>
</tr>
<tr>
<td>18</td>
<td>101.8</td>
<td>93.4</td>
<td>129</td>
<td>84</td>
<td>1.03</td>
<td>1.65</td>
</tr>
<tr>
<td>20</td>
<td>102.0</td>
<td>94.0</td>
<td>130</td>
<td>85</td>
<td>1.03</td>
<td>1.70</td>
</tr>
</tbody>
</table>

*WC indicates waist circumference; NCEP ATP, US National Cholesterol Education Program Adult Treatment Panel III; IDF, International Diabetes Federation; SBP, systolic blood pressure; DBP, diastolic blood pressure; HDL-C, high-density lipoprotein cholesterol; and TG, triglycerides.

1Metabolic syndrome cut-off point values represent the midpoint of a 1-year increment (ie, the values for age 12 years represent the values at age 12.5 years) and can be used for individuals within the 1-year age range (ie, 12.0 - 12.9 years). Criteria for ages 13, 15, 17, and 19 years can be found in tables in the article.

2Metabolic syndrome defined as 3 of the 5 criteria (WC, BP, HDL-C, TG, and blood glucose).

3Metabolic syndrome defined as having elevated WC and 2 of the remaining 4 criteria (BP, HDL-C, TG, and blood glucose).


Jolliffe and Janssen found some racial differences in the prevalence of metabolic syndrome, with non-Hispanic black teenagers having a lower prevalence than whites and Hispanics.

“This could be explained by the more favorable lipoprotein profiles of non-Hispanic blacks,” they note. However, they say they decided against race-specific cut-off points because the NCEP ATP III and IDF adult cut-off points are not race-specific (with the exception of the IDF waist circumference measures).

**Validation Required**

The researchers acknowledge that there has been debate about the usefulness of the metabolic syndrome as a diagnostic tool. However, the purpose of this study was not to discuss the utility of the syndrome, rather it was to help facilitate comparison of results across studies.

“This study represents the first attempt to create classification systems for metabolic syndrome in adolescents that are linked to adult-based values. We have developed two metabolic syndrome criteria to reflect the adult definitions most commonly applied in the clinical and research settings.”

But, the authors add that future work is needed to validate the figures developed in this study. Janssen told heartwire that this could be done with intermediate cardiovascular disease and metabolic outcomes as part of ongoing trials such as the Bogalusa Heart Study.
"I hope our criteria will be picked up," he concluded.


The complete contents of Heartwire, a professional news service of WebMD, can be found at www.theheart.org, a Web site for cardiovascular healthcare professionals.

Clinical Context

The metabolic syndrome, a constellation of symptoms affecting approximately 25% of Americans, is a strong risk factor for diabetes and cardiovascular disease, and diagnosis is important for preventing morbidity and mortality. In adults, metabolic syndrome criteria have been developed by different groups, including the World Health Organization, the ATP III, and the IDF. However, although the risk factors track from adolescence to adulthood, consistent and objective criteria for diagnosing metabolic syndrome in adolescents are not available, according to the current authors, and cut-off points for adolescents have been arbitrarily chosen in the past.

This is a cross-sectional study combining data from National Health and Nutrition Examination Survey (NHANES) III and previous NHANES surveys with adult ATP III and IDF criteria to arrive at age-specific criteria for metabolic syndrome diagnosis in adolescents.

Study Highlights

- The benefits of a separate set of criteria for adolescents that are linked to ATP III or IDF criteria are linked to cardiovascular disease risk prediction and reflect age-related changes in measurements.
- ATP III defines metabolic syndrome as having 3 or more of the following: WC of 102 cm or higher in men and 88 cm or higher in women, SBP/DBP of 130/85 mm Hg or higher, HDL-C levels less than 1.03 mmol/L in men and less than 1.30 mmol/L in women, triglyceride levels of 1.7 mmol/L or higher, and blood glucose level of 5.6 mmol/L or higher.
- The IDF requires the presence of high WC (≥ 94 cm in men and ≥ 80 cm in women) and at least 2 of 4 remaining components (similar to the ATP III criteria).
- The IDF uses different cut-off points for WC on the basis of race or country of origin.
- The dataset used for deriving adolescent criteria were from 3 NHANES studies involving 2921 males and 3146 females aged 12 to 19 years, from 1988 to 2002.
- Adolescents had a history and physical examination with anthropomorphic measurements and blood tests performed.
- Age- and sex-specific growth curves were developed, and a z-score corresponding to the adult cut-off point at age 20 years was created.
- The z-scores were then regressed through the adolescent distribution using a formula.
- Thus, by defining the percentile that corresponds to the adult cut-off point and by regressing it backwards into adolescence, the adolescent cut-off points were linked to those of adults.
- Growth curves corresponding to the metabolic syndrome cut-off points for WC, BP, HDL-C, and triglycerides were developed using the ATP III and IDF criteria.
- Fasting glucose remained constant and did not change between age 12 and 19 years. Thus, a cut-off point of 5.6 mmol/L could be used at all adolescent ages.
- Age- and sex-specific adolescent body mass index cut-off points linked to a body mass index of 30 kg/m² were created.
- SBP and DBP curves were linked to the adult ATP III and IDF cut-off points such that the curves passed through the 130 and 85 mm Hg points at 20 years of age.
- For males, the HDL-C cut-off points declined slightly until age 16 years, but for females, the cut-off points increased marginally after age 15 years.
- The curves for HDL-C were linked to the adult cut-off points and represented the 26th and 43rd percentiles, respectively.
- The male and female trajectories for triglycerides differed. The male curve increased linearly with age, while the female curve declined in early adolescence and increased to approach adult concentrations.
- The prevalence of metabolic syndrome in the entire sample was 7.6% according to adolescent ATP III criteria and 9.6% according to IDF adolescent criteria.
- In the past decade, the prevalence of metabolic syndrome increased from 4.7% to 7.6% using the ATP III adolescent criteria and from 5.3% to 9.6% using the adolescent IDF criteria (P < 0.01). The increase was probably due to the 50% increase in adolescent obesity in the same period.
- The authors noted that race-specific metabolic syndrome cut-off points might provide more accurate assessment of risk status.
- The authors suggested that the new criteria and cut-off points would provide age-appropriate approaches for diagnosing metabolic syndrome among adolescents.
Pearls for Practice

- Linking adolescent criteria for metabolic syndrome to ATP III and IDF criteria, which differ in their WC criteria, improves prediction of cardiovascular disease and accounts for age-related changes.
- The prevalence of metabolic syndrome as defined by ATP III or IDF criteria for adolescents has doubled in the last decade.

1. According to this study, which of the following distinguishes the ATP III from the IDF criteria for metabolic syndrome in adults? *(Required for credit)*
   - SBP
   - WC measurements
   - HDL-C levels
   - DBP

2. In this study using adult ATP III and IDF criteria for metabolic syndrome to derive adolescent criteria for metabolic syndrome based on growth curves, which of the following options best describes the prevalence of metabolic syndrome in adolescents older than 10 years using the new criteria? *(Required for credit)*
   - Same
   - Doubled
   - Tripled
   - Quadrupled

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