

# The cutoff values of indirect indices measuring insulin resistance for metabolic syndrome in Korean children and adolescents

Jun Woo Kim, Heon-Seok Han

Department of Pediatric, College of Medicine,  
Chungbuk National University College of Medicine, Cheongju, Korea



## INTRODUCTION

- Nothing to disclosure.
- The widely reported variation in the prevalence rate of metabolic syndrome (MetS) in childhood is due to the absence of a unifying definition of this condition in childhood. Considering the insulin resistance (IR) is a cause of MetS, it is possible to screen at-risk groups for childhood MetS. Instead of invasive and expensive direct measurement of insulin IR, indirect index, such as homeostasis model assessment of IR (HOMA-IR) is widely used. Base on the finding that elevation of serum triglyceride (TG) is related to a decrease in insulin sensitivity by interfering with muscle glucose metabolism, another indirect index, the TG and glucose (TyG) index, has been used in some adult studies. However, there are few pediatric studies and reference criteria in Korea.
- The aim of our study was to calculate the prevalence rate of MetS, tabulate the distribution of the percentile values of the HOMA-IR and TyG index, and propose a cutoff value to clarify an at-risk group among Korean children and adolescents.

## SUBJECTS AND METHODS

- Primary data obtained from the 4<sup>th</sup> and part of the 5<sup>th</sup> Korean National Health and Nutrition Examination Survey (K-NHANES, 2007-2010).
- Among the 4,244 children and adolescents aged 10-18 years, 3,313 (1,756 boys and 1,557 girls) were included in the final analysis after excluding 931 individuals with missing data on body measurements or inadequate blood test results (i.e., without fasting for 8 h).
- Three most commonly used criteria for MetS in children and adolescents (Cook et al., de Ferranti et al, IDF) were used for analysis.
- $HOMA-IR = \text{fasting insulin } (\mu\text{U/mL}) \times \text{fasting glucose (mmol/L)} / 22.5$ ,  $TyG \text{ index} = \text{Ln} [\text{triglyceride (mg/dL)} \times \text{fasting glucose (mg/dL)} / 2]$
- Statistical analysis by SPSS (ver. 21.0), Variables presented as means with 95% confidence intervals (CI)
- ROC analysis for sensitivity and specificity of HOMA-IR and TyG index, Youden index (maximum "sensitivity + specificity -1") for cutoff point.

## RESULT

Table 1. General characteristics of the participants and percentage of MetS.

|                               | Male (n=1756)       | Female (n=1557)     |
|-------------------------------|---------------------|---------------------|
| Age (years)                   | 14.1 (14.0-14.3)    | 14.1 (13.9-14.2)    |
| WC (cm)                       | 71.8 (71.2-72.4)    | 67.2 (66.6-67.7)    |
| BMI (kg/m <sup>2</sup> )      | 21.0 (20.8-21.2)    | 20.1 (19.9-20.4)    |
| Systolic BP (mmHg)            | 106.4 (105.7-107.1) | 101.9 (101.3-102.5) |
| Diastolic BP (mmHg)           | 65.9 (65.3-66.5)    | 64.6 (64.0-65.2)    |
| Fasting glucose (mg/dL)       | 89.3 (88.9-90.0)    | 88.4 (88.0-88.8)    |
| HDL-cholesterol (mg/dL)       | 48.3 (47.8-48.8)    | 50.7 (50.1-51.3)    |
| Triglyceride (mg/dL)          | 86.8 (83.3-90.3)    | 89.5 (86.3-92.7)    |
| <b>Metabolic syndrome (%)</b> |                     |                     |
| Cook et al.                   | 4.6 (3.6-5.8)       | 3.6 (2.6-4.9)       |
| de Ferranti et al.            | 13.9 (12.0-16.1)    | 12.3 (10.5-14.4)    |
| IDF                           | 1.4 (0.9-2.1)       | 1.8 (1.2-2.7)       |

Table 2. The distribution of the HOMA-IR and the TyG index by gender.

| Characteristics  | Mean (95% CI)    | Percentile       |                  |                  |                  |                  |
|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                  |                  | 10 <sup>th</sup> | 25 <sup>th</sup> | 50 <sup>th</sup> | 75 <sup>th</sup> | 90 <sup>th</sup> |
| <b>HOMA-IR</b>   |                  |                  |                  |                  |                  |                  |
| Total            | 2.97 (2.90-3.04) | 1.59             | 2.06             | 2.85             | 3.45             | 4.57             |
| Male             | 2.92 (2.83-3.00) | 1.55             | 2.01             | 2.58             | 3.33             | 4.51             |
| Female           | 3.03 (2.93-3.13) | 1.66             | 2.12             | 2.71             | 3.54             | 4.67             |
| <b>TyG index</b> |                  |                  |                  |                  |                  |                  |
| Total            | 8.13 (8.11-8.16) | 7.51             | 7.78             | 8.11             | 8.44             | 8.79             |
| Male             | 8.11 (8.08-8.14) | 7.48             | 7.74             | 8.08             | 8.44             | 8.80             |
| Female           | 8.15 (8.13-8.19) | 7.55             | 7.84             | 8.14             | 8.45             | 8.78             |

Table 3. The proposed cutoff values of the HOMA-IR and TyG index for Korean children and adolescents according to three sets of criteria of metabolic syndrome (Sn: sensitivity, Sp: specificity)

| Criteria         | Cook et al.  |        |        | de Ferranti et al. |        |        | IDF          |        |        |
|------------------|--------------|--------|--------|--------------------|--------|--------|--------------|--------|--------|
|                  | Cutoff point | Sn (%) | Sp (%) | Cutoff point       | Sn (%) | Sp (%) | Cutoff point | Sn (%) | Sp (%) |
| <b>HOMA-IR</b>   |              |        |        |                    |        |        |              |        |        |
| Total            | 3.29         | 73.3   | 72.1   | 2.96               | 71.1   | 64.7   | 3.54         | 80.8   | 77.7   |
| Male             | 2.98         | 76.5   | 66.2   | 2.86               | 71.5   | 64.2   | 3.54         | 79.2   | 79.3   |
| Female           | 3.49         | 75.9   | 75.4   | 2.96               | 74.9   | 61.3   | 3.69         | 82.1   | 79.1   |
| <b>TyG index</b> |              |        |        |                    |        |        |              |        |        |
| Total            | 8.48         | 95.6   | 79.9   | 8.41               | 85.0   | 80.7   | 8.66         | 90.4   | 86.4   |
| Male             | 8.48         | 96.3   | 81.1   | 8.40               | 88.2   | 81.8   | 8.66         | 95.8   | 86.5   |
| Female           | 8.48         | 94.4   | 78.8   | 8.38               | 85.3   | 76.3   | 8.61         | 89.3   | 84.1   |

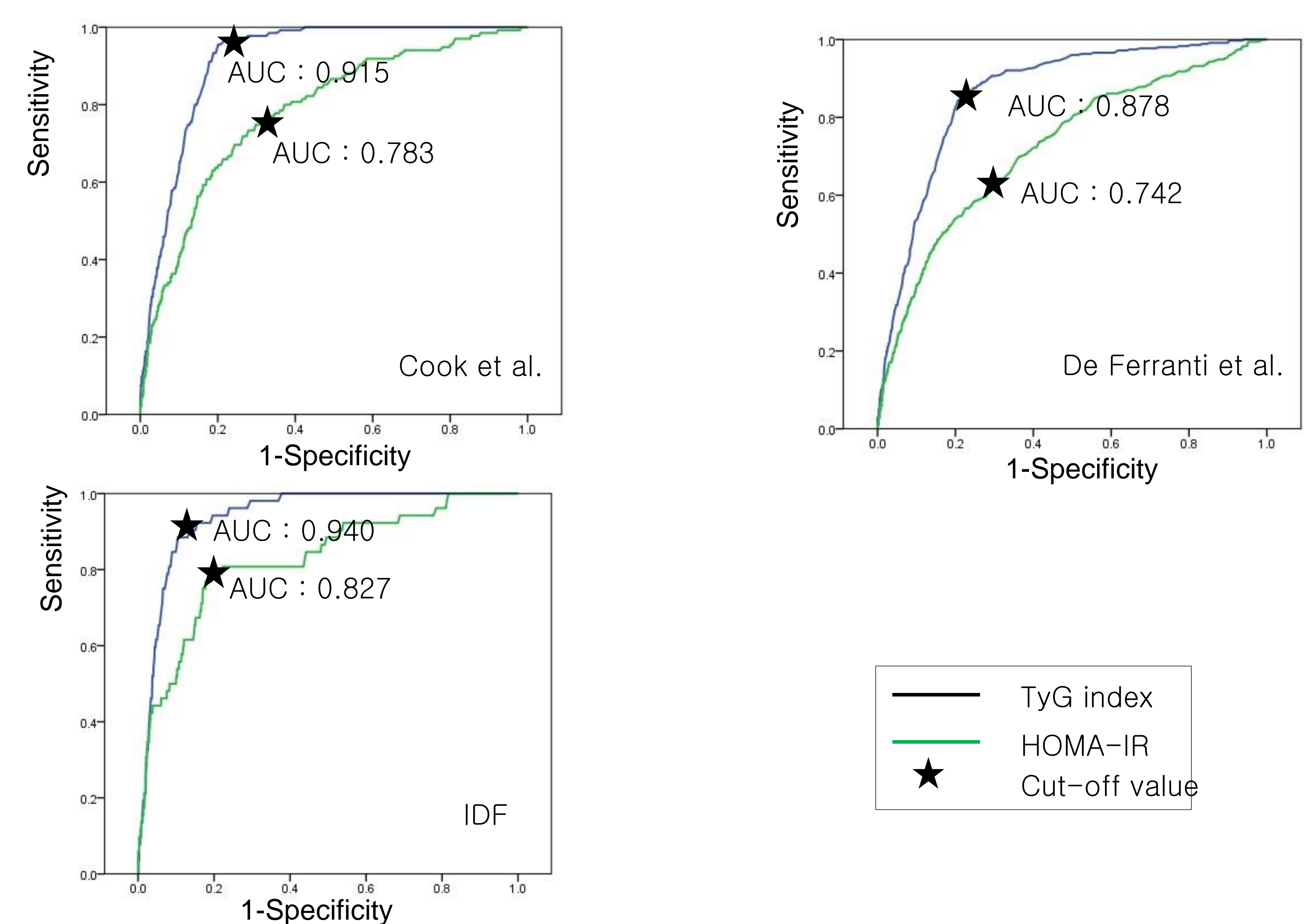


Figure 1. The ROC curves and cutoff values of the HOMA-IR and TyG index for MetS according to the three criteria.

## CONCLUSION

- We described the prevalence rates of MetS in Korean children and adolescents, an index of IR, and the cutoff values for MetS with the aim of detecting high-risk groups. The usefulness of these criteria needs to be verified by further evaluation.

