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THE CATHOLIC UNIVERSITY OF KOREA
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Comparison of Different Criteria for the Definition of Insulin Resistance and Its Relation with Metabolic Risk in Overweight and Obese Adolescents

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* No conflicts of interest to we solve.

Purpose This study aimed to compare cut-off points corrected for age and gender (CCOP) with fixed cut-off points (FCOP) for fasting plasma insulin and homeostasis model assessment-insulin resistance (HOMA-IR) for the diagnosis of IR in Korean obese children and adolescents and to identify IR applying CCOP and FCOP using as outcome the presence of dyslipidemia and Metabolic syndrome (MetS).

Methods We performed a cross sectional analysis of data from 195 adolescents aged 12-18 years who participated in Korean National Health and Nutrition Examination Survey (KNHANES, 2009-2010). Overweight and obese individuals were defined by BMI z score ≥ 1. IR was defined as two criteria: FCOP and CCOP.

Results The prevalence of IR using HOMA-IR in FCOP and CCOP was 105 (53.8%) and 53 (27.2%) respectively. The prevalence of IR using fasting plasma insulin was 120 (61.5%) of FCOP and 79 (40.5%) of CCOP. Dyslipidemia, abdominal obesity and MetS were not associated to FCOP or CCOP. Fasting blood glucose remained in normal ranges in all patients with IR.

Conclusion More cases of IR were detected in FCOP of plasma insulin or of HOMA-IR compared to the CCOP, but were not associated with incidence of metabolic disease. There is no fluctuation of blood glucose in this age group, even though presence of IR, and there is no significant difference in fasting plasma insulin between IR detected by HOMA-IR and by fasting insulin.

Table 1. Characteristics of Adolescents in Groups of Participants with Metabolic Syndrome or without Metabolic Syndrome

	Without MetS (n=165)	With MetS (n=30)	*p*-value
Gender (M:F)	83:82	25:5	0.001*
Age (yr)	14.11±1.64	15.2±1.58	0.001*
Weight (kg)	69.7±10.01	86.36±10.94	0.000*
Weight z score	1.51±0.54	2.06±0.53	0.000*
BMI (kg/m^2)	25.64±2.04	29.16±2.49	0.000*
BMI z score	1.45±0.39	1.94±0.46	0.000*
PBF (%)	34.41±6.2	33.98±5.98	0.721
Trunk fat (%)	34.34±6.44	35.57±6.68	0.341
WHtR	0.49±0.36	0.54±0.04	0.000*
Fat mass (g)	23606.38±5251.86	29064.80±6254.88	0.000*
WC (cm)	80.71±7.07	92.69±7.3	0.000*
Insulin (μIU/mL)	18.35±8.22	25.04±12.54	0.008*
HOMA-IR	3.71±1.82	5.12±2.83	0.013*

Table 2. Comparison of Metabolic abnormality Frequencies in Children with Insulin Resistance Based on Fixed or Age-Adjusted Cut-off Points of Insulin or of HOMA-IR

Alteration	Increased insulin		Increased HOMA-IR	
	FCOP %, (n=120)	CCOP %, (n=79)	FCOP %, (n=105)	CCOP %, (n=53)
TC ≥ 200 mg/dL	10 (12)	10.1 (8)	9.5 (10)	9.4 (5)
LDL-C ≥ 130 mg/dL	8.3 (10)	11.4 (9)	9.5 (10)	9.4 (5)
HDL-C < 40 mg/dL	29.2 (35)	26.6 (21)	27.6 (29)	32.1 (17)
TG ≥ 150 mg/dL	32.5 (39)	30.4 (24)	31.4 (33)	32.1 (17)
FBS ≥ 100 mg/dL	47.5 (57)	46.8 (37)	46.7 (49)	50.9 (27)
WC ≥ 95th percentile	44.2 (53)	53.2(42)	46.7 (49)	50.9 (27)
Metabolic syndrome	20 (24)	25.3 (20)	22.9 (24)	24.5 (13)

Table 3. Characteristics of Adolescents with Obesity and Insulin Resistance according to Fixed or Age-Adjusted Cut-off Points of Fasting Plasma Insulin or of HOMA-IR

Characteristic	All (n=195)	Increased plasma insulin (n)			Increased HOMA-IR (n)		
		FCOP (n=120)	CCOP (n=79)	*p*-value	FCOP (n=105)	CCOP (n=53)	*p*-value
Gender (M:F)	108:87	70:50	49:30	NS	64:41	35:18	NS
Age (yr)	14.28±1.67	13.99±1.64	14.24±1.70	NS	13.96±1.65	14.00±1.71	NS
Weight (kg)	72.26±11.79	73.16±12.89	75.78±12.51	NS	73.89±13.03	75.42±13.81	NS
Weight z score	1.60±0.58	1.66±0.61	1.81±0.57	NS	1.73±0.60	1.80±0.60	NS
BMI (kg/m^2)	26.18±2.46	26.49±2.72	27.09±2.79	NS	26.71±2.78	27.10±2.97	NS
BMI z score	1.53±0.43	1.59±0.47	1.68±0.49	NS	1.63±0.47	1.68±0.48	NS
PBF (%)	34.35±6.15	34.82±5.42	34.90±5.31	NS	34.69±5.36	34.37±5.49	NS
Trunk fat (%)	46.36±9.83	46.99±3.65	47.57±3.62	NS	47.30±3.66	47.49±3.63	NS
WHtR	0.50±0.04	0.51±0.04	0.51±0.44	NS	0.51±0.04	0.51±0.47	NS
TyG (TG/FBS)	1.20±0.59	1.27±0.62	1.36±0.63	NS	1.34±0.63	1.24±0.56	NS
WC (cm)	82.55±8.32	83.98±9.03	85.66±9.33	NS	84.57±9.31	85.90±10.09	NS
TC (mg/dL)	159.64±32.38	160.63±34.06	162.66±34.28	NS	161.44±34.89	161.34±33.19	NS
LDL-C (mg/dL)	94.34±28.11	93.92±29.94	96.71±29.27	NS	93.99±31.20	94.11±28.83	NS
HDL-C (mg/dL)	43.82±7.94	43.71±8.15	44.48±8.07	NS	43.13±7.69	43.13±7.40	NS
TG (mg/dL)	107.39±52.92	115.02±55.12	114.48±59.06	NS	131.55±55.54	116.26±60.65	NS
FBS (mg/dL)	90.33±6.98	109.54±73.05	103.68±69.26	NS	102.90±65.51	109.92±67.14	NS
Insulin (μIU/mL)	19.38±9.30	24.08±8.94	27.31±9.40	0.01*	25.26±8.96	30.19±10.11	0.03*
HOMA-IR	3.93±2.06	4.92±2.06	5.64±2.18	0.02*	5.19±2.06	6.35±2.34	0.03*

Values are presented as number only or mean±standard error of the mean.
HOMA-IR; Homeostatic model assessment-insulin resistance, FCOP; fixed cut-off point (fasting plasma insulin > 15 μU/mL, HOMA-IR > 3.16),
CCOP; corrected cut-off point (according to age and gender), NS; not significant, BMI; body mass index, PBF; percent of body fat, WHtR; waist to height ratio, TyG; triglyceride and glucose, TG; triglyceride, FBS; fasting blood sugar, WC; waist circumference, TC; total cholesterol, LDL-C; low density lipoprotein cholesterol, HDL-C; high density lipoprotein cholesterol.
*Fisher's exact test