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Comparison of HbA1c and OGTT to diagnose diabetes in Korean children

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Introduction

Recently, the American Diabetes Association introduced HbA1c test for diagnosing diabetes with a cut point of $\geq 6.5\%$ in addition to criteria based on either fasting plasma glucose (FPG) or 2 hour plasma glucose after on oral glucose tolerance test (2-hr OGTT). The aim of this study was to evaluate the correlation between plasma glucose (FPG and 2-hr OGTT) and HbA1c for diagnosing diabetes in Korean children.

Subjects and Methods

- Selection of subjects
 - 2010. 3 – 2014. 8
 - Age : under 18 year-old
 - Exclusion : known diabetes mellitus
 - Medical records : retrospectively reviewed
- Demographic findings
 - Age and gender
 - Symptoms
 - Body mass index (BMI, kg/m²)
- Laboratory data
 - Serum glucose level, HbA1c, serum c-peptide,
 - HOMA-IR (homeostasis model of assessment-insulin resistance)
 - Oral glucose tolerance test (OGTT)

Results

Table 1. Demographic and clinical features of studied subjects by OGTT

Characteristic	Total	NGT	Glucose intolerance			P value (NGT vs IGT vs DM)
			IGT	DM	Sub-total	
Number (%)	143 (100.0)	74 (51.7)	27 (18.9)	42 (29.4)	69	
Age (yr)	13.82±3.29	13.54±3.71	13.31±3.09	14.62±2.44	14.11±2.76	0.162
Gender (%)						
Female	75 (52.4)	32 (43.2)	15 (55.6)	28 (66.7)	43 (62.3)	0.014
Male	68 (47.6)	42 (56.8)	12 (44.4)	14 (33.4)	26 (37.7)	
BMI (kg/m ²)	24.33±5.85	23.33±5.61	24.93±6.76	25.77±5.41	25.43±5.95	0.088
HbA1c (%)	6.69±2.06	5.52±0.33*	6.20±1.13 †	8.97±2.36‡	7.89±2.39	<0.001
FPG (mg/dL)	119.23±59.29	90.41±8.95*	97.67±16.41*	184.76±75.87†	150.18±73.37	<0.001
2-hr OGTT (mg/dL)	191.70±120.25	113.86±14.83*	159.44±20.48†	351.63±110.16‡	274.18±127.89	<0.001
Serum c-peptide (ng/mL)	2.66±1.48	2.24±1.01*	2.73±1.27†	3.29±1.95†	3.07±1.73	0.001
HOMA-IR	5.27±6.35	3.02±2.35*	4.60±3.79*	10.04±9.74†	7.75±8.21	<0.001

Table 2. Sensitivities and specificities of different diagnostic factors level for diagnosing diabetes

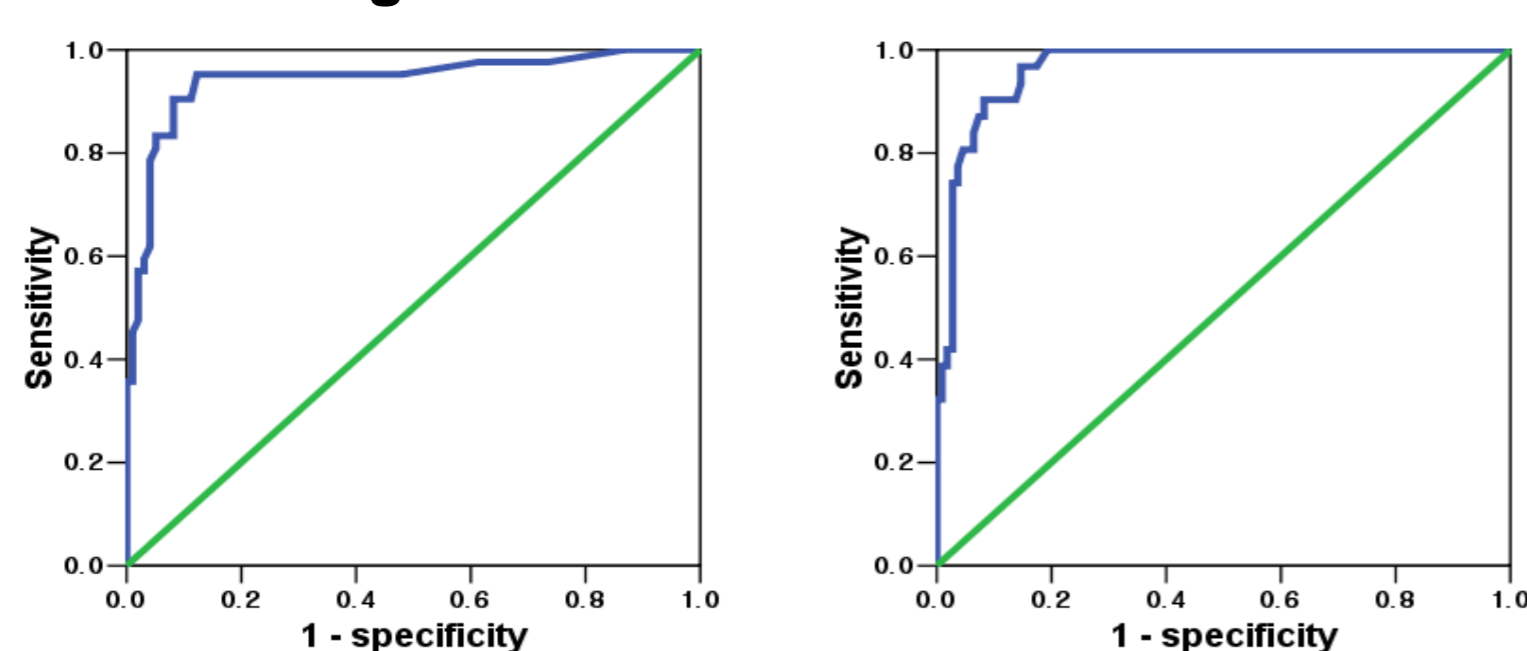
		Non-DM (%)	DM (%)	Total (%)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	P value	K coefficient
HbA1c	<6.5%	93 (100.0)	5 (10.0)	98 (68.5)	90.0	100.0	100.0	94.9	<0.001	0.921
	$\geq 6.5\%$	0 (0.0)	45 (90.0)	45 (31.5)						
	Total	93 (100.0)	50 (100.0)	143 (100.0)						
FPG	<126 mg/dL	94 (100.0)	18 (36.7)	112 (78.3)	63.3	100.0	100.0	83.9	<0.001	0.694
	≥ 126 mg/dL	0 (0.0)	31 (63.3)	31 (21.7)						
	Total	94 (100.0)	49 (100.0)	143 (100.0)						
2-hr OGTT	<200 mg/dL	94 (100.0)	7 (14.3)	101 (70.6)	85.7	100.0	100.0	93.1	<0.001	0.887
	≥ 200 mg/dL	0 (0.0)	42 (85.7)	42 (29.4)						
	Total	94 (100.0)	49 (100.0)	143 (100.0)						

PPV : positive predictive value
NPV : negative predictive value

Table 3. P value and kappa coefficient of different diagnostic factors with HbA1c level for diagnosing diabetes

		HbA1c <6.5% (%)	HbA1c $\geq 6.5\%$ (%)	Total (%)	P value	K coefficient
FPG (%)	<126 mg/dL	96 (85.7)	16 (14.3)	112 (100.0)	<0.001	0.681
	≥ 126 mg/dL	2 (6.5)	29 (93.5)	31 (100.0)		
	Total	98 (68.5)	45 (31.5)	143 (100.0)		
FPG and/or 2-hr OGTT (%)	<126 mg/dL and <200 mg/dL	93 (93.9)	6 (6.1)	99 (100.0)	<0.001	0.821
	≥ 126 mg/dL or ≥ 200 mg/dL	5 (11.4)	39 (88.6)	44 (100.0)		
	Total	98 (68.5)	45 (31.5)	143 (100.0)		
2-hr OGTT (%)	<200 mg/dL	93 (92.1)	8 (7.9)	101 (100.0)	<0.001	0.785
	≥ 200 mg/dL	5 (11.9)	37 (88.1)	42 (100.0)		
	Total	98 (68.5)	45 (31.5)	143 (100.0)		

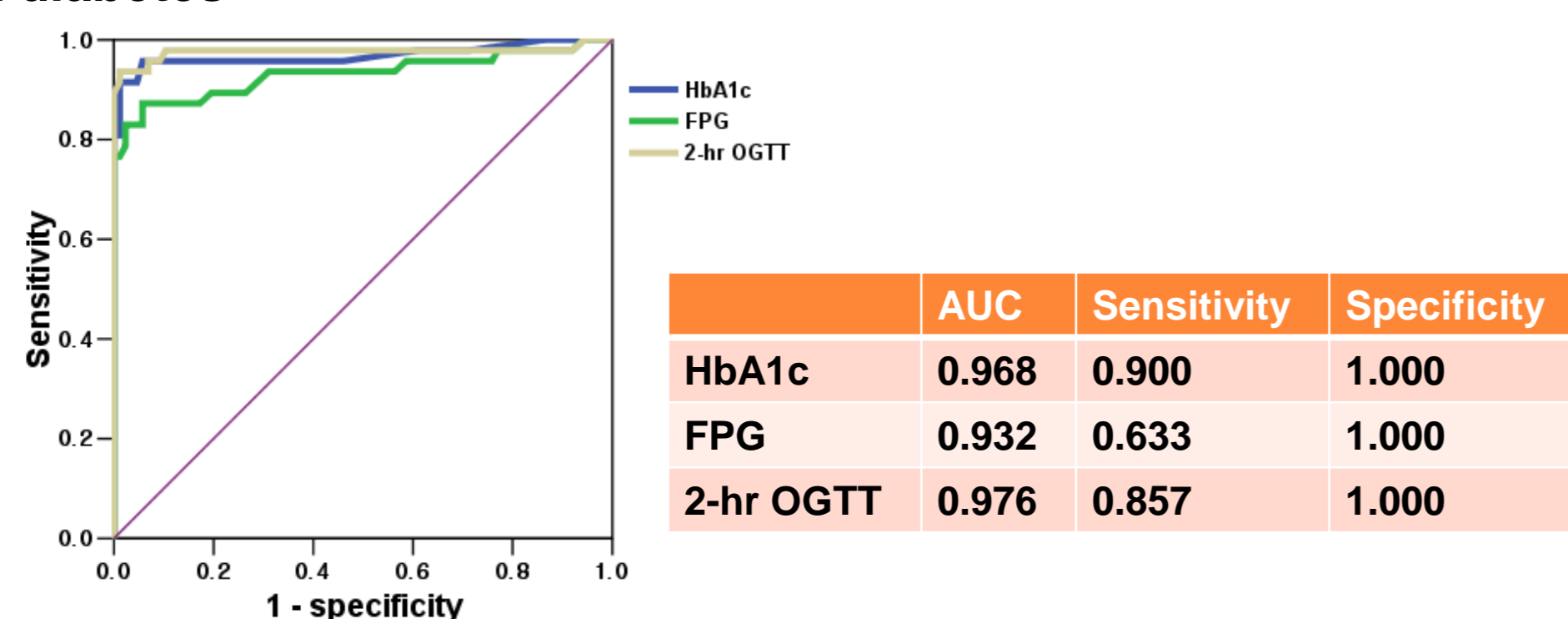
Fig 1. The ROC curves of HbA1c level for identifying subjects with diabetes according to FPG and 2-hr OGTT criteria



AUC of HbA1c according to 2-hr OGTT = 0.943

AUC of HbA1c according to FPG = 0.965

Fig 2. The ROC curves of diagnostic factors level for identifying subjects with diabetes



HbA1c level (%)	Sensitivity	Specificity	PPV	NPV
6.25	0.917	0.956	0.920	0.956
6.35	0.917	0.989	0.979	0.957
6.45	0.896	0.989	0.978	0.947
6.55	0.854	0.989	0.977	0.928
6.65	0.813	0.989	0.976	0.909

FPG (mg/dL)	Sensitivity	Specificity	PPV	NPV
110.0	0.833	0.956	0.909	0.918
112.5	0.833	0.967	0.930	0.918
114.5	0.833	0.978	0.952	0.919
116.5	0.771	0.989	0.974	0.893
127.5	0.625	1.000	1.000	0.838

Conclusion

As a screening test for diagnosing diabetes, HbA1c is showed a substantial agreement with fasting plasma glucose and 2-hr OGTT level for diagnosing diabetes among children and adolescents. Students with HbA1c of 6.35% to 6.5% or FPG of 114 mg/dL to 125 mg/dL should be tested OGTT to confirm diagnosis of diabetes.