Elevated HbA1c and cardiometabolic risk factors in Korean adolescents: the Korea National Health and Nutrition Examination Survey 2011-2012 (KNHANES V-2,3)

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Background

Prediabetes often precedes type 2 diabetes, which is associated with obesity and increased risk of developing cardiovascular disease. Haemoglobin A1c (HbA1c) has been recently recommended as a useful tool for the diagnosis of diabetes and prediabetes.

Objective

We therefore investigated whether prediabetes according to HbA1c was associated with cardiometabolic risk factors in Korean children and adolescents.

Methods

We used data from the 2011-2012 Korea National Health and Nutrition Examination Survey (KNHANES), which is the nationally representative database. In total, 1,581 subjects aged 10-19 years were assessed. We classified the subjects into two groups based on HbA1c level (the normoglycemia group with HbA1c of < 5.7%; the prediabetes group with HbA1c of 5.7-6.4%). Clinical characteristics and cardiometabolic risk factors between the normoglycemia and prediabetes groups were compared.

Results

Table 1. Characteristics of all subjects according to HbA1c

		Normal (HbA1c <5.7%) (N=1,276)	Prediabetes (HbA1c ≥5.7%) (N=305)	P-value
Age (years)		14.8 ± 0.1	14.3 ± 0.2	0.03
Sex (Male:Female)		658 (52.2%) : 618 (47.8%)	171 (55.7%) : 134 (44.3%)	0.38
Height (cm)		162.2 ± 0.4	162.2 ± 0.8	0.985
Weight (kg)		54.9 ± 0.5	57.8 ± .1.1	0.018
Body mass index (kg/m^2)		20.6 ± 0.1	21.8 ± 0.3	<0.001
Obesity	Normal (%)	1007 (77.9%)	205 (66.5%)	0.001
	Overweight (%)	143 (11.1%)	43 (12.9%)	
	Obesity (%)	126 (11.0%)	57 (20.6%)	
Obesity	Normal (%)	1007 (77.9%)	205 (66.5%)	<0.001
	Overweight/Obesity (%)	269 (22.1%)	100 (33.5%)	
Waist circumference (cm)		69.2 ± 0.3	72.2 ± 0.8	<0.001
Waist circumference to height ratio		0.43 ± 0.001	0.45 ± 0.004	<0.001
Systolic blood pressure (mm Hg)		107.0 ± 0.4	107.1 ± 0.7	0.825
Diastolic blood pressure (mm Hg)		66.5 ± 0.4	65.7 ± 0.8	0.337
Total cholesterol (mg/dL)		156.8 ± 1.1	167.9 ± 2.2	<0.001
Triglyceride (mg/dL)		67.4 ± 1.4	88.6 ± 3.3	<0.001
HDL cholesterol (mg/dL)		50.9 ± 0.4	50.8 ± 0.9	0.928
Non-HDL cholesterol (mg/dL)		105.9 ± 1.0	117.1 ± 2.2	<0.001
Triglyceride/HDL		1.44 ± 0.03	1.58 ± 0.08	0.073
Fasting glucose (mg/dL)		87.9 ± 0.3	91.2 ± 0.4	<0.001
HbA1c (%)		5.32 ± 0.01	5.78 ± 0.01	<0.001
Serum AST (IU/L)		17.3 ± 0.2	19.0 ± 0.5	<0.001
Serum ALT (IU/L)		11.1 ± 0.2	17.9 ± 1.0	<0.001
Metabolic syndrome (%)		12 (1.4%)	7 (3.5%)	0.098
Central obesity (%)		87 (7.3 %)	41 (16.7%)	0.004
Hypertension (%)		35 (3.7%)	6 (1.3%)	0.012
Hyperglycemia (%)		47 (3.7%)	33 (9.1%)	0.001
Hypertriglyceridemia (%)		76 (7.7%)	40 (14.5%)	0.003
Low HDL-cholesterol (%)		185 (16.3%)	45 (19.2%)	0.473

Data are expressed as weighted mean ± SE or number (weighted percent).

Table 2. Comparison of characteristics between normal weight and overweight/obesity groups in both normoglycemia and prediabetes groups

	HbA1c <5.7%			HbA1c ≥5.7%		
	Normal weight (n=1,007)	Overweight/ obesity (n=269)	P-value	Normal weight (n=205)	Overweight/ obesity (n=100)	P-value
Age (years)	14.6 ± 0.1	15.5 ± 0.2	<0.001	14.0 ± 0.2	15.1 ± 0.3	0.003
Sex (male:female)	499:508	159:110	0.007	113:92	58:42:00	0.807
Height (cm)	160.9 ± 0.4	166.8 ± 0.7	<0.001	161.3 ± 0.9	164.0 ± 1.3	0.052
Weight (kg)	50.0 ± 0.4	72.2 ± 0.9	<0.001	50.7 ± 0.9	71.8 ± 1.7	<0.001
Body mass index (kg/m^2)	19.1 ± 0.1	25.7 ± 0.2	<0.001	19.3 ± 0.2	26.5 ± 0.4	<0.001
Waist circumference (cm)	65.6 ± 0.2	81.9 ± 0.5	<0.001	66.7 ± 0.6	83.3 ± 1.0	<0.001
Waist circumference to height ratio	0.41 ± 0.001	0.49 ± 0.003	<0.001	0.41 ± 0.003	0.51 ± 0.005	<0.001
Systolic blood pressure (mm Hg)	105.4 ± 0.4	112.6 ± 0.8	<0.001	105.8 ± 0.8	109.9 ± 1.0	0.001
Diastolic blood pressure (mm Hg)	65.7 ± 0.4	69.5 ± 0.8	<0.001	65.3 ± 0.9	66.6 ± 1.1	0.291
Total cholesterol (mg/dL)	155.7 ± 1.2	160.4 ± 2.6	0.084	162.7 ± 2.5	178.0 ± 4.0	0.002
Triglyceride (mg/dL)	67.4 ± 1.4	88.6 ± 3.3	<0.001	67.1 ± 2.9	107.1 ± 7.0	<0.001
HDL cholesterol (mg/dL)	52.2 ± 0.4	46.1 ± 0.6	<0.001	53.2 ± 1.1	46.1 ± 1.1	<0.001
Non-HDL cholesterol (mg/dL)	103.5 ± 1.0	114.3 ± 2.5	<0.001	109.5 ± 2.2	132.0 ± 4.0	<0.001
TG/HDL ratio	1.30 ± 0.03	1.95 ± 0.08	<0.001	1.29 ± 0.07	2.37 ± 0.19	<0.001
Fasting glucose (mg/dL)	87.6 ± 0.3	88.9 ± 0.5	0.008	90.5 ± 0.5	92.6 ± 1.0	0.051
Hb A1c (%)	5.32 ± 0.01	5.35 ± 0.01	0.059	5.8 ± 0.01	5.8 ± 0.01	0.42
Serum AST (IU/L)	17.3 ± 0.2	19.0 ± 0.5	<0.001	18.1 ± 0.4	20.5 ± 0.9	0.01
Serum ALT (IU/L)	11.1 ± 0.2	17.9 ± 1.0	<0.001	11.7 ± 0.4	20.1 ± 1.5	<0.001
Metabolic syndrome (%)	0 (0%)	12 (6.5%)	<0.001	0 (0%)	7 (10.5%)	0.001
Central obesity (%)	1 (0.04%)	86 (32.8%)	<0.001	2 (2.0%)	39 (45.7%)	<0.001
Hypertension (%)	16 (2.0%)	19 (9.8%)	<0.001	5 (1.7%)	1 (0.6%)	0.322
Hyperglycemia (%)	34 (3.2%)	13 (5.1%)	0.157	18 (6.7%)	15 (13.6%)	0.128
Hypertriglyceridemia (%)	43 (5.6%)	33 (15.1%)	0.001	12 (5.9%)	28 (31.5%)	<0.001
Low HDL-cholesterol (%)	114 (13.0%)	71 (28.1%)	<0.001	21 (14.1%)	24 (29.3%)	0.014

Data are expressed as weighted mean ± SE or number (weighted percent).

Table 3. Adjusted odds ratio (95% CI) of cardiometabolic risk factors for predicting prediabetes (HbA1c 5.7-6.4%)

	OR (95% CI)	P-value
Obesity	1.52 (1.26, 1.84)	<0.001
Abdominal obesity	2.75 (1.71, 4.41)	<0.001
Hypertension	1.01 (0.62, 1.67)	0.955
hypertriglyceridemia	2.02 (1.24, 3.29)	0.005
Low HDL	1.40 (0.81, 2.41)	0.225
TG/HDL >3	1.87 (1.21, 2.86)	0.004
AST	2.32 (1.25, 4.30)	0.008
ALT	2.65 (1.57, 4.48)	<0.001

All models were adjusted for age, sex, and income.
TG, triglyceride

Conclusion

Prediabetic HbA1c levels in Korean children and adolescents were strongly associated with increased cardiometabolic risk factors. HbA1c might be a useful marker to assess cardiometabolic risk in children and adolescents.

Disclosure statement

Nothing to declare

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