

Prediabetes and Diabetes among Older Children with Obesity in a Diverse Northern California Population



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Abstract

Purpose: To examine the prevalence of prediabetes or diabetes by race/ethnicity, weight, and health behaviors among children with obesity in order to identify metabolic disparities and modifiable behaviors prior to adulthood.

Methods: Data were examined from 2296 children 10-17 years of age who were identified to have obesity (body mass index \geq 95th percentile) at well-child visits in 2012-2013. They completed a questionnaire pertaining to dietary and lifestyle behaviors (including juice or sugar-sweetened beverage intake and exercise frequency) at the visit and also had fasting glucose or hemoglobin A1C measured within 1 year. Obesity was classified as moderate or severe, and glycemic status was examined using standard laboratory criteria for prediabetes and diabetes.

Results: Of 2296 children (mean age 13 years, 21% non-Hispanic white), the prevalence of prediabetes (31.8%) or diabetes (1.3%) was 33.1% overall; among 2049 children, 9.6% were classified by fasting glucose alone, and among 1548 children, 43.2% were classified by hemoglobin A1c alone. The prevalence of prediabetes or diabetes varied substantially by race/ethnicity and increased with severity of obesity, but did not differ by exercise level or consumption of sugar sweetened beverage or juice.

Conclusion: One in three children with obesity had prediabetes or diabetes based on laboratory findings. The prevalence of prediabetes or diabetes increased with obesity severity and varied by race/ethnicity. Future studies should examine racial/ethnic differences in glycemic status, including variation by fasting glucose and hemoglobin A1C among these high risk children.

Keywords: Prediabetes; Adolescence; Body mass index; Obesity

Abbreviations: HbA1C: Hemoglobin A1C; OR: Odds Ratio

Introduction

Approximately 20.6% of U.S. adolescents 12-19 years of age are obese, an increase of nearly 2-fold within the past 20 years [1]. The prevalence of prediabetes and diabetes has also increased among U.S. adolescents, based on fasting glucose levels [2] and/or hemoglobin A1C [3], increasing the risk of cardiovascular disease in adulthood. Currently, data from diverse pediatric populations receiving health care remain limited. In this study, we examined the prevalence of prediabetes and diabetes and associated health behaviors among northern

California children with obesity to characterize their metabolic risk and identify modifiable behaviors prior to adulthood.

Methods

The source cohort included 4856 children 10-17 years of age with body mass index \geq 95th percentile identified at well-child visits from 2012-2013 as part of Kaiser Permanente Northern California's "Get Healthy Action Plan", a pediatric clinic-based weight program that assessed all children with elevated BMI from participating pediatric clinics [4]. Parents or teens were

asked to complete a questionnaire about dietary and lifestyle behaviors, including juice or sugar-sweetened beverage (SSB) intake and exercise frequency. The study was approved by the Kaiser Permanente Northern California Institutional Review Board and the requirement for informed consent was waived due to the nature of the study. For these analyses, we examined data from the 2296 children with fasting glucose and/or HbA1C measured within 1 year of their visit. A fasting glucose of 100-125mg/dL or HbA1c of 5.7-6.4% defined prediabetes and higher values were considered diabetes range. Moderate and severe obesity were defined by a body mass index 100-119% and ≥120% of the 95th percentile, respectively. Subgroups were compared using the chi-square test, with a p-value criterion of <0.05 for statistical significance (SAS 9.4, Cary NC).

Results

Among 2296 children (mean age 13.1±2.2 years), 69.6% were 10-14 years of age. The cohort was extremely diverse, with 21.4% non-Hispanic white, 11.8% black, 46.1% Hispanic, 13.5% Asian/Pacific Islander and 7.2% other/unknown race. There were 761 (33.1%) individuals who met laboratory criteria for prediabetes (N=731, 31.8%) or diabetes (N=30, 1.3%), with a prevalence of 9.6% among 2049 children by fasting glucose

alone and 43.2% among 1548 children by HbA1C alone (with measurements). Notably, among the 1301 children with fasting glucose and HbA1c obtained within 1 year of the visit (including results on separate days, taking the value on the closest date to the well-child visit), 12.0% and 43.7% had prediabetes or diabetes by fasting glucose and HbA1C, respectively, with a prevalence of 46.2% by either test criteria.

Using data from fasting glucose, HbA1C, or both to classify glycemic status, the prevalence of prediabetes or diabetes varied by race/ethnicity and was highest for black (47.6%) and Asian (39.7%) children followed by Hispanic (33.3%) and white children (21.8%, p<0.05). Prediabetes or diabetes prevalence increased with obesity severity, with 28.3% for moderate obesity versus 38.8% for severe obesity (p<0.001; Table 1). Black (adjusted odds ratio, OR 3.1, 95% confidence interval CI 2.2-4.2), Asian (OR 2.5, 95% CI 1.8-3.4) and Hispanic (OR 1.8, 95% CI 1.4-2.3) children had a higher odds of prediabetes or diabetes than white children after accounting for age, sex and body mass index. Exercise and sugar sweetened beverage or juice intake did not differ significantly by prediabetes or diabetes status (Table 1), with notably high proportions of children with (60.5%) and without (57.6%) prediabetes or diabetes consuming at least 2 sugar sweetened beverage/juice drinks per day.

Table 1: Demographic weight and behavioral characteristics among children with obesity 10-17 years of age, by prediabetes/diabetes status.

	N	No Prediabetes/Diabetes	Prediabetes or Diabetes
ALL*	2296*	1535(66.9%)	761(33.1%)
Gender			
Female	1124	761(67.7%)	363(32.3%)
Male	1172	774(66.0%)	398(34.0%)
Race/Ethnicity			
White	491	384(78.2%)	107(21.8%)
Black	271	142(52.4%)	129(47.6%)
Hispanic	1059	706(66.7%)	353(33.3%)
Asian/Pacific Islander	310	187(60.3%)	123(39.7%)
Other/Unknown	165	116(70.3%)	49(29.7%)
Weight Category			
Moderate obesity	1240	889(71.7%)	351(28.3%)
Severe obesity	1056	646(61.2%)	410(38.8%)
Sugar-Sweetened Beverage(SSB) or Juice Intake**			
<2 SSB/juice per day	938	642(68.4%)	296(31.6%)
≥2 SSB/juice per day	1326	873(65.8%)	453(34.2%)
Exercise Level**			
<3x per week	881	590(67.0%)	291(33.0%)
≥3x per week	1354	912(67.4%)	442(32.6%)

* Row percentage among N=2296 with either fasting glucose (N=2049) or Hemoglobin A1c (N=1548) values.

** Among 2264 and 2235 respondents reporting sugar sweetened beverage (SSB)/ juice intake and exercise level (for at least 60 minutes, excluding school

Discussion

In a diverse population of children 10-17 years of age with obesity, 1 in 3 met criteria for prediabetes or diabetes, with only 1.3% in the diabetes range. The prevalence of prediabetes or diabetes also increased with obesity severity but did not differ by certain health behaviors. Our prediabetes estimate of 31.8% is higher than that reported for U.S. adolescents [5] which may be expected for an ethnically-diverse pediatric obesity cohort; however, our observed prevalence based on fasting glucose compared to HbA1C criteria differs from national estimates [2]. Tester et al. [6] similarly reported a higher prediabetes prevalence using HbA1C (31.6%) compared to fasting glucose level (7.8%) in 1356 northern California children with obesity aged 2-19 years (36.0% and 9.4% for adolescents, respectively). Whether differences in laboratory procedures or assays, selection for obesity, and ethnic or pediatric variation in the predictive value of HbA1C and fasting glucose thresholds contribute to these findings is unclear [7-9]. In this study, we combined findings from both fasting glucose and HbA1C to classify prediabetes and diabetes. However, future studies should also examine the extent to which race/ethnicity contributes to variation in glycemic status among children with obesity.

In summary, we observed a high prevalence of prediabetes or diabetes among children with obesity. While our data are cross-sectional and focus on a diverse community-based pediatric cohort in the healthcare setting, these findings may have implications for population management. The much higher prevalence of prediabetes identified by HbA1C in our study and the limited sensitivity and predictive value of HbA1C thresholds and/or correlation with fasting glucose reported in other pediatric studies [7,9,10] underscore the need to determine the optimal screening test thresholds for metabolic risk in children with obesity. In the meantime, continued efforts toward behavioral targets for weight reduction and improved glucose homeostasis are paramount to promoting prevention of metabolic disease into adulthood.

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