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Race/ethnicity and measures of glycaemia in the year after diagnosis among youth with type 1 and type 2 diabetes mellitus☆,☆☆

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ABSTRACT

Aims: To assess associations between race/ethnicity, glycated hemoglobin (HbA1c), and glycemic control among youth with type 1 (T1D) or type 2 diabetes (T2D).
Methods: The study sample was youth < 20 years old from the SEARCH California Center diagnosed from 2002 to 2009 who remained insured for at least one year. HbA1c at one year was from clinical data; HbA1c at diagnosis was from clinical data (81%) or imputed (19%). Multivariable logistic and linear regression models were used to examine associations between race/ethnicity and poor glycemic control (≥9.5%), HbA1c at one-year, and change in HbA1c.
Results: The study included 1162 Hispanic (52.3%), non-Hispanic White (NHW, 28.4%), African American (15.1%) and Asian/Pacific Islander (4.1%) youth. Among T1D youth (n = 789), Hispanics were 1.60 times as likely (95% CI 1.01–2.53) to have poor control at one year compared to NHWs, after adjustments. Among T2D youth (n = 373), only African American youth were significantly more likely (OR = 4.85; 95% CI 1.49–15.77) to have poor control at one year, after adjustments. HbA1c at one year and change in HbA1c did not differ by race/ethnicity.
Conclusion: Poor glycemic control was evident one year after diagnosis in some minority youth with T1D or T2D in an integrated managed health care setting.

1. Introduction

Individuals with diabetes are at risk for serious long term complications, such as neuropathy, nephropathy, retinopathy, cardiovascular disease, and stroke (Nathan et al., 2009; Stolar, 2010). These conditions negatively impact quality of life and cost the United States $245 billion in direct and indirect medical costs in 2012 (American Diabetes Association, 2013). Several diabetes-related complications disproportionately affect persons with diabetes from racial and ethnic minority populations (Roy, Peng, & Roy, 2007; Wong et al., 2006; Young, Maynard, & Boyko, 2003; Young, Maynard, Reiber, & Boyko, 2003).

Good glycemic control, which requires achieving and maintaining near-normal blood sugar levels while avoiding severe hypoglycemia, can prevent or delay the onset or progression of some long term complications (Diabetes Control and Complications Trial (DCCT) Research Group, 1993; UK Prospective Diabetes Study (UKPDS) Group, 1998) and represents an important clinical goal for the management of type 1 (T1D) and type 2 diabetes (T2D) (American Diabetes Association, 2011). SEARCH for Diabetes in Youth and other studies have reported that minority youth have worse glycemic control than non-Hispanic White (NHW) youth in the years following diagnosis (Auslander, Thompson, Dreitzer, White, & Santiago, 1997; Delamater et al., 1999; Gallegos-Macias, Macias, Kaufman, Skipper, & Kalishman, 2003; Petitti et al., 2009). Some evidence suggests that adjusting for socioeconomic status (SES) attenuates but does not eliminate differences observed by race/ethnicity (Auslander et al., 1997), while other studies suggests that SES may largely account for the racial/ethnic disparities in glycemic control among youth with diabetes (Beck et al., 2009; Gallegos-Macias et al., 2003; Lipton, Zierold, Drum, Klein-Gitelman, & Kohrman, 2002; Springer et al., 2006). SES assessments in previous studies have included health insurance status (Auslander et al., 1997; Beck et al., 2009; Delamater et al., 1999; Gallegos-Macias et al., 2003; Lipton et al., 2002; Petitti et al., 2009), household income (Gallegos-Macias et al., 2003; Lipton et al., 2002; Petitti et al., 2009), household structure (Petitti et al.,

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2009), parental education (Auslander et al., 1997; Gallegos-Macias et al., 2003; Lipton et al., 2002; Petitti et al., 2009), and median household income in the census block (Springer et al., 2006).

To assess whether racial/ethnic differences in glycemic control were evident in an insured cohort of socioeconomically diverse youth, we explored glycemic control and glycated haemoglobin (HbA1c) levels at approximately one year after diagnosis, as well as change in HbA1c from diagnosis to 12 months among youth with T1D or T2D.

2. Subjects, Materials, and Methods

SEARCH is a multi-center study that in 2001 began conducting population-based ascertainment of youth who were <20 years of age when diagnosed with diabetes (SEARCH Study Group, 2004). SEARCH recruited youth from four geographically-defined populations, Indian Health Service beneficiaries from four American Indian populations, and enrollees in several managed health care plans. Institutional review board(s) for each site approved the study protocol. All registered cases were asked to complete a brief initial survey; survey respondents were invited to a research visit. The sample for these analyses is composed of youth newly-diagnosed with diabetes from 2002 through 2009 (incident cases) who were registered by the SEARCH California center. Eligibility criteria for incident cases included Kaiser Permanente Southern California (KPSC) Health plan membership at the time of diabetes diagnosis and residence in one of the seven counties comprising the surveillance area for the SEARCH study in California. At this SEARCH center, 1660 youth were diagnosed with diabetes from 2002 through 2009.

Date of birth, date of diabetes diagnosis, race/ethnicity, sex, and clinical diabetes type were obtained for each youth as part of the SEARCH study protocol. Type of diabetes was based on the physician's clinical assessment. Race/ethnicity was collected as part of the initial participant survey using 2000 U.S. Census question format (U.S. Department of Census, 2000) for most participants and categorized as Hispanic (regardless of race), NHW, African American, Asian/Pacific Islanders, and persons of multiple race and unknown race/ethnicity.

All of the other variables included in these analyses were obtained from KPSC clinical and administrative databases. HbA1c was measured as a part of clinical care. All blood samples were drawn in local outpatient medical offices and hospitals throughout the region, transferred to the KPSC Regional Reference Laboratory, and tested using the Roche immunoassay (Roche Diagnostics, Indianapolis). Two HbA1c values were used for this study: the HbA1c measured closest to the date of diabetes diagnosis within a time window 30 days before and after the diagnosis date ("diagnosis HbA1c"), and HbA1c measured closest to one year after the diagnosis date within a time window 90 days before and 365 days after the 12 month date ("one-year HbA1c"). We allowed this time window to be more skewed to the right to include the maximum number of youth in the analysis. Change in HbA1c was calculated as the difference between these two measures. To assess glycemic control at approximately one year after diagnosis, the one-year HbA1c values were categorized using the American Diabetes Association (ADA) recommended age-specific cut-points for good control (<8.5% for age <6 years, <8.0% for age 6–12 years, <7.5% for age 13–18 years, and <7.0% for age ≥19 years) (American Diabetes Association (ADA) (ADA), 2011). Poor control was defined as ≥9.5%, regardless of age, based on the Diabetes Control and Complications Trial (DCCT) adolescent control group documenting risk for complications (White et al., 2001), and for consistency with previous SEARCH analyses (Petitti et al., 2009).

Diabetes pharmacological treatment was based on outpatient prescriptions filled for insulin and oral antidiabetic agents (metformin, sulfonylureas and other drugs to treat diabetes) which covered some or all of the 90 day period before the one-year HbA1c measurement. Receipt of care from an endocrinologist was evaluated by identifying all endocrinologists (pediatric and adult) who practiced in KPSC during the study period by name and querying the outpatient records to determine which participants had seen at least one endocrinologist at any time in the year after diagnosis. SES was assessed for each participant in two ways: 1) payer for insurance dichotomized as private/employer-based or self-pay ("privately-insured") and Medicaid or other low-income program ("publically-insured"), and 2) median household income in the census block of residence at the time of diabetes diagnosis.

2.1. Sample Selection

We restricted our study to youth with at least 12 months of continuous health plan membership (insurance) after the date of diagnosis in order to assess the primary study outcome. Disenrollment from the health plan in the year after diagnosis affected 17% of youth and was slightly more common in youth with T2D (20%) than T1D (16%) (data not shown). Nearly half of youth with T2D compared to less than 20% of youth with T1D were 15–19 years old at diagnosis, an age where changes in insurance are more common. Of the 1328 youth with T1D or T2D in the 2002–2009 incident cohort years that remained insured for at least one year after diagnosis, exclusions were made sequentially for missing HbA1c measurements around one year after diagnosis (n = 124 [9.3%]) and missing race/ethnicity (n = 42 [3.2%]), resulting in a final sample size of 1162 (87.5% of the cohort) for this analysis (Fig. 1).

2.2. Statistical Analysis

All analyses were conducted using SAS 9.2 statistical software (SAS Institute, Cary, North Carolina). Associations between categorical characteristics and race/ethnicity stratified by diabetes type were assessed using chi-square tests; Fisher's exact test was used for categorical traits with expected counts <10. Differences in mean continuous characteristics by racial/ethnic group were assessed with one-way analysis of variance (ANOVA). Continuous HbA1c values were log transformed to approximate univariate normality. Geometric means are presented for HbA1c, with standard errors (SE) computed by the Delta Method (Oehlert, 1992; Feb). Diagnosis HbA1c values were adjusted for age at diagnosis, sex, and payer for insurance and one-year HbA1c values were additionally adjusted for care by an endocrinologist, antidiabetic medication use in the 90 days before the one-year HbA1c test date, diagnosis HbA1c and time from diabetes diagnosis to the one-year HbA1c test date.

The associations of race/ethnicity and HbA1c as a continuous variable and as a categorical variable based on age-specific targets for glycemic control were examined at approximately one year after diagnosis. Additionally, we decided a priori to examine the change in HbA1c from diagnosis to one year post-diagnosis to assess whether any observed difference in HbA1c at one year could be attributed to higher HbA1c at diagnosis or differences in the percent decline by racial/ethnic group. Multivariable logistic regression was used to examine the association of race/ethnicity and poor glycemic control (HbA1c > 9.5%) at approximately 1 year after diagnosis (Model 1). Multivariable linear regression was used to examine the association of race/ethnicity with log HbA1c at one-year (Model 2) and change in A1c between diagnosis and one-year (Model 3). Since the distribution of the change in HbA1c was approximately normal, no transformation was required. Regression coefficients in Model 3 indicate the change in HbA1c over one year; negative coefficients reflect larger declines and positive coefficients reflect smaller declines. Two measures of SES, payer for insurance and median household income tertile, were considered as potential confounders, and their correlation was examined to avoid potential multicolinearity. If there was