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Changes in Type 1 Diabetes Health Indicators from High School to College

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Abstract

Objective—Evaluate trajectories of type 1 diabetes health indicators from high school through the first year of college.

Participants—Seventy-four students with type 1 diabetes who maintained pediatric endocrinology care during the first year of college.

Methods—HbA1c, blood glucose monitoring frequency, BMI, and clinic attendance data were collected via retrospective medical chart review in spring, 2012. Group-based trajectory models evaluated diabetes-related health indicators over time and identified distinct growth trajectory groups.

Results—BMI increased and clinic attendance decreased in the first year of college. Trajectories for other health indicators were heterogeneous and stable over time; 69% of students were classified as having stable good glycemic control. Racial minority youth and youth on conventional insulin regimens were disproportionally represented in higher-risk groups.

Conclusions—Diabetes health indicators are stable or decline upon college entrance. Results signal the need for targeted support for college students with type 1 diabetes.

Diabetes affects 1 in 433 youth under age 20,¹ and over 53,000 students with type 1 diabetes (T1DM) currently attend college across the U.S.² T1DM management requires frequent blood glucose (BG) monitoring, insulin administration, and attention to diet, physical activity, and acute complications.³ Young adults are at increased risk for T1DM-related complications, and >80% of young adults with T1DM routinely fail to meet recommendations for glycemic control.⁴ Limited research suggests that clear trajectories of glycemic control first emerge by age 17 and are maintained or further diverge across early adulthood.⁵

Entering college is a seminal time when many young adults assume independent responsibility for T1DM management.⁶ However, changes in routine, decreased parental involvement, and increased exposure to risky behaviors during college may disrupt diabetes

self-care and potentially set the stage for enduring health outcomes.^{7, 8} Prior research with young adults with T1DM has failed to disentangle developmental transitions, such as entering college, from the transfer from pediatric to adult care.^{9, 10} Yet research suggests that up to 50% of young adults remain in pediatric endocrinology care the first year after high school.^{9, 11} Evaluation of health indicators in rising college students with T1DM can direct prevention and intervention efforts of health care providers.

This study employed retrospective medical chart review to explore change in T1DM health indicators, including hemoglobin A1c (HbA1c), BG monitoring frequency, body mass index (BMI), and medical visit frequency, across the transition from high school to college for students maintaining T1DM care in a pediatric endocrinology practice. It was hypothesized that T1DM health indicators would remain stable or worsen during the first year of college.

Methods

Participants

Participants were 74 college students with T1DM receiving treatment at a mid-Atlantic pediatric diabetes center. The sample included young adults (53% male; 65% Caucasian) ages 17–20 years (*M* age upon entering college=18.6±.5) enrolled in higher education (65% in-state college; 35% out-of-state college). Most students were prescribed intensive insulin regimens (82%; e.g., multiple daily injections, pump therapy), which offer flexibility in insulin administration, versus conventional insulin regimens, which require a fixed number of insulin doses per day. Participants were diagnosed with T1DM for a mean of 9.0 years ±4.0 years.

Procedures

This retrospective cohort study utilized medical chart review to identify patients with T1DM who were freshmen in college from 2007–2010, were seen in the pediatric setting for at least one year after entering college, and did not have another major medical condition (e.g. cystic fibrosis). A patient list was generated from the electronic medical record and clinic letters were reviewed to confirm a “transition point” (i.e., discrete move from high school to college) so that clinical data could be isolated for one year prior to one year following the identified transition point. The initial medical record extraction identified 178 patients; 75 were ineligible due to age, diagnosis, or lack of college attendance. Additionally, 17 patients had no visits during college and 12 patients had insufficient information to determine college status and/or health indicators, resulting in a final sample of 74 participants. Data were independently reviewed by two coders and de-identified to protect personal health information. This study was approved by the Institutional Review Board.

Sex, race, date of birth, diagnosis date, and insulin regimen were obtained for all participants via medical chart review. HbA1c, height/weight, and number of clinic visits over the two year period were collected from review of medical charts and physician-generated medical clinic letters. BG monitoring frequency (30 days) was collected from downloaded glucometer data or analysis of written BG data. The number of medical clinic visits one year pre- and post-college entrance was summed.

Analyses

Descriptive statistics were generated for all variables pre- and post-college entrance, including HbA1c, BG monitoring frequency, BMI, and clinic visit attendance. Correlational analyses (continuous variables, i.e. age) and chi square analyses (categorical variables, i.e. race) evaluated relations among demographic characteristics and T1DM indicators pre-college. Paired *t*-tests were used to investigate differences over time for HbA1c, BG frequency, BMI, and clinic attendance. Group-based trajectory models, using SAS Proc Traj procedure, were applied for longitudinal analysis on health outcome change over time; the unknown a priori trajectory groups of the T1DM indicators were identified and participants were classified into their most likely trajectory group.^{12, 13} Relations between group membership and individual characteristics were examined.

Results

Demographics and T1DM Health Indicators

Age at diagnosis was significantly correlated with pre-college HbA1c. Young adults diagnosed at older ages had better glycemic control. Intensive insulin regimens were associated with lower HbA1c and higher BG monitoring frequency. Caucasian students had lower HbA1c, higher BG monitoring frequency, and lower BMI than non-Caucasian students. No other significant differences were found for T1DM health indicators.

Change from Pre- to Post-College Entrance

Paired *t*-tests revealed a significant increase in BMI from pre-college ($M=20.8\pm 4.1$) to post-college start ($M=21.7\pm 4.3$; $t=-2.29$, $p<.05$, Cohen's $d=.27$). The number of clinic visits decreased after starting college, with participants attending a mean of 3.2 medical visits (± 0.8) the last year of high school vs. 2.2 medical visits (± 0.8) the first year of college ($t=9.14$, $p < .01$, $d=1.06$). This difference was not related to college location, as in-state students (2.27 visits) attended a similar number of visits as out-of-state students (2.04 visits), ($t=1.89$, $p=.24$). There were no significant changes from pre- to post-college start for HbA1c or BG monitoring frequency.

Group-Based Trajectory Models

The goal of group-based trajectory models was to test possible heterogeneity of growth trajectories over the last year of high school and the first year of college. For each T1DM health indicator, several models with varying numbers of trajectory groups were implemented and model results were compared. Model selection was based on Bayesian Information Criterion (BIC); the smaller the BIC, the better the model fits the data. In addition, a minimum number of cases ($n>5$) per group was ensured. The model results show that the growth trajectories of HbA1c, BG monitoring frequency, and BMI were heterogeneous (Figure 1). Individuals were classified into specific groups based on their most likely class membership estimated from the Bayesian approach. Individuals are similar within group, but different across groups in regard to the corresponding growth trajectories.

For HbA1c, two distinct groups emerged. Sixty-nine percent of students fell in Group 1 (stable good glycemic control; baseline HbA1c=7.4%) and 31% of students were in group 2

(poor glycemic control; baseline HbA1c=10.5%). Model results indicate that change in HbA1c over time were not statistically significant in Group 1 ($\beta=0.05$, $p=0.54$) or Group 2 ($\beta=-0.14$, $p=0.24$). Students in the poor glycemic control group were more likely to be non-Caucasian and prescribed conventional insulin regimens ($ps<.05$). Similarly, two distinct groups for BG monitoring frequency emerged. Group 1 included 85% of students and represented stable low BG monitoring frequency (baseline BG monitoring frequency=3.2 checks/day). Group 2 included 15% of students with relatively high BG monitoring frequency (baseline BG monitoring frequency=6.2 checks/day). BG monitoring frequency did not change significantly over time in Groups 1 ($\beta=-0.01$, $p=0.84$) or 2 ($\beta=0.35$, $p=0.07$). There were no demographic differences when comparing groups.

Three distinct BMI groups emerged. Students were split among a low/average BMI group (Group 1; 32%; baseline BMI=17.5); an average BMI group (Group 2; 43%; baseline BMI=20.3); and a high/average BMI group (Group 3; 25%; baseline BMI=24.1). BMI significantly increased over time in Groups 1 ($\beta=0.22$, $p=0.04$) and 2 ($\beta=0.24$, $p=0.01$). The change in BMI for Group 3 was not statistically significant ($\beta=0.23$, $p=0.05$) but was variable over time. Students in the high/average BMI group were more likely to be non-Caucasian and prescribed conventional insulin regimens ($ps<.05$).

Comment

This study prospectively evaluates change in T1DM health indicators across the first year of college. Data were drawn from chart review and are representative of a population of rising college students in a large pediatric diabetes practice. Trajectories of T1DM health indicators did not significantly change over the first year of college and group membership was maintained. Surprisingly, 69% of students demonstrated stable good glycemic control and the mean baseline HbA1c for this group was below recommendations for youth <19 years (HbA1c 7.5%).¹⁴ Maintaining care in a pediatric practice may be protective during the first year of college, as other studies have demonstrated early transition to adult care is associated with poorer glycemic control.⁹ Conversely, college students may also be better equipped to manage diabetes due to other factors (e.g. executive functioning). The majority of students (85%) were in a group checking BG levels less than 4x/day, suggesting that students did not increase BG monitoring frequency to adapt to changing schedules. Patterns of glycemic control and BG monitoring frequency are likely stable by early young adulthood.^{5, 15}

BMI increased in college and students who entered college with a higher BMI experienced more BMI variability. Although none of the BMI trajectories indicated overweight, the average student gains 3.86 pounds during freshman year,¹⁶ and weight gain may have health consequences for students with T1DM in later years. Paradoxically, weight gain is sometimes observed when glycemic control improves;¹⁷ however, in this sample, glycemic control was maintained as BMI increased, suggesting that other factors like declining physical activity may be driving this change.¹⁸ The first year of college – or earlier – may be a critical period for intervention to prevent further weight gain.¹⁹

Non-Caucasian race and conventional insulin regimens were associated with representation in subgroups of poor glycemic control and higher BMI. Racial minority status is a known risk factor for poor glycemic control,¹⁵ and minority students may particularly benefit from integrated interventions to promote T1DM health in college. Only 18% of the total sample utilized conventional insulin regimens, but these regimens likely do not offer the flexibility needed for college students. Intensive insulin regimens should be considered for this group.²⁰

Mean clinic attendance decreased by 1 visit from high school to college. Declines in clinic attendance are typically observed in young adulthood and are often ascribed to disjointed transition from pediatric to adult medical care.²¹ Competing life events and developmental milestones, such as entering college, also contribute to decreased clinic attendance, particularly as college location did not influence attendance. Maintaining a consistent source of endocrinology care during the college transition is important,⁹ and college students should engage local endocrinology services to maintain adequate medical supervision during this potentially risky period. Increased flexibility to meet the needs of college students with chronic conditions, such as evening and walk-in appointments, electronic health portals, and telemedicine, may improve access to medical care. T1DM student groups exist on many college campuses and also can provide support. The College Diabetes Network (<https://collegediabetesnetwork.org/>) is a national organization dedicated to promoting adjustment for college students, and over 75 local chapters offer resources, peer support, and targeted events.

Limitations

This study utilized medical chart data from one pediatric diabetes practice. Participants were excluded if college attendance and maintenance of pediatric T1DM care could not be confirmed from medical records. While the use of retrospective chart data eliminates some of the recruitment bias found with research volunteers,²² some youth may have been excluded for insufficient documentation. Data could not discriminate among students who transferred to adult care versus those with no medical visits during the first year of college, and neither group were included in analyses. Information about health care utilization with other providers and other factors potentially associated with T1DM outcomes (e.g. income) was not available. Future research should consider prospective enrollment prior to college entrance to track key health indicators in college students with T1DM and obtain more specific information on T1DM self-care and health care utilization.

Conclusion

College students with T1DM are at increased risk for weight gain, and disengagement from routine endocrinology care may occur during the first year of college. College-based health care providers and advocacy groups are uniquely poised to meet the needs of this group and can proactively identify on- and off-campus health-related services to promote T1DM self-care. Glycemic control and BG monitoring patterns are relatively stable, suggesting that students with suboptimal health behaviors may require increased support to improve T1DM self-care. The first year of college may represent a critical point to intervene to promote healthy diabetes care.¹⁹

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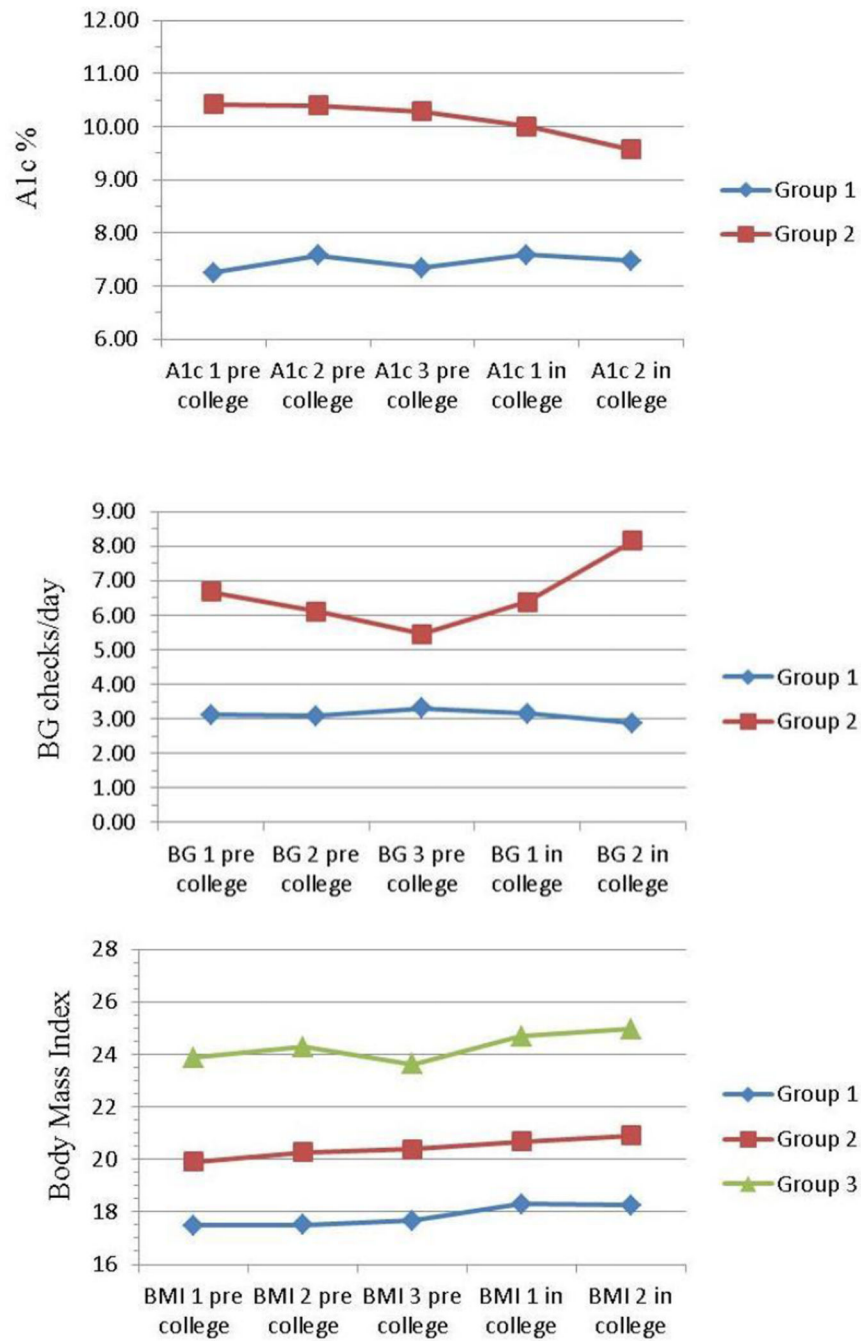


Figure 1.
Group-based Trajectory Models for T1DM Health Indicators