Does age of diabetes diagnosis influence long-term physical and behavioral outcomes?

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Type 1 diabetes is a complex chronic illness. Because self-care is such an essential element of successful diabetes management, cognitive and behavioral aspects of childhood development may interfere with effective self-care behaviors and impact the probability of later complications. The objective of this study was to examine if the age of diagnosis of diabetes is significantly related to physical and behavioral outcomes in adulthood. It may be that children diagnosed in adolescence spend their first few years of diabetes rebelling against the therapeutic demands of treatment. An intense phase of inadequate care could lead to health consequences later in life; behaviors adopted in adolescence could also linger long into adulthood. Conversely, it is possible that being diagnosed very early in life leads to a dependence on others that affects health and behavior long into the future.

RESEARCH DESIGN AND METHODS
This study used the patient survey data collected as part of the Translating Research into Action for Diabetes (TRIAD) study which has been previously described. All patients with diabetes who participated in the TRIAD study, had baseline patient survey and chart review data for the period between July 2000 and October 2001, and reported being diagnosed with diabetes at or before 21 years of age were selected for inclusion in this study. The Casro Response Rate was 69%.

We abstracted information about health outcomes and social outcomes. Health outcomes included reported weight, BMI, prevalences of heart attack and stroke, and self-reported general health. We also assessed physical health status using the Short Form (SF)-12 physical component subscores. Social outcomes included levels of income and education, and smoking behavior. Demographic data were gathered on each patient, including age at time of interview, number of years since diagnosis, race, and sex. The main predictor was self-reported age at diagnosis of diabetes.

To adjust for potential confounding factors in analyses of continuous outcome variables, we used multiple regressions. Covariates included in all of the models were sex, race/ethnicity, and duration of diabetes. Even though age is a continuous variable, we collapsed age of diabetes onset, into 3 categories (0 – 9 years; 10 – 13 years; and 14 – 21 years). We did this to more adequately reflect our hypothesis and to be consistent with prior studies that performed similar analyses. For linear regression models, we estimated the beta-coefficient (slope) and its 95% confidence interval (CI) for the age of diabetes onset. For logistic regression models, we estimated the odds ratio (OR) and its 95% confidence interval (CI) for the age of diabetes onset. Statistical significance is defined at level 0.05 (two-sided).
RESULTS

Five hundred and ninety participants met inclusion criteria for this study. Over half of participants were female (59.8%) and 43.4% were non-white. Almost half were diagnosed with diabetes between the ages of 14 and 21 (48.6%), with the remainder diagnosed between 0-9 years of age (29.5%) and 10-13 years of age (21.9%). Mean current age at the time of the TRIAD survey did not differ significantly across the three diabetes age-at-onset categories. Because of this, mean duration of diabetes was longest for persons diagnosed between 0 and 9 years of age (duration = 32.7 years) and shortest for persons diagnosed between ages 14 and 21 (duration = 24.6). There were no differences in reported treatment by patient by age of diagnosis group.

Adjusted Associations between Age of Onset and Later Health Outcomes (Table 1)

After adjusting for personal characteristics and duration of disease, those diagnosed between ages 14 and 21 were significantly heavier (BMI +1.99 kg/m2, 95% CI 0.46-3.52) than those diagnosed between ages 10 and 13. Those diagnosed between ages 0 and 9 were significantly less likely to have had a heart attack (OR 0.48, 95% CI 0.23-0.97) compared to those diagnosed with DM between 10 and 13 years old. We also found that children diagnosed between the ages of 10 and 13 years were more likely to have adopted a risky behavior, smoking that continues in adulthood, than children diagnosed between 14-21 years of age.

CONCLUSIONS

Our analyses show that the timing of childhood diabetes diagnosis was significantly associated with important health-related factors later in life. After adjusting for duration of disease, adults diagnosed between the ages of 10 and 13 were significantly more likely to have a heart attack than those children diagnosed between 0-9 years old. There are several limitations to this study. Our sample size was relatively small, and we may have lacked statistical power to detect meaningful differences in some of the main outcome variables. Our study was also cross-sectional, and we analyzed several outcomes that depended on recall of events. Even though participants across the three
study groups were diagnosed with diabetes as either children or adolescents on average about 30 years ago, it is also possible that some of the participants in this study had type 2 diabetes. This seems unlikely given that a diagnosis of type 2 diabetes was extremely rare during the era in which the diagnosis was made. We made every effort to identify those who might have type 2 diabetes, however, and conducted sensitivity analyses. Our analysis was also limited by the fact that it is impossible to control both diabetes duration and current age in a regression setting due to the dependencies among age of onset, duration and current age.

Diabetes is a difficult disease to manage under ideal conditions. The unique demands of adolescent development, particularly the separation from parental norms and the development of a self identity, clearly can impact the demands of diabetes treatment. Our data suggest that age of diagnosis may be an important factor in the long-term outcomes associated with the disease.

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REFERENCES


Table 1. Adjusted associations between age of diagnosis and current social and behavioral outcomes*

<table>
<thead>
<tr>
<th>Comparison to adolescent age of onset (10-13 years old)</th>
<th>Odds Ratio (95% CI)</th>
<th>Odds Ratio (95% CI)</th>
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</thead>
<tbody>
<tr>
<td>0 – 9 years old</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 – 21 years old</td>
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<tr>
<td>Education (high school or more)</td>
<td>0.91 (0.44, 1.89)</td>
<td>0.86 (0.42, 1.74)</td>
</tr>
<tr>
<td>Annual income &gt; $40k</td>
<td>0.83 (0.50, 1.38)</td>
<td>1.02 (0.64, 1.64)</td>
</tr>
<tr>
<td>Smoked cigarettes in last year</td>
<td>0.73 (0.42, 1.25)</td>
<td>0.45 (0.27, 0.74)</td>
</tr>
</tbody>
</table>

*All results are comparisons to adolescent age of onset (10 – 13 years old). Adjusted odds ratios include 95% confidence intervals (CI) as determined using logistic regression models. All models adjusted for sex, race, and duration of diabetes in years.