Increased Adiposity at Diagnosis in Younger Children With Type 1 Diabetes Does Not Persist

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Increased adiposity, as measured by BMI, has been described in younger children at diagnosis of type 1 diabetes compared with older children (1–3) in support of the "accelerator hypothesis" (1). Australia has one of the highest rates of childhood obesity in the Western world, but a disproportionate increase in type 1 diabetes incidence has not been observed in young children (4), which is contrary to recent reports of other populations (5,6). We therefore sought to investigate whether anthropometric data at diagnosis from 1976 to 2004 support the accelerator hypothesis in our population.

In addition to its potential contribution to type 1 diabetes etiology, the insulin resistance associated with increased adiposity places these children at greater risk of vascular disease (7–9). In a cross-sectional study of children with median diabetes duration of 3 years, we have previously found that those with the highest BMI SD score (SDS) were younger and had worse metabolic control (10). Hence, in this longitudinal study, we examined whether increased adiposity at diagnosis persisted in the youngest children after 5 years.

RESEARCH DESIGN AND METHODS

The study group consisted of children and adolescents attending the diabetes outpatient and outreach clinics of the Royal Alexandra Hospital for Children in Sydney and rural New South Wales, Australia, from 1976 to 2004. To exclude the initial weight loss due to acute destabilization, only height, weight, and BMI available 1–3 months postdiagnosis were analyzed ($n = 960$). In those diagnosed from 1976 to 2000 ($n = 661$), height, weight, and BMI were available in 443 children (67%) after a 5-year diabetes duration (range 4–6 years). Patients were stratified into three groups according to their age at diagnosis, 2–4.9 ($n = 68$), 5–9.9 ($n = 220$), and 10–14.9 years ($n = 155$).

Height was measured by Harpenden stadiometer, and weight was measured with digital scales. Height, weight, and BMI were expressed as SDSs using the Centers for Disease Control and Prevention 2000 growth data for the entire cohort to enable valid comparison over time (11). Data were analyzed using SAS version 8 (Cary, NC). The Kruskal-Wallis test was used to compare SDSs across the three age-groups. The signed-rank test was used to test whether SDSs changed 5 years after diagnosis. Factors associated with BMI SDSs (year, age at diagnosis, insulin dose, and their interaction terms) were examined using multiple regression.

RESULTS

In the entire cohort ($n = 960$), younger age at diagnosis was associated with higher BMI SDSs ($\beta = -0.05$, $P < 0.0001$); however, BMI SDSs did not change over the period 1976–2004 (regression coefficient for year: 0.011, $P = 0.11$). There was no significant interaction between age and year of diagnosis in the model, and no correlation between age at diagnosis and year of diagnosis ($r = 0.05$, $P = 0.12$).

In the longitudinal group of 443 subjects, height, weight, and BMI SDSs at diagnosis were higher in the youngest age-group compared with both the older groups ($P = 0.05$, $P < 0.001$, and $P = 0.004$, respectively) (Fig. 1).

Five years after diagnosis, differences in anthropometric measures were no longer significant across the three age-groups. Height and weight SDSs decreased significantly in the <5 years age-group ($P = 0.001$ and $P = 0.01$, respectively) (Fig. 1*A*), indicating regression toward the mean. In contrast, BMI SDSs increased significantly in the 10–14.9 years age-group ($P < 0.001$) (Fig. 1*B*).

At diagnosis, the median insulin dose was 0.44 units/kg (interquartile range 0.32–0.60) and was not significantly different across the three age-groups. After 5 years, insulin dose significantly increased in all groups (0.89, 1.19, and 1.12 units/kg in the 2–4.9, 5–9.9, and 10–14.9 years age-groups, respectively) ($P < 0.001$). The median HbA_{1c} (A1C) was 8.3% and was not significantly different between the three age-groups.

CONCLUSIONS

Younger children were taller and had higher BMI SDSs at diagnosis than older children, which is in line with previous studies (1,2,12). Our new finding is that after 5 years of diabetes duration, the <5 years age-group demonstrated a deceleration of growth with a decrease in height and weight SDSs. This is in contrast to the trend toward increasing BMI and weight SDSs in the general Australian population (13). The decrease in height SDSs could indicate that growth is slowing, following a period of rapid growth, but may also

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A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

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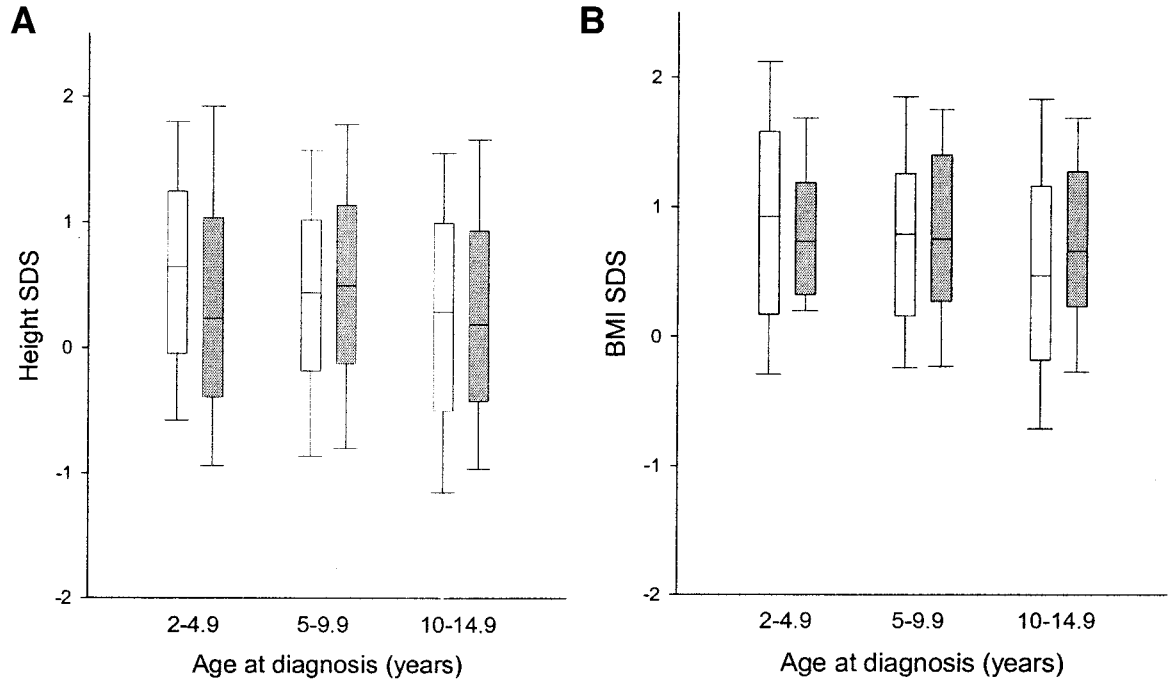

Figure 1— A: *Comparison of height SDSs across three age-groups at diagnosis of type 1 diabetes* (□, P = *0.05) and after 5 years* (▨, P = *0.11).* B: *Comparison of BMI SDSs across three age-groups at diagnosis* (P = *0.004) and after 5 years* (P = *0.41). Between the two time points, height SDSs decreased in the 2–4.9 years age-group* (P = *0.001), and BMI SDSs increased in the 10–14.9 years group* (P = *0.0001).*

represent a loss of height associated with suboptimal glycemic control.

Recent studies have found a rise in BMI SDSs in children at diagnosis of type 1 diabetes, suggesting an increased role for adiposity as an environmental risk factor (1,14). Even though the Australian pediatric population as a whole has increased their BMI (13), there has not been an increase in BMI at diagnosis of type 1 diabetes; however, the youngest children have been overweight for almost 30 years. This temporaneously supports the "accelerator hypothesis" as a consistent mechanism underlying diabetes over this time in Australia, particularly in young children. Combined with other recent studies (1–3,12,14), we speculate that there may be a threshold at which higher adiposity is associated with earlier onset of type 1 diabetes and that this threshold was reached some time ago in Australia (earlier than in Western Europe). Indeed, the BMI SDS at diagnosis was 0.93 in our 2–5 years age-group, which is higher than in the same age-group in the U.K. (0.21) and Germany (0.5) (12). Recent data from the U.S. also demonstrate an association between higher BMI and younger age at diagnosis of type 1 diabetes (3), but only in patients with low fasting C-peptide levels, suggesting that acceleration occurs late in the evolution of type 1 diabetes, when β-cell function is already compromised.

While the younger group demonstrated a decrease in growth parameters after 5 years of diabetes, conversely, the oldest group increased their weight and BMI SDSs. The weight gain in the older children, who were less overweight at diagnosis, is likely to be related to changes of puberty and resulted in increased insulin requirements.

The deceleration in weight and BMI are encouraging for the future health of children with very-early-onset diabetes. While this may be a natural phenomenon after growth acceleration, such changes may also be influenced by frequent contact with health professionals discussing meal plans and demonstrating individual measurement on growth charts. Older children are at risk of sustained weight gain from diagnosis and may be an additional risk factor for development of microvascular complications.

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