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Transfer from paediatric to adult care for young adults with Type 2 diabetes: the SEARCH for Diabetes in Youth Study

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Abstract

Aim—To describe factors associated with transfer from paediatric to adult care and poor glycaemic control among young adults with Type 2 diabetes, using the SEARCH for Diabetes in Youth study.

Methods—Young adults with Type 2 diabetes were included if they had a baseline SEARCH visit while in paediatric care at < 18 years and ≥ 1 follow-up SEARCH visit thereafter at 18–25 years. At each visit, HbA_{1c}, BMI, self-reported demographic and healthcare provider data were collected. Associations of demographic factors with transfer of care and poor glycaemic control (HbA_{1c} ≥ 75 mmol/mol; 9.0%) were explored with multivariable logistic regression.

Results—182 young adults with Type 2 diabetes (36% male, 75% minority, 87% with obesity) were included. Most (n = 102, 56%) reported transfer to adult care at follow-up; a substantial

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Author contributions

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Competing interests

None declared.

proportion (n = 28, 15%) reported no care and 29% did not transfer. Duration of diabetes [odds ratio (OR) 1.4, 95% confidence interval (95% CI) 1.1, 1.8] and age at diagnosis (OR 1.8, 95% CI 1.4, 2.4) predicted leaving paediatric care. Transfer to adult or no care was associated with a higher likelihood of poor glycaemic control at follow-up (adult: OR 4.5, 95% CI 1.8, 11.2; none: OR 4.6, 95% CI 1.4, 14.6), independent of sex, age, race/ethnicity or baseline HbA_{1c} level.

Conclusions—Young adults with Type 2 diabetes exhibit worsening glycaemic control and loss to follow-up during the transfer from paediatric to adult care. Our study highlights the need for development of tailored clinical programmes and healthcare system policies to support the growing population of young adults with youth-onset Type 2 diabetes.

Introduction

Type 2 diabetes in youth has increased steadily on a global scale in the past decade, demanding attention to address this evolving public health emergency [1–4]. In the USA, from 2001 to 2009, the SEARCH for Diabetes in Youth Study (SEARCH) estimated a 30.5% overall increase in the prevalence of Type 2 diabetes in US youth [3]. Compared with adult-onset Type 2 diabetes, youth tend to have more severe disease requiring earlier initiation of insulin, and experience more micro- and macrovascular complications as well as higher mortality [5–8]. Thus, this growing population has the potential to place significant burden on health systems. The American Diabetes Association (ADA) recently published a consensus report on youth with Type 2 diabetes, citing an ‘urgent need for targeted treatments and patient-centered care in what appears to be a more aggressive disease in youth’ [9]. However, thus far, efforts to understand patient-centered issues remain limited.

Diabetes management requires continued lifestyle modification and effective treatments, which need to be developmentally tailored to youth. The period of young adulthood, defined as ages 18–30 years, is a stage of life that involves progressively higher levels of independence from the family unit and the assumption of more responsibility for self-care [10]. For young adults with chronic disease, self-management and health-related care tasks present a particular challenge during this transitional period, which is rife with competing demands of geographical and educational/vocational changes, as well as social and financial priorities [10]. Studies in young adults with chronic disease have demonstrated that healthcare transition from paediatric to adult care places additional burden and may result in loss to follow-up, deterioration of disease control, increased hospitalizations and early mortality [11–15]. The vast majority of research has focused on Type 1 diabetes and healthcare transition, because of its historical predominance in paediatric diabetes. Given the growing population of paediatric cases of Type 2 diabetes, it is imperative to understand how healthcare transition affects this population, which has differing treatment paradigms and needs than Type 1 diabetes.

The objective of this study was to determine how the healthcare transition affects outcomes in young adults with Type 2 diabetes. Specifically, we examined factors associated with transfer and poor glycaemic control after leaving paediatric care, using data from SEARCH. We hypothesized that the healthcare transition would increase the risk for loss to medical follow-up and deterioration of glycaemic control.

Patients and methods

Study overview and procedures

SEARCH is a multicentre study aimed at understanding the burden and clinical course of diabetes among youth in the USA. The SEARCH study has identified over 20 000 individuals from 2000 to 2015 who were diagnosed with diabetes at < 20 years of age. Youth were recruited from five centres based on geographical sites in the USA: Ohio, Colorado, Washington, South Carolina and California [16]. Institutional review boards for each of the study sites approved this study protocol.

As part of the SEARCH protocol, participants completed a brief initial survey, after which those with diabetes not secondary to other conditions (steroid-induced or genetic cause) were invited to a research visit where consent/assent were obtained, questionnaires administered, and physical exam and fasting blood samples taken. Individuals in selected incident years were invited for follow-up visits, in which a physical exam was conducted, and additional questionnaires and blood samples were obtained. In addition to demographic and clinical characteristics, questionnaires included information on type of provider, which was used in the current study to define transfer of care.

Study population and eligibility

SEARCH participants were included in these analyses if they were diagnosed with Type 2 diabetes by their healthcare provider between 2002 and 2005, had an initial SEARCH visit before age 18 years while in paediatric care, and had at least one follow-up SEARCH visit thereafter at ages 18–25 years. Follow-up visits spanned from 2005 to 2015. If more than one follow-up visit was available, the first visit where a non-paediatric provider was reported was used. If all visits indicated paediatric care providers, the last visit was used for the analysis. Only one follow-up visit was used for all analysis. Participants were included if they had available information on HbA_{1c} levels and type of healthcare provider at both the baseline and follow-up visits (Fig. 1).

Some 532 SEARCH participants had Type 2 diabetes diagnosed between 2002 and 2005, and completed an initial study visit prior to 18 years of age; 212 were excluded because they did not have a follow-up SEARCH visit after age 18 years. Of the remaining 320 participants, 72 were excluded because they did not report paediatric care at the initial visit, and 33 were excluded because there was no information on healthcare provider at follow-up. Of the 215 remaining participants, 33 did not have HbA_{1c} values available at the baseline and follow-up visits. A total of 182 participants were included for analysis (Fig. 1).

Variables

Demographic characteristics—Demographic characteristics collected as part of the initial SEARCH visit included age at diagnosis, age at the study visit and sex. Race/ethnicity was self-reported using the 2000 census question and categorized as non-Hispanic white, non-Hispanic black, Hispanic and other race/ethnicity. Highest parental education was self or parent-reported during the initial visit. Health insurance was reported at each visit as

'private'; 'Medicaid/Medicare/other' (other state-funded plans, Indian Health Service, student health clinics, military or other/unknown sources) and 'none'.

Clinical characteristics—BMI was calculated as weight in kilograms divided by height in metres squared and converted to a *z*-score [17]. Diabetes duration was calculated as the difference between the diagnosis date and each visit date. Concurrent medical comorbidity was self-reported based on pre-specified categories and included asthma, renal disease, coeliac disease, hypertension, hyperthyroidism, hypothyroidism and polycystic ovary syndrome. HbA_{1c} was measured in whole blood with an automated nonporous ion-exchange high-performance liquid chromatography system (model G-7; Tosoh Bioscience, Montgomeryville, PA, USA) on blood samples obtained at baseline and follow-up visits.

Healthcare provider characterization—The current healthcare provider was self-reported in prespecified categories at each visit. Paediatric care was assigned if participants selected 'paediatrician' or 'paediatric endocrinologist' as their healthcare provider at the time of the SEARCH visit. Adult care was assigned if participants selected 'family practice doctor', 'general practice doctor', 'adult endocrinologist' or 'internist'. Participants who selected 'nurse practitioner/PA', 'nurse diabetes educator' or 'other/don't know' were excluded ($n = 33$) because it could not be determined whether nurse practitioners or physician assistants were affiliated with paediatric or adult care. Participants could also select 'none', which was assigned to the 'no care' group.

Outcomes—'Leaving paediatric care' was defined as reporting a non-paediatric provider or no provider at any SEARCH follow-up visit when participants were ≥ 18 years. If the participant reported that they had a paediatric provider at the last SEARCH follow-up visit on record at age ≥ 18 years, they were considered as not having left pediatric care. Glycaemic control was measured as HbA_{1c}. Poor glycaemic control was defined as $HbA_{1c} \geq$ 75 mmol/mol (9.0%) based on data from the Diabetes Control and Complications Trial, which found elevated risk of complications for young adults (age > 18 years) with HbA_{1c} levels above this range [18].

Statistical analyses—All analyses were performed with SAS version 9.4 (SAS Institute, Cary, NC, USA). Descriptive statistics were used to explore baseline characteristics, stratified by type of healthcare provider at follow-up. Multivariable logistic regression models were used to identify predictors of the two outcomes of interest: (1) leaving paediatric care, and (2) poor glycaemic control at follow-up. Variables included in the multivariable models were selected *a priori* based on their established contribution to glycaemic control. They included age at follow-up, sex, race/ethnicity (Hispanic/non-Hispanic black/ other vs. non-Hispanic white), HbA_{1c} at baseline, duration of diabetes at follow-up and paediatric vs. adult vs. no care at follow-up. More specific racial/ethnic subgroups and insurance status could not be added to models due to sample size. Models were adjusted for SEARCH study site. The distribution of the residuals for the final models were reviewed for outliers and leverage points. Sensitivity analysis conducted after removing questionable observations arrived at similar results as the primary analysis.

Results

Participant characteristics

For the 182 individuals included in analyses, mean age at diagnosis was 14.2 years and diabetes duration at the baseline SEARCH visit was 6.9 months. Thirty-six per cent of participants were male ($n = 65$). The participants were racially and ethnically diverse; 45% ($n = 82$) were non-Hispanic black, 25% ($n = 46$) were non-Hispanic white, 25% ($n = 45$) were Hispanic, and 5% ($n = 9$) were 'other' race/ethnicities. At baseline, 58% ($n = 104$) were privately insured, 41% ($n = 75$) were publicly insured, and 1% ($n = 3$) were uninsured. Fifty-one per cent ($n = 92$) had received high school education or less, 33% ($n = 59$) had some college education, and 17% ($n = 30$) had at least a bachelor's degree. Mean baseline HbA_{1c} was 53 mmol/mol (7.0%) and 15% ($n = 28$) had poor glycaemic control at baseline. The majority (87%) were obese (Table 1).

Characteristics by care at follow-up

Most participants ($n = 102$, 57%) reported transfer to adult care at follow-up; a substantial proportion ($n = 28$, 15%) reported no care and 28% ($n = 52$) had not transferred out of paediatric care. Male sex, racial/ethnic minority proportions, and parental education were similar across the three care groups (paediatric care, adult care, none) ($P > 0.05$) (Table 1). The major difference between groups was in health insurance status; 74% of participants in the no care group were uninsured compared with 15% and 8% in the adult and paediatric care groups, respectively ($P < 0.0001$; Table 1).

Average duration of follow-up time after the SEARCH baseline visit ranged from 6.8 to 7.6 years, and was ~ 6 months longer for the no care group (Table 1). At follow-up, HbA_{1c} levels were higher for those in adult care (75 mmol/mol; 9.0%) and no care (78 mmol/mol; 9.3%) groups compared with those in the paediatric care group (64 mmol/mol; 8.0%) ($P = 0.0402$ and 0.0772, respectively) (Table 1). This resulted in higher proportions of participants with poor glycaemic control, similar to baseline levels, in the adult (52.9%) and no care (53.6%) groups compared with the paediatric care group (26.9%) ($P = 0.0022$ and 0.0277, respectively) (Table 1). Mean number of medical visits in the previous 6 months did not differ between the adult and paediatric care groups (2.4 and 2.6 visits per year, respectively) (Table 1). There was also no significant difference in the likelihood of poor glycaemic control in specialty (59%) vs. primary (50%) adult care ($P = 0.40$) (data not shown). Forty-six per cent of the no care group was not taking diabetes medication, compared with 23% and 16% in the paediatric and adult care groups, respectively (Table 1).

Factors associated with transfer from paediatric care

Table 2 presents factors associated with transferring out of paediatric care to either adult care or no care. Higher age at diagnosis (per year) and diabetes duration at follow-up (per year) were each associated with higher likelihood (1.8 and 1.4, respectively) of leaving compared with remaining in paediatric care ($P < 0.0001$, $P = 0.006$), after adjusting for race/ethnicity, sex, and baseline HbA_{1c} (Table 2). There was no significant interaction between age at diagnosis and diabetes duration (data not shown). Race/ethnicity and sex, were not significantly associated with transfer from paediatric care (Table 2). There was a trend

towards worse baseline glycaemic control and higher likelihood of transfer to adult care. Likely, this might have been significant, but this study may have been inadequately powered to detect these differences.

Poor glycaemic control at follow-up

Transferring from paediatric care was associated with a 4.5 and 4.6 higher odds of poor glycaemic control at follow-up in adult and no care, respectively, after adjusting for baseline HbA_{1c}, age at diagnosis, duration of diabetes, sex, and race/ethnicity (Table 3). Additionally, poor glycaemic control at baseline [per unit increase above target value of 53 mmol/ mol (7%)] was associated with a greater likelihood of having poor glycaemic control at follow-up, regardless of transfer status [odds ratio (OR) = 1.4, $P < 0.001$) (Table 3). Proportions of participants taking insulin (insulin alone or insulin + other medication) did not differ by care group at follow-up, but those taking insulin were more likely to have poor glycaemic control ($P < 0.0001$) (data not shown). Increasing age at diagnosis was protective against poor glycaemic control (OR = 0.8, $P = 0.01$), independent of sex, race/ ethnicity, and insulin treatment (Table 3). Duration of diabetes at follow-up, race/ethnicity and sex were not associated with poor glycaemic control (Table 3).

Discussion

In this geographically and ethnically diverse sample from the SEARCH for Diabetes in Youth study, 57% of young with Type 2 diabetes transferred from paediatric to adult care after age 18, but a substantial proportion (15%) reported receiving no medical care. There were few demographic or clinical characteristics that predicted transfer status or age at transfer. Leaving paediatric for adult care or no care was associated with 4.5 and 4.6 times higher odds of poor glycaemic control, respectively, regardless of baseline control, sex, race/ ethnicity, age at diagnosis and duration of diabetes. Poor glycaemic control at baseline predicted poor glycaemic control at follow-up, regardless of transfer status. To our knowledge, this is the first report of healthcare transition trends in youth with Type 2 diabetes, and sheds light on how the transition period influences risk specific to Type 2 diabetes populations.

Although it is encouraging that the majority of young adults transferred to adult care by age 25 years, it is concerning that a large proportion experienced significantly worsened glycaemic control at follow-up. Based upon earlier reports from SEARCH on transition to adult care among young adults with Type 1 diabetes, young adults were similarly more likely to have poor glycaemic control after transfer to adult care [15]. However, the likelihood estimate of worsened glycaemic control was more pronounced in our current study of young adults with Type 2 diabetes [OR 4.5, 95% confidence interval (95% CI) 1.8–11.2] than in the prior report in Type 1 diabetes (OR 2.5, 95% CI 1.09–5.55) [15], highlighting potentially worse outcomes in the young adults Type 2 diabetes population. This is alarming given the increasing burden of youth with Type 2 diabetes on healthcare systems.

Many reasons exist to explain the phenomenon of worsened control observed among young adults who transferred to adult care in our study. Specifically, the transition to adulthood

superimposed on the more severe disease process of youth-onset Type 2 diabetes poses particular challenges. Because of competing priorities at this time in life and loss of structural supports in family and school, gaps in medical care could occur after leaving paediatric care in which disease maintenance with medication and self-care decrease, leading to unintended exacerbations [19–21]. Studies have determined that a gap of at least 6 months can significantly influence outcomes during transition [19,22], and might explain why the adult care and no care groups in our study had similarly poor glycaemic profiles. Additionally, general lack of engagement of young adults in their health care due to feelings of invulnerability to long-term complications could lead to decreased frequency of medical visits or inadequate self-care [10,21]. Our data might also represent the natural progression of youth-onset Type 2 diabetes. The Treatment Options for Type 2 Diabetes in Adolescents and Youth (TODAY) study showed that β-cell pancreatic failure was accelerated in young adults with youth-onset Type 2 diabetes and that acute worsening of glycaemic control occurred despite insulin use [23]. Thus, even with proper access to and use of diabetes care, biological variables may be influential. Lastly, primary care practices, who usually treat adult-onset Type 2 diabetes, may not be adequately trained or prepared to manage the more aggressive disease course of youth-onset Type 2 diabetes [24–26]. Early efforts to train adult specialists and generalists alike on both the influential developmental aspects of the transition to adulthood and management and risk stratification of youth-onset vs. adult-onset Type 2 diabetes would be beneficial and could prevent unnecessary deterioration. Furthermore, recognition of the need for extra psychosocial support for this population would help practices stratify resources for patients and care for these patients more effectively. Anticipatory guidance for patients on self-advocacy for reasonable accommodations in secondary education and/or the workplace would be a feasible pragmatic approach. Additional focus on developmentally appropriate ways to approach and care for these often overweight or obese patients without penalizing them for their lifestyles may also aid in more long-term retention of this vulnerable group in care.

Health system factors related to transfer in care systems also must be considered. Selection of young adults to refer to adult care may ultimately play a significant role in outcomes. In particular, referral of poorly controlled patients and those that have inconsistent follow-up in paediatric care are at particular risk. In addition, differences between paediatric and adult systems care paradigms are often stark. Paediatric systems can accommodate young adults needs with access to social work and psychology resources, and family-centred, team-based approaches to care [27–30], whereas adult systems are often resource-scarce and individual patient-focused [27,29,30]. Healthcare transition literature suggests that young adults struggle with relationships with new adult care teams given longstanding bonds with paediatric providers, and lack of familiarity with adult care approaches [20,29]. Given specific emphasis on behaviour change and lifestyle modification in Type 2 diabetes management [31,32], young adults with this disease need tailored approaches to care, with careful planning of developmentally appropriate strategies [32,33]. Furthermore, adult providers may not be trained, with a recent study of adult endocrinologists reporting feeling ill-prepared to care for young adults [30]. Further education and exposure to young adult patient care paradigms are needed and could be delivered in didactic form in medical school curricula or through various web-based or in-person formats to practitioners by professional

medical societies. In addition, there needs to be prioritization of clinical care pathways and health system policies which improve collaboration between paediatric and adult medical systems, and focus on delivering young adults care through a gradual transition process as opposed to an abrupt transfer. Several such programmes exist in Type 1 diabetes and report improved outcomes for this population [34–39].

Lastly, the role of social determinants of health in young adults with Type 2 diabetes should be noted. Although not studied in depth here, determinants of health have been found to be major contributors to poor outcomes in adults with Type 2 diabetes [8,40,41]. The population of young adults studied here was mostly comprised of racial/ethnic minorities, had low parental educational attainment, with a large proportion on public insurance plans. Thus, this population likely experienced access to care issues, or had low enough general or health literacy to impact self-management knowledge, adherence and maintenance of adequate Type 2 diabetes care [40,42]. Expedited social work evaluation in these cases would facilitate timely screening of barriers such as low health literacy/numeracy, food insecurity and cost burdens that could positively impact outcomes if intervened upon early.

There are several limitations to this study. First, due to inclusion criteria definitions and lack of available information on every SEARCH participant with Type 2 diabetes, we had to exclude a significant number of participants. Although future work needs to be done to confirm our findings in larger cohorts, this population is notoriously difficult to capture. As such, our findings may be an underestimation of the actual risk that healthcare transition poses on this population. Second, because most SEARCH sites are a mix of academic centres and private practices, and did not have formalized transition programmes, these centres and practices have varying degrees of support for this unique population, which likely makes it more real-world in nature than in a controlled setting. Third, we could not measure the duration of gaps in care accurately because SEARCH participants were not asked the timeframe of when they transferred to adult care. Further research is needed to determine whether gaps in care are influential because they could potentially be prevented. Fourth, we could not fully examine the impact of factors related to low socio-economic status or racial/ethnic minority status due to sample size limitations. Given the pivotal role of social determinants of health in Type 2 diabetes outcomes, it would be important to examine how these known determinants of health modify healthcare transition. Lastly, examining the difference in outcomes based on primary versus specialty adult diabetes care is of interest. Our data suggest that there was no difference based on care received, but this study was not designed to directly compare specialty and generalist care, and needs to be a focus of future studies.

In summary, this study reveals that healthcare transition is a critical period of worsening glycaemic control and loss to follow-up for young adults with Type 2 diabetes. Although also present in Type 1 diabetes, the deleterious effects of healthcare transition may be more pronounced in young adults with Type 2 diabetes, but further research is required. Our study underscores the need for the development of tailored clinical programmes and healthcare system policies to support the growing population of young adults with youth-onset Type 2 diabetes. Ultimately, increased focus on patient-centred care in youth-onset Type 2 diabetes during this vulnerable period has the potential to attenuate the risk of poor health outcomes

in adulthood. Concerted efforts to train endocrinologists and primary care practitioners to incorporate developmentally appropriate approaches to young adult care, implementation of standardized clinical care pathways which bridge paediatric and adult medical systems, and recognition of the need for more ancillary support services, especially social work and psychosocial support, ultimately will be needed to curb this emergent problem.

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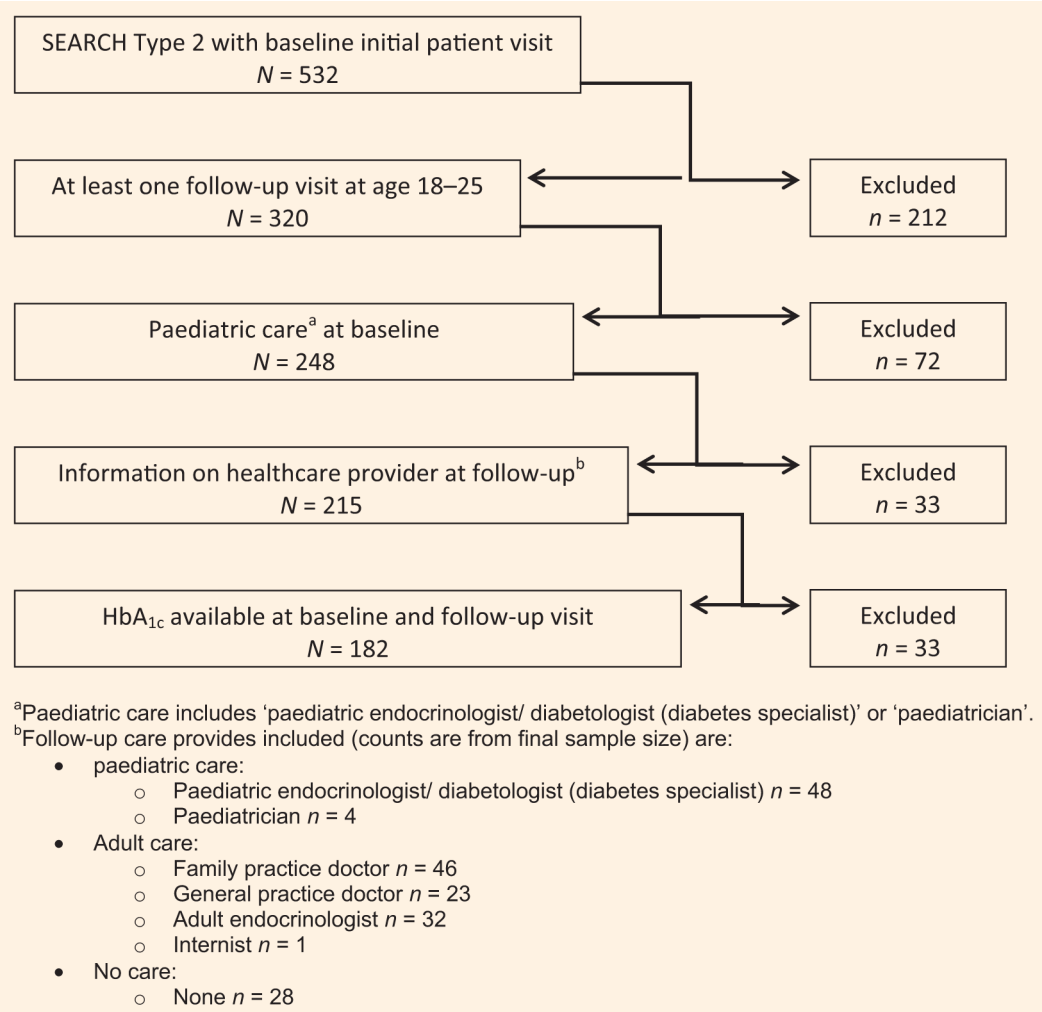
What's new?

- This is the first report of paediatric to adult healthcare transfer trends in young adults with youth-onset Type 2 diabetes.
- This work studies a population-based group of young adults with Type 2 diabetes across a wide geographic and demographic range, who are difficult to capture in research.
- Findings reveal substantial worsening of glycaemic control and loss to follow-up during healthcare transfer, highlighting a previously unidentified issue for this vulnerable population.
- This research has implications for clinicians and healthcare systems, to focus on tailored approaches and policies for young adults with Type 2 diabetes in transition.



[a]Paediatric care includes 'paediatric endocrinologist/ diabetologist (diabetes specialist)' or 'paediatrician'.
[b]Follow-up care provides included (counts are from final sample size) are:

- paediatric care:
  - Paediatric endocrinologist/ diabetologist (diabetes specialist) *n* = 48
  - Paediatrician *n* = 4
- Adult care:
  - Family practice doctor *n* = 46
  - General practice doctor *n* = 23
  - Adult endocrinologist *n* = 32
  - Internist *n* = 1
- No care:
  - None *n* = 28

FIGURE 1.
Inclusion criteria for analysis.

Table 1

Descriptive characteristics of individuals with Type 2 diabetes, overall and by healthcare provider at baseline and follow-up study visits (N = 182)

		Healthcare provider at follow-up visit			
Characteristics	**Baseline**	**Paediatric**	**Adult**	**No care**	***P*-value**
Total	182	52 (28.6)	102 (56.6)	28 (15.3)	
Age at diagnosis [a] (years) [*]	14.2 ± 2.1	13.2 ± 2.3	14.7 ± 1.9	14.3 ± 1.9	< 0.0001
Duration of follow-up (years) [*]	7.2 ± 0.7	6.8 ± 0.9	7.1 ± 0.6	7.6 ± 0.8	< 0.0001
Male sex [a]	65 (35.7)	19 (36.5)	34 (33.3)	12 (42.9)	0.6410
Race/ethnicity [a]					0.3826
Non-Hispanic white	46 (25.3)	17 (32.7)	20 (19.6)	9 (32.1)	
Non-Hispanic black	82 (45.1)	23 (44.2)	47 (46.1)	12 (42.9)	
Hispanic	45 (24.7)	9 (17.3)	29 (28.4)	7 (25.0)	
Other	9 (4.9)	3 (5.8)	6 (5.9)	0 (0.0)	
Insurance status at visit					< 0.0001
Has private health insurance	104 (57.5)	25 (47.1)	48 (46.5)	1 (4.3)	
Medicaid/Medicare/other	75 (40.9)	23 (45.1)	39 (38.6)	6 (21.7)	
Uninsured	3 (1.6)	4 (7.8)	15 (14.9)	21 (73.9)	
Highest parental education [a]					0.2003
High school or less	92 (50.8)	28 (53.8)	45 (44.6)	19 (67.9)	
Some college	59 (32.6)	14 (26.9)	39 (38.6)	6 (21.4)	
Bachelor's degree or more	30 (16.6)	10 (19.2)	17 (16.8)	3 (10.7)	
Diabetes duration at visit, months [*]	9.8 ± 6.8	85.0 ± 21.1	82.1 ± 24.7	91.5 ± 24.9	0.1801
HbA_{1c} at baseline (mmol/mol [%]) [*]	53 ± 9 [7.0 ± 1.9]	49 ± 6 [6.6 ± 1.6]	54 ± 10 [7.1 ± 2.0]	55 ± 11 [7.2 ± 2.1]	0.2002
HBA_{1c} at follow-up (mmol/mol [%]) [*]	–	64 ± 13 [8.0 ± 2.8]	75 ± 15 [9.0 ± 2.8]	78 ± 20 [9.3 ± 3.8]	0.0823
Poor glycaemic control at visit [c]	28 (15.4)	14 (26.9)	54 (52.9)	15 (53.6)	0.0060
Have a comorbidity at visit [b]	54 (40.6)	35 (67.3)	61 (59.8)	16 (57.1)	0.5800
BMI categories at visit [d]					0.4913
Normal or underweight	12 (6.8)	8 (15.7)	10 (9.8)	2 (7.1)	
Overweight	11 (6.2)	6 (11.8)	18 (18.0)	7 (25.0)	
Obese	154 (87.0)	37 (72.5)	72 (72.0)	19 (67.9)	
Number self-reported clinical visits in 6 months prior to follow-up SEARCH visit [*e]		2.4 ± 4.6	2.6 ± 2.4	–	0.7090
Type of diabetes medication(s)					0.0295
Metformin only	81 (44.5)	11 (21.2)	22 (21.6)	4 (14.3)	
Insulin only	23 (12.6)	12 (23.1)	27 (26.5)	6 (21.4)	
Insulin + other medication	54 (29.7)	14 (26.9)	27 (26.5)	1 (3.6)	
Other oral (sulfonylurea, incretin)	12 (6.6)	3 (5.8)	10 (9.8)	4 (14.3)	

		Healthcare provider at follow-up visit			
Characteristics	**Baseline**	**Paediatric**	**Adult**	**No care**	***P*-value**
None	12 (6.6)	12 (23.1)	16 (15.7)	13 (46.4)	

Values are given as number (%), except

[*] mean SD.

[a] Measured only at baseline; one person missing data.

[b] Have a medical comorbidity: presence of at least one of the following physician-diagnosed conditions (as reported by study participants): asthma, polycystic ovarian disease, kidney disease, celiac disease, hypertension, hyperthyroidism, or hypothyroidism.

[c] Poor glycaemic control: $HbA_{1c} \geq 75$ mmol/mol (9.0%).

[d] For participants aged under 18 years, BMI groups are defined by using z-score based on age and sex norms, and for those 18 and older groups are based on BMI score (normal or underweight < 85th percentile OR BMI < 25; overweight: 85th to 95th percentiles OR BMI between ≥ 25 and < 30; obese: 95th percentile or higher OR BMI ≥ 30.

[e] Some missing data ($n = 151$; paediatric $n = 49$, adult $n = 94$, no care $n = 8$).

P-values are from Chi-square test for categorical measures and Type 3 *P*-value from an ANOVA for continuous measures.

Table 2

Factors predicting transfer from paediatric care to either adult care or no care at follow-up study visit

Adjusted results (*N* = 182)			
Variable	**Odds ratio**	**95% CI**	***P*-value**
Duration of diabetes at follow-up (years)	1.4	1.1, 1.8	0.0064
Age at diagnosis (years)	1.8	1.4, 2.4	< 0.0001
Sex (female vs. male)	1.7	0.8, 3.7	0.1986
Race/ethnicity (Hispanic/non-Hispanic black/other vs. non-Hispanic white)	1.5	0.6, 3.4	0.3510
HbA_{1c} at baseline	1.2	1.0, 1.5	0.0824

Model controls for all variables presented in the table plus SEARCH study site. *P*-values are type 3 chi-square tests of the model's maximum likelihood estimates.

Table 3

Factors predicting poor glycaemic control (HbA_{1c} ≥ 75 mmol/mol [9.0%]) at follow-up study visit

Adjusted results (*N* = 182)			
Variable	**Odds ratio**	**95% CI**	***P*-value**
Duration of diabetes at follow-up (years)	0.9	0.7, 1.1	0.2856
Age at diagnosis (years)	0.8	0.6, 0.9	0.0099
Sex (female vs. male)	1.1	0.5, 2.2	0.8582
Race/ethnicity (Hispanic/non-Hispanic black/other vs. non-Hispanic white)	1.1	0.5, 2.4	0.8339
HbA_{1c} at baseline (%)	1.4	1.1, 1.7	0.0011
Provider at follow-up			0.0035
visit (reference: paediatric)			
Adult care	4.5	1.8, 11.2	
No care	4.6	1.4, 14.6	

Model controls for all variables presented in the table plus SEARCH study site. *P*-values are type 3 chi-square tests of the model's maximum likelihood estimates.