Characteristics and care of young people with type 2 diabetes included in the national diabetes audit datasets for England

Shivani Misra | Naomi Holman | Emma Barron | Peter Knighton | Justin Warner | Partha Kar | Bob Young | Jonathan Valabhji

1National Diabetes Audit Programme, NHS England & Improvement, London, UK
2Division of Metabolism, Digestion and Reproduction, Imperial College London, London, UK
3Department of Diabetes and Endocrinology, St Mary's Hospital, Imperial College Healthcare NHS Trust, London, UK
4Clinical Biochemistry, Blood Sciences, Northwest London Pathology, London, UK
5School of Public Health, Imperial College London, London, UK
6NHS England and NHS Improvement, London, UK
7Analytical services, Population health, Clinical audit and Specialist Care, NHS Digital, Leeds, UK
8Dept of Paediatric Endocrinology and Diabetes, Noah's Ark Children's Hospital for Wales, Cardiff, UK
9National Paediatric Diabetes Audit Programme, Royal College of Paediatrics and Child Health (RCPCH), London, UK
10Portsmouth Hospitals NHS Trust, Portsmouth, UK

Abstract

Introduction: We report contemporary age-related prevalence, characteristics and care of children and young people with type 2 diabetes in England.

Methods: Individuals with a recorded diagnosis of type 2 diabetes between January 2019 and March 2020 were identified from a whole population register. Age, sex, ethnicity, deprivation quintile, weight, HbA1c and receipt of the nine National Institute for Health & Care Excellence (NICE) recommended annual care processes were extracted from electronic clinical records and analysed by pre-specified age bands.

Results: In total, 122,780 (4.6%) of 2,642,435 individuals in England with type 2 diabetes were aged under 40 years, comprising; 650 (0.5%) under 16 years, 910 (0.7%) aged 16–18 years, 8245 (6.7%) aged 19–25 and 112,975 (92%) aged 26–39 years. Compared to people with type 2 diabetes aged above 40 years, young people were significantly more likely to be from minority ethnic groups: 51% under 16 years, 41% 16–18 years, 38% 19–25 years, 38% 26–39 years, 27% 40–59 years and 15% 60–79 years were of Black or Asian ethnicity. In addition, those aged under 40 years were more likely to be obese, women, to live in the most-deprived socioeconomic areas and less likely to receive the NICE recommended annual care processes or achieve target HbA1c.

Interpretation: The substantial number of people under 40 years of age with type 2 diabetes, are more likely to have characteristics associated with inequalities and are less likely to achieve HbA1c targets and receive recommended care processes. These findings highlight the need to consider novel approaches to service provision for this high-risk group.

Keywords
epidemiology, ethnic minority, obesity, type 2 diabetes
1 | INTRODUCTION

Type 2 diabetes has classically been considered a condition affecting middle-aged or older individuals. In recent years, increasing numbers of individuals presenting in younger age groups have become apparent. Early onset of type 2 diabetes carries significant risks of mortality, with an estimated median 7 years of life lost in those with a diagnosis between 21 and 40 years compared to those without diabetes. Affected individuals have a more aggressive diabetes phenotype than older-onset presentations, with a more rapid deterioration in glycaemic control that requires insulin treatment earlier, a worse cardiometabolic risk factor profile and higher proportions affected with diabetes-related microvascular and macrovascular complications. In the most comprehensive analysis to date, 60% of children diagnosed with type 2 diabetes had at least one microvascular complication after a mean duration of 13 years.

Early onset type 2 diabetes has been extensively studied in north American paediatric incident cohorts, but the characteristics of those with type 2 diabetes in early-adulthood have been less comprehensively studied with analysis of either single ethnicity datasets, absence of age-stratification of early-onset cases or, in the United Kingdom, analysis of local cohorts and general practice datasets with less than population-wide coverage.

In the present analysis, we addressed these limitations by studying a population-level registry of all people with type 2 diabetes in England to determine (1) the proportions of people with type 2 diabetes aged under 40 years stratified by paediatric, adolescent and early-adulthood age bands, (2) the characteristics (ethnicity, index of multiple deprivation and BMI) of people aged under 40 years with type 2 diabetes compared to those aged over 40 years and (3) the proportions of people with type 2 diabetes receiving the National Institute for Health & Care Excellence (NICE) recommended annual care processes and meeting HbA1c targets, by age.

2 | METHODS

We linked records of people in England aged under 80 years old from the National Diabetes Audit (NDA) dataset (primary care and specialist care comprising greater than 97% of people with a recorded diagnosis of diabetes, full description of cohort available here and National Paediatric Diabetes Audit data (NPDA, comprising data on children attending specialist paediatric diabetes clinics) to generate a population level cohort of people with diabetes aged under 40 years.

We included the following individuals (Figure S1):

1. All individuals recorded as having type 2 diabetes in the NPDA April 2019 to March 2020 and those aged 19–39 years recorded as type 2 diabetes in NDA from January 2019 to March 2020 (n = 115,390).
2. Those aged 0–18 years recorded as type 2 diabetes in the NDA from January 2019 to March 2020 who did not appear in the NDPA. We further selected from these, those with an HbA1c greater than or equal to 48 mmol/mol (6.5%) (n = 370) and/or those prescribed oral hypoglycaemics with or without insulin or metformin alone (n = 190).
3. Finally, we selected those aged 0–39 in NDA, not in NPDA and recorded with type 1 or unknown diabetes who were not prescribed insulin alone or insulin plus metformin but who had an HbA1c greater than or equal to 48 mmol/mol (6.5%) (n = 5395) or who were prescribed non-metformin oral hypoglycaemic drugs with or without insulin or metformin alone (n = 1430).

This made a final cohort of 122,780 individuals with type 2 diabetes aged under 40 years old. People aged 40–79 years recorded as having type 2 diabetes in NDA from January 2019 to March 2020 were also included in the cohort (n = 2,519,655).

To fulfil its statutory duties, NHS England and NHS Improvement require access to and linkage of various pseudonymised national datasets, in line with the requirements of the General Data Protection Regulation. The legal basis for the NDA data collection and linkage is a direction from NHS England to NHS Digital according to section 254 of the Health and Social Care Act for England 2012. Data are not extracted if the person has withdrawn their permission to use their record for...
Records were grouped by age into children under 16 years, adolescents aged 16–18 years, young adults aged 19–25 years and adults aged 26–39 years. We also analysed older age groups split into those aged 40–59 years and 60–79 years. Sex was recorded as male or female. Ethnicity was grouped as white, Asian, Black, mixed and other based on data recorded in routine health records, submitted to the NDA and NPDA. Socio-economic deprivation was defined by the English Index of Multiple Deprivation (IMD) 2019 associated with the Lower Layer Super Output Area derived from the individuals home postcode and grouped into quintiles (from 1 = most deprived to 5 = least deprived).24 BMI was categorised by age and ethnicity as follows; for those under 19 years from all ethnicities, WHO z-scores centiles were used: underweight below 2nd centile, healthy weight 2nd–85th centile, overweight 85th–95th centile and obese above 95th centile. White adults were classified as: underweight BMI less than 18.5, healthy weight 18.5 to less than 25, overweight 25 to less than 30 and obese greater than or equal to 30 kg/m². For people from other ethnic groups,25 adults were classified as: underweight BMI below 18.5, healthy weight 18.5 to less than 23, overweight 23 to 27.5 and obese greater than or equal to 27.5 kg/m². For each variable (sex, ethnicity, IMD and BMI) records with missing data were included as an additional category.

Consistent with NICE guidelines, 19,20 we assessed receipt of diabetes care processes as follows: under 12 years old, HbA1c, BMI, cholesterol, blood pressure and urine albumin care processes; 12–18 years: HbA1c, BMI, cholesterol, blood pressure, urine albumin, retinal screening and foot care processes; 19 years and over: HbA1c, BMI, cholesterol, blood pressure, urine albumin, retinal screening, foot check, smoking status and creatinine care processes. Finally, we assessed proportions achieving the treatment target of HbA1c <58 mmol/mol (7.5%) using the latest recorded HbA1c in the audit period.

2.1 | Statistical methods

Characteristics by sex, ethnicity, deprivation, BMI category and duration of diabetes were presented stratified by age group with associations tested using a two-way chi-square test. The median (and interquartile range) was calculated for HbA1c and Kruskal–Wallis tests performed to assess differences across age categories.

We used population estimates for England and Wales (2019) for age and ethnicity from the Office for National Statistics (ONS) 26 to calculate expected cross-sectional prevalence for Asian and Black ethnic group populations based on white prevalence, to account for differences in population structure in Asian and Black individuals by age.

Missing data were included for all statistical tests except for those related to receipt of care processes, differences in weight categories by ethnicity and achievement of HbA1c targets.

Statistical significance was set at <0.05 and all analyses were done in SAS Enterprise Guide version 8.3.

3 | RESULTS

During the study period, we identified a total of 122,780 individuals with type 2 diabetes aged under 40 years in England, comprising: 650 (0.5%) children under 16 years, 910 (0.7%) adolescents aged between 16 and 18 years, 8,245 (6.7%) young adults aged between 19 and 25 years and 112,975 (92%) adults aged between 26 and 39 years. In total, those aged under 40 years of age with type 2 diabetes, accounted for 4.6% of all people aged below 80 years with type 2 diabetes coded in the NDA dataset (Table 1).

3.1 | Sex

Up until the age of 25 years, women predominated, accounting for over 60% of type 2 diabetes cases, both under the age of 18 years and between 19 and 25 years. Between the ages of 26–39 years, cases in men and women were equal (women 49%). In contrast, for those aged between 40 and 59 years, men predominated with only 41% of cases in women and similarly, 43% of those aged 60–79 years were in women (p < 0.001).

3.2 | Ethnicity

Among all those aged under 40 years, 11,145 had no ethnicity coded (9.1%). There were age-related differences in the distribution of people with type 2 diabetes by ethnic group (p < 0.001) (Table 1). Among those aged under 40 years, 49% were white, 31% were of Asian ethnicity, 7% were of Black ethnicity, 2% were of mixed ethnicity and 2% were from another ethnic group. For those aged 40 years and over, 66% were white, 15% were of Asian ethnicity, 5% were of Black ethnicity, 1% were of mixed ethnicity and 2% were from another ethnic group.

The age distributions of the Asian and Black populations across England and Wales were younger than for white ethnicity (Table S1). Applying the estimated prevalence from white individuals aged under 40 years old
## Table 1

Key characteristics of people living with type 2 diabetes in England stratified by current age, in those aged under 80 years

|                  | <16 years | 16–18 years | 19–25 years | 26–39 years | 40–59 years | 60–79 years | p-value |
|------------------|-----------|-------------|-------------|-------------|-------------|-------------|---------|
|                  | n         | %           | n           | %           | n           | %           | n       | %       |
| **Total**        | 650       | 910         | 8245        | 112,975     | 945,080     | 1,574,575   |         |         |
| **Sex**          |           |             |             |             |             |             |         |         |
| Men              | 230       | 35          | 3195        | 39          | 57,400      | 59          | 899,485 | 57      |
| Women            | 415       | 64          | 5045        | 61          | 55,575      | 49          | 675,095 | 43      |
| Missing          | 5         | 0.8         | —           | —           | —           | —           | 5       | 0       |
| **Ethnicity**    |           |             |             |             |             |             |         |         |
| White            | 230       | 35          | 4445        | 54          | 54,770      | 48          | 1,108,415 | 70      |
| Asian            | 245       | 38          | 1865        | 23          | 35,555      | 31          | 180,355  | 11      |
| Black            | 85        | 13          | 590         | 7.2         | 7860        | 7.0         | 56,710   | 3.6     |
| Mixed            | 35        | 5.4         | 210         | 2.5         | 2385        | 2.1         | 12,930   | 0.8     |
| Other            | 20        | 3.1         | 170         | 2.1         | 2360        | 2.1         | 23,095   | 1.5     |
| Missing          | 40        | 6.2         | 965         | 12          | 10,045      | 8.9         | 193,075  | 12      |
| **Deprivation**  |           |             |             |             |             |             |         |         |
| IMD 1(most deprived) | 270       | 42          | 2890        | 35          | 38,985      | 35          | 344,110  | 22      |
| IMD 2            | 180       | 28          | 220         | 24          | 2015        | 24          | 236,905  | 21      |
| IMD 3            | 105       | 16          | 150         | 16          | 1365        | 17          | 327,995  | 21      |
| IMD 4            | 45        | 6.9         | 90          | 9.9         | 960         | 12          | 304,930  | 19      |
| IMD 5 (least deprived) | 30        | 4.6         | 75          | 8.2         | 700         | 8.5         | 252,860  | 16      |
| Missing          | 20        | 3.1         | 315         | 3.8         | 1015        | 0.9         | 7765     | 0.5     |
| **Body mass index** |           |             |             |             |             |             |         |         |
| Underweight      | 5         | 0.8         | 10          | 1.1         | 65          | 0.8         | 6250     | 0.4     |
| Healthy weight   | 45        | 6.9         | 70          | 7.7         | 555         | 6.7         | 151,265  | 9.6     |
| Overweight       | 45        | 6.9         | 90          | 9.9         | 925         | 11          | 433,840  | 28      |
| Obese            | 505       | 78          | 595         | 65          | 4735        | 57          | 736,485  | 47      |
| Missing          | 50        | 7.7         | 145         | 16          | 1965        | 24          | 246,740  | 16      |
| **Duration**     |           |             |             |             |             |             |         |         |
| <2 years         | 410       | 63          | 415         | 46          | 3010        | 37          | 165,595  | 11      |
| 2 to <10 years   | 230       | 35          | 465         | 51          | 4470        | 54          | 645,825  | 41      |
| 10 years plus    | 10        | 1.5         | 25          | 2.7         | 740         | 9.0         | 762,810  | 48      |
| Missing          | —         | —           | 5           | 0.5         | 25          | 0.3         | 345      | 0       |

*Note: In line with National Diabetes Audit information governance rules, all counts are rounded to the nearest 5. This means that the sum of counts in the table do not always match the totals provided. p-values represent statistical significance using Chi Square tests of the distribution across age bands and all the categories of each variable.*
to Asian and Black populations of the same age resulted in an expected number of 9440 cases in Asian and 3975 cases in Black individuals. These expected cases were far exceeded by the observed cases presented in this analysis (37,945 in Asian ethnic groups and 8630 in Black ethnic groups).

### 3.3 Social deprivation

People from the most deprived quintile accounted for significantly higher proportions of younger individuals compared to older individuals; 42% of those aged under 16 years, 38% of adolescents aged 16–18 years, 35% of 19- to 25-year-olds and 35% aged 26–39 years were from the most deprived quintile ($p < 0.001$). In contrast, 29% of those aged 40–59 years and 22% of those aged 60–79 years were from the most deprived quintile ($p < 0.001$).

### 3.4 BMI

The proportions of those living with obesity decreased with increasing age; 78% of children under 16 years, 65% of adolescents aged 16–18 years, 57% of 19-25-year-olds and 58% of 26–39-year-olds were living with obesity ($p < 0.001$). In contrast, 55% of 40- to 59-year-olds and 47% of 60–79 years olds were living with obesity. Taking those under 40 years together, 58% were living with obesity compared to 50% of those aged 40–79 years ($p < 0.001$).

Analysis of BMI by ethnic group (Figure 1) revealed high proportions of obesity across all ethnicities in those aged under 19 years; 72% of Asian individuals, 70% of Black individuals and 70% of white individuals aged under 19 years with type 2 diabetes were living with obesity $p < 0.0001$. The proportions living with obesity reduced in the 19- to 39-year-old age band across all ethnic groups. The proportions living with obesity in those aged 40–79 years was 43% in Asian individuals, 57% in Black individuals and 50% in white individuals.

### 3.5 Care processes and treatment targets

The proportion of individuals meeting all NICE, age-related, recommended care processes increased significantly with higher age (Table 2). The overall percentage meeting an HbA$_1c$ target of below 58 mmol/mol (7.5%) was highest in older adults and significantly lower in those age 16–18 and 19–26 years ($p < 0.001$).

In all age bands, a longer duration of diabetes was associated with higher median HbA$_1c$ ($p < 0.001$) (Table 3).

### 4 DISCUSSION

In this first ever population-level analysis of children, adolescents and young adults in England with type 2 diabetes, we found 122,780 individuals living with type 2 diabetes and aged under 40 years. Children under 19 years account for only 1.3% of people under 40 years with type 2 diabetes but the number of people with type 2 diabetes rises progressively with each age-band studied from age 19 to

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**FIGURE 1** Bar chart depicting percentage of individuals in each weight category stratified by current age (in those aged under 80 years) and ethnicity in people living with type 2 diabetes in England.
Compared to people with type 2 diabetes aged over 40 years, those aged below 40 years were considerably more likely to be from a minority ethnic group, to be in an obese weight category and to live in an area with high rates of social deprivation. This analysis shows that these ethnicity, weight and deprivation differences are inversely related to age even just in those up to 40 years, with the proportions living with obesity or from the most deprived quintiles decreasing as age increases. We also show that cases in women predominate only up until the age of 25 years after which men become and remain the more affected sex throughout adulthood.

Our analysis reveals that in contrast to ‘later-onset’ type 2 diabetes, where Asian people have the lowest proportion in the obese category, in children aged under 19 years there are equally high proportions in the obese category across all ethnic groups. It is important to consider that interpretation of proportions in obese and overweight categories is complicated by the different BMI thresholds applied for obesity between children and adults. We show that compared to older individuals living with type 2 diabetes, those aged below 40 years are less likely to receive the NICE recommended care processes or achieve target HbA1c.

The numbers of young adults (under 40 years) with type 2 diabetes in England now exceeds those living with type 1 diabetes (albeit most with type 2 diabetes are in the 26–39 age group). In the recently published NDA data, 84,595 adults living with type 1 diabetes were aged 19–40 years, whereas in this analysis we found 121,220 adults with type 2 diabetes.27

Our findings are consistent with emerging data from other countries and datasets, although the current analysis represents, to our knowledge, the largest analysis to date in a whole multi-ethnic population. A Swedish study showed high rates of obesity in those diagnosed <40 years5,28 attenuating with increasing age and analysis of GP registries in England have also shown over-representation of ethnic minority groups in those aged under 40 years17 with high rates of obesity at diagnosis.8 Our observations outline the already high caseload of those aged <40 years and identify some key age related characteristics of those affected—a preponderance of people from ethnic minority groups, higher proportions of women (with implications for pre-gestational diabetes affecting pregnancy), high proportions of those living with obesity that attenuate with increasing age within the early-onset group and high proportions of people living in areas of high social deprivation.

It remains unclear whether the reported adverse outcomes associated with early-onset type 2 diabetes are related to personal characteristics, to its longer lifetime impact or to the provision of care received or accessed. Routine ongoing diabetes management is the element most amenable to

### Table 2: Care processes received and HbA1c targets achieved in people living with type 2 diabetes in England stratified by current age for those aged under 80 years

| Age group (years) | Total | <16 years | 16–18 years | 19–25 years | 26–39 years | 40–59 years | 60–79 years | HbA1c <58 mmol/mol or <7.5% |
|------------------|-------|-----------|-------------|-------------|-------------|-------------|-------------|-----------------|
|                  | n (%) |           |             |             |             |             |             | n (%)           |
| Care processes received | 650 (25) | 165 (25) | 245 (27) | 1880 (23) | 38,000 (34) | 439,975 (47) | 921,780 (59) | 355 (65) |
| Median (IQR) % | 57 (48–78) | 58 (47–81) | 56 (48–75) | 56 (48–70) | 56 (48–70) | 56 (48–70) | 56 (48–70) | 56 (48–70) |
| **p**-value | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |

*Care processes received were different across age groups. Under 12 years old: HbA1c, blood pressure, urine microalbumin and foot care; 12–18 years: HbA1c, blood pressure, urine microalbumin, foot care, retinal screening and smoking status; 19 years and over: HbA1c, BMI, cholesterol, blood pressure, urine microalbumin, retinal screening, foot check, smoking status and creatinine.*
healthcare intervention with the low proportion of individuals receiving all care processes and achieving the HbA1c treatment target, areas for potential improvement. A recent study of the national diabetes retinal screening service found that people with diabetes aged 18–34 years were least likely to attend for annual retinal screening and despite reductions in certifications for vision loss in every other age group, this reduction had not been observed in those 18–34. Interestingly, compared to white individuals, Asian people were more likely to attend and Black people similarly more likely to attend but those of mixed ethnicity least likely and there was also 27% higher odds of non-attendance in those from the most deprived quintile. These analyses were not stratified by age and one may speculate there may be differences by type of diabetes.

Irrespective of the underlying drivers for poor outcomes, these results suggest there will be a need for novel approaches to care provision in those living with type 2 diabetes under the age of 40 years. These approaches must include a focus on strategies that engage people of working age, women of child-bearing age and indeed those that are tailored to people from deprived communities of any ethnic group and those from minority ethnic groups.

### 5 | LIMITATIONS

Our analysis has some limitations. First, we relied on submitted diagnostic coding to identify cases of type 2 diabetes and acknowledge that in those aged below 40 years the potential for miscoding may be higher as other types of diabetes may be more frequently encountered and phenotypically difficult to segregate from early-onset type 2 diabetes. Second, due to the cross-sectional nature of our analysis, we did not undertake linkage of the combined NPDA/NDA dataset with Hospital Episode Statistics to verify ethnicity and this likely accounts for the level of missing ethnicity data obtained in this analysis. Third, the ONS estimates used in this analysis are likely to underestimate prevalence due to the combined denominator for England and Wales and the proportion of cases with missing ethnicity data. Finally, we restricted analyses of the receipt of care processes and achievement of HbA1c targets to those with complete data and acknowledge that these outcomes are likely to be worse in those with missing data.

### 6 | CONCLUSION

This large contemporary population-based analysis has identified 122,780 individuals aged under 40 years living with type 2 diabetes in England. Children account for a relatively small percentage of this group. The total number is similar to the population of young people with Type 1 diabetes (aged under 40 years). In contrast to their young type 1 counterparts and to older people with type 2 diabetes, people with type 2 diabetes in this age-group are significantly more likely to be from minority ethnic groups, to be in obese weight categories, to be women up to the age of 25 years and to live in the most socio-economically deprived areas. Current models of diabetes care provision were developed and implemented when early-onset type 2 diabetes cases were infrequent. The burgeoning numbers demonstrated in this analysis both in adolescence and early adulthood, suggest that there is a pressing need for research into the best therapeutic approaches and to reconsider how services are best organised to support this group, which is both at high-risk and currently has poorer care outcomes.

### ACKNOWLEDGEMENTS

We thank members of the National Diabetes Audit advisory group for young-onset type 2 diabetes including: NPDA Holly Robinson and Dr Fiona Campbell; NDA
Dr Andrew Askey, Dr Soon Song, Dr Kate Hunt, Dr Koteshwara Muralidhara, Dr Dulmini Kariyawasam and Dr Chirag Bakhai; Diabetes UK representatives, Alex Berry & Sophie Colling; patient representatives, Mandy West, Richard Umpleby, Sarah Gibbs and NHS Digital; James Smith, Matt Curley and Jackie O’Keefe. SM is supported by the National Institute for Health Research (NIHR) Biomedical Research Centre at Imperial College Healthcare NHS Trust. NH is funded by Diabetes UK and NHS England and NHS Improvement.

CONFLICTS OF INTEREST
All authors are or have been members of clinical advisory groups to the National Diabetes Audit. BY and JV are members of the NDA Research Advisory Group. JV is National Clinical Director for Diabetes and Obesity at NHS England & NHS Improvement.

DATA AVAILABILITY STATEMENT
Data from the NDA can be requested through the NHS Digital Data Access Request Service process at: https://digital.nhs.uk/services/data-access-request-service-dars/data-access-request-service-dars-process.

ORCID
Shivani Misra https://orcid.org/0000-0003-2886-0726
Emma Barron https://orcid.org/0000-0001-6257-9044
Jonathan Valabhji https://orcid.org/0000-0001-9756-4061

REFERENCES
1. Tancredi M, Rosengren A, Svensson A-M, et al. Excess mortality among persons with type 2 diabetes. N Engl J Med. 2015;373:1720-1732.
2. Rao Kondapally Seshasai S, Kaptoge S, Thompson A, et al. Diabetes mellitus, fasting glucose, and risk of cause-specific death. N Engl J Med. 2011;364:829-841.
3. Naveed S, Araz R, Stefan F, et al. Age at diagnosis of type 2 diabetes mellitus and associations with cardiovascular and mortality risks. Circulation. 2019;139:2228-2237.
4. Lascar N, Brown J, Pattison H, Barnett AH, Bailey CJ, Bellary S. Type 2 diabetes in adolescents and young adults. Lancet Diabetes Endocrinol. 2018;6:69-80.
5. Nanayakkara N, Pease AJ, Ranasinha S, et al. Younger people with type 2 diabetes have poorer self-care practices compared with older people: results from the Australian National Diabetes Audit. Diabet Med. 2018;35:1087-1095.
6. Steinarsson AO, Rawshani A, Gudbjörnsdottir S, Franzén S, Svensson A-M, Sattar N. Short-term progression of cardiometabolic risk factors in relation to age at type 2 diabetes diagnosis: a longitudinal observational study of 100,606 individuals from the Swedish National Diabetes Register. Diabetologia. 2018;61:599-606.
7. Huo X, Gao L, Guo L, et al. Risk of non-fatal cardiovascular diseases in early-onset versus late-onset type 2 diabetes in China: a cross-sectional study. Lancet Diabetes Endocrinol. 2016;4:115-124.
8. Wright AK, Welsh P, Gill JMR, et al. Age-, sex- and ethnicity-related differences in body weight, blood pressure, HbA1c, and lipid levels at the diagnosis of type 2 diabetes relative to people without diabetes. Diabetologia. 2020;63:1542-1553.
9. Hillier TA, Pedula KL. Complications in young adults with early-onset type 2 diabetes. Diabetes Care. 2003;26:2999-3005.
10. Yang W, Cai X, Xan X, Ji L. Clinical characteristics of young type 2 diabetes patients with atherosclerosis. PLoS One. 2016;11:e0159055.
11. Gregg EW, Hora I, Benoit SR. Resurgence in diabetes-related complications. JAMA. 2019;321:1867-1868.
12. Fang M, Echouffo-Tcheugui J, Selvin E. Burden of complications in U.S. adults with young-onset type 2 or type 1 diabetes. Diabetes Care. 2020;43:e47-e49.
13. TODAY Study group. Long-term complications in youth-onset type 2 diabetes. N Engl J Med. 2021;385:416-426.
14. SEARCH for Diabetes in Youth Study writing Group. Incidence of diabetes in youth in the United States. JAMA. 2007;297:2716-2724.
15. TODAY Study Group. Effects of metformin, metformin plus rosiglitazone, and metformin plus lifestyle on insulin sensitivity and beta-cell function in TODAY. Diabetes Care. 2013;36:1749-1757.
16. Wright AK, Kontopantelis E, Emsley R, et al. Life expectancy and cause-specific mortality in type 2 diabetes: a population-based cohort study quantifying relationships in ethnic subgroups. Diabetes Care. 2017;40:338-345.
17. Koye DN, Ling J, Dibato J, Khunti K, Montvida O, Paul SK. Temporal trend in young-onset type 2 diabetes-the macrovascular and mortality risk: study of U.K. primary care electronic medical records. Diabetes Care. 2020;43:2208-2216.
18. Benhalima K, Song SH, Wilmot EG, et al. Characteristics, complications and management of a large multiethnic cohort of younger adults with type 2 diabetes. Prim Care Diabetes. 2011;5:245-250.
19. NICE NG18 Diabetes in children and young people. (Accessed April 20, 2020). https://www.nice.org.uk/guidance/ng18/resources/diabetes-type-1-and-type-2-in-children-and-young-people-e-diagnosis-and-management-pdf-1837278149317
20. NICE Guidelines [NG28] Type 2 diabetes in adults. 2015. (Accessed July 15, 2022). https://www.nice.org.uk/guidance/ng28
21. National Diabetes Audit Dataset. (Accessed July 15, 2022). https://digital.nhs.uk/data-and-information/publications/statistical/national-diabetes-audit
22. Holman N, Knighton P, Wild SH, et al. Cohort profile: National Diabetes Audit for England and Wales. Diabet Med.2021;38:e14616.
23. National Paediatric Diabetes Audit Dataset. (Accessed July 15, 2022). https://digital.nhs.uk/about-nhs-digital/corporate-information-and-documents/directions-and-data-provision-notices/data-provision-notices-dpns/national-paediatric-diabetes-audit
24. English indices of deprivation 2019. 2019. (Accessed March 24, 2021). https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019
25. Caleyachetty R, Barber TM, Mohammed NI, et al. Ethnicity-specific BMI cutoffs for obesity based on type 2 diabetes risk
in England: a population-based cohort study. *Lancet Diabetes Endocrinol*. 2021;9:419-426.

26. Population estimates by ethnic group and religion, England and Wales: 2019. 2019. (Accessed March 22, 2022). https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/articles/populationestimatesbyethnicgroupandreligionenglandandwales/2019

27. Type 1 Diabetes National Audit. (Accessed Aug 15, 2021). https://digital.nhs.uk/data-and-information/publications/statistical/national-diabetes-audit/national-diabetes-audit-2019-20-type-1-diabetes

28. Sattar N, Rawshani A, Franzén S, et al. Age at diagnosis of type 2 diabetes mellitus and associations with cardiovascular and mortality risks findings from the Swedish National Diabetes Registry. *Circulation*. 2019;139:2228-2237.

29. Lawrenson JG, Bourmpaki E, Bunce C, et al. Trends in diabetic retinopathy screening attendance and associations with vision impairment attributable to diabetes in a large nationwide cohort. *Diabet Med*. 2021;38:e14425.

30. Misra S, Gable D, Khunti K, et al. Developing services to support the delivery of care to people with early-onset type 2 diabetes. *Diabet Med*. 2022. doi:10.1111/dme.14927

**SUPPORTING INFORMATION**

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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**How to cite this article:** Misra S, Holman N, Barron E, et al. Characteristics and care of young people with type 2 diabetes included in the national diabetes audit datasets for England. *Diabet Med*. 2023;40:e14940. doi: [10.1111/dme.14940](https://doi.org/10.1111/dme.14940)