Incidence of Type 1 Diabetes in Children Has Fallen to Pre–COVID-19 Pandemic Levels: A Population-Wide Analysis From Scotland

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We previously reported in *Diabetes Care* (1) that the incidence of type 1 diabetes among children aged 0–14 years in Scotland during 2020–2021 was 20% higher than the 7-year average across 2015–2021. Among people aged 15–34 years, we observed a continued slow linear year-on-year rise across the study period (1). Our report aligned with the findings of a recent meta-analysis showing a rise in 2020 and a peak in 2021 (2). However, using RT-PCR test data, we found no evidence supporting a direct causal effect of coronavirus disease 2019 (COVID-19) infection itself, consistent with a recent analysis in the prospective, multinational The Environmental Determinants of Diabetes in the Young (TEDDY) cohort of children (3). These reports of rising type 1 diabetes cases are deeply concerning (4), as they herald increased morbidity, a decline in children's quality of life, and increased burden on health services. An important question is whether this incidence rise continued in 2022 amid a less severe pandemic and lifted social restrictions.

In Scotland, health care is free at the point of delivery, and all new type 1 diabetes diagnoses in primary or secondary care are captured in the nationwide Scottish Care Information – Diabetes (SCI-Diabetes) registry within 24 h of diagnosis. Furthermore, the nationwide policy mandates the inpatient admission of all children under 16 years of age with suspected diabetes to a specialist unit on the day of presentation. Using updated data from SCI-Diabetes and hospital admissions, we examined type 1 diabetes incidence in the pediatric population for 2022, assessing differences in age, sex, or diabetic ketoacidosis (DKA) presence at admission between 2020–2021 and the surrounding years 2019 and 2022.

Data on incident type 1 diabetes cases from 1 January 2015 to 31 December 2022, obtained from SCI-Diabetes for people aged 0–5, 6–14, and 15–34 years, were combined with daily population estimates for Scotland, derived by fitting a spline function to publicly available midyear estimates. As before (1), adjusted smoothed effects of calendar time were estimated jointly from the counts of daily cases by age-group, using the R package *mgcv* to fit a generalized additive model. Thus, the underlying trend in incidence over time was estimated and plotted relative to the age-group–specific average across the period (Fig. 1). DKA presence at admission was ascertained from the ICD-10–coded Scottish Morbidity Records 01, the nationwide database of general/acute hospital admissions and discharges.

Between 2015 and 2022, the incidence was highest and most variable in children 6–14 years old. In this group, incidence peaked in early 2021, at about 20% above the 8-year average, but regressed to slightly below it by 2022 (Fig. 1). No substantial changes occurred over time in children 0–5 years old, while a slow but nonsignificant increase was observed in individuals 15–34 years old.

We examined the characteristics of diagnosed 6- to 14-year-old children for each year from 2019 to 2022. The mean age (95% CI) at onset was 10.7 (10.4–11.0), 10.7 (10.4–11.0), 10.4 (10.1–10.6), and 10.6 (10.3–10.9) years. The proportion of males (95% CI) was 45.8% (39.7–52.0), 51.9% (46.1–57.8), 51.2% (45.9–56.5), and 52.4% (46.2–58.7). The percentage of new-onset cases with a DKA ICD-10 code on hospital admission records (95% CI) was 31.2% (25.5–37.0), 31.4% (26.0–36.9), 31.4% (26.5–36.3), and 34.1% (28.2–40.1).

Subdividing children aged 0–14 years into two subgroups revealed that the sharp increase in type 1 diabetes incidence seen in 2021 was restricted to children aged 6–14 years and did not persist into 2022. This finding should provide substantial reassurance to parents and service providers. In that group, there was no significant difference in age, sex,

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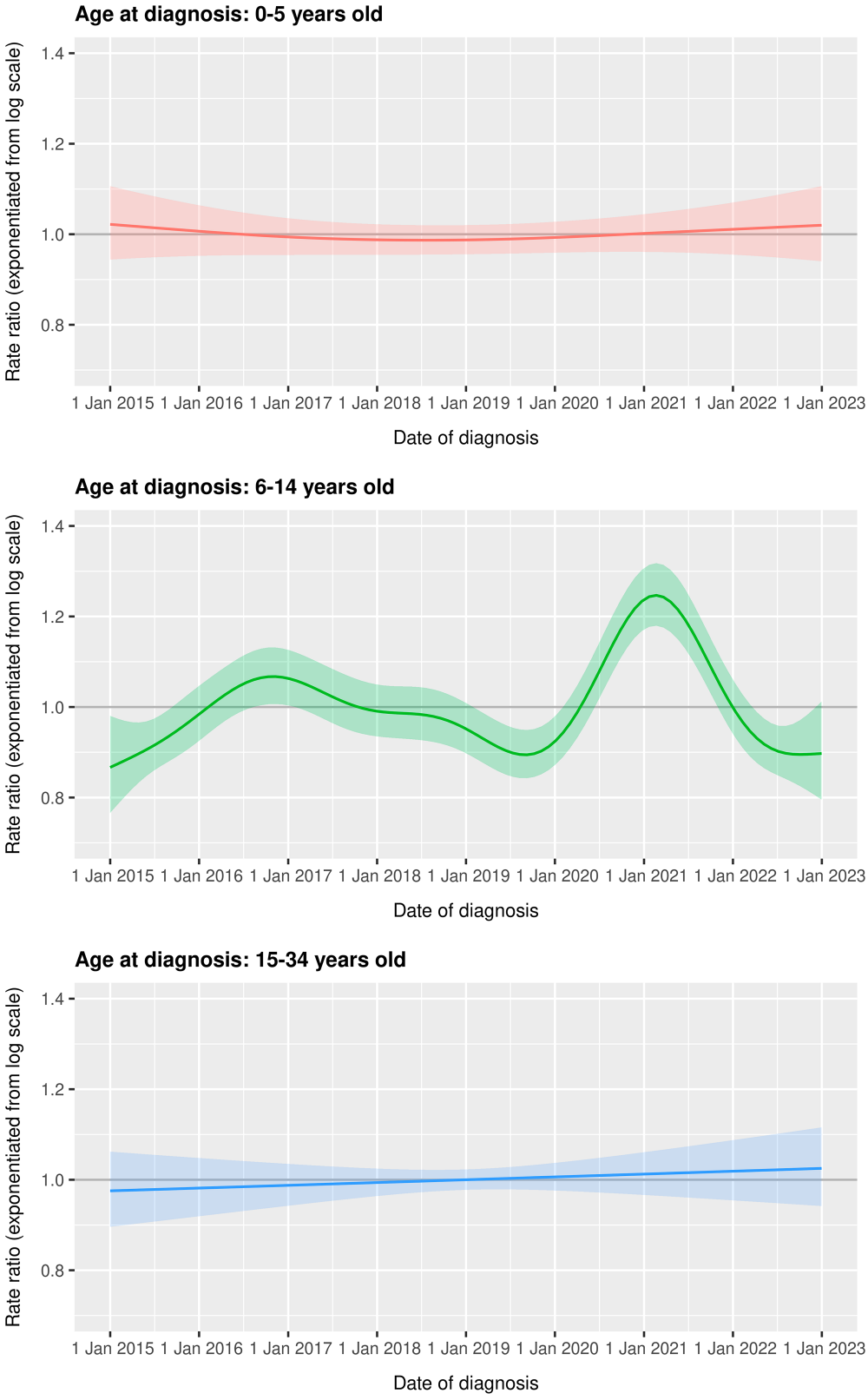

Figure 1—Fitted curves for relation of type 1 diabetes incidence in Scotland to calendar time from 2015 through 2022, adjusted for age, seasonality, and weekday/weekend and stratified by age. Ribbon edges are 1 SE above and below the fitted curve. A rate ratio of 1.0 corresponds to the 8-year average within each age-group.

or DKA presentation among incident cases between 2020–2021 and surrounding years.

A limitation of our analysis is that the cessation of nationwide free RT-PCR testing for COVID-19 in January 2022 precluded reexamining the infection's direct effect on type 1 diabetes incidence. However, as previously noted, serology

and RT-PCR surveillance data indicated a cumulative proportion of prior pediatric COVID-19 infection of ∼25% by June 2021, when type 1 diabetes incidence had peaked, and a rise to about 60% by January 2022. This time course is not consistent with a direct causal effect. Additionally, vaccination in Scotland was not introduced until April 2022 in 5- to 11-year-old children. Alternative explanations include altered infection rates or timings in children for pathogens that may have a causal role in type 1 diabetes. Recent reports from Germany suggest that the rise in incidence there during the pandemic was greatest in children below 6 years of age. However, a decrease in older children was also noted in 2022 (5). Continued monitoring of type 1 diabetes incidence remains paramount, and it will be of interest to see whether similar patterns are observed in other countries.

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