Short Communication

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Decline in case rates of youth onset type 2 diabetes in year three of the COVID-19 pandemic

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Abstract

**Objectives:** To determine changes in case rates of youth onset type 2 diabetes in the three years following the COVID-19 pandemic.

**Methods:** A single-center, retrospective medical record review was conducted for patients newly diagnosed with T2D between 3/1/18 and 2/28/23 at a pediatric tertiary care center. The number of patients referred to CHLA with a T2D diagnosis date between 3/1/2020 and 2/28/2023 was compared to historical rates between 3/1/18 and 2/29/2020. χ² or Fisher’s exact test was used to compare categorical variables between each year and 2019.

**Results:** Compared to prepandemic baseline (3/1/19–2/29/20, 11.8±3.7 cases/month), there was a significant increase in new T2D monthly case rates in pandemic year 1 (3/1/20–2/28/21, 20.1±6.0 cases/month, 171 %, p=0.005) and pandemic year 2 (3/1/21–2/28/22, 25.9±8.9 cases/month, 221 %, p=0.002). Case rates declined in pandemic year 3 to 14.5±4.1 cases/month (3/1/22–2/28/23, p=0.43). Compared to prepandemic year 1, the frequency of DKA at diagnosis was higher in pandemic year 1 (13.3 vs. 5.0 %, p=0.009). The DKA rate in pandemic years 2 (6.8 %) and 3 (3.4 %) were comparable to prepandemic year 1 (p=0.53 and 0.58, respectively).

**Conclusions:** Youth onset type 2 diabetes cases and DKA rates in year 3 of the pandemic have returned to prepandemic level.

**Keywords:** type 2 diabetes; youth onset; COVID-19

The COVID-19 pandemic has significantly overburdened global healthcare systems. One of the major challenges observed during this unprecedented global health emergency was a striking rise in the rate of youth onset type 2 diabetes (YOT2D) [1]. Our single-center findings of increased YOT2D corroborated reports from other regional and national studies [1–3]. As the federal COVID-19 Public Health Emergency ended with an overall decline in COVID-19 rate and severity, it was unclear whether the previously reported rise of YOT2D case rates would persist [4]. The primary aim of the current study was to determine whether the case rate and severity of YOT2D has remained elevated in the third year (3/1/22–2/28/23) of the COVID-19 pandemic. To address this question, the case rates of T2D and diabetes ketoacidosis (DKA) at diagnosis prepandemic were compared to those observed during the pandemic years.

To determine changes in new onset T2D case rates in the three years following onset of the COVID-19 pandemic, we examined the number of patients referred to Children’s Hospital Los Angeles (CHLA) with a T2D diagnosis date between 3/1/2020 and 2/28/2023 and compared these to historical rates between 3/1/2018 and 2/29/2020 (Table 1). CHLA is a private, nonprofit urban tertiary pediatric hospital that receives referral throughout the Southern California area. A total of 94 % of patients who receive care for T2D at CHLA are publicly insured. The data review and analyses complied with regulations set forth by the CHLA Institutional Review Board (Los Angeles, CA).

Prepandemic years (PPY) were defined as: PPY2: 3/1/18–2/28/19 and PPY1: 3/1/19–2/29/20. Pandemic years (PY) were defined as: PY1: 3/1/20–2/28/21, PY2: 3/1/21–2/28/22, and PY3: 3/1/22–2/28/23. T2D was diagnosed in accordance with the criteria of the American Diabetes Association [5]. All persons with positive type 1 diabetes autoantibodies were excluded from this analysis. Ethnicity and race were self-reported and collected from the electronic medical record. DKA was defined as blood glucose >200 mg/dL, pH <7.3 or bicarbonate <15 mEq/L, and ketonuria or ketonemia.

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PPY1 was defined as the reference year for comparisons. Compared to PPY1 (11.8±3.7 cases/month), we observed a significant increase in new T2D monthly case rates in PY1 (20.1±6.0 cases/month, 171 %, p=0.005) and PY2 (25.9±8.9 cases/month, 221 %, p=0.002). Case rates declined in PY3, however, to 14.5±4.1 cases/month (p=0.43). The frequency of DKA at diagnosis was higher in PY1 compared to PPY1 (PPY1 5.0 % vs. PY1 13.3 %, p=0.009) but was comparable to the baseline in PY2 (6.8 %, p=0.53) and PY3 (3.4 %, p=0.58). The median HbA1c exhibited a downward trend between 2018 and 2022 (p=0.03). We did not observe differences in the age of diagnosis (Table 1). The percentage of female patients trended downward in PY1 (p=0.06). We observed a change in race and ethnicity distribution across the five years, with more persons identified as “Other” in PY2 and PY3, and fewer persons identifying as Hispanic in PPY1 and PY1.

To our knowledge, this is the first report identifying a decline in the case rates of T2D and DKA frequency at diagnosis in youth, following the dramatic increase in both during the first year of the COVID-19 pandemic [2]. While this is a single-center study, our data highlight a consistent temporal sequence between two major public health events in the recent years – the COVID-19 pandemic and the pandemic of YOT2D, buttressing the argument for a strong association between the two entities.

Although the mechanism(s) by which the COVID-19 pandemic promoted the increased incidence of YOT2D remain unclear, amelioration of several T2D risk factors known to have increased during the pandemic may have contributed to the downturn in case rates and severity of YOT2D. First, overall active infections have decreased, attributable to both vaccination and prior infections [6]. The reduced overall virulence of the SARS-CoV-2, including viral infectivity, transmissibility, and disease severity, may have diminished the inflammatory assault to beta cells, a pathophysiological mechanism presumed to promote COVID-associated diabetes [7]. In addition, the return to school has allowed youth to resume pre-pandemic access to healthier food and exercise at school, reversing two of the factors associated with weight gain during the first pandemic year. Furthermore, regaining access

### Table 1: Characteristics of patients with new onset type 2 diabetes.

<table>
<thead>
<tr>
<th>Pandemic year</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases/mo, mean±SD</td>
<td>PPY2</td>
<td>PPY1</td>
<td>PY1</td>
<td>PY2</td>
<td>PY3</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Age, years, mean</td>
<td>8.2±3.7</td>
<td>11.8±3.7 (Ref)</td>
<td>20.1±6.0</td>
<td>25.9±8.9</td>
<td>14.5±4.1</td>
<td></td>
</tr>
<tr>
<td>Biological sex, % female</td>
<td>57</td>
<td>55</td>
<td>45</td>
<td>50</td>
<td>50</td>
<td>0.24</td>
</tr>
<tr>
<td>HbA1c, mmol/mol</td>
<td>9.2 (4.6)</td>
<td>8.6 (4.5)</td>
<td>9.1 (4.7)</td>
<td>8.9 (4.3)</td>
<td>7.7 (3.5)</td>
<td>0.03</td>
</tr>
<tr>
<td>DKA, %</td>
<td>3.1</td>
<td>5.0</td>
<td>13.3</td>
<td>6.8</td>
<td>3.4</td>
<td>0.76</td>
</tr>
<tr>
<td>Race, %</td>
<td>56</td>
<td>51</td>
<td>51</td>
<td>58</td>
<td>61</td>
<td>0.0001</td>
</tr>
<tr>
<td>Hispanic</td>
<td>26</td>
<td>28</td>
<td>39</td>
<td>30</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic</td>
<td>18</td>
<td>21</td>
<td>10</td>
<td>12</td>
<td>20</td>
<td>0.006</td>
</tr>
<tr>
<td>Unknown</td>
<td>3.1</td>
<td>4.3</td>
<td>1.7</td>
<td>2.3</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>5.1</td>
<td>2.8</td>
<td>6.2</td>
<td>3.5</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>6.3</td>
<td>17.7</td>
<td>14.9</td>
<td>6.4</td>
<td>8.6</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>5.2</td>
<td>15.6</td>
<td>10.8</td>
<td>13.2</td>
<td>17.2</td>
<td></td>
</tr>
</tbody>
</table>

PPY, prepandemic year; PY, pandemic year; mo, month; SD, standard deviation; reference year for comparison; IQR, interquartile range. One person identifying as American Indian was included in “Other” in 2020. Statistical analysis was performed with Prism 10 software. The χ² test for trend (Cochran-Armitage method) was used to analyze categorical variables across the 5 years. χ² or Fisher’s exact test was used to compare categorical variables between each year and 2019 (prepandemic year). One-way ANOVA or the Kruskal-Wallis test was used for normally (age) or non-normally (hemoglobin A1c [HbA1c]) distributed continuous variables, respectively. Dunnett’s multiple comparisons test was done using 2019 as the reference year for continuous variables. Normality was determined using the D’Agostino and Pearson test. Mean (SD) and median (interquartile range, IQR) were reported for continuous variables with normal and non-normal distributions, respectively. A 5 % level of significance was used for all tests. p-value shown represents comparison across 2018–2022. Pair-wise analysis performed between 2019 (Ref) and each of the other years, with statistical denoted by c(p<0.05) or (p<0.01).
to the routine preventive healthcare monitoring (e.g., blood work for metabolic health screening, anticipatory obesity care) may have contributed to earlier recognition of nascent metabolic derangements, preventing rapid disease progression. Lastly, reduction in the heightened level of stress (and stress hormones) in response to the global health emergency may have broadly improved insulin sensitivity. While there was a high percentage of “Unknown” or “Other” race and ethnicity in PY2 and PY3, the significance of these changes is unclear. However, it does not appear that there was a significant change in the racial and ethnic demographic profile in Los Angeles County during this period.

Our conclusions are constrained by several limitations. The strength of the current investigation includes the use of data from a large, urban, diverse pediatric population with comparison to historical data collected before and during the peak of COVID-19 pandemic. The retrospective design precludes inferences regarding the causal relationship between prior COVID-19 infection and development of T2D. The design also omitted consideration of variables unmeasured or uncontrolled biases (such as family history, referral bias to a specialized clinic, or history of symptoms before presentation) that may influence the observed differences in T2D referral rates.

We report a downtrend in the referral rate of YOT2D in year three of the COVID-19 pandemic. It is unclear whether these observations will be generalizable to other cohorts. Large, longitudinal studies are warranted to further elucidate the long-term effects of the COVID-19 pandemic on YOT2D.

Research ethics: The local Institutional Review Board deemed the study exempt from review due to retrospective nature and thus received IRB approval as an except study through the CHLA IRB.

Informed consent: Not applicable.

Author contributions: The authors have accepted responsibility for the entire content of this manuscript and approved its submission. LCC conceptualized and drafted the initial manuscript, analyzed the data, and revised the manuscript. AK, HM, and AV contributed to the writing of the manuscript. DG and JR critically reviewed the manuscript. BM and RZ contributed to data collection and chart review. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Competing interests: Not applicable. The authors have no financial relationships or relevant conflict of interest to disclose.

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Data availability: The raw data can be obtained on request from the corresponding author.

References