Editorial

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# Is Type 1 Diabetes a Post-Acute Sequela of COVID-19?

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Type 1 diabetes is a global health problem [1], as is the coronavirus disease 2019 (COVID-19) [2]. Whether new-onset type 1 diabetes is a consequence of COVID-19 has been a subject of considerable debate within the medical community [2, 3]. In a recent meta-analysis, epidemiological data from seven cohorts across six studies involving over 11 million children and adolescents were synthesized [4]. The analysis showed that the risk of developing type 1 diabetes was 42% higher among long-COVID patients than those without COVID-19 (risk ratio: 1.42, 95% CI 1.13, 1.77) [4]. Notably, most cohorts (5 out of 7) showed a positive association. The risk ratios from all four U.S. cohorts and the Norway cohort were significant and greater than one, while those from the Scotland and Denmark cohorts were less than one and non-significant. Variations in study results could be attributed to differences in children's ages, genetic susceptibility, and vaccination status, specific pandemic periods studied, duration of follow-up, confounding variables adjusted for in regression models, and rates of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) testing.

Insights into the presence of islet autoantibodies in children infected with SARS-CoV-2 were obtained from the TEDDY (The Environmental Determinants of Diabetes in the Young) and GPPAD (Global Platform for the Prevention of Autoimmune Diabetes) studies [5, 6]. In the TEDDY study, 4,586 children (aged 9 to 15 years) in the U.S., Sweden, Finland, and Germany were followed from January 2020 to December 2021. Among them, 18.6% of those with islet autoantibodies tested positive for SARS-CoV-2 antibodies, compared to 15.4% without islet autoantibodies over two years [5]. More compelling evidence emerged from the GPPAD study, which followed 1,050 infants (aged 4 to 7 months) from April 2018 through June 2022 across Germany, Poland, Sweden, Belgium, and the UK. In this study, children with SARS-CoV-2 antibodies had a significantly higher incidence rate of islet autoantibodies than those without SARS-CoV-2 antibodies (7.8 per 100 person-years vs. 3.5 per 100 person-years), with a hazard ratio of 3.5 (95% CI, 1.6, 7.7; p=0.002) [6]. Notably, one-third (33.3%) of children with islet autoantibodies developed type 1 diabetes.

Collectively, data from the recent meta-analysis of epidemiological data and mechanistic studies provide strong evidence that new-onset diabetes is a post-acute sequela of COVID-19 [3, 7, 8]. This underscores the importance of conducting research on the long-term health consequences of COVID-19, especially new-onset type 1 diabetes to better inform clinical care [3, 7].

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## Author Contributions
TS conceived the idea, conducted the literature search, and drafted the manuscript. TT contributed to the literature search and drafting of the manuscript. NB and AT reviewed the manuscript and gave critical comments. All authors approved the manuscript for submission to the journal.

## Competing Interests
The authors declare no competing financial interests or personal relationships that could have appeared to influence the work re-

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