Received: 6 February 2022 | Revised: 11 March 2022 | Accepted: 17 March 2022

DOI: 10.1002/hsr2.579

RESEARCH LETTER

Health Science Reports Open Access WILEY

Thyroid stimulating hormone levels in children before and during the coronavirus disease-19 pandemic

Sarah Shidid | Stephan Kohlhoff | Tamar A. Smith-Norowitz

Department of Pediatrics, Division of Infectious Diseases, State University of New York Downstate Health Sciences University, Brooklyn, New York, USA

Correspondence
Tamar A. Smith-Norowitz, Department of Pediatrics, State University of New York Downstate Health Sciences University, Box 49, 450 Clarkson Ave., Brooklyn, NY 11203, USA.
Email: tamar.smith-norowitz@downstate.edu

KEYWORDS
endocrinology and metabolic disorders, immunology, infectious diseases

Coronavirus disease-2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) may have a direct effect on several endocrine glands, including the thyroid.[1] SARS-CoV-2 enters cells using the angiotensin-converting enzyme-2 (ACE-2) receptor, expressed by the thyroid.[2] Prior literature reported low levels of triiodothyronine (TT3) and thyroid stimulating hormone (TSH) in adult patients with COVID-19.[3] However, levels of TSH in children during the pandemic are unknown. The aim of this study was to identify the frequency of abnormal TSH levels in children who were screened for thyroid disease during the COVID-19 pandemic compared to prepandemic levels.

A retrospective chart analysis was performed on patients in an outpatient pediatric practice located in the Kensington neighborhood of Brooklyn, New York. The COVID-19 infection rate in this community was 1.41% in November 2021. The daily average positivity rate in New York City during that period was 2.37%.[4] Children, 6–18 years who were tested for thyroid function with TSH levels (Quest Diagnostics; LabCorp) before (January 2017–October 2019) or during the COVID-19 pandemic (March 2020–October 2021) were included in the study. Results of TSH levels were reported as mIU/L (normal range: 0.45–4.3 mIU/L). Detection of past COVID-19 infection was performed by SARS-CoV-2 antibody test (IgG Nucleocapsid) (Quest Diagnostics). Statistical analyses were performed in SAS v9.4.3 (SAS Institute). This was a retrospective chart analysis from a private pediatric practice; all subjects were deidentified. This study was exempt from institutional ethical approval.

A total of 233 children (115 females [49%] and 118 males [51%]; mean age: 14.27 ± 1.66 years) were screened for TSH levels. The primary screening test for thyroid dysfunction is TSH testing. Other thyroid hormones (e.g., TT3 and thyroxine [TT4]) were not examined in this study. All subjects were White, non-Hispanic and lower to middle class.

Numbers (%) of abnormal TSH tests reported per year are shown in Figure 1. An abnormal test was defined as <0.45 or >4.3 mIU/L. The most number of TSH tests (147) were ordered in 2021. The number (%) of abnormal tests reported were high during 2018 and 2020 (Figure 1). No significant differences were observed in % of abnormal TSH tests reported pre and post pandemic $p = 0.121$, generalized Fisher exact test). Median TSH test values ranged from 1.65 to 2.25 mIU/L and the median age ranged from 14 to 16 years ($p = 0.302$, 0.916, respectively) (Kruskal–Wallis test) (Table 1). Participants with or without abnormal TSH test value tested positive for SARS-CoV-2 IgG antibody in 2020 and 2021 (40% vs. 27% and 0% vs. 13%; $p = 1.0$, 0.3, respectively). Participants with or without abnormal TSH test value tested negative for SARS CoV-2 IgG antibody in 2020 and 2021 (60% vs. 59% and 17% vs. 30%; $p = 1.0$, 0.3, respectively) (Fisher's exact test).

Wang et al., evaluated thyroid function in 96 hospitalized adults with COVID-19[3]; levels of TSH were significantly lower than those of healthy controls.[3] Levels of TSH increased gradually within 2 months after hospitalization.[3] Similarly, Chen et al. reported TSH levels lower than the normal range in 28 of 50 (56%) adult patients with COVID-19.[5] It is unknown what caused the observed pattern and/or how significant it was. Children were not evaluated. In this study,

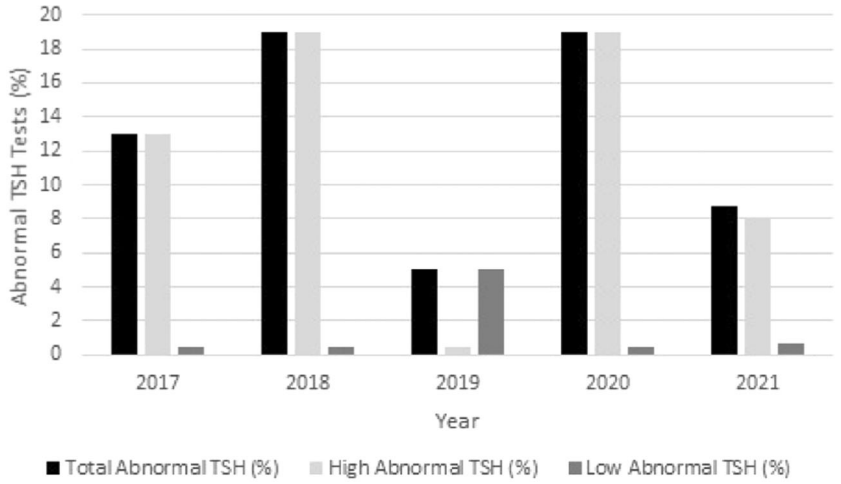

FIGURE 1 Abnormal thyroid stimulating hormone (TSH) tests. Number (%) of abnormal TSH tests reported (2017–2021). Black bar: total number of abnormal values. White bar: number of abnormal high values. Gray bar: number of abnormal low values. Number of tests ordered per year: 2017: 15; 2018: 26; 2019: 18; 2020: 27; 2021: 147

TABLE 1 Comparison of thyroid stimulating hormone (TSH) levels in children 2017–2021

Year	Variable	*N*	Minimum	Lower quartile	Median	Upper quartile	Maximum
2017	Age	15	10.00	13.00	16.00	16.00	18.00
	TSH	15	0.97	1.41	1.65	3.98	7.36
2018	Age	26	7.00	14.00	16.00	17.00	18.00
	TSH	26	0.53	1.29	2.25	3.25	34.01
2019	Age	18	7.00	14.00	15.00	16.00	18.00
	TSH	18	0.36	1.29	1.84	2.60	4.10
2020	Age	27	9.00	12.00	14.00	15.00	18.00
	TSH	27	0.81	1.15	2.01	2.70	24.08
2021	Age	147	6.00	12.00	15.00	16.00	18.00
	TSH	147	0.45	1.43	1.90	2.60	25.77

Note: Kruskal–Wallis tests: Age $p = 0.302$; TSH score $p = 0.916$;
TSH levels: normal range: 0.45–4.3 mIU/L.

participants were pediatric outpatients. It is unknown which children had initial or prior COVID-19 infection, or COVID-19 vaccination.

Children with COVID-19 are frequently asymptomatic. Testing for SARS-CoV-2 was performed when indicated or requested, and at the discretion of the treating clinician based on past or current symptoms consistent with COVID-19 infection. Children might have been tested because someone in the family tested positive. SARS-CoV-2 IgG antibody may not have been present in patients with acute or subacute infections. In general, SARS-CoV-2 IgG antibody is detected in blood several days post-infection and is indicative of prior infection or exposure; duration of antibody after acute infection is not well characterized. It is possible that SARS-CoV-2 IgG antibodies could be from vaccinated individuals; however, vaccination status was not reported.

This study has limitations including it was retrospective, the study population was small, and recruited from one community-based outpatient pediatric practice. Tests were excluded between October 2019 and February 2020. SARS-CoV-2 was officially identified in March 2020; however, it is unknown whether COVID-19 might have been circulating in the community in the months before March 2020. While there was an increase in numbers of TSH tests ordered and corresponding abnormal test between 2020 and 2021, the practice had expanded with an increase in patient population and reflected in number of tests. The percentage of abnormal tests remained constant.

TSH levels may also differ according to ethnicity and race; discrepancies may exist between Asian, White, Black, and Hispanics. Thus, this finding may only reflect one specific community representation, and may not apply to non-White children. There might have been selection bias; systematic COVID-19 testing was not performed. Conclusions of this study may be limited to people for whom testing was requested or indicated. While we did not find any association of abnormal TSH test with SARS CoV-2 antibodies, future examination of TSH levels in larger studies of children during the COVID-19 pandemic is warranted.

AUTHOR CONTRIBUTIONS

Conceptualization: Tamar Smith-Norowitz. *Data curation*: Sarah Shidid, Stephan Kohlhoff, and Tamar Smith-Norowitz. *Formal analysis*: Sarah Shidid, Stephan Kohlhoff, and Tamar Smith-Norowitz. *Investigation*: Sarah

Shidid, Stephan Kohlhoff, and Tamar Smith-Norowitz. *Methodology*: Sarah Shidid, Stephan Kohlhoff, and Tamar Smith-Norowitz. *Project administration*: Tamar Smith-Norowitz. *Supervision*: Tamar Smith-Norowitz. *Validation*: Tamar Smith-Norowitz. *Visualization*: Tamar Smith-Norowitz and Stephan Kohlhoff. *Writing: Original draft preparation*: Tamar Smith-Norowitz. *Writing: Review and editing*: Sarah Shidid, Stephan Kohlhoff, and Tamar Smith-Norowitz.

ACKNOWLEDGMENTS

We acknowledge Jeremy Weedon, PhD (Biostatistician, SUNY Downstate Health Sciences University, Brooklyn, NY, USA) for statistical analyses. We acknowledge Vatcharapan Umpaichitra, MD (Director, Pediatric Endocrinology, SUNY Downstate Health Sciences University, Brooklyn, NY, USA) for manuscript review. We acknowledge Margaret R. Hammerschlag, MD (Professor, Pediatrics and Medicine, SUNY Downstate Health Sciences University, Brooklyn, NY, USA) for fruitful discussions.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

ETHICS STATEMENT

This study was exempt from institutional ethical approval.

ORCID

Tamar A. Smith-Norowitz http://orcid.org/0000-0002-8204-6728

REFERENCES

1. Khoo B, Tan T, Clarke SA, et al. Thyroid function before, during and after COVID-19. *J Clin Endocrinol Metab*. 2021;106(2):e803-e811.
2. Rotondi M, Coperchini F, Ricci G, et al. Detection of SARS-CoV-2 receptor ACE-2 mRNA in thyroid cells: a clue for COVID-19-related subacute thyroiditis. *J Endocrinol Invest*. 2021;44(5):1085-1090.
3. Wang W, Su X, Ding Y, et al. Thyroid function abnormalities in COVID-19 patients. *Front Endocrinol*. 2021;11:623792. doi:10.3389/fendo.2020.623792
4. NYC Health. *COVID-19: Data;* 2021. https://www1.nyc.gov/site/doh/covid/covid-19-data-neighborhoods.pagehttps://www1.nyc.gov/site/doh/covid/covid-19-data-neighborhoods.page
5. Chen M, Zhou W, Zu W. Thyroid function analysis in 50 patients with COVID-19: a retrospective study. *Thyroid*. 2021;31(1):8-11.

How to cite this article: Shidid S, Kohlhoff S, Smith-Norowitz TA. Thyroid stimulating hormone levels in children before and during the coronavirus disease-19 pandemic. *Health Sci Rep*. 2022;5:e579. doi:10.1002/hsr2.579