

The Role of Children in the Dynamics of Intra Family Coronavirus 2019 Spread in Densely Populated Area

Eli Somekh, MD,*† Alexandra Gleyzer, MD,*
Eli Heller, MD,‡ Miriam Lopian, MD,†§
Lior Kashani-Ligumski, MD,†§ Shelly Czeiger, MD,§
Yehudit Schindler, PhD,¶ Joseph. B. Lessing, MD,†§
and Michal Stein, MD||**

Abstract: We examined the dynamics of coronavirus 2019 (Covid-19) transmission within families. Our investigation demonstrated significantly lower rates of Covid-19 positivity in children compared with adults residing in the same household. Children of 5–17 years of age were 61% and children of 0–4 years of age were 47% less likely to have positive polymerase chain reaction results compared with adults residing in the same household.

Accepted for publication May 10, 2020.

From the *Department of Pediatrics, Mayanei Hayeshua Medical Center, Bnei Brak, †Sackler School of Medicine, Tel Aviv University, ‡Maccabi Health Services, §Department of Obstetrics and Gynecology, Mayanei Hayeshua Medical Center, ¶Laboratory of Microbiology, Mayanei Hayeshua Medical Centre, Bnei Brak, ||Hillel Yaffe Medical Center, Hadera, and **Rappaport Faculty of Medicine, Technion—Israel Institute of Technology, Haifa, Israel. Address for correspondence: Eli Somekh, MD, Department of Pediatrics, Mayanei Hayeshua Medical Center, Bnei Brak, Israel. E-mail: esomekh@gmail.com.

Copyright © 2020 Wolters Kluwer Health, Inc. All rights reserved.
DOI: 10.1097/INF.0000000000002783

While the morbidity of coronavirus 2019 (Covid-19) infection in children has been largely recognized, the potential role of children in the transmission and dynamics of Covid-19 among the whole population is not completely clear. The concern about asymptomatic shedding of SARS-CoV-2 by children has also motivated many countries to close down school as one of the tools to halt spreading of infection.¹

A recent Centers for Disease Control and Prevention (CDC) Morbidity and Mortality Weekly Report as well as recent report from Italy re-enforced previous data of pediatric patients reported in China: About 1.7% of Covid-19 cases occurred in patients <18 years (persons <18 years comprise 22% of the U.S. population). Common symptoms in affected children included fever, cough and to a lesser extent shortness of breath. These are less frequent in children in comparison with affected adults.^{2–4} More recently, a Covid-19 related postinflammatory response has been also described.⁵

In a recent study from Iceland that included screening of both targeted, high risk and sample from the general population, it was found that with high-risk population, children under 10 years of age were less likely to receive a positive result than were persons 10 years of age or older, while in the general population screening, no child under 10 years of age had a positive result, compared with 0.8% of those 10 years of age or older.⁶

In addition, results of studies from Australia and the Netherlands have also doubted the assumption that children play a dominant role in the transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).^{7,8}

However, it should be emphasized that these results are not necessarily relevant to other countries especially those with more crowded and with higher average number of children in household.

In Israel, children younger than 19 years of age comprise more than 20% of patients diagnosed with Covid-19, a much higher rate that described in other reports, and it is necessary to reveal the dynamics of this infection in this demographic set up.

Therefore, we opted to examine the role of children in the city of Bnei Brak, Israel, which is one of the most crowded cities in the world and the city with the highest rates of children per family in Israel. This city has been one of the main epicenters of Covid-19 infection in Israel.

METHODS

Mayanei Hayeshuah Medical center is located in the city of Bnei Brak, Central Israel.

Bnei Brak is a “young” city. Children of 0–19 years of age comprise almost 50% of its 200,000 population, and the average number of children in a family is 4.57.

Investigation of Family Clusters

Clusters of infections within families living in Bnei Brak were identified and investigated. The parents were asked regarding the first case of the infection in the family and regarding the presumed source of the infection.

In addition, household members underwent polymerase chain reaction (PCR) testing whether they were symptomatic or not.

This study was approved by the ethics committee at the Mayanei Hayeshua Medical Center.

Statistical analysis: Chi square and Fisher Exact Probability Tests were used for comparisons.

RESULTS

Family Clusters

Thirteen family clusters were investigated; all families reside in the city of Bnei Brak. Age of children ranged from 6 months to 17 years. The age of the adults ranged from 18 to 48 years (some of the adults were the older children residing in the same household).

Index cases were omitted from the analysis to prevent biased higher rates in adults since in almost all cases, the index case that led to testing the household was an adult.

SARS-CoV-2 positive PCR was documented in the different age groups as follows:

1. In 21 out of 36 adults (>18 years) (58.3%).
2. In 13 of 40 children, 5–17 years (32.5%), ($P = 0.037$ for the difference between group 1 and group 2, risk ratio: 0.61, 95% confidence interval [CI]: 0.39–0.96).
3. In 2 of 18 children, 0–4 (<5) years of age (11.8%), ($P < 0.002$ for the difference between group 1 and group 3, risk ratio: 0.47, 95% CI: 0.30–0.71).

In 12 of the 13 families, the first diagnosed member was 1 of the parents. In one case, the first case was a 14.5-year-old male who was exposed at the Yeshiva.

In 3 additional cases, exposure was related to contacts at the local synagogue, in one case, the presumed source was participation in a holiday feast (Purim feast), and in another case, there was an exposure in work. In the rest 7 cases, the source of the infection was unknown.

DISCUSSION

Determination of the role of children in the transmission of Covid-19 is a critical matter in the plans how to slow the pandemics. Measures such as school closure were undertaken by many countries to attenuate Covid-19 spread under the assumption that children are effective spreader of infection as described in other infections such as influenza epidemics.⁹

Probably, the best way to determine the role of children in the dynamics of Covid-19 transmission is to follow the epidemiology infection in a family set up, and determine the source of transmission and the introduction of the virus into the family.

However, this mode of investigation is not always possible since while it is known who was the first case diagnosed with Covid-19 in the family, it is many times unclear whether another family member (an adult or a child) who was asymptomatic or mildly symptomatic was the real source of the infection. The ambiguity regarding the source of the infection is especially prominent during time when there is significant transmission of the virus within the community as has been happened in Bnei Brak during the study period.

Since the role of children in the transmission of Covid-19 is a critical matter in the plans to slow the pandemics including measures like school closure, we looked for the indirect surrogate for examination of this issue. We assume that if children have a significant role in Covid-19 spread, we will be able to document that in a family set up, the involvement of children in Covid-19 infection would be at least as high as that of adult household members. Involvement of children in Covid-19 transmission dynamics is expected to be more accentuated in the city of Bnei Brak, which is the crowded city of Israel and with the highest number of children in the family where children 0–14 years of age comprise 42% of its population.

The investigation of infection within families in Bnei Brak demonstrated lower rates of Covid-19 positivity in children compared with adults residing in the same household after exclusion of the first sick person in the family. Children 5–17 years of age were about 61% and children 0–4 years were 47% less likely to have positive PCR results compared with adults older than 18 years of age residing in the same household.

To the best of our knowledge, this is the first study that examined the role of children in such a dense and relatively young population.

The results of PCR testing could be influenced by several factors such as false negative or false positive results. In addition, the results of PCR testing within families could be influenced by timing of sampling since theoretically samples could have been obtained before infection or after the resolution of infection.

However, the nasopharyngeal samples were taken in similar conditions both in adults and children and the prominent differences

found between children and adults are unlikely to be explained only by these factors.

Our results have significant implications for other, less crowded locations since the inability to demonstrate a dominant contribution of children in Covid-19 dynamics even in a “child-oriented” city such as Bnei Brak suggest that it would be less likely to demonstrate a significant role of children in less crowded cities and locations in Israel and outside Israel.

Our results do not necessarily indicate that reopening school is safe regarding the potential of re-emergence of Covid-19 spread since various rates of transmission are expected to occur also in school (as occurred in a family set up) and therefore reopening school should be practiced with caution and with close monitoring of Covid-19 spread.

REFERENCES

1. Viner RM, Russell SJ, Croker H, et al. School closure and management practices during coronavirus outbreaks including COVID-19: A rapid systematic review. *Lancet Child Adolesc Health*. 2020;4:397–404.
2. CDC COVID-19 Response Team. Coronavirus disease 2019 in children—United States, February 12–April 2, 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69:422–426.
3. Henry BM, Lippi G, Plebani M. Laboratory abnormalities in children with novel coronavirus disease 2019 [published online ahead of print, 2020 March 16]. *Clin Chem Lab Med*. 2020. doi:10.1515/cclm-2020-0272.
4. Parri N, Lenge M, Buonsenso D; Coronavirus Infection in Pediatric Emergency Departments (CONFIDENCE) Research Group. Children with Covid-19 in pediatric emergency departments in Italy. *N Engl J Med*. 2020;10:1056.
5. Riphagen S, Gomez X, Gonzalez-Martinez C, et al. Hyperinflammatory shock in children during COVID-19 pandemic. *Lancet*. 2020;395:1607–1608.
6. Gudbjartsson DF, Helgason A, Jonsson H, et al. Spread of SARS-CoV-2 in the Icelandic population. *N Engl J Med*. 2020; NEJMoa2006100. Epub ahead of print.
7. Macartney K, Wood N, Noni Winkler N et al. COVID-19 in schools—the experience in NSW. National Centre for Immunisation Research and Surveillance. 2020. Available at: http://ncirs.org.au/sites/default/files/2020-04/NCIRS%20NSW%20Schools%20COVID_Summary_FINAL%20public_26%20April%202020.pdf. Accessed May 26, 2020.
8. National Institute for Public Health and the Environment, Ministry of Health, Welfare and Sport, The Netherlands. Children and COVID-19. 2020. Available at: <https://www.rivm.nl/en/novel-coronavirus-covid-19/children-and-covid-19>. Accessed May 26, 2020.
9. Cauchemez S, Ferguson NM, Wachtel C, et al. Closure of schools during an influenza pandemic. *Lancet Infect Dis*. 2009;9:473–481.