

Episode #34 – Pediatric Population & COVID-19: Part 2 April 16, 2021

Overview
Children account for only a small percentage of COVID-19 cases. For example, in a large case series study by Wu & McGoogan (2020) of 44,672 confirmed cases of COVID-19 in mainland China, only 1% of the individuals infected with SARS-CoV-2 were 9 years or younger and 1% were 10 to 19 years [1]

Even when children are infected with SARS-CoV-2, they are more likely to experience mild or asymptomatic illness, and a low mortality rate. In a study by Dong et al. (2020) of 2,135 pediatric cases with COVID-19, 52% were asymptomatic or had mild illness and there was only one death. [2]

Shekerdemian et al. (2020) conducted a cross-sectional study of 46 North American pediatric intensive care units (PICUs), between March 14 and April 3, 2020. A total of 48 children were admitted to 14 PICUs in the US, 83% of whom had significant preexisting comorbidities (e.g., genetic anomalies, immune suppression, etc.). The researchers reported a mortality rate of 4.2%. [3]

Preston et al. (2021) also found an increased association of severe COVID-19 in pediatric patients with one or more comorbidities versus those without in a cohort study of hospitalized pediatric patients. [4]

Theories why children are less affected
Researchers have suggested numerous hypotheses to explain why COVID-19 is milder in children. One leading hypothesis is that children's immune response is less robust, resulting in a lower likelihood of severe disease from cytokine storm. Cytokine storm is thought to be important in the pathogenesis of severe SARS-CoV-2 infections. According to a systematic review by Ludvigsson (2020), a less vigorous immune response was suggested in several of the reviewed studies where elevated inflammatory markers were less common in children, resulting in milder disease than in adults. [5] [6] [7] [8]

Williams et al. (2020) also proposed that children may experience less severe disease as a result from differences in their immune response to the virus, including a lower predisposition to pro-inflammatory states, less co-morbidities, and the differential expression of angiotensin-converting enzyme 2 (ACE2) in children, which may attenuate viral entry, as well as ongoing replication and subsequent inflammation, hypoxia, and tissue injury. [7]

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Sinaei et al. (2020) theorized, in their narrative review of 81 articles, that children may have partial immunity to COVID-19 due to previous exposure to other respiratory pathogens, such as seasonal coronaviruses, respiratory syncytial virus, and *Mycoplasma pneumoniae*. They also proposed additional explanations for mild disease in children that included a lower viral load, less comorbidities, and a more active innate immune response. Differences in distribution and functioning of renin-angiotensin system (RAS) and ACE2 receptors in children and adults were also offered as a reason for milder disease in children[1]. [5]

Sharif-Askari et al. (2020) suggested that children's young immune system may be more efficient in clearing the infection compared with the adult immune system or that the presence of cross immunity from previous exposure to milder common coronaviruses may explain why children are less susceptible to SARS-CoV-2 infection.

The researchers hypothesized that the difference in COVID-19 severity between children and adults could, in part, be attributed to the difference in ACE2 and transmembrane protease serine 2 (TMPRSS2) airways tissue expression levels. The virus uses the cell receptor, ACE2, to enter the cell and requires TMPRSS2 for priming of the viral spike protein. Thus, the level of expression of ACE2 and TMPRSS2, especially in the nasal tissue, may be critical for the ability of the virus to enter cells and replicate.

To test their hypothesis, the researchers evaluated airway tissue gene expression levels of SARS-CoV-2 receptors, ACE2 and TMPRSS2, using publicly available transcriptomic datasets of nasal and lung airway tissue. They found that the expression levels of both ACE2 and TMPRSS2 were significantly lower in nasal and bronchial epithelial tissue of children compared with those of adults.

Therefore, the authors concluded that the reduced airway tissue expression of ACE2 and TMPRSS2 may contribute to the lower risk for infection and the reduced disease severity observed in the younger population. [9]

Pierce et al. (2020) examined serum and cell samples from pediatric (age <24 years, n = 65) and adult (>24 years, n = 60) patients hospitalized with COVID-19 between March 13 and May 17, 2020.

The researchers found that children expressed higher levels of two specific immune system molecules, interleukin-17A (IL-17A)[2] and interferon-gamma (IFN-γ)[3] compared to adults. IL-17A helps mobilize immune system response during early infection, and

[1] The renin-angiotensin system (RAS) plays an important role in inflammation. However, ACE2 may alter RAS activity from a proinflammatory response towards anti-inflammatory response (i.e., reduce inflammation and promote healing). https://www.nature.com/articles/s41390-020-0881-y

[2] IL-17A, also known as IL-17, is a key cytokine that links T cell activation to neutrophil mobilization and activation. As such, IL-17A can mediate protective innate immunity to pathogens or contribute to the pathogenesis of inflammatory diseases, such as psoriasis and rheumatoid arthritis and possibly periodontal disease. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4530463/

[3] IFN-γ is a cytokine critical to both innate and adaptive immunity, and functions as the primary activator of macrophages, in addition to stimulating natural killer cells and neutrophils.

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INF-γ combats viral replication. Both are part of the innate immune system. Conversely, the adults showed a more vigorous adaptive immune system response, including higher $CD4^+$ T cell response to the viral spike protein and higher neutralizing antibody levels. The neutralizing antibody titer correlated positively with age and negatively with IL-17A and IFN-γ serum concentrations.

The study's findings suggest that children have a more robust, earlier innate immune response to the virus, which may protect them from progressing to severe disease. Moreover, the poor outcome in hospitalized adults with COVID-19 is not likely attributable to a failure to generate adaptive immune responses. [10]

Pierce et al. (2021) reinforced the theory that children have a more robust early innate immune response to SARS-CoV-2 compared to adults, protecting them against severe disease development. Researchers compared clinical outcomes, SARS-CoV-2 viral copies, and cellular gene expression in nasopharyngeal swabs from 12 children and 27 adults seen at an emergency department.

SARS-CoV-2 copies, ACE2, and TMPRSS2 gene expression were similar in children and adults, but children displayed higher expression of genes associated with interferon signaling, NLRP3 inflammasome, and other innate pathways. Higher levels of the protective cytokines IFN-α2, IFN-γ, IP-10, IL-8, and IL-1β protein were detected in nasal fluid in children versus adults. Children also expressed higher levels of genes associated with immune cells, whereas expression of those associated with epithelial cells did not differ in children versus adults. Anti-SARS-CoV-2 IgA and IgG were detected at similar levels in nasal fluid from both groups. None of the children required oxygen, while 7 of the 27 adults needed oxygen and 4 adults died.

The authors concluded that the findings provide direct evidence of a more vigorous early mucosal immune response and activation of innate immune pathways in the nasopharynx of children compared to adults, contributing to favourable clinical outcomes. The reasons for the age-associated differences in the early immune responses to SARS-CoV-2 require further study, but strategies for bolstering innate immunity might help in treating severe COVID-19 disease. [11]

Yang et al. (2021) found that children ≤10 years produced more antibodies in response to coronavirus infection than adolescents and adults. The researchers conducted a cross-sectional study to evaluate 31,426 SARS-CoV-2 antibody tests from 1,194 pediatric patients (aged 1-18 years) and 30,232 adult patients (aged 19-102 years) performed between April 9 and August 31, 2020 in a New York City hospital on inpatients and outpatients. The seroprevalence[4] in the pediatric (197) and adult (5,630) patient populations was similar, 16.5% and 18.6% respectively.

The researchers then examined a subset of patients who tested positive (85 children and 3,648 adults) to determine the levels of immunoglobulin G (IgG) antibodies.

[4] Seroprevalence is the percentage of individuals in a population who have antibodies to an infectious agent. https://www.cdc.gov/coronavirus/2019-ncov/covid-data/seroprevalance-surveys-tell-us.html

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The SARS-CoV-2 IgG level in the pediatric population exhibited a moderate but significant negative correlation with age and the adult population exhibited a weakly positive correlation with age. Notably, the 32 children aged 1 to 10 years showed a significantly higher median SARS-CoV-2 IgG (443 RFU)[5] than 127 young adults aged 19 to 24 years (95 RFU), levels 4.7 times higher.

Additionally, the researchers analyzed antibody profiles on a subset of 126 outpatients (aged 1 to 24 years), none of whom had experienced severe COVID-19, to further characterize the antibody response. Children aged 1 to 10 years had 2.5 the median levels of IgG antibodies compared to adolescents aged 11 to 18 years (473 RFV vs. 191 RFU), and in turn, adolescents had 2.2 the median level of IgG antibodies compared to young adults aged 19 to 24 years (191 RFU vs. 85 RFU).

The authors concluded that the findings suggest that there are distinct SARS-CoV-2 viral–specific antibody response profiles that vary based on age, with younger children exhibiting higher levels of IgG, total, and functional antibody activity than adolescents and young adults. The data could partly explain the overall lower rate of symptoms and cases of severe disease in children with COVID-19. However, the lower incidence of symptoms and decreased disease severity in pediatric patients raises the possibility that this population could represent an important reservoir for viral transmission in the community. Thus, increased screening of school-aged children, even those without overt symptoms or exposure, may be an important step in curbing the pandemic. [12]

Bunyavanich et al. (2020) postulated that children receive smaller doses of the virus than adults when exposed because their nasal passages contain fewer ACE2 receptors, which the virus uses to gain access to cells. The researchers conducted a retrospective examination to investigate ACE2 gene expression in nasal epithelium from 305 individuals aged 4 to 60 years. Their results showed an age-dependent expression of ACE2 in nasal epithelium, which may help explain why COVID-19 is less prevalent in children than in adults. [13]

Take home messages

Further research is needed to fully understand the variable pathology of COVID-19 in children and adults. The rationale why COVID-19 seems to affect children less than adults may be multifactorial, including a more robust antibody response. [5] [14] [15]

Children & SARS-CoV-2 transmission

The role of children in the transmission and community spread of SARS-CoV-2 is unclear and with new research, the evidence is evolving. For instance, in most household cluster investigations, children were not the index case; however, emerging evidence suggests that the virus can spread efficiently in all age groups. While children over 10 years may be as likely as adults to transmit the virus to others, those under 10 years may also transmit the virus, but are less likely to do so than adults. [16] For

[5] Relative fluorescence unit (RFU) is a unit of measurement used in analysis which employs fluorescence detection.

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instance, Tönshoff et al. (2021), in a cross-sectional study, found that children aged 1 to 10 years did not appear to be particular drivers of the pandemic. [17]

Bullard et al. (2021) aimed to quantify the infectivity of SARS-CoV-2 in nasopharyngeal samples from children compared with adults to help determine children's role in viral transmission. The researchers obtained nasopharyngeal swabs from both adult and pediatric COVID-19 cases and their contacts who tested positive for SARS-CoV-2 in Manitoba between March and December 2020.

The researchers compared viral growth in cell culture, cycle threshold values from the reverse transcription polymerase chain reaction (RT-PCR) of the SARS-CoV-2 envelope gene, and the 50% tissue culture infective dose between adults and children. In total, 305 samples, 97 from children ≤10 years, 78 from children 11-17 years, and 130 from adults ≥18 years, were analyzed.

The virus was successfully cultured in 93 of 305 samples (31%), including 57 of 130 adults (44%). In comparison, the virus was cultured in only 18 of 97 samples in children ≤10 years (19%) and 18 of 78 samples in children 11-17 years (23%).

The results showed that samples from the 175 children had about half the odds of containing culturable virus than samples from adults. When the virus was successfully cultured, there was significantly less viable virus present in the pediatric samples than adult samples. Moreover, the culture positivity rate of samples from children ≤10 years was significantly lower than for children 11-17 years or adults. These results illustrate that RT-PCR positivity does not necessarily equate to culture positivity, as RT-PCR positivity alone does not distinguish between live virus in an infectious patient and residual viral RNA in a patient who may no longer be infectious.

These results are contrary to what has been observed with other respiratory viruses (e.g., influenza) where children play a substantial role as drivers of widespread community transmission. However, these findings are consistent with some epidemiological studies that show limited SARS-CoV-2 spread from children.

The authors concluded that the results suggest that children do not appear to be the main drivers of SARS-CoV-2 transmission. Their findings have important public health and clinical implications. If younger children are less capable of transmitting infectious virus, daycare, in-person school, and cautious extracurricular activities may be safe to continue, with appropriate precautions in place, and with lower risk to child care staff, educators, and support staff than initially anticipated. Given the difficulties in keeping children isolated within the home environment and the significant impact of prolonged isolation on both child development and parental livelihood (such as loss of work or income), a robust tool to decrease the length of, or need for, quarantine would be an important public health development.

A limitation of the study was that the findings may not apply to the new variants of concern that have shown higher levels of infectivity, as such variants were not

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commonly circulating during the study period. However, the researchers plan to continue their research by examining pediatric samples with variants of concern. [18]

COVID-19 variants of concern

The virus that causes COVID-19, like all viruses, is constantly changing. Globally, there are multiple COVID-19 variants of concern, most notably the following have been detected in Canada:

- B.1.1.7: first identified in the United Kingdom and currently the most common variant in Canada
- B.1.351: first identified in South Africa
- P.1: first identified in Brazil [19]

These new variants of concern include mutations that seem to make the virus more infectious, allowing it to spread more easily. They may also affect the severity of the disease. At this time, there is evidence that some variants may have an impact on certain drugs and vaccines. However, more research is needed to verify these findings.

The variants do not currently affect diagnosis through authorized laboratory tests. Given the limited data on the new variants, more research is needed to confirm these early findings. The Canadian and global medical, public health and research communities are actively evaluating these variants and other significant mutations. [20]

The clinical impact of the new variants of concern on children and young people (aged 18 years or younger) regarding acute respiratory COVID-19 is yet to be fully defined.

Brookman et al. (2021) compared data of patients ≤18 years SARS-CoV-2 positive admitted to a hospital in south London, during the first wave (from March 1 to May 31, 2020; n=20) when B.1.1.7 was not circulating and the second wave (from November 1, 2020 to January 19, 2021; n=60) when B.1.1.7 was circulating. There were no significant differences in age, proportion of patients with comorbidities, ethnic background, or deprivation score. However, the proportions of patients requiring oxygen therapy (35% vs. 8%), non-invasive ventilation (15% vs. 3%), or invasive ventilation support (20% vs. 2%) were higher in the first wave than in the second wave

The researchers found no evidence of more severe disease having occurred in children and young people during the second wave, suggesting that infection with the B.1.1.7 variant does not result in an appreciably different clinical course to the original strain. Severe acute respiratory COVID-19 remains an uncommon occurrence in children and young people. [21]

COVID-19 vaccine research[6]

The Pfizer-BioNTech COVID-19 vaccine is already approved for use in Canada starting at age 16. In a March 31, 2021 news release, Pfizer and BioNTech announced that, in a Phase 3 trial in adolescents 12 to 15 years of age with or without prior evidence of

[6] Refer to Episode #15 – Vaccines and SARS-CoV-2 and Episode #28 – COVID-19: What We Know So Far for more information on COVID-19 vaccines.

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SARS-CoV-2 infection, the Pfizer-BioNTech COVID-19 vaccine BNT162b2 demonstrated 100% efficacy and robust antibody responses, exceeding those recorded earlier in vaccinated participants aged 16 to 25 years old, and was well tolerated. These are topline results from a pivotal Phase 3 trial in 2,260 adolescents. The U.S. Food and Drug Administration (FDA) and Health Canada have yet to review the study findings.

Pfizer and BioNTech is also conducting a study evaluating the safety, tolerability, and immunogenicity of the Pfizer-BioNTech COVID-19 vaccine on a two-dose schedule (approximately 21 days apart) in three age groups: children aged 5 to 11 years, 2 to 5 years, and 6 months to 2 years. Phase 1/2/3 study will enroll approximately 4,644 children 6 months to 11 years old in the United States and Europe. They anticipate results from this study will be available in the second half of 2021. If safety and immunogenicity is confirmed, and pending agreement with and endorsement from regulators, they hope to receive authorization for vaccination of these younger children by early 2022. Children younger than 6 months of age may subsequently be evaluated, once an acceptable safety profile has been established. [22] [23] [24]

Moderna, which is already conducting trials on children 12- to 17-years-old, aims to enroll 6,750 younger children in the United States and Canada in the KidCOVE study, Moderna announced in March 2021 in a news release. The Moderna vaccine is currently approved for use in Canada for people who are 18 years of age and older. [25] [26] [27]

Johnson & Johnson, whose Janssen COVID-19 vaccine was approved for use on adults 18 years in older in Canada in March 2021, with the first shipment expected to arrive at the end of April, expanded a Phase 2 trial to include children aged 12 to 17, with plans to include younger children in the near future. [28] [29]

AstraZeneca launched a trial in February 2021 to assess the safety and efficacy of their vaccine in children aged 6 to 17 years-old, however the trial was paused April 7, 2021 pending a safety review of blood clot cases by U.K. regulators. The vaccine trial in children was not paused because of safety concerns, but to allow the wider review of very rare and unusual blood clots in adults. The AstraZeneca vaccine is currently approved for use for people who are 18 years of age and older. [30] [31] [32]

Impact on children's vaccine schedules

The World Health Organization (WHO) and UNICEF have warned of an alarming decline in the number of children receiving life-saving vaccines around the world due to disruptions in the delivery and uptake of immunization services caused by the COVID-19 pandemic. These disruptions threaten to reverse hard-won progress to reach more children and adolescents globally with a wider range of vaccines. [33]

O'Leary et al. (2020) compared the number of childhood and adolescent vaccinations administered before and after the COVID-19 outbreak in Colorado. The researchers found that since the onset of the COVID-19 pandemic, vaccination uptake (e.g., measles, mumps, rubella [MMR] and *Haemophilus influenzae* type b [Hib] vaccines) in children and adolescents had significantly decreased in Colorado. While the clinical

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implications of their observation are not yet known, public health advocates should consider addressing this drop to avoid the potential for vaccine-preventable diseases. Primary care professionals should consider implementing reminders and recalls to parents to ensure their children receive immunization. [34]

Bramer et al. (2020) evaluated whether vaccination coverage had changed during the COVID-19 pandemic by analyzing data from the Michigan Care Improvement Registry. The vaccination status of milestone age cohorts of children at ages 1, 3, 5, 7, 16, 19, and 24 months was assessed, with each cohort including an average sample size of 9,269 for the study period years 2016-2019, and 9,539 for 2020.

The research revealed that vaccination coverage declined in all milestone age cohorts, except for birth-dose hepatitis B coverage, which is typically administered in the hospital setting. Missed vaccinations included rotavirus (Rota); diphtheria, tetanus, and acellular pertussis (DTaP); *Haemophilus influenzae* type b (Hib); pneumococcal conjugate (PCV); inactivated poliovirus (IPV); measles, mumps, rubella (MMR); varicella (Var), hepatitis A, and 2nd dose of hepatitis B.

The observed declines in vaccination coverage might leave young children and communities vulnerable to vaccine-preventable diseases, such as measles. If measles vaccination coverage of 90%-95% (the level needed to establish herd immunity) is not achieved, measles outbreaks can occur. Concerted efforts are needed to ensure rapid catch-up for children who are not up-to-date with measles-containing vaccines as well as other recommended vaccinations. [35]

Take home messages
Parents should be encouraged to maintain children's preventive medical visits, including routine immunization appointments.

Impact of COVID-19 pandemic on oral health
Several studies have investigated the impact that the COVID-19 pandemic has had on pediatric oral health.

Üstün et al. (2021) conducted a retrospective study to assess the effect of the COVID-19 pandemic on dental appointments and treatment requirements of children (age 0-14 years) from March 16, 2020 to June 30, 2020, compared to the same time period in 2019. The timeline of the study covered the temporary suspension of routine dental care (11 weeks), plus the mitigation stage (5 weeks) when routine dental procedures (e.g., recare visits, preventative therapies, etc.) could once again be provided.

Data collected from a university pediatric dental clinic demonstrated that during the March-June 2020 pandemic period, average daily visits for emergency dental care decreased to half of the non-pandemic period. Severe dental pain from pulpal inflammation and abscess and localized pain and swelling were the most frequently observed urgent problems in both the non-pandemic and pandemic periods.

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Non-emergency or routine dental procedures could be provided only during the mitigation stage of the pandemic period, which drastically reduced access to oral health care. Overall, a relatively stable decrease in dental clinic visits was observed even when non-emergency care could be provided, which may be related to ongoing fear and anxiety caused by the pandemic.[7]

The authors concluded that the COVID-19 pandemic dramatically reduced the number of patient visits, which may cause an increased number of oral health-related complications in the long-term. [36]

Sen Tunc et al. (2021) conducted a cross-sectional survey from July 1 to October 1, 2020 to evaluate parental knowledge, attitudes, and practices about self-medication to treat their children's dental problems. Self-medication refers to taking medication without consultation with a healthcare provider. A total of 389 parents with children aged 0-12 years from a public pediatric dental clinic in Turkey participated in the study.

The majority of the parents (n = 287; 73.8%) were under the age of 40 years and most parents (n = 287; 73.8%) had at least a secondary education degree. A small proportion of the parents (n = 42; 10.8%) lived in rural areas.

The results of the study revealed that a high percentage of parents (n = 272; 70%) self-medicated their children when their children had dental problems. Some parents practiced self-medication of their children with analgesics (n = 268; 98%), antibiotics (n = 104; 38.1%), mouthwashes (n = 36; 13.1%), and herbal medicines (n = 24; 8.8%). Analgesics were the most preferred medicine for toothaches (n = 180; 83.3%) and toothache was the major trigger for parents practicing self-medication of their children.

The study also revealed that most parents practiced self-medication (n = 208; 87%) because of difficulties accessing health care providers during COVID-19. Also, 42.7% (n = 166) of the parents had limited knowledge of medication side effects (e.g., antibiotic resistance, allergic reactions, gastrointestinal problems). There were no significant statistical results between self-medication administration and the demographic characteristics of the participating families (e.g., parents' age, gender, level of education, economic status, health insurance and children's age, gender, and medical history).

The authors concluded that the prevalence of self-medication practices for children's dental problems was high in Turkey during the COVID-19 pandemic. Thus, increasing access to oral healthcare providers, for example via teledentistry, could prevent self-medication during public crises that make it difficult for patients to obtain oral healthcare services. [37]

[7] The term 'coronaphobia' was coined by Asmundson & Taylor (2020) which refers to the fear of COVID-19 that leads to mental distress and behaviour change in people. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7134790/

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Samuel et al. (2020) investigated the impact of children's dental pain and parental distress and fear of the virus on the oral health-related quality of life (OHRQoL) of preschool children (2- to 6-year-old) during the nationwide COVID-19 pandemic lockdown in India. A cross-sectional study was conducted among 222 parent-child dyads who visited a dental institute from March to June 2020 to manage their child's dental pain as dental services were not available elsewhere in the city because of the lockdown.

The study found that greater parental distress and fear of COVID-19 among caregivers, higher self-perceived dental pain among children, and caries experience was associated with poor OHRQoL of preschool children during the COVID-19 pandemic lockdown in South India. The researchers concluded that:

- Pain from odontogenic origin in preschool children during a pandemic can negatively impact the child's OHRQoL.
- Greater fear of SARS-CoV-2 among parents negatively affects the OHRQoL of their child, and may affect how parents seek dental care during the pandemic increasing the unmet dental needs of the child.
- A child suffering from pain during a pandemic can impact the whole family as they are confined in their homes, which can adversely affect the OHRQoL of the child. [38]

C.S. Mott Children's Hospital in Michigan administered a survey in January 2021 to a randomly selected, stratified national US sample of parents (n = 1,882) of children ages 3 to 18 years about their children's dental care experiences during the pandemic.

The results revealed that since the pandemic began, a total of 40% of parents had not tried to obtain preventive care for their children. Out of these parents, 40% were worried about exposing their child to COVID-19 and were delaying making a dental appointment for their child. However, 28% said they did not make an appointment because their child was not having dental problems and 23% stated that their child was not due for dental care.

Most parents (67%) believed it was safe for their child to receive dental care right now, while 14% felt it was not safe and 19% were unsure. One-third of parents (32%) felt COVID-19 had made it harder to obtain preventive dental care for their child.

Also, 1 in 4 parents stated that their child's oral health habits had improved during the pandemic, including more frequent brushing (16%), flossing (11%), and use of fluoride rinse (9%), and drinking less sugary beverages (15%). [39]

Burgette et al. (2021) performed a cross-sectional household survey of 348 families in Pittsburgh, Pennsylvania, from June 25 to July 2, 2020 to determine the association between pandemic-related household job or income loss and children's dental care.

Approximately 40% (138 of 348) of caregivers in the study reported a job loss or decrease in household income due to the COVID-19 pandemic. Caregivers reported

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that dental care (16% [54 of 348]) was the greatest unmet child healthcare need during the past 3 months during the COVID-19 pandemic. This was followed by a medical appointment for a check-up or well check or shots (5% [18 of 348]), mental health services (3% [12 of 348]), and vision care (3% [9 of 348]).

The risk of experiencing unmet child dental care in a household that experienced job loss or decrease in income due to the COVID-19 pandemic was 21% (29 of 138) compared with 12% (25 of 210) in a household that did not experience job loss or decrease in income due to the COVID-19 pandemic.

They found that 3 times as many households reported unmet dental care for a child compared with unmet medical care and unmet child dental care was more common in households where pandemic-related job or income loss occurred.

The authors offered several strategies to combat unmet child dental care needs. For example, for both the private and public dental care systems, there are opportunities to improve access to dental care for children, including teledentistry, a focus on caries prevention strategies including topical fluoride and sealants, and minimally invasive dental care services that do not generate aerosols. These evidence-based strategies offer opportunities to enhance care in general, but specifically during the COVID-19 pandemic in which physical distancing and avoidance of aerosolizing procedures are important.

In addition, there are a myriad interprofessional opportunities to promote child oral health by engaging nondental health professionals including physicians, social workers, dietitians, and community health workers to educate families about child oral health knowledge and prevention practices.

An investment in dental public health efforts is also needed to decrease the burden of dental disease and potentially decrease the level of unmet dental care during the COVID-19 pandemic. Finally, the COVID-19 pandemic has stressed the financial system that supports the delivery of dental care services, revealing that changes are required to support access to dental care during times of changing financial situations. [40]

Baptista et al. (2020) conducted a cross-sectional study from April 24-26, 2020 to evaluate sleep disorders among Brazilian and Portuguese children during social distancing, and its association with parental perception of child's oral hygiene. A total of 253 parents/caregivers of children 3-15 years who were socially isolated at home during the COVID-19 pandemic completed the online survey. The researchers compared the differences between parental perception of the child's oral hygiene and sociodemographic characteristics, the child's changes of habits during social distancing and sleep disturbances.

A total of 50.2% of families were from Brazil and 49.8% were from Portugal. The majority of children were male (52.2%) and had school activities online (77.5%) during social distancing. The children’s mean age was 7.5 years (±3.4). Most

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parents/caregivers reported that their child's routine had changed due to social distancing (72.2%).

A total of 42.7% of parents reported that their child's sleep quality was poor during social distancing, and 22.9% of parents reported that their child's oral hygiene was poor during social distancing.

The study found that children whose oral hygiene decreased during social distancing had higher scores of sleep breathing disorders and sleep-wake transition disorders when compared to children whose oral hygiene remained the same. Also, children whose oral hygiene declined during social distancing had higher disorders of excessive somnolence scores when compared to children whose oral hygiene unchanged or improved during social distancing. The authors concluded that sleep disorders were associated with poor oral hygiene during social distancing.

They proposed that psychological distress caused by quarantine and social distancing might explain the children's sleep disturbances, as well as the decrease in a child's oral hygiene and sleep quality. For instance, during challenging times it is difficult to maintain a child's sleep and oral hygiene routines. Also, excessive sleepiness may result in improper or a lack of oral self-care in children. Furthermore, due to an increase in parental/caregiver responsibilities and activities at home, including work, caring for the child, and household tasks, parents/caregivers might not be able to closely supervise their child's oral hygiene.

The results of this research demonstrate the importance of reinforcing preventive measures and oral hygiene instruction for pediatric patients and their parents, as well as performing a detailed clinical examination to assess for possible new carious lesions and evidence of sleep disordered breathing (e.g., sleep bruxism, obstructive sleep apnea). Also, oral health professionals can help families maintain their oral hygiene and sleep routines through education, reducing possible negative impacts on children's oral and general health. [41]

Brescia et al. (2021) utilized an anonymous online questionnaire to analyse the daily lifestyle of Italian families during the pandemic lockdown and evaluate its possible impact on the children's behaviour in the dental office. The behaviour of 212 children (103 F, 109 M), aged 3 to 16 years (mean age 9 years) was assessed during dental visits before and after lockdown orders in Italy.

The researchers hypothesized that the lockdown would strengthen parent-child relationships and positively affect child behaviour at the dental office. It was found that 82% of children had an improvement in behaviour after the lockdown, especially children whose parents were home with the child during the lockdown. Also, there was an association between increase in time devoted to child home oral hygiene with greater presence of parents at home. [42]

Brondani et al. (2021) conducted a cohort study to explore the psychosocial and behavioural changes related to oral health that occurred in adolescents due to the

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COVID-19 pandemic. The study evaluated 207 adolescents (99 F, 108 M; aged 10-15 years;) from November 2019 to February 2020 (before the pandemic) and June to July 2020 (during the pandemic) in southern Brazil.

During the pandemic, the frequency of toothbrushing, the use of dental services, and the self-perceived need for dental treatment significantly decreased. The odds of toothbrushing ≥3 times a day was 47% lower during the pandemic period. The proposed rationale for the decreased toothbrushing frequency was the change in routine made maintaining oral hygiene habits a challenge.

The demand for dental care decreased by 48%, which may have been caused by pandemic-induced anxiety resulting in individuals not wanting to leave their homes. The odds of self-perceived need for dental treatment among adolescents was 48% lower during the pandemic. It is possible that adolescents may have minimized the perception of their oral problems during a time period that is considered atypical and frightening, viewing their problems as trivial in context of global illness and death related to COVID-19. Sugar consumption, bruxism, and quality of sleep did not change significantly. The degree of social distancing did not influence any of the behavioural and psychosocial factors investigated in the study. These findings demonstrate that interventions will need to be put in place to prevent future oral health problems with the changes in behaviours created by the pandemic. [43]

Eating habits

Eating habits have undergone somewhat contradictory changes. Some survey results have indicated that individuals have started a better diet during confinement, while others indicated the opposite.

Brondani et al. (2021) found that adolescent sugar consumption decreased slightly but the change was not statistically significant. [43]

Carroll et al. (2020) discovered that the pandemic had an impact on eating patterns of Canadian families. The authors administered a survey between April 20 to May 15, 2020 to Ontario parents with young children to examine how health behaviours (i.e., physical activity, eating patterns, sleep, screen time) and level of family stress, financial and food security have changed since the COVID-19 physical restrictions were implemented. A total of 254 families participated in the study (235 mothers, 126 fathers, and 310 children). The average age for the children was 6 years, and the average age for the mothers and fathers was 37 and 39 years, respectively.

More than half of the participants (mothers, 70%; fathers, 60%; children, 51%) stated their eating had changed since COVID-19. The most commonly reported eating behaviour changes were eating more food (mothers, 57%; fathers, 46%; children, 42%) and eating more snack foods (mothers, 67%; fathers, 59%; children, 55%), such as chips or cookies. Considering that many snack foods are high in added sugar, saturated fat, and sodium, the increase in snack food consumption may impact families' oral and general health. [44]

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Pietrobelli et al. (2020) conducted a longitudinal study to assess the effects of COVID-19 lockdown on lifestyle behaviours of children in Italy. Lifestyle behaviours (e.g., diet, activity, and sleep) were compared prepandemic (May-July 2019) and during pandemic lockdown (March-April 2020). The study included 41 children (19 F; 22 M) with a mean baseline age of 13.0 (range, 6-18) years at baseline. The results revealed that the number of meals eaten per day increased by 1.15, a difference that was significant. Furthermore, the consumption of potato chips, red meat, and sugary drinks increased significantly during the lockdown.

The results of this study highlight the critical need for implementation of preventive measures during periods of lockdown, particularly when its duration is uncertain. Such measures might include access to healthcare providers via telemedicine to provide guidance on healthy lifestyle choices. [45]

Allabadi et al. (2020) assessed the impact of the country-wide lockdown on dietary and lifestyle behaviours of adolescents in Palestine. The researchers performed telephone interviews with 600 adolescents (10-19 years old) between April 24 and April 27, 2020. In total, 36.7% increased fried food intake and 46.5% increased sweets and sugar-added food intake, which was associated with weight gain and worsening financial status during lockdown.

The study emphasizes the adverse effects that the COVID-19 pandemic has had on dietary and lifestyle behaviours and highlights the importance of providing guidance and implementing programs to protect adolescents' long-term health. [46]

Ruiz-Roso et al. (2020) conducted a cross-sectional study to assess nutritional modifications during COVID-19 confinement in a multi-country cohort of adolescents aged 10 to 19 years from Italy, Spain, Chile, Colombia, and Brazil. The study found sweet food and fried food consumption had increased during COVID-19 confinement as compared to before the pandemic. There were significant country differences and those who watched TV during mealtimes had higher sweet food and fried food consumption. The authors concluded that multiple factors may have increased the intake of unhealthy or comfort foods during the COVID-19 lockdown, including already being overweight or obese, more sedentary time at home, and an overall change in dietary habits/patterns. Understanding adolescents' nutrition behaviour during COVID-19 lockdown is important to encourage adoption of healthy diets among adolescents. [47]

Take home messages

Oral health professionals should be proactive in reminding parents about the importance of regular oral health check-ups for children, good homecare, and healthy eating habits. Reminder notices and website information outlining changes to the office may help parents feel safe bringing children in for their appointments.

Cagetti & Angelino (2020) and Mallineni et al. (2020) discussed the benefits of minimal intervention treatment for the pediatric population, such as interim stabilization therapy, resin infiltration for incipient caries, silver diamine fluoride, selective caries

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removal, and the Hall technique, as well as utilizing fluoride therapy and pit and fissure sealants for at-risk clients. Examples of the benefits include:

- Minimally intervention treatment is an approach to caries treatment that aims to preserve as much tooth structure as possible.
- Procedures are well-proven and child friendly, and can be carried out relatively quickly, requiring clients to stay in the dental chair for only a short period of time.
- Reduced aerosol production, which is desirable, especially since the transmission risk of SARS-CoV-2 is potentially higher in the dental environment [48] [49]

Unintended consequences of hand sanitizer: ocular injury

Alcohol-based hand sanitizer (ABHS) use has increased in effort to prevent the transmission of the SARS-CoV-2. However, the widespread use of ABHS has been associated with an increase in unintentional exposures in children since the pandemic's onset.

Martin et al. (2021) conducted a retrospective case series review to compare the number of ocular exposures to ABHS in children between April to August 2020 and April to August 2019. Cases were retrieved from the national database of the French Poison Control Centers and from a pediatric ophthalmology referral hospital in Paris, France.

The researchers found a 7-fold increase in the number of ABHS ocular exposures in children in 2020, with a corresponding increase in surgeries required to manage severe injuries resulting from these exposures.

The researchers hypothesized the pediatric increase of ABHS ocular exposures is likely due to the placement of sanitizer dispensers within the proximity of children's eyes and pressure-operated dispensers, which deliver unit doses of ABHS, are usually around 1 metre high. In addition, the delay in washing the eyes owing to a lack of access to a water supply or to the viscosity of certain preparations, is very detrimental to the ocular surface. [50]

Yangzes et al. (2021) documented two case reports of toxic keratopathy in children (4-year-old girl and 5-year-old boy) after unintentional contact between ABHS and the eye. Although ocular findings resolved within 2 weeks in both cases, authors cautioned that small children are at risk of severe ocular injury and possibly even blindness due to inadvertent ocular exposure to ABHS. [51]

Take home messages

To limit risks of ABHS-induced ocular injuries, experts recommend parents promote hand washing with soap and water over ABHSs among children, especially when at home. Teach children how to use sanitizers. Supervise children when using hand sanitizers, and keep these products of reach of children when not in use. Having separate dispensers for children at lower heights in public places (i.e., below face level), and placing caution signs next to dispensers could also help mitigate risks.

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Unintended consequences of hand sanitizer: ingestion
The unintentional ingestion of hand sanitizer has also increased during the pandemic. For example, in March 2020 (during the COVID-19 pandemic), calls to US Poison Control Centers related to hand sanitizer increased by 79% compared to March of 2019. The majority of these calls were for unintentional exposures in children 5 years of age and younger. [52]

Gharpure et al. (2020) conducted a survey for the Centers for Disease Control and Prevention (CDC) survey. The results revealed that 46% of adult respondents were unaware that hand sanitizers should be kept out of children's reach. [53]

McCulley et al. (2020) searched the American Association of Poison Control Centers' National Poison Data System from January to April 2020 to increase understanding of ABHS effects in children ≤5 years. The authors identified 4,451 exposures in children ≤5 years. The National Poison Data System received an increase in cases (35.8%) from January (n = 904) to April 2020 (n = 1228), consistent with rising demand for hand sanitizers during the COVID-19 pandemic. Ethanol ABHS exposure (98.7%) was most common; isopropanol ABHS exposure was minimal (1.3%). Ingestion (94.0%) was the primary route, followed by ocular (5.5%). Of 81 children referred for medical evaluation, five were hospitalized. Unintentional exposures accounted for 99.8% of calls. Primary residence was the most common setting (96.1%), which may coincide with COVID-19 quarantine and increased access. In contrast, non-residence settings (e.g., schools, health care facilities) were less frequent (3.9%). [54]

Risks of ingestion
Children may ingest hand sanitizer because many hand sanitizers come in brightly coloured bottles, can be laced with glitter, and smell like food or candy. This type of packaging makes them very tempting to young children. A child ingesting hand sanitizer could be at risk for alcohol poisoning. The amount of alcohol in hand sanitizer ranges from 40% to 95%. Most hand sanitizer products contain over 60% ethyl alcohol, a stronger alcohol concentration than most hard liquors. By comparison, wine and beer contain about 10-15% and 5-10% alcohol, respectively. Even a small amount of alcohol can cause alcohol poisoning in children. Alcohol poisoning can cause confusion, vomiting and drowsiness, and in severe cases, respiratory arrest and death. [55]

Health Canada safety alerts
In June 2020, Health Canada released a safety alert on the risk of poisoning from hand sanitizers sold in beverage containers, which may confuse some consumers, who mistake the hand sanitizer for water or other beverages. Health Canada advises to store these products away from beverages, and keep them out of the reach of children. Also, always supervise children when they use hand sanitizer, because ingesting even small amounts can be dangerous or fatal. If hand sanitizer is swallowed, call a poison control centre or seek medical attention right away. [56]

In September 2020, Health Canada released a safety alert to advise the public and healthcare professionals that certain hand sanitizers are being sold in packaging that could appeal to children, such as squeeze pouches that typically contain food or

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beverages. Parents and guardians should be particularly vigilant about these products because children may accidentally mistake them for edible products and consume them. Health Canada recommends against using hand sanitizers sold in packaging that resembles food or beverage containers in settings in which direct adult supervision cannot be assured at all times, such as at school. [57]

Canadian Paediatric Society's advice parents:

- When using hand sanitizer on yourself or others, apply a dime-sized amount to dry hands. Rub hands together until completely dry.
- Keep hand sanitizers out of reach of pets and children. Young children, especially toddlers, may be attracted by the pleasant smell and the brightly coloured bottles.
- Young children should only use hand sanitizer with adult supervision.
- Make sure children do not put any hand sanitizer into their mouth. Ingesting even a small amount of hand sanitizer can cause alcohol poisoning in children.
- If you suspect your child has ingested hand sanitizer, call a Poison Control Centre immediately. Do not wait for symptoms to develop.
- Watch to ensure children do not rub their eyes when their hands are wet with sanitizer.
- You don't need to be concerned if your children eat with their hands or lick their hands after using hand sanitizer, as long as hands are dry. [58]

Recall of certain hand sanitizers that may pose health risks[8]

The COVID-19 outbreak has created a high demand for hand sanitizers, which has resulted in an influx of these products into Canada. However, certain lots of hand sanitizers have been recalled from the market because they do not meet Health Canada requirements. Reasons for recall include:

- Containing (or possibly containing) ingredients that are not permitted by Health Canada;
- Improper labelling;
- Missing risk statements;
- Being unauthorized for sale in Canada;
- Being sold without proper product testing;
- Being counterfeit; or
- Having defective or faulty packaging. [59] [60]

[8] See client resources for links to Health Canada's approved and recalled ABHSs searchable databases

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References

[1] Z. Wu and J. McGoogan, "Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: Summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention," *JAMA,* vol. 323, no. 13, pp. 1239-1242, 24 February 200.

[2] Y. Dong, X. Mo, Y. Hu, X. Qi, F. J. Z. Jiang and S. Tong, "Epidemiology of COVID-19 among children in China," *Pediatrics,* vol. 145, no. 6, pp. 1-10, June 2020.

[3] L. Shekerdemian, N. Mahmood, K. Wolfe, B. Riggs, C. Ross, C. McKiernan, S. Heidemann, L. Kleinman, A. Sen, M. Hall, M. Priestley, J. McGuire, K. Boukas, M. Sharron and J. Burns, "Characteristics and outcomes of children with coronavirus disease 2019 (COVID-19) infection admitted to US and Canadian pediatric intensive care units," *JAMA Pediatrics,* vol. 174, no. 9, pp. 868-873, 11 May 2020.

[4] L. Preston, J. Chevinsky, L. Kompaniyets, A. Lavery, A. Kimball, T. Boehmer and A. Goodman, "Characteristics and disease severity of US children and adolescents diagnosed with COVID-19," *JAMA Network Open,* vol. 4, no. 4, pp. 1-4, 9 April 2021.

[5] R. Sinaei, S. Pezeshki, S. Parvaresh and R. Sinaei, "Why COVID-19 is less frequent and severe in children: A narrative review," *World Journal of Pediatrics,* vol. 17, pp. 10-20, 25 September 2021.

[6] B. Henry, S. Benoit, M. Santos de Oliveira, W. Hsieh, J. Benoit, R. Ballout, M. Plebani and G. Lippi, "Laboratory abnormalities in children with mild and severe coronavirus disease 2019 (COVID-19): A pooled analysis and review," *Clinical Biochemistry,* vol. 81, pp. 1-8, July 2020.

[7] P. Williams, A. Howard-Jones, P. Hsu, P. Palasanthiran, P. Gray, B. McMullan, P. Britton and A. Bartlett, "SARS-CoV-2 in children: Spectrum of disease, transmission and immunopathological underpinnings," *Pathology,* vol. 52, no. 7, pp. 801-803, 1 December 2020.

[8] J. Ludvigsson, "Systematic review of COVID-19 in children shows milder cases and a better prognosis than adults," *Acta Paediatrica,* vol. 109, no. 6, pp. 1088-1095, 23 March 2020.

[9] N. Sharif-Askari, F. Sharif-Askari, M. Alabed and M. Temsah, "Airways expression of SARS-CoV-2 receptor, ACE2, and TMPRSS2 is lower in children than adults and increases with smoking and COPD," *Molecular Therapy: Methods & Clinical Development,* vol. 18, pp. 1-6, 11 September 2020.

[10] C. Pierce, P. Preston-Hurlburt, Y. Dai, C. Burn Aschner, N. Cheshenko, B. Galen, S. Garforth, N. Herrera, R. Jangra, N. Morano, E. Orner, S. Sy, K. Chandran, J. Dziura, S. Almo, A. Ring, M. Keller, K. Herold and B. Herold, "Immune responses to SARS-CoV-2 infection in hospitalized pediatric and adult patients," *Science Translational Medicine,* vol. 12, no. 564, pp. 1-10, 7 October 2020.

[11] C. Pierce, S. Sy, B. Galen, D. Goldstein, E. Orner, M. Keller, K. Herold and B. Herold, "Natural mucosal barriers and COVID-19 in children," *JCI Insight,* In-press preview, 6 April 2021.

[12] H. Yang, V. Costa, S. Racine-Brzostek, K. Acker, J. Yee, Z. Chen, M. Karbaschi, R. Zuk, S. Rand, A. Sukhu, P. Klasse, M. Cushing, A. Chadburn and Z. Zhao,

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"Association of age with SARS-CoV-2 antibody response," *JAMA Network Open,* vol. 4, no. 3, pp. 1-12, 22 March 2021.

[13] S. Bunyavanich, A. Do and A. Vicencio, "Nasal gene expression of angiotensin-converting enzyme 2 in children and adults," *JAMA,* vol. 323, no. 23, pp. 2427-2429, 20 May 2020.

[14] Public Health Ontario, "Coronavirus disease 2019 and the pediatric population: An umbrella review," 2020.

[15] Nogrady, "How kids' immune systems can evade COVID," *Nature,* vol. 588, p. 382, 10 December 2020.

[16] Government of Canada, "COVID-19 guidance for schools Kindergarten to Grade 12," 12 February 2021. [Online]. Available: https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/health-professionals/guidance-schools-childcare-programs.html. [Accessed 9 April 2021].

[17] B. Tönshoff, B. Müller, R. Elling, H. Renk, P. Meissner, H. Hengel, S. Garbade, M. Kieser, et al., "Prevalence of SARS-CoV-2 infection in children and their parents in Southwest Germany," *JAMA Pediatrics,* pp. E1-E8, 22 January 2021.

[18] J. Bullard, D. Funk, K. Dust, L. Garnett, K. Tran, A. Bello, J. Strong, S. Lee, J. Waruk, A. Hedley, D. Alexander, P. Van Caeseele, C. Loeppky and G. Poliquin, "Infectivity of severe acute respiratory syndrome coronavirus 2 in children compared with adults," *CMAJ,* Early release, pp. 1-6, 9 April 2021.

[19] Government of Canada, "COVID-19 variants of concern," 17 March 2021. [Online]. Available: https://www.sac-isc.gc.ca/eng/1615991390358/1615991423624. [Accessed 9 April 2021].

[20] Government of Canada, "Coronavirus disease (COVID-19): Outbreak update," 5 March 2021. [Online]. Available: https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection.html#a8. [Accessed 10 April 2021].

[21] S. Brookman, J. Cook, M. Zucherman, S. Broughton, K. Harman and A. Gupta, "Effect of the new SARS-CoV-2 variant B.1.1.7 on children and young people," *The Lancet Child & Adolescent Health,* Early release, pp. E9-E10, 9 April 2021.

[22] Government of Canada, "Pfizer-BioNTech COVID-19 vaccine: What you should know," 8 April 2021. [Online]. Available: https://www.canada.ca/en/health-canada/services/drugs-health-products/covid19-industry/drugs-vaccines-treatments/vaccines/pfizer-biontech.html. [Accessed 8 April 2021].

[23] Pfizer Inc., "Pfizer-BioNTech announce positive topline results of pivotal COVID-19 vaccine study in adolescents," 31 March 2021. [Online]. Available: https://www.pfizer.com/news/press-release/press-release-detail/pfizer-biontech-announce-positive-topline-results-pivotal. [Accessed 10 April 2021].

[24] Pfizer Inc., "Studies In Additional Populations," 2021. [Online]. Available: https://www.pfizer.com/science/coronavirus/vaccine/additional-population-studies. [Accessed 10 April 2021].

[25] Moderna Inc., "Moderna Announces First Participants Dosed in Phase 2/3 Study of COVID-19 Vaccine Candidate in Adolescents," 10 December 2020. [Online]. Available: https://investors.modernatx.com/news-releases/news-release-

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details/moderna-announces-first-participants-dosed-phase-23-study-covid. [Accessed 10 April 2021].

[26] Moderna Inc., "Moderna Announces First Participants Dosed in Phase 2/3 Study of COVID-19 Vaccine Candidate in Pediatric Population," 16 March 2021. [Online]. Available: https://investors.modernatx.com/news-releases/news-release-details/moderna-announces-first-participants-dosed-phase-23-study-0. [Accessed 10 April 2021].

[27] Government of Canada, "Moderna COVID-19 vaccine: What you should know," 8 April 2021. [Online]. Available: https://www.canada.ca/en/health-canada/services/drugs-health-products/covid19-industry/drugs-vaccines-treatments/vaccines/moderna.html. [Accessed 10 April 2021].

[28] Government of Canada, "Janssen COVID-19 Vaccine," 7 April 2021. [Online]. Available: https://covid-vaccine.canada.ca/janssen-covid-19-vaccine/product-details. [Accessed 10 April 2021].

[29] Johnson & Johnson Services, Inc., 2 April 2021. [Online]. Available: https://www.jnj.com/johnson-johnson-expands-phase-2a-clinical-trial-of-covid-19-vaccine-candidate-to-include-adolescents?ftag=MSF0951a18. [Accessed 10 April 2021].

[30] University of Oxford , "Oxford University extends COVID-19 vaccine study to children," 12 February 2021. [Online]. Available: https://www.ox.ac.uk/news/2021-02-12-oxford-university-extends-covid-19-vaccine-study-children. [Accessed 10 April 2021].

[31] University of Oxford , "UK and EU regulators conclude benefits of vaccination continue to outweigh the risks," 7 April 2021. [Online]. Available: https://www.ox.ac.uk/news/2021-04-07-uk-and-eu-regulators-conclude-benefits-vaccination-continue-outweigh-risks. [Accessed 10 April 2021].

[32] Government of Canada, "AstraZeneca COVID-19 vaccine: What you should know," 8 April 2021. [Online]. Available: https://www.canada.ca/en/health-canada/services/drugs-health-products/covid19-industry/drugs-vaccines-treatments/vaccines/astrazeneca.html. [Accessed 10 April 2021].

[33] World Health Organization, "WHO and UNICEF warn of a decline in vaccinations during COVID-19," 15 July 2020. [Online]. Available: https://www.who.int/news/item/15-07-2020-who-and-unicef-warn-of-a-decline-in-vaccinations-during-covid-19. [Accessed 10 April 2021].

[34] S. O'Leary, L. Trefren, H. Roth, A. Moss, R. Severson and A. Kempe, "Number of childhood and adolescent vaccinations administered efore and after the COVID-19 outbreak in Colorado," *JAMA Pediatrics,* vol. 175, no. 3, pp. 305-307, 7 December 2020.

[35] C. Bramer, L. Kimmins, R. Swanson, J. Kuo, P. Vranesich, L. Jacques-Carroll and A. Shen, "Decline in child vaccination coverage during the COVID-19 pandemic - Michigan Care Improvement Registry, May 2016-May 2020," *American Journal of Transplantation,* vol. 20, no. 7, pp. 1930-1931, July 2020.

[36] N. Üstün, A. B and M. Bayram, "Influence of COVID-19 pandemic on paediatric dental attendance," *Clinical Oral Investigations,* pp. 1-7, 30 March 2021.

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[37] E. Sen Tunc, E. Aksoy, H. Arslan and Z. Kaya, "Evaluation of parents' knowledge, attitudes, and practices regarding self-medication for their children's dental problems during the COVID-19 pandemic: A cross-sectional survey," *BMC Oral Health,* vol. 21, no. 98, pp. 1-7, 5 March 2021.

[38] S. Samuel, S. Kuduruthullah, A. Khair, M. Shayeb, A. Elkaseh and S. Varma, "Dental pain, parental SARS-CoV-2 fear and distress on quality of life of 2 to 6 year-old children during COVID-19," *International Journal of Paediatric Dentistry,* vol. 31, no. 3, pp. 436-441, 21 November 2020.

[39] S. Clark, S. Schultz, A. Gebremariam, D. Singer and G. Freed, "Pandemic-posed challenges to children's oral health. C.S. Mott Children's Hospital National Poll on Children's Health," vol. 38, no. 1, 15 February 2021.

[40] J. Burgette, R. Weyant, A. Ettinger, E. Miller and K. Ray, "What is the association between income loss during the COVID-19 pandemic and children's dental care?," *JADA,* Article in press, pp. 1-8, 6 February 2021.

[41] A. Baptista, I. Prado, M. Perazzo, T. Pinho, S. Paiva, A. Pordeus and J. Serra-Negra, "Can children's oral hygiene and sleep routines be compromised during the COVID-19 pandemic?," *International Journal of Paediatric Dentistry,* vol. 31, no. 1, pp. 12-19, 25 September 2020.

[42] A. Brescia, C. Bensi, G. Di Gennaro, M. Monda and R. Docimo, "Impact of lockdown on children's lifestyle and their collaboration during dental sessions," *European Journal of Paediatric Dentistry,* vol. 22, no. 1, pp. 61-65, 2021.

[43] B. Brondani, J. Knorst, F. Tomazoni, M. Dutra Cósta, A. Vargas, T. Noronha, F. Mendes and T. Ardenghi, "Effect of the COVID-19 pandemic on behavioral and psychosocial factors related to oral health in adolescents: A cohort study," *International Journal of Paediatric Dentistry,* 17 March 2021.

[44] N. Carroll, A. Sadowski, A. Laila, V. Hruska, M. Nixon, D. Ma, J. Haines, and on behalf of the Guelph Family Health Study, "The impact of COVID-19 on health behavior, stress, financial and food security among middle to high income Canadian families with young children," *Nutrients,* vol. 12, no. 8, pp. 1-14, 7 August 2020.

[45] A. Pietrobelli, L. Pecoraro, A. Ferruzzi, M. Heo, M. Faith, T. Zoller, F. Antoniazzi, G. Piacentini, S. Fearnbach and S. Heymsfield, "Effects of COVID-19 lockdown on lifestyle behaviors in children with obesity living in Verona, Italy: A longitudinal study," *Obesity,* vol. 28, no. 8, pp. 1382-1385, 30 April 2020.

[46] A. H, J. Dabis, V. Aghabekian, A. Khader and U. Khammash, "Impact of COVID-19 lockdown on dietary and lifestyle behaviours among adolescents in Palestine," *Dynamics of Human Health,* vol. 7, no. 2, pp. 1-11, 2020.

[47] M. Ruiz-Roso, P. de Carvalho Padilha, D. Mantilla-Escalante, N. Ulloa, P. Brun, D. Acevedo-Correa, W. Arantes Ferreira Peres, M. Martorell, M. Aires, L. de Oliveira Cardoso, F. Carrasco-Marín, K. Paternina-Sierra, J. Rodriguez-Meza, et al., "Covid-19 confinement and changes of adolescent's dietary trends in Italy, Spain, Chile, Colombia and Brazil," *Nutrients,* vol. 12, no. 6, pp. 1-18, 17 June 2020.

[48] M. Cagetti and E. Angelino, "Could SARS-CoV-2 burst the use of non-invasive and minimally invasive treatments in paediatric dentistry?," *International Journal of Paediatric Dentistry,* vol. 31, no. 1, pp. 27-30, 3 August 2020.

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[49] S. Mallineni, N. Innes, D. Raggio, M. Araujo, M. Robertson and J. Jayaraman, "Coronavirus disease (COVID-19): Characteristics in children and considerations for dentists providing their care," *International Journal of Paediatric Dentistry,* vol. 30, no. 3, pp. 245-250, 6 April 2020.

[50] G. Martin, G. Le Roux, D. Guindolet, E. Boulanger, D. Hasle, E. Morin, D. Vodovar, C. Vignal, E. Gabison, A. Descatha, for the French PCC Research Group, "Eye injuries by hydroalcoholic gel in the context of the coronavirus disease 2019 pandemic," *JAMA Ophthalmology,* vol. 139, no. 3, pp. 348-351, 21 January 2021.

[51] S. Yangzes, S. Grewal, T. Gailson and S. Grewal, "Hand sanitizer–induced ocular injury: A COVID-19 hazard in children," *JAMA Ophthalmology,* vol. 139, no. 3, pp. 362-364, 21 January 2021.

[52] FDA, "Q&A for Consumers | Hand Sanitizers and COVID-19," 15 December 2020. [Online]. Available: https://www.fda.gov/drugs/information-drug-class/qa-consumers-hand-sanitizers-and-covid-19. [Accessed 7 April 2021].

[53] R. Gharpure, C. Hunter, A. Schnall, C. Barrett, A. Kirby, J. Kunz, K. Berling, J. Mercante, J. Murphy and A. Garcia-Williams, "Knowledge and practices regarding safe household cleaning and disinfection for COVID-19 prevention - United States, May 2020," *Am. J. Transplant.,* vol. 20, pp. 2946-2950, 29 September 2020.

[54] L. McCulley, C. Cheng, E. Mentari, I. Diak and T. Michele, "Alcohol-based hand sanitizer exposures and effects on young children in the U.S. during the COVID-19 pandemic," *Clinical Toxicology,* vol. 59, no. 4, pp. 355-356, 27 August 2020.

[55] American Association of Poison Control Centers, "Hand Sanitizer," [Online]. Available: https://aapcc.org/track/hand-sanitizer. [Accessed 10 April 2021].

[56] Government of Canada, "Risk of poisoning from hand sanitizers sold in beverage containers," 10 June 2020. [Online]. Available: https://healthycanadians.gc.ca/recall-alert-rappel-avis/hc-sc/2020/73291a-eng.php. [Accessed 10 April 2020].

[57] Government of Canada, "Hand Sanitizers and Children's Safety: What you need to know," 4 September 2020. [Online]. Available: https://healthycanadians.gc.ca/recall-alert-rappel-avis/hc-sc/2020/73883a-eng.php. [Accessed 10 April 2021].

[58] G. Jong, N. Le Saux and M. Rieder, "Hand sanitizers: Promoting safe use by children," Canadian Paediatric Society, 3 April 2020. [Online]. Available: https://www.cps.ca/en/blog-blogue/hand-sanitizers-promoting-safe-use-by-children. [Accessed 10 April 2021].

[59] Government of Canada, "Recall of certain hand sanitizers that may pose health risks (Part 1 - June 17, 2020 to March 24, 2021)," 24 March 2021. [Online]. Available: https://www.healthycanadians.gc.ca/recall-alert-rappel-avis/hc-sc/2020/73385a-eng.php. [Accessed 10 April 2021].

[60] Government of Canada, "Recall of certain hand sanitizers that may pose health risks (Part 2 – March 31, 2021 to present)," 7 April 2021. [Online]. Available: https://www.healthycanadians.gc.ca/recall-alert-rappel-avis/hc-sc/2021/75267a-eng.php. [Accessed 10 April 2021].

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Client Resources

Oral Health for Children – *A Parent's Guide*, ODHA Factsheet
https://odha.on.ca/wp-content/uploads/2016/08/ODHA-Facts-children.VFS18.9-copyright.pdf

COVID-19 and your child, Canadian Paediatric Society
Contains information for parents and families on a variety of COVID-19 topics
https://www.caringforkids.cps.ca/handouts/health-conditions-and-treatments/the-2019-novel-coronavirus-covid-19

COVID-19 Fact Sheet: Talking to Children About the Pandemic, Ministry of Health
https://www.health.gov.on.ca/en/pro/programs/publichealth/coronavirus/docs/2019_talking_children_guidance.pdf

Read. Learn. Understand. A Parent's Decision to Immunize, Immunize Canada
The downloadable PDF comes in four languages (English, Arabic, Swahili, Tigrignya)
https://immunize.ca/parents

Hand sanitizers: Promoting safe use by children, Canadian Paediatric Society, April 3, 2020
https://www.cps.ca/uploads/blog_uploads/hand_sanitizers_PRINTABLE.pdf

Ontario Poison Centre
Contact information: 1-800-268-9017 (Toll-Free) or 416-813-5900 (Toronto)
They provide help over the phone 24 hours a day, every day of the year with poison emergencies and with questions about poisoning in more than 170 languages.
https://www.ontariopoisoncentre.ca/about-us/contact-us/

Hand sanitizers that look like drinks, Institute for Safe Medication Practices in Canada, ISMP Canada Safety Bulletin, Volume 20, Issue 3, May 1, 2020
https://www.ismp-canada.org/download/safetyBulletins/2020/ISMPCSB2020-i3-ALERT-Hand-Sanitizers.pdf

Hard-surface disinfectants and hand sanitizers (COVID-19): List of hand sanitizers authorized by Health Canada – searchable database
https://www.canada.ca/en/health-canada/services/drugs-health-products/disinfectants/covid-19/hand-sanitizer.html

Recall of certain hand sanitizers that may pose health risks (Part 1 - June 17, 2020 to March 24, 2021) – searchable database
https://www.healthycanadians.gc.ca/recall-alert-rappel-avis/hc-sc/2020/73385a-eng.php

Recall of certain hand sanitizers that may pose health risks (Part 2 – March 31, 2021 to present) – searchable database
https://www.healthycanadians.gc.ca/recall-alert-rappel-avis/hc-sc/2021/75267a-eng.php

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Hand Sanitizers and Children's Safety: What you need to know
https://healthycanadians.gc.ca/recall-alert-rappel-avis/hc-sc/2020/73883a-eng.php

Risk of poisoning from hand sanitizers sold in beverage containers
https://healthycanadians.gc.ca/recall-alert-rappel-avis/hc-sc/2020/73291a-eng.php

Additional Resources

Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: Summary of a report of 72 314 Cases from the Chinese Center for Disease Control and Prevention, Wu, Z; McGoogan, J. *JAMA*, Volume 323, Issue 12, February 24, 2020, p 1239-1242
https://jamanetwork.com/journals/jama/fullarticle/2762130

Epidemiology of COVID-19 among children in China, Dong, Y; Mo, X; Hu, Y; Qi, X; Jiang, F: Jiang, Z; Tong, S. *Pediatrics*, Volume 145, Issue 6, June 2020, p 1-10
https://pediatrics.aappublications.org/content/145/6/e20200702

Characteristics and outcomes of children with coronavirus disease 2019 (COVID-19) infection admitted to US and Canadian pediatric intensive care units, Shekerdemian, L; Mahmood, N; Wolfe, K; Riggs, B; Ross, C; McKiernan, C; Heidemann, S; et al. *JAMA Pediatrics*, Volume 74, Issue 9, May 11, 2020, p 868-873
https://jamanetwork.com/journals/jamapediatrics/fullarticle/2766037

Characteristics and disease severity of US children and adolescents diagnosed with COVID-19, Preston, L; Chevinsky, J; Kompaniyets, L; Lavery, A; Kimball, A; Boehmer, T; Goodman, A. *JAMA Network Open*, Volume 4, Issue 4, April 9, 2021, p 1-4
https://jamanetwork.com/journals/jamanetworkopen/article-abstract/2778347

Laboratory abnormalities in children with mild and severe coronavirus disease 2019 (COVID-19): A pooled analysis and review, Henry, B; Benoit, S; Santos de Oliveira, M; Hsieh, W; Benoit, J; Ballout, R; Plebani, M; Lippi, G. *Clinical Biochemistry*, Volume 81, July 2020, p 1-8
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7251358/

Systematic review of COVID-19 in children shows milder cases and a better prognosis than adults, Ludvigsson, J. *Acta Paediatrica*, Volume 109, Issue 6, March 23, 2020, p 1088-1095
https://onlinelibrary.wiley.com/doi/10.1111/apa.15270

SARS-CoV-2 in children: Spectrum of disease, transmission and immunopathological underpinnings, Williams, P; Howard-Jones, A; Hsu, P; Palasanthiran, P; Gray, P; McMullan, B; Britton, P; Bartlett, A. *Pathology*, Volume 52, Issue 7, December 1, 2020, p 801-808
https://www.pathologyjournal.rcpa.edu.au/article/S0031-3025(20)30884-9/fulltext

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA

Why COVID-19 is less frequent and severe in children: A narrative review, Sinaei, R; Pezeshki, S; Parvaresh, S; Sinaei, R. *World Journal of Pediatrics*, Volume 17, September 25, 2021, p 10-20
https://link.springer.com/article/10.1007/s12519-020-00392-y

Airways expression of SARS-CoV-2 receptor, ACE2, and TMPRSS2 is lower in children than adults and increases with smoking and COPD, Sharif-Askari, N; Sharif-Askari, F; Alabed, M; Temsah, M; Al Heialy, S; Hamid, Q; Halwani, R. *Molecular Therapy: Methods & Clinical Development*, Volume 18, September 11, 2020, p 1-6
https://www.cell.com/molecular-therapy-family/methods/fulltext/S2329-0501(20)30100-5

Immune responses to SARS-CoV-2 infection in hospitalized pediatric and adult patients, Pierce, C; Preston-Hurlburt, P; Dai, Y; Burn Aschner, C; Cheshenko, N; Galen, B; Garforth, S; Herrera, N; Jangra, R; Morano, N; Orner, E; Sy, S; Chandran, K; et al. *Science Translational Medicine*, Volume 12, Issue 564, October 7, 2020, p 1-10
https://stm.sciencemag.org/content/12/564/eabd5487

Natural mucosal barriers and COVID-19 in children, Pierce, C; Sy, S; Galen, B; Goldstein, D; Orner, E; Keller, M; Herold, K; Herold, B. *JCI Insight*, In-press preview, April 6, 2021
https://insight.jci.org/articles/view/148694

Association of age with SARS-CoV-2 antibody response, Yang, H; Costa, V; Racine-Brzostek, S; Acker, K; Yee, J; Chen, Z; Karbaschi, M; Zuk, R; Rand, S; Sukhu, A; Klasse, P; Cushing, M; Chadburn, A; Zhao, Z. *JAMA Network Open*, Volume 4, Issue 3, March 22, 2021, p 1-12
https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2777743

Nasal gene expression of angiotensin-converting enzyme 2 in children and adults, Bunyavanich, S; Do, A; Vicencio, A. *JAMA*, Volume 323, Issue 23, May 20, 2020, p 2427-2429
https://jamanetwork.com/journals/jama/fullarticle/2766524

Coronavirus disease 2019 and the pediatric population: An umbrella review, Public Health Ontario, November 4, 2020, p 1-26
https://www.publichealthontario.ca/-/media/documents/ncov/ipac/2020/10/covid-19-pediatric-population-umbrella-review-synthesis.pdf?la=en

COVID-19 pneumonia in children: From etiology to management, Parisi, G; Indolfi, C; Decimo, F; Leonardi, S; Miraglia del Giudice, M. *Frontiers in Pediatrics*, Volume 8, Article 616622, December 2020, p 1-8
https://www.frontiersin.org/articles/10.3389/fped.2020.616622/full

Will children reveal their secret? The coronavirus dilemma, Cristiani, L; Mancino, E; Matera, L; Nenna, R; Pierangeli, A; Scagnolari, C; Midulla, F. *European Respiratory Journal*, Volume 55, Issue 4, April 23, 2020, p 1-5
https://erj.ersjournals.com/content/55/4/2000749

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COVID-19 in children and altered inflammatory responses, Molloy, E; Bearer, C. *Pediatric Research*, Volume 88, April 3, 2020, p 340-341
https://www.nature.com/articles/s41390-020-0881-y

Prevalence of SARS-CoV-2 infection in children and their parents in southwest Germany, Tönshoff, B; Müller, B; Elling, R; Renk, H; Meissner, P; Hengel, H; Garbade, S; Kieser, M; et al. *JAMA Pediatrics*, January 22, 2021, p E1-E8
https://jamanetwork.com/journals/jamapediatrics/fullarticle/2775656

Infectivity of severe acute respiratory syndrome coronavirus 2 in children compared with adults, Bullard, J; Funk, D; Dust, K; Garnett, L; Tran, K; Bello, A; Strong, J; Lee, S; Waruk, J; Hedley, A; Alexander, D; et al. *CMAJ*, Early release, April 9, 2021, p 1-6
https://www.cmaj.ca/content/early/2021/04/09/cmaj.210263

Effect of the new SARS-CoV-2 variant B.1.1.7 on children and young people, Brookman, S; Cook, J; Zucherman, M; Broughton, S; Harman, K; Gupta, A. *The Lancet Child & Adolescent Health*, Volume 5, Issue 4, April 1, 2021, p E9-E10
https://www.thelancet.com/journals/lanchi/article/PIIS2352-4642(21)00030-4/fulltext

Coronavirus disease 2019 (COVID-19) in children, Mirza, A. *Medscape*, April 8, 2021
https://emedicine.medscape.com/article/2500132-overview

Number of childhood and adolescent vaccinations administered before and after the COVID-19 outbreak in Colorado, O'Leary, S; Trefren, L; Roth, H; Moss, A; Severson, R; Kempe, A, *JAMA Pediatrics*, Volume 175, Issue 3, December 7, 2020, p 305-307
https://jamanetwork.com/journals/jamapediatrics/fullarticle/2773308

Decline in child vaccination coverage during the COVID-19 pandemic – Michigan Care Improvement Registry, May 2016-May 2020, Bramer, C; Kimmins, L; Swanson, R; Kuo, J; Vranesich, P; Jacques-Carroll, L; Shen, A. *American Journal of Transplantation*, Volume 20, Issue 7, July 2020, p 1930-1931
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7361263/

COVID-19 and primary measles vaccination rates in a large primary care network, Bode, S; Gowda, C; Mangihi, M; Kemper, A. *Pediatrics*, Volume 147, Issue 1, January 2021, p 1-5
https://pediatrics.aappublications.org/content/147/1/e2020035576

Impact of COVID-19 pandemic on the utilization of routine immunization services in Lebanon, Mansour, Z; Arab, J; Said, R; Rady, A; Hamadeh, R; Gerbaka, B; Bizri, A. *PLOS ONE*, February 17, 2021, p 1-11
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0246951

Vaccines and routine immunization strategies during the COVID-19 pandemic, Dinleyici, E; Barrow, R; Safadi, M; van Damme, P; Munoz, F. *Human Vaccines & Immunotherapeutics,* Volume 17, Issue 2, August 26, 2020, p 400-407
https://www.tandfonline.com/doi/full/10.1080/21645515.2020.1804776

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Value of immunizations during the COVID-19 emergency, Stefanati, A; d'Anchera, E; De Motoli, F; Savio, M; Toffoletto, M; Gabutti, G. *International Journal of Environmental Research and Public Health*, Volume 18, Issue 2, January 18, 2021, p 1-10
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7831295/

Influence of COVID-19 pandemic on paediatric dental attendance, Üstün, N; Akgöl, B; Bayram, M. *Clinical Oral Investigations*, March 30, 2021, p 1-7
https://link.springer.com/article/10.1007%2Fs00784-021-03917-5

Evaluation of parents' knowledge, attitudes, and practices regarding self-medication for their children's dental problems during the COVID-19 pandemic: A cross-sectional survey, Sen Tunc, E; Aksoy, E; Arslan, H; Kaya, Z. *BMC Oral Health*, Volume 21, Article 98, March 5, 2021, p 1-7
https://bmcoralhealth.biomedcentral.com/articles/10.1186/s12903-021-01466-7

Dental pain, parental SARS-CoV-2 fear and distress on quality of life of 2 to 6 year-old children during COVID-19, Samuel, S; Kuduruthullah, S; Khair, A; Shayeb, M; Elkaseh, A; Varma, S. *International Journal of Paediatric Dentistry*, Volume 31, Issue 3, November 21, 2020, p 436-441
https://onlinelibrary.wiley.com/doi/10.1111/ipd.12757

Pandemic-posed challenges to children's oral health, C.S. Mott Children's Hospital, Volume 38, Issue 1, February 15, 2021
https://mottpoll.org/reports/pandemic-posed-challenges-childrens-oral-health

What is the association between income loss during the COVID-19 pandemic and children's dental care? Burgette, J; Weyant, R; Ettinger, A; Miller, E; Ray, K. *JADA*, Article in press, February 6, 2021, p 1-8
https://jada.ada.org/article/S0002-8177(21)00077-5/fulltext#%20

Can children's oral hygiene and sleep routines be compromised during the COVID-19 pandemic? Baptista, A; Prado, I; Perazzo, M; Pinho, T; Paiva, S; Pordeus, A; Serra-Negra, J. *International Journal of Paediatric Dentistry*, Volume 31, Issue 1, September 25, 2020, p 12-19
https://onlinelibrary.wiley.com/doi/10.1111/ipd.12732

Impact of lockdown on children's lifestyle and their collaboration during dental sessions, Brescia, A; Bensi, C; Di Gennaro, G; Monda, M; Docimo, R. *European Journal of Paediatric Dentistry*, Volume 22, Issue 1, 2021, p 61-65
https://ejpd.eu/EJPD_2021_22_01_11.pdf

Effect of the COVID-19 pandemic on behavioral and psychosocial factors related to oral health in adolescents: A cohort study, Brondani, B; Klöckner Knorst, JK; Tomazoni, F; Dutra Cósta, M; Vargas, AW; Noronha, TG; Mendes, FM; Ardenghi, TM. *International Journal of Paediatric Dentistry*, 2021
https://onlinelibrary.wiley.com/doi/10.1111/ipd.12784

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Coronaphobia: Fear and the 2019-nCoV outbreak, Asmundson, G; Taylor, S. *Journal of Anxiety Disorders,* Volume 70, Article 102196, March 2020, p 1-2
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7134790/

Coronaphobia revisited: A state-of-the-art on pandemic-related fear, anxiety, and stress, Asmundson, G; Taylor, S. *Journal of Anxiety Disorders*, Volume 76, Article 102326, December 2020, p 1-3
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7585502/

Understanding coronaphobia, Arora, A; Jha, A; Alat, P; Das, S. *Asian Journal of Psychiatry*, Volume 54, Article 102384, December 2020, p 1-6
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7474809/

Incremental validity of coronaphobia: Coronavirus anxiety explains depression, generalized anxiety, and death anxiety, Lee, S; Jobe, M; Mathis, A; Gibbons, J. *Journal of Anxiety Disorders*, Volume 74, Article 102268, July 1, 2020, p 1-4
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7328548/

The impact of COVID-19 on health behavior, stress, financial and food security among middle to high income Canadian families with young children, Carroll, N; Sadowski, A; Laila, A; Hruska, V; Nixon, M; Ma, D; Haines, J; and on behalf of the Guelph Family Health Study. *Nutrients*, Volume 12, Issue 8, Article 2352, August 7, 2020, p 1-14
https://www.mdpi.com/2072-6643/12/8/2352/htm

Effects of COVID-19 lockdown on lifestyle behaviors in children with obesity living in Verona, Italy: A longitudinal study, Pietrobelli, A; Pecoraro, L; Ferruzzi, A; Heo, M; Faith, M; Zoller, T; Antoniazzi, F; Piacentini, G; Fearnbach, S; Heymsfield, S. *Obesity*, Volume 28, Issue 8, April 30, 2020, p 1382-1385
https://onlinelibrary.wiley.com/doi/10.1002/oby.22861

Impact of COVID-19 lockdown on dietary and lifestyle behaviours among adolescents in Palestine, H, Allabadi; Dabis, J; Aghabekian, V; Khader, A; Khammash, U. *Dynamics of Human Health*, Volume 7, Issue 2, 2020, p 1-11
https://journalofhealth.co.nz/?page_id=2170

Covid-19 confinement and changes of adolescent's dietary trends in Italy, Spain, Chile, Colombia and Brazil, Ruiz-Roso, M; de Carvalho Padilha, P; Mantilla-Escalante, D; Ulloa, N; Brun, P; Acevedo-Correa, D; Arantes Ferreira Peres, W; Martorell, M; et al. *Nutrients*, Volume 12, Issue 6, Article 1807, June 17, 2020, p 1-18
https://www.mdpi.com/2072-6643/12/6/1807/htm

Could SARS-CoV-2 burst the use of non-invasive and minimally invasive treatments in paediatric dentistry, Grazia Cagetti, M; Angelino, E. *International Journal of Paediatric Dentistry*, Volume 31, Issue 1, August 3, 2020, p. 27-30
https://onlinelibrary.wiley.com/doi/10.1111/ipd.12679

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Coronavirus disease (COVID-19): Characteristics in children and considerations for dentists providing their care, Mallineni, S; Innes, N; Procida Raggio, D; Pinheiro Araujo, M; Robertson, M; Jayaraman, J. *International Journal of Paediatric Dentistry*, Volume 30, Issue 3, April 6, 2020, p 245-250
https://onlinelibrary.wiley.com/doi/full/10.1111/ipd.12653

Paediatric dental care during and post-COVID-19 era: Changes and challenges ahead, Luo, W; Lee, G; Nalabothu, P; Kumar, H. *Pediatric Dental Journal*, Volume 31, Issue 1, April 2021, p. 33-42
https://www.sciencedirect.com/science/article/pii/S0917239421000045

Pediatric eye injuries by hydroalcoholic gel in the context of the coronavirus disease 2019 pandemic, Martin, G; Le Roux, G; Guindolet, D; Boulanger, E; Hasle, D; Morin, E; Vodovar, D; Vignal, C; Gabison, E; Descatha, A; Group, for the French PCC Research. *JAMA Ophthalmology*, Volume 139, Issue 3, 2021, p 384-351
https://jamanetwork.com/journals/jamaophthalmology/fullarticle/2775155

Hand sanitizer-induced ocular injury: A COVID-19 hazard in children, Yangzes, S; Grewal, S; Gailson, T; Pal Singh Grewal, S. *JAMA Ophthalmology*, Volume 139, Issue 3, January 21, 2021, p 362-364
https://jamanetwork.com/journals/jamaophthalmology/fullarticle/2775159

Knowledge and practices regarding safe household cleaning and disinfection for COVID-19 prevention – United States, May 2020, Gharpure, R; Hunter, C; Schnall, A; Barrett, C; Kirby, A; Kunz, J; Berling, K; Mercante, J; Murphy, J; Garcia-Williams, A. *American Journal of Transplantation*, Volume 20, Issue 10, September 29, 2020, p 2946-2950
https://onlinelibrary.wiley.com/doi/10.1111/ajt.16300

Alcohol-based hand sanitizer exposures and effects on young children in the U.S. during the COVID-19 pandemic, McCulley, L; Cheng, C; Mentari, E; Diak, I; Michele, T. *Clinical Toxicology*, Volume 59, Issue 4, August 27, 2020, p 355-356
https://www.tandfonline.com/doi/full/10.1080/15563650.2020.1811298

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