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response with production of substantial numbers of plasmablasts, mostly of IgM isotype. This response is not observed in adults with severe disease (who have a depletion of the B-cell compartment). Further studies are ongoing to show the difference in the specificities of the antibodies of children and adults. In addition to antibody production, B cells also have the function to secrete cytokines. IL-10, a potent anti-inflammatory cytokine is produced by neonatal B cells, activated B cells,<sup>13</sup> and IgA plasmablasts. Thus, the child immune response might have the double function of exerting protection and reducing immune-mediated tissue damage, in particular, in the lung.

Evolution has endowed a survival advantage to children to combat known and unknown pathogens. The adult is also well protected by the balance of cells with high and low specificity. With ageing, malnutrition, immunosuppression, and co-morbid states, our immune system loses the ability to adapt to novelty. Although vaccines are the way forward, in emergency situations such as the COVID-19 pandemic, the investigation and use of immune tools that nature has endowed to children might improve management outcomes.

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## Promoting healthy movement behaviours among children during the COVID-19 pandemic

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For movement behaviour guidelines for preschool children see <https://apps.who.int/iris/handle/10665/311664>

Global movement behaviour guidelines recommend that preschool children (aged 3–4 years) accumulate at least 180 min physical activity, engage in no more than 1 h sedentary screen time, and have 10–13 h good-quality sleep per day. For school-age children and adolescents (5–17 years), the recommendations are to participate in at least 60 min moderate-intensity to vigorous-intensity physical activity, engage in no more than 2 h sedentary

recreational screen time, and have 9–11 h good-quality sleep each day.

Children typically obtain their daily physical activity through active travel to school; physical education and recess; organised sports, games, and dance; active play; and spending time in playgrounds and parks. Conversely, most of their sedentary time and sleep are accumulated at home. As a result of the coronavirus disease 2019

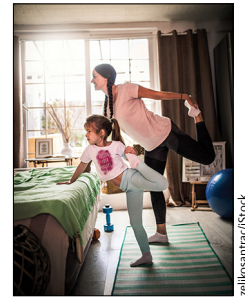
(COVID-19) pandemic, opportunities for children to meet the movement behaviour guidelines have been affected by school closures and physical distancing measures implemented by many governments.

To date, we have little evidence to know if, as a result of home confinement, children are spending less time active, going to bed later, and sleeping in later because they do not have to travel to school, or spending more time sedentary, especially through recreational screen time. Evidence shows that children are less active and more sedentary, with less consistent sleep patterns, on unstructured or non-school days (ie, when they are not physically at school) than on school days.<sup>1</sup> Community mobility data from Google across the 15 countries represented by our authorship show that—compared with the week ending Feb 23, 2020, before the WHO pandemic announcement—time spent in places associated with physical activity such as parks, beaches, and community gardens was down by 31%, and travel by public transport, which is also associated with physical activity, was down by 59% during the week ending April 5, 2020, after a pandemic was declared. Conversely, time spent in places of residence increased by an average of 17%. Compared with before the COVID-19 crisis, Canadians aged 15–49 years reported a 66% increase in time watching TV and 35% increase in time spent playing video games between March 29 and April 3, 2020. Interviews done with 15 parents of preschool children in Beijing, China, found that, compared with pre-COVID-19, nearly all children were going to bed later and waking up later. Sedentary screen time had increased and physical activity levels were very low, with children not being allowed outdoors (unpublished data). In South Korea, we surveyed 97 parents of young children between March 27 and 31, 2020; 79 (81%) reported that their children’s screen time had increased and 46 (94%) of 49 reported that their children’s use of play and sports facilities had decreased.

If this pandemic has reduced healthy movement behaviours among children, we should be concerned for several reasons. First, data from the pre-COVID-19 period show that, on average, only a fifth of preschoolers and less than 10% of school-aged children meet all the movement guidelines.<sup>2</sup> Given the strong associations of health outcomes with movement behaviours,<sup>3,4</sup> children’s health will be even more compromised during COVID-19. Second, this period of home confinement—especially if indoors and in small spaces—could lead to higher

risk of vitamin D deficiency<sup>5</sup>, mental health issues,<sup>6</sup> and myopia.<sup>7</sup> Third, although children seem less susceptible to COVID-19, maintaining or increasing levels of physical activity can reduce their risk of respiratory infections.<sup>8</sup> Fourth, benefits that help children to cope with life-changing circumstances, such as the role of physical activity in resilience building, might be compromised. Fifth, the interactive effects of each movement behaviour might be more pronounced—eg, children who are less active and engaged in more screen time are likely to have poorer sleep. Finally, there could be potential longer-term health and economic consequences if the adverse behavioural adaptations, such as less activity, become the new normal.<sup>9</sup>

It is important to examine whether children from low-income and middle-income countries and vulnerable families in high-income countries are especially at risk during the COVID-19 pandemic, as a greater proportion of these populations live in apartments or shelters that are exposed to overcrowding (appendix), making physical distancing virtually impossible. These groups tend to accumulate physical activity through outdoor play and active commuting to school, which is threatened



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For movement behaviour guidelines for school-age children and adolescents see [https://www.who.int/dietphysicalactivity/factsheet\\_young\\_people](https://www.who.int/dietphysicalactivity/factsheet_young_people)

For more on government responses to COVID-19 see <https://covidtracker.bsg.ox.ac.uk>

For more on community mobility data from Google see <https://www.google.com/covid19/mobility>

For more on the data from Canada see <https://www150.statcan.gc.ca/n1/pub/11-627-m/11-627-m2020029-eng.htm>

**Panel: Recommendations for promoting healthy movement behaviour**

- Parents and carers should incorporate physical activity into children’s daily routine (including using electronic media to facilitate participation) and encourage the whole family to join while adhering to regulations on physical distancing and access to outdoor spaces. Extended periods of sitting should be broken up every 30–60 min (eg, by standing and stretching for 1 min). They should follow sedentary recreational screen-time recommendations and encourage co-viewing and positive social interactions and experiences. To help children to get enough sleep, keep bed and wake times consistent, keep screens out of the room where children sleep, and avoid screen use before bedtime.
- Educators and teachers should know and promote the movement behaviour guidelines, and embrace opportunities to incorporate healthy movement messages, practices, and policies into daily home-school routines and lessons—eg, when scheduling online lessons, limit prolonged sitting and encourage changes in posture such as regularly standing, stretching, or moving on the spot.
- Health professionals should understand and recommend the current guidelines to parents, family members, and caregivers and reinforce their positive association with children’s health during all visits, including remote contacts and telemedicine.
- Governments should promote healthy movement behaviours in children as part of response strategies and public messaging, and should engage influential people in promotion of such messages.
- The media should provide regular messages to promote physical activity and break up extended periods of sitting.
- Children should speak up and advocate for their right to a healthy, active life, while carefully observing pandemic restrictions. Forming peer groups can help with maintaining healthy movement behaviour patterns.

For more on data from South Korea see <https://bit.ly/2ygb8yP>  
See Online for appendix

For online resources to support healthy movement behaviours see <https://www.who.int/news-room/q-a-detail/be-active-during-covid-19>, <https://www.unicef.org/parenting/coronavirus-covid-19-guide-parents/indoor-play-ideas-stimulate-young-children-home>, and <https://www.unicef.org/coronavirus/keep-your-child-safe-online-at-home-covid-19>

by an increase in time indoors.<sup>10</sup> Poorer neighbourhood safety—especially in countries where schools might be the only safe play space in the neighbourhood—make it harder for children to be active when schools are closed. At home, there might be reduced access to the internet or inability to pay for increased data usage to access online content such as videos and virtual activity classes.

Many resources aimed at promoting healthy movement behaviours in children have rapidly emerged. As such, there is a real need to support stakeholders with a trusted source of activities and curated online resources. Such activities and resources should consider equity, minimal equipment, protection of children online, opportunities for parent-child interactions, and consideration of small spaces. This is especially crucial in communities with little access to the internet.

Based on the evidence presented, we outline our recommendations for promoting healthy movement behaviours during the COVID-19 pandemic (panel). We acknowledge that many parents are juggling reduced income, food insecurity, and working from home while supervising their children’s daily schooling, so movement behaviours might not be a priority. However, we believe that the pandemic provides an opportunity to raise awareness of movement behaviour guidelines for children and to promote their uptake across all areas of society.

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## Leveraging artificial intelligence to monitor unhealthy food and brand marketing to children on digital media

Food and brand marketing refers to commercial promotions designed to increase recognition, appeal, and consumption of particular foods and brands.<sup>1</sup> Successive systematic reviews<sup>2,3</sup> have shown that unhealthy food and brand marketing, particularly on television and within advergimes (ie, advertising in

video games), adversely affects children’s diet quality and diet-related health.

Marketing has traditionally entailed one-way communication of information in a particular time and place (eg, television commercials). However, digital media—including overt and covert (eg, product