For more on **data from South Korea** see https://bit.ly/2ygB8yP

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by an increase in time indoors.[10] 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.

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

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.

We declare no competing interests. DS is a UNICEF staff member. The opinions and statements in this Comment are those from the author and may not reflect official UNICEF policies. HG and ADO contributed equally.

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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.[1] Successive systematic reviews[2,3] have shown that unhealthy food and brand marketing, particularly on television and within advergames (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

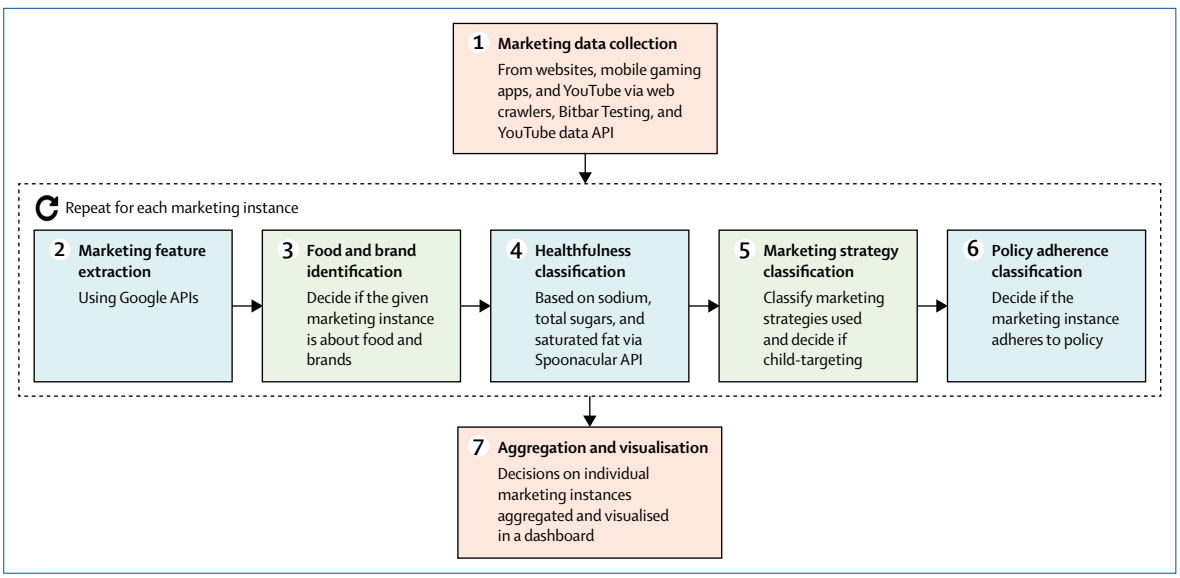

Figure: **AI system overview**
Modules inside the dashed line are repeated for each marketing instance. Red indicates bulk operations. Blue indicates computational or rules-based algorithms. Green indicates machine learning models. AI=artificial intelligence.

placement, social media influencers) promotional activities on websites, social media, text messaging, applications, email, and online games—allows marketers to push unprecedented volumes of information to children in real time, often using artificial intelligence (AI)-enabled tactics.[4,5] In the digital age, commercial messages no longer interrupt, but are instead intimately integrated with content,[6] and thus cues that can help children identify marketing (eg, commercial breaks) are absent or not prominently displayed.[7] As a result, children have more difficulty recognising marketing on websites than on television, making it difficult to initiate consumer defences.[7] Digital marketing might therefore foster deeper and more sustained engagement with unhealthy foods and brands, with potentially more negative dietary and health consequences.[4]

While industry has leveraged AI to market unhealthy foods and brands to children on digital media, researchers continue to manually assess the extent and nature of these AI-enabled tactics. As a result, even the largest international studies have only examined unhealthy food and brand marketing on a few hundred websites or gaming applications, or small numbers of social media accounts, or YouTube channels (appendix p 1). Given the massive size and the dynamic and varied nature of digital marketing, manual approaches clearly lack appropriate speed, cost-effectiveness, feasibility, and scalability. Failure to leverage AI precludes more comprehensive understanding of the extent and nature of digital marketing of unhealthy foods and brands to children and hinders development of effective policy responses.

In 2010, WHO recommended that all member states restrict unhealthy food and brand marketing to children across all media.[8] At least 16 countries have now imposed statutory restrictions on food and brand marketing to children; however, only a few regulate marketing on digital media.[9] Widespread reluctance to regulate digital media has been attributed to evidentiary gaps concerning the extent and nature of the digital marketing problem, and the difficulty of monitoring policy adherence.[7,10] Such concerns are valid, as policy makers require evidence to justify regulatory intervention and inform policy provisions (eg, what constitutes marketing to children), and a robust way to monitor adherence.

Given the volume (eg, millions of websites), velocity (eg, content changes frequently), and variety (eg, games, display adverts) of digital marketing, AI is essential for research and policy making in the digital sphere, as it can automate a range of tasks that require substantial human effort or that cannot be accomplished by humans. Most successful AI systems use machine learning, in which machines learn how to do tasks by automatically identifying and learning from patterns in the data, rather than by being programmed to follow a specific routine. The application of AI can allow researchers to efficiently and accurately automate

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processes such as extracting features (eg, foods, brands, marketing strategies) from text, images, and videos; mapping marketed foods and brands to nutrition information; identifying child-targeted marketing; and classifying marketing strategies. Such an AI system can be used to comprehensively and frequently assess the extent and nature of digital food and brand marketing to children and adherence to policy, including compensatory changes in unregulated forms of marketing (eg, advertisers might target adolescents more often if marketing to children is restricted).

For the **CLICK framework** see http://www.euro.who.int/en/health-topics/disease-prevention/nutrition/publications/2019/monitoring-and-restricting-digital-marketing-of-unhealthy-products-to-children-and-adolescents-2019

The WHO CLICK monitoring framework helpfully elaborates how a combination of methods including manual content analyses, novel software, and apps can facilitate monitoring of food and brand marketing to children on digital media. One particular strength of the framework is its attempt to characterise targeted and personalised marketing to children, albeit primarily using more conventional approaches that catalogue what representative groups of children view in digital environments. Crucially, however, the CLICK framework does not encompass AI. This omission is important, as AI is currently the only feasible way of coping with the massive volume, variety, and dynamic nature of digital food and brand marketing. If we are to succeed in curtailing unhealthy food and brand marketing to children, the power of AI needs to be leveraged for research and monitoring purposes. AI can complement CLICK by providing a more comprehensive perspective of the frequency and nature of unhealthy food and brand marketing to children on digital media, and by enabling rapid detection of policy breaches that CLICK cannot uncover or might take substantially longer to uncover.

We therefore propose a seven-step process for an AI system to monitor unhealthy food and brand marketing to children on digital media (figure). Together with the WHO CLICK monitoring framework, AI can enable a comprehensive perspective of the digital food and brand marketing landscape that will inform policy development. Moreover, when used in combination, CLICK and AI can provide a robust basis to monitor compliance with policy and encourage industry adherence, thereby helping to ensure children receive maximum protection. In this way, AI is essential to enable children to participate in the digital world without negatively impacting their long-term health.

DLO and JL have a planned patent pertaining to one or more components of the AI system described in this Comment to monitor food and brand marketing, and declare funding from the Canadian Institutes of Health Research (FRN 165925; FRN 166212) and the New Frontiers in Research Fund (NFRFE-2018–00793).

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