

## Adolescent Nutrition 2



## Food choice in transition: adolescent autonomy, agency, and the food environment

Lynnette M Neufeld, Eduardo B Andrade, Ahna Ballonoff Suleiman, Mary Barker, Ty Beal, Lauren S Blum, Kathrin M Demmler, Surabhi Dogra, Polly Hardy-Johnson, Anwasha Lahiri, Nicole Larson, Christina A Roberto, Sonia Rodríguez-Ramírez, Vani Sethi, Teresa Shamah-Levy, Sofia Strömmer, Alison Tumilowicz, Susie Weller, Zhiyong Zou\*

Dietary intake during adolescence sets the foundation for a healthy life, but adolescents are diverse in their dietary patterns and in factors that influence food choice. More evidence to understand the key diet-related issues and the meaning and context of food choices for adolescents is needed to increase the potential for impactful actions. The aim of this second Series paper is to elevate the importance given to adolescent dietary intake and food choice, bringing a developmental perspective to inform policy and programmatic actions to improve diets. We describe patterns of dietary intake, then draw on existing literature to map how food choice can be influenced by unique features of adolescent development. Pooled qualitative data is then combined with evidence from the literature to explore ways in which adolescent development can interact with sociocultural context and the food environment to influence food choice. Irrespective of context, adolescents have a lot to say about why they eat what they eat, and insights into factors that might motivate them to change. Adolescents must be active partners in shaping local and global actions that support healthy eating patterns. Efforts to improve food environments and ultimately adolescent food choice should harness widely shared adolescent values beyond nutrition or health.

## Introduction

Nutrition is central to adolescent growth and the realisation of potential.<sup>1</sup> Recent calls to address malnutrition in all its forms among adolescents emphasise the importance of multisectoral approaches to improve diets,<sup>2</sup> but programmatic action to do so across most countries is woefully lagging. Adolescence is the time of transition from primary dependence on caregivers to increasingly diverse roles and responsibilities related to food acquisition, preparation, and consumption, presenting a unique opportunity to foster healthy eating. Yet adolescence is not universal in its nature or duration across sociocultural contexts.<sup>3</sup> To foster healthy eating during adolescence, an in-depth understanding of adolescent dietary intake and food choice across different contexts is essential.

These many contextual factors are depicted in this Series' conceptual framework,<sup>4</sup> including natural, social, cultural, political, and economic systems. For dietary intake and food choice, these factors manifest in the so-called food environment, defined as the point of interaction of consumers with the food system, where they make decisions about acquiring, preparing, and consuming food.<sup>5-8</sup> For the individual, this is captured in the experience of availability, affordability, desirability, and convenience of food.<sup>9</sup> Throughout the day and over time, adolescents might be exposed to varying food environments, including home, school, workplace, and formal and informal markets.

The aim of this paper is to elevate the importance given to adolescent dietary intake and food choice, bringing a developmental perspective to inform policy and programmatic actions to improve diets. In the first

section, we illustrate the importance of the issue by describing patterns of dietary intake among adolescents. In the second section, we draw on existing literature to map how food choice can be influenced by unique features of adolescent development. In the third section, we use pooled qualitative data combined with evidence from the literature to explore the ways in which adolescent development can interact with sociocultural context and the food environment to influence food choice, ending with a series of key considerations for policies, programmes, and further research.

## Current knowledge of dietary intake and pattern among adolescents

A 2019 review from Europe, the USA, Canada, Australia, and New Zealand found 13 surveillance systems of adolescent diets but identified serious limitations in data quality and comparability.<sup>10</sup> A 2018 systematic review of dietary intake among adolescent girls from low-income and middle-income countries (LMICs) also highlighted critical gaps in data and noted the absence of data for boys.<sup>11</sup> Here we explore three data sources to highlight current knowledge of dietary intake patterns. First, we present dietary data from adolescents in three countries, purposefully selected to permit comparisons over time and between countries (China and Mexico), and variability among subgroups within a country (India). Second, we use the Global School-based Student Health Surveys (GSHS) to illustrate patterns of consumption of select foods. Finally, we present a global map of dietary data availability, generated from a systematic review of scientific and grey literature

Published Online  
November 29, 2021  
[https://doi.org/10.1016/S0140-6736\(21\)01687-1](https://doi.org/10.1016/S0140-6736(21)01687-1)

This is the second in a **Series** of three papers on adolescent nutrition

\*All authors after the first author are listed in alphabetical order

Global Alliance for Improved Nutrition (GAIN), Geneva, Switzerland (L M Neufeld PhD); Brazilian School of Public and Business Administration (EBAPE), Getulio Vargas Foundation (FGV), Rio de Janeiro, Brazil (Prof E B Andrade PhD); Department of Public Health, California State University, Sacramento, CA, USA (A Ballonoff Suleiman DrPH); NIHR Southampton Biomedical Research Centre, University of Southampton, Southampton, UK (Prof M Barker PhD, S Strömmer PhD); MRC Lifecourse Epidemiology Centre, Southampton General Hospital, Southampton, UK (Prof M Barker, S Strömmer, P Hardy-Johnson PhD); School of Health Sciences, Faculty of Environmental and Life Sciences, University of Southampton, Southampton, UK (Prof M Barker); Global Alliance for Improved Nutrition, Washington, DC, USA (T Beal PhD, L S Blum PhD); Global Alliance for Improved Nutrition, London, UK (K M Demmler PhD); Lancet Standing Commission on Adolescent Health and Wellbeing, Noida, India (S Dogra MA); Institute of Economic Growth, New Delhi, India (A Lahiri MTech); Division of Epidemiology and Community Health, University of Minnesota School of Public Health, Minneapolis, MN, USA (N Larson PhD); Department of Medical Ethics & Health Policy, Perelman School of Medicine,

University of Pennsylvania,  
Philadelphia, PA, USA  
(C A Roberto PhD); National  
Institute of Public Health,  
Cuernavaca, Morelos, Mexico  
(S Rodríguez-Ramírez PhD,  
T Shamah-Levy PhD); UNICEF  
India, New Delhi, India  
(V Sethi PhD); Bill & Melinda  
Gates Foundation, Seattle, WA,  
USA (A Tumilowicz PhD); Clinical  
Ethics and Law at  
Southampton (CELS), Primary  
Care, Population Sciences and  
Medical Education, University  
of Southampton,  
Southampton General  
Hospital, Southampton, UK  
(S Weller PhD); Institute of Child  
and Adolescent Health, Peking  
University School of Public  
Health, Beijing, China  
(Z Zou MD); National Health  
Commission Key Laboratory of  
Reproductive Health, Beijing,  
China (Z Zou)

Correspondence to:  
Dr Lynnette M Neufeld, Global  
Alliance for Improved Nutrition,  
1202 Geneva, Switzerland  
lneufeld@gainhealth.org

### Key messages

- Evidence of dietary intake among adolescents remains insufficient for policy and programme decision making in many countries. Future data collection efforts should always include sex disaggregation, and disaggregation by socioeconomic status and area of residence (rural or urban), given persistent—and in some cases, increasing—inequalities in many countries.
- Adolescence is a unique life stage, one during which biological and social changes are rapid and profound, but highly variable by context. Programmes must be designed to this unique life stage and adjusted to the unique contextual features that drive dietary intake and food choice. They must have the potential to evolve in approaches over the trajectory from 10 to 24 years of age and account for the uniqueness of this trajectory across contexts.
- Adolescents have a lot to say about why they eat what they eat, and the factors that might motivate them to change. Adolescents must be active partners in shaping local and global actions that support healthy eating patterns. Efforts to improve food environments and ultimately adolescent food choice should harness widely shared adolescent values and desire for social interaction around food.
- The current tendency towards celebrity and social media influencers to advertise and promote nutrient-poor, energy-dense foods must be reversed through regulation of social media advertising and public pressure on celebrities.
- Autonomy and agency along with the stronger desire for uniqueness and belonging creates the circumstances that foster unhealthy diets in many modern and some mixed food environment contexts. Harnessing these factors to create a sense of urgency regarding the current state of food environments could be a needed trigger of change, but we must work with adolescents to do so—knowledge of the importance of healthy foods alone will not be that trigger.
- Adolescents living in poverty and food insecurity are keenly aware of the precarity of their individual, family, and perhaps community situations in relation to food. Many are active participants in food production, preparation, and income generation, in some settings in ways that put their health and wellbeing at risk. Concerted efforts are urgently needed to adapt social protection and income generation efforts for adolescents, with their input.
- Current food environments across contexts are not conducive to healthy food choice. In many contexts, nutrient-dense foods are insufficiently accessible whereas nutrient-poor, energy-dense foods are too readily available, inexpensive, and often socially alluring. While working on the regulatory and other actions to support sustainable change, a bottom-up approach is needed. Adolescents can be empowered with knowledge, skills, and motivation to navigate towards a healthy and socially appealing diet. Understanding of how to make nutritious foods more desirable is urgently needed.

concerning dietary intake among adolescent boys and girls (10–24 years of age) in all countries (249 countries and territories in total) and all languages, collected between January, 2010 and September, 2020. Further details of methodology and results for all three data sources are provided in the appendix (pp 1–9).

India's Comprehensive National Nutrition Survey<sup>12</sup> (cross-sectional survey from 2016 to 2018) assessed frequency of consumption of nine food groups for 35 824 boys and girls. Representative samples by sex, urban or rural residence, economic quintile, and state provide a level of granularity rarely available in surveys. A significantly higher proportion of adolescents in urban areas and with higher economic status reported regularly consuming nutrient-rich foods (eg, fruits or vegetables, dairy, meat or eggs), but also nutrient-poor, energy-dense foods (eg, sugar-sweetened beverages, fried foods, sweets) as compared with their rural and lower economic status counterparts (figure 1 and appendix p 2). Consumption patterns, however, are highly variable by state (figure 2 and appendix p 2). This illustrates the importance of subnational data for decision making, particularly for large countries with substantial regional diversity, like India.

Repeat cross-sectional data from China (8015 girls and boys, 1997–2011) and Mexico (18 121 girls and boys, 2006–18) were analysed for five common dietary

indicators: fruit and vegetable intake (>400 g daily), minimum dietary diversity (at least five food groups out of ten), animal-source foods (percentage of energy intake), ultra-processed foods (percentage of energy intake), and sugar-sweetened beverages (at least once per day). Significant positive time trends (eg, increased dietary diversity and fruit and vegetable intake) were found in China ( $p<0.01$ ) but not Mexico (figure 3). In Mexico, diets were already relatively diverse but also high in ultra-processed foods and sugar-sweetened beverages in 2006.

The GSHS currently provide the only methodologically comparable source of dietary intake data for adolescent boys and girls in LMICs. Using GSHS data, Beal and colleagues<sup>13</sup> previously highlighted several negative dietary patterns, such as low consumption of fruit and vegetables and high consumption of carbonated beverages. We re-analysed GSHS data from 72 countries to explore variability among and between countries and regions, and sex variability within countries. Results show substantial variability in consumption patterns among adolescents across and within world regions. Adolescents in only two countries (girls in Morocco in 2010 and in Vanuatu in 2011) came close on average to the often quoted five-a-day recommendation<sup>14</sup> for consumption of fruits and vegetables (appendix p 5).

See Online for appendix

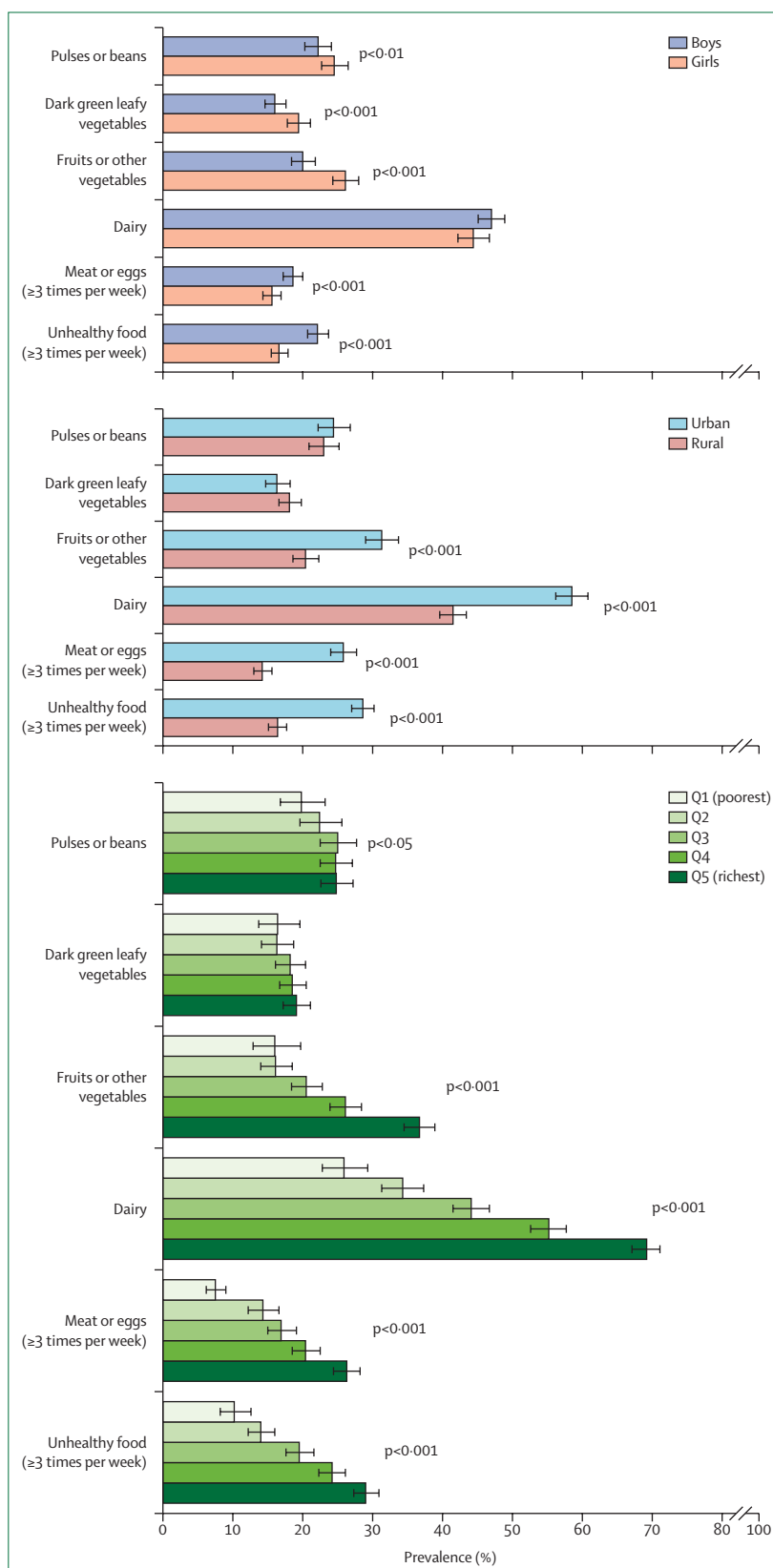
Conversely, adolescents in most countries are, on average, consuming carbonated beverages at least once a day (appendix p 6) and fast food at least once a week (appendix p 7). Sex differences within regions or economic classification were not statistically significantly different.

The systematic review revealed that some evidence on dietary patterns among adolescents is available for 154 (62%) of all 249 countries (figure 4). Only 28 countries (11%) have detailed food intake data at national or subnational level that would permit assessment of, for example, nutrient adequacy, analogous to the examples from China and Mexico (dark green on map). Almost half of these (46%) are high-income countries, and predominantly in the Americas (36%), Europe (29%), and Asia (29%). An additional 104 countries (42%) have nationally or subnationally available evidence but only for selected foods or food groups (light green on map), analogous to the GSHS data. Several countries had evidence from smaller studies for detailed food intake (eight countries [3%]; red on map), or only selected foods or food groups (14 countries [6%]; orange on map). Of the 717 papers identified, the majority (410 [57%]) present data that cannot be disaggregated by sex, five (1%) present data for boys only, and 45 (6%) present data for girls only.

In summary, nationally representative detailed dietary intake data are still scarce, particularly with the granularity necessary to characterise dietary patterns among subgroups (like in India), or over time (like in Mexico and China). The systematic review, however, revealed a surprising amount of extant dietary data that have not been fully analysed and synthesised in published form. Nevertheless, data are particularly scarce in some world regions, most notably Africa, and a substantial proportion of available data cannot be disaggregated by sex, something that urgently needs to be addressed. Such data generally do not provide insights into the proportion of adolescents choosing to adopt dietary patterns that might emphasise or exclude specific food groups (eg, vegan or vegetarian). Despite limitations, these data and the published evidence highlight the need to address diet quality among adolescents globally. To do so requires an understanding of the forces that influence adolescents' food choices.

### Food choice at the intersection of adolescent development, sociocultural context, and the food environment

Story and colleagues<sup>15,16</sup> explain adolescent dietary behaviours using a model drawing on social cognitive and ecological theory. Analogous to the conceptual framework of this Series,<sup>4</sup> food-related behaviour is



**Figure 1: Prevalence of intake at least once per day (except as indicated) of different food groups among Indian adolescents (2016–18)**

Error bars show 95% CIs. The p values are for differences between subgroups. Q=quintile.

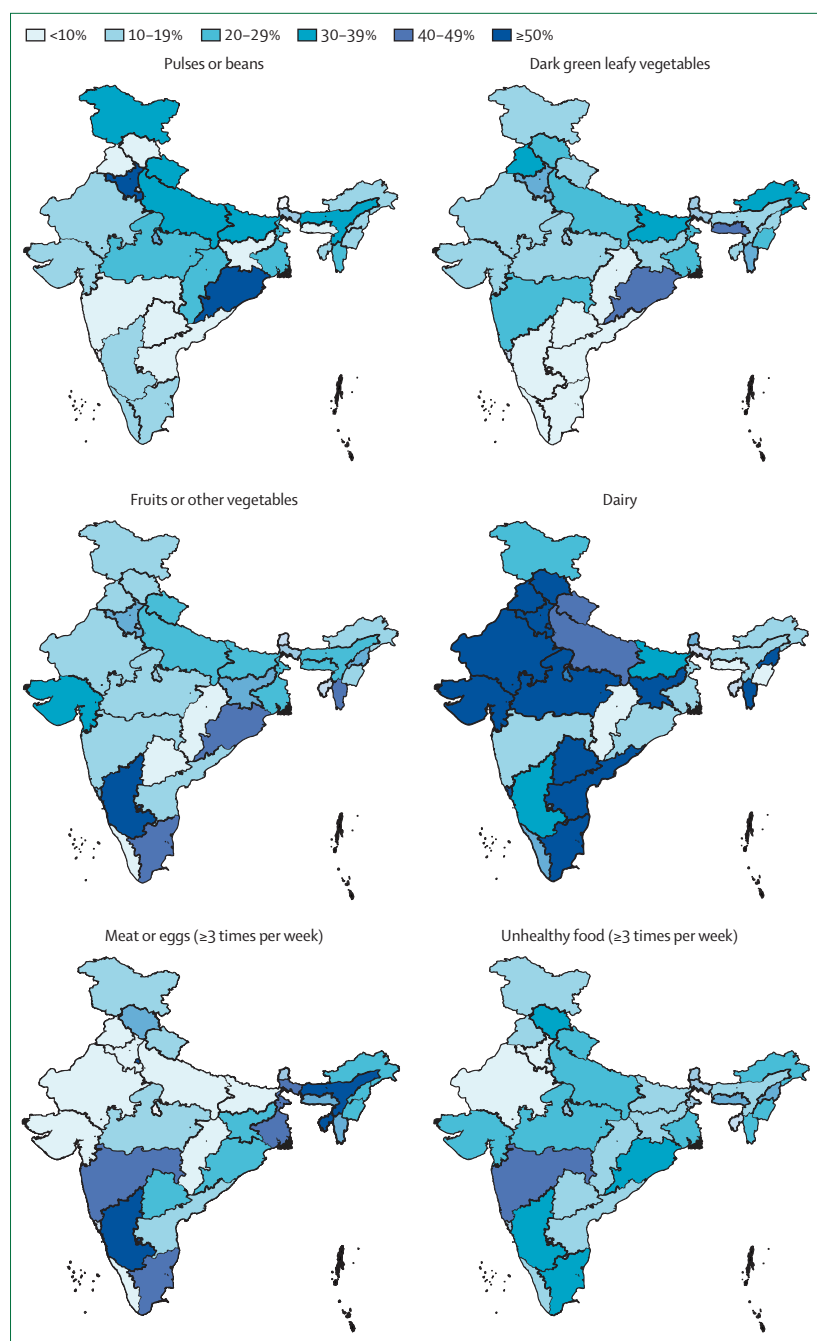


Figure 2: Prevalence of intake at least once per day (except as indicated) of different food groups among Indian adolescents (2016–18) by state

explained as a reciprocal interaction across four levels of factors: individual (psychosocial, neurodevelopmental, biological, lifestyle); social environmental (family, peers); physical environmental (community setting); and macro systems (eg, media and social or cultural norms). As adolescents age, their food-related behaviours shape and are shaped by the interaction among these factors.<sup>15</sup> The contexts in which adolescents live, however, are diverse

and highly dynamic, as is their level of autonomy and agency<sup>17</sup> and the process of identity development.<sup>18</sup> The framework developed by Story and colleagues draws mainly on data from the USA, and although the four levels are probably applicable across contexts, the balance and interaction among them at different points in the developmental trajectory and across cultural and social contexts is likely to be highly variable. Rights, roles, and responsibilities also transition markedly across the adolescent period,<sup>19,20</sup> and the trajectory of that transition differs among sociocultural contexts.<sup>21</sup> For example, timing of life events (eg, school completion, marriage, pregnancy) varies substantially across social and cultural contexts, profoundly affecting interactions with the food environment at varying ages and developmental stages. For some adolescents, rapid transitioning from childhood to adulthood expands their roles to being carers for younger siblings or elderly relatives, or to becoming a spouse or parent. This changes who purchases and prepares their food, when and with whom they eat, and what priority they are given in accessing nutritious foods;<sup>22,23</sup> in some contexts, these changes are determined by gender. Finally, several aspects of adolescent biological and social development can create unique opportunities and vulnerabilities related to food choice and influence longer-term eating habits and food preferences.

The onset of puberty initiates a concert of biological and neurodevelopmental transitions that can affect and be affected by nutrient intake and food choice. Rapid physical growth coupled with sexual maturation increases nutrient requirements, and whether these requirements are met affects biological development, growth, long-term health, and longevity.<sup>1,24,25</sup> Simultaneous neurodevelopmental changes influence motivations and behaviours, including dietary patterns. During adolescence, brain remodelling and increased testosterone are associated with heightened sensitivity to social evaluation and influence, increasing the desire for autonomy and motivation for risk-taking to gain social status and recognition.<sup>19,26,27</sup> Some studies suggest that reward processing systems, which are remodelled during the adolescent period, might become more sensitive to and increase the appeal of energy-dense foods.<sup>28,29</sup> Increased sensitivity to social evaluation and threats to social status, coupled with the development of physical secondary sex characteristics, contribute to new awareness of body image and might be accompanied by associated dietary changes.<sup>30</sup> This heightened identity and social sensitivity<sup>17</sup> can also lead to increased awareness of one's food habits and those of peers, family, and other social groups.<sup>31</sup> Neurodevelopmental changes motivate adolescents to seek not only autonomy<sup>32</sup> but also belonging, which might promote eating habits that differentiate from family and assimilate to valued social groups and norms. Adolescence presents unique opportunities to foster healthy food choice and the formation of longer-term healthy dietary habits.<sup>33</sup> Throughout the life course, the

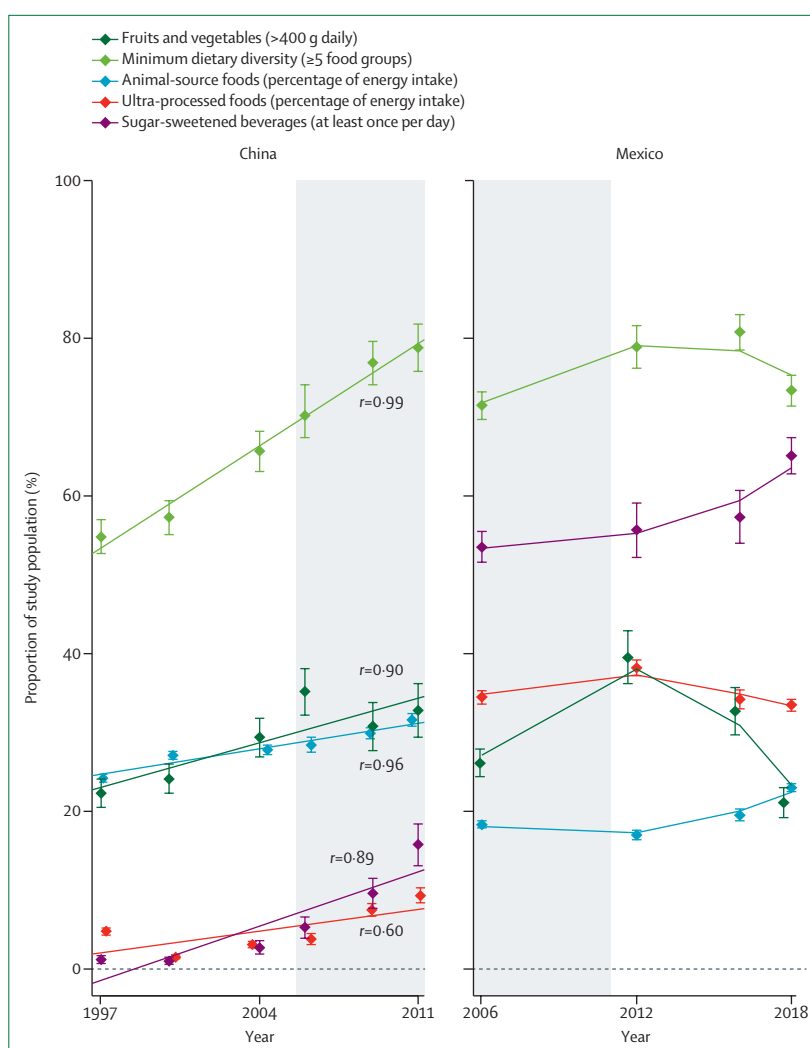
locus of control of many actions, including food-related behaviours, moves from full dependency on caregivers during infancy, to the individual and the family unit during adulthood. The process and timing of that transition depends on age, context, cultural and religious norms, and economic and other factors.<sup>21</sup> Similarly, the balance of individual versus collective (eg, family) considerations, including the fundamental meaning of autonomy, can vary across cultural contexts.<sup>34</sup> These unique features of adolescence and their interaction with contextual diversity have not been adequately studied, and raise questions on the role of autonomy and agency in food-related decisions across contexts. There is much discussion and debate in the literature about the meaning of autonomy and agency, a review of which is beyond the scope of this paper. For our purposes, we distinguish between the autonomy to make decisions (which requires economic and informational resources, mobility, and opportunity) and agency (which is the ability to act on such decisions);<sup>35,36</sup> both are explored in the following analysis.

### An exploration of influences on adolescent dietary intake and food choice

We explored influences on adolescent food choices using a pooled analysis of qualitative data from 11 studies with adolescents and adult informants from eight countries (Bangladesh, Côte d'Ivoire, England, Ethiopia, India, Indonesia, South Africa, and The Gambia). For each study we classified context as a traditional, mixed, or modern food environment based on the criteria of the High-Level Panel of Experts on Food Security and Nutrition<sup>8</sup> (for details, see appendix p 10 and pp 15–18). This was complemented by a literature search for publications (PubMed and grey literature with cross referencing) reporting adolescents' perspectives on their food choices (for search strategies see appendix p 22).

Studies in the pooled analysis varied in objectives and methods,<sup>37–40</sup> but all focused on speaking with adolescents and adult key informants about diet and food choice. Data were analysed using a novel breadth-and-depth method designed for large-scale qualitative data analysis<sup>41</sup> (for details, see appendix pp 10–12). This iterative process has four steps: (1) construction of a composite dataset; (2) using a computational text-mining tool to explore word frequencies, concordance, co-location, proximity, and salience (breadth); (3) preliminary analysis of a large volume of short data extracts with concepts identified in step 2 to explore how they address the research questions; and (4) detailed thematic analysis of the sampled data (depth).

Integrating results from the pooled analysis and published literature and building on the Series' conceptual framework,<sup>4</sup> figure 5 provides our interpretive summary of the evidence describing the interaction of adolescent autonomy, agency, and food environments on food choice. Although adolescents have autonomy and express agency across all food environments, their centrality to food choice



**Figure 3: Trends in the proportion of Chinese (n=8 015; age 10–19 years) and Mexican (n=18 121; age 12–19 years) adolescents consuming select dietary factors**  
Error bars show 95% CIs. China: bivariate linear regression. Mexico: smoothing splines.  $r$ =Pearson's correlation coefficient ( $p<0.01$ ). Shaded area represents overlapping years.

is much stronger in modern than traditional food environments. In the latter, there was a consistent narrative of family and community priorities often superseding individual considerations, which was absent in modern food environments. Second, although availability, affordability, and desirability of food emerged as drivers of adolescent choice in all three food environments, their relative importance varied. The concept of affordability also took on different meaning, reflecting value for money in modern food environments, rather than the explicit lack of financial resources to pay identified in traditional ones. Convenience was evident in the narrative of adolescents from modern and mixed food environments, and absent in traditional ones. Across all food environments, more than its healthiness or tastiness, food was valued for its role as part of sharing in social time with friends, and in some contexts, with families. Each country for which



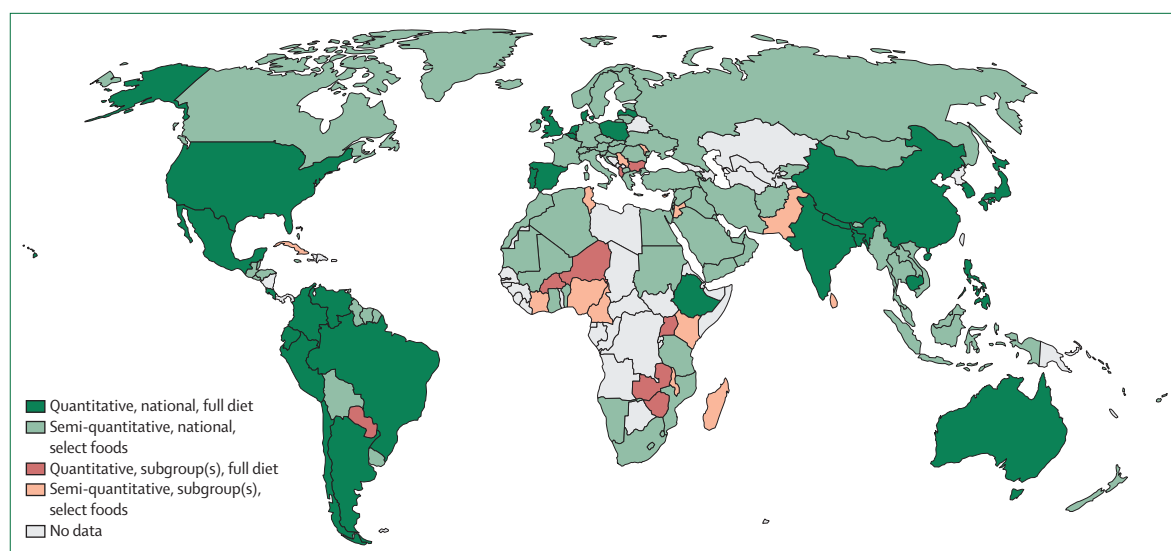


Figure 4: Availability of evidence regarding dietary intake

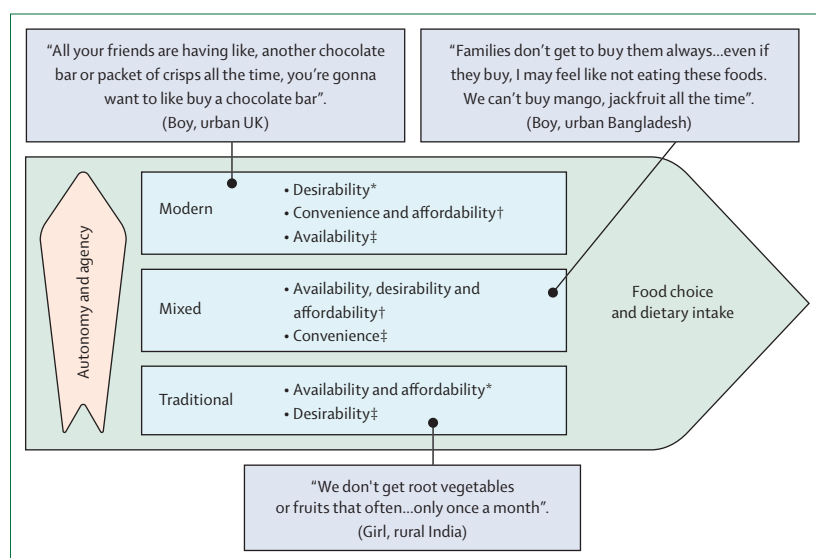


Figure 5: Interpretive summary of key findings from the pooled qualitative data and literature review of influences on food choice among adolescents

\*Higher reported importance. †Moderate reported importance. ‡Lower reported importance.

evidence was available had many unique features, but grouping sites by food environment, and drawing on published literature, illustrated common themes with important implications for policies and programmes to foster better diets among adolescents.

### Traditional food environments

*Adolescents living in poverty and food insecurity are keenly aware of the precarity of their individual, family, and perhaps community situations in relation to food*

The literature review yielded few studies from traditional food environments, all from contexts of extreme poverty

and from geographically isolated regions within each country. The discourse across all contexts (Ghana, Tanzania, Malawi;<sup>42</sup> Kenya;<sup>43</sup> Uganda<sup>44</sup>) focused on hunger and the intersection of food insecurity, climate, and coping strategies to mitigate hunger. Adolescents from the five countries lamented the lack of rain leading to poor harvests and elevated rates of livestock deaths. Coping strategies led to income-generating activities that put health and wellbeing in danger, including transactional sex reported by girls in Tanzania<sup>42</sup> and Kenya,<sup>43</sup> heavy labour among boys and girls in Uganda,<sup>44</sup> and selling alcohol in Kenya and Uganda. Abusing alcohol and other substances to suppress hunger was also reported.<sup>43,44</sup> A cohort study in Ethiopia presents a compelling narrative of how food insecurity drives many life decisions for adolescents, but also highlights the central role of community.<sup>45</sup>

Adolescents and adults in the traditional food environments from the pooled analysis also spoke about food as a basic need. They made a link between eating well and having a healthy body and mind and felt that both underweight and overweight were unhealthy. However, both adolescents and adults reported limited availability and affordability of healthy foods and, in some sites, felt that their food supplies were threatened by drought.

*Food choice is an expression of agency, exercised in moments of autonomy*

Adolescents in the pooled analysis described seeking places with friends between the supervised spaces of home and school. Adolescents often reported sharing food in these spaces and pooling money to purchase food outside of home or school. Girls described less freedom than boys, identifying earlier transition to adult roles

and, for some, early marriage. Even in the more resource-constrained environments, food was still one way in which adolescents exercised some autonomy (eg, by choosing not to consume the food, as reported by one participant in Abidjan, Côte d'Ivoire). In the five studies from the literature, more than individual autonomy, adolescents emphasised their critically important roles in the production, acquisition, and preparation of foods for themselves and their families.

#### *Implications for policy and programmes in traditional food environment contexts*

Evidence from traditional food environments that has captured adolescent voices describing why they eat what they do is scarce. Several published studies and our pooled analysis provide a strong and consistent picture of the profound effects of poverty, resulting in transition to adult roles at young ages. Community and household reliance on adolescents for income to purchase food is likely to be limiting their educational opportunities. Social protection that safeguards against food insecurity is vital and could be linked to age-appropriate and context-appropriate education opportunities for young people, including training in agriculture and other skills, and to employment opportunities. Programmes should engage adolescents as agents of change to overcome barriers to better diets, leveraging the social aspect of food sharing; the strength of family and community commitment expressed by many adolescents; and their critical roles in the production, acquisition, and preparation of food.

#### **Mixed food environments**

##### *Being healthy is desirable for adolescents but not a strong motivator of food choice*

In our pooled analysis, adolescents expressed concerns over food hygiene and the introduction of non-food items into food (eg, plastics) more than its nutrient content. Being underweight and overweight were both associated with poor health, but some girls from Bangladesh described being “fat” as healthier than thinness. By contrast, in previously published studies from Bangladesh,<sup>46</sup> Guatemala,<sup>47</sup> Morocco,<sup>48</sup> India,<sup>49</sup> and Iran<sup>50</sup> (as examples), adolescent girls reported reducing food intake as a result of heightened awareness of body image and a desire to control weight.

Disruption in meal patterns, particularly skipping meals, was a finding across the published studies reviewed from mixed food environments.<sup>46–48,50–53</sup> Many adults expressed concerns about a trend towards adolescents rejecting traditional, home-cooked foods, and favouring unhealthy snack foods, feeling that this indicated that adolescents did not understand the importance of a healthy diet. By contrast, many adolescents said they understood what healthy meant but did not find the idea of being healthy motivating in relation to food choice. Interestingly, in the published

literature, nearly all adolescents asked to delineate between healthy and unhealthy foods described foods consumed at home, typically including many more fruits and vegetables, as healthier. However, like our pooled analysis findings, such knowledge did not necessarily translate into consumption of healthier foods.<sup>54</sup> Socioeconomic disparity is still an important driver of access to nutritious food in mixed food environments (eg, India<sup>55</sup>).

##### *Consuming food with friends outside the home is part of a social ritual, brings a sense of belonging, and demonstrates agency and autonomy from one's family, by actively making food-related decisions*

In mixed as compared with traditional food environments, adolescents emphasised food's social significance more and mentioned food as a basic need less. Adolescents in the pooled analysis reported often choosing to spend the small amount of money they had on food and snacks, which, consistent with the published literature,<sup>46,47</sup> were widely available and cheap. Sharing food with friends was part of social occasions and reflected a growing sense of identity and autonomy. In the pooled analysis, girls from Jakarta reported using social media as a means to share information about “cool” hang-out places and where to find good food. Adults in that context expressed concern about new food outlets and unhealthy products that were packaged and priced to attract adolescents. In some settings, however, girls mentioned being denied opportunities to be out because it was culturally inappropriate and risked eliciting social disapproval.

Food becomes more imbued with social status in the literature describing mixed food environments. Qualitative evidence from Brazil and Ethiopia suggests that dietary variety serves both signalling and social integration purposes.<sup>56</sup> In India, non-traditional foods (eg, pizza) were considered prestigious,<sup>57</sup> and consuming them reflected adolescents' aspirations to advance themselves economically and be more modern than the previous generation.<sup>58</sup> The role that commercial advertising (traditional and social media) might play in this regard is not well studied outside of high-income countries. Food choices can help to fulfil adolescents' newfound autonomy and agency,<sup>51</sup> but also their desire for both uniqueness and belonging.<sup>59</sup> Several studies, however, highlighted that adolescents still value meals at home.<sup>46,50</sup> For example, in Iran, adolescents preferred eating home meals because of the “emotional atmosphere of eating with family members”, as well as the safety and security of ingredients.<sup>50</sup>

#### *Implications for policy and programmes in mixed food environment contexts*

Populations are highly diverse in mixed food environments, and in lower-income populations, adolescents' experience can be much like that of traditional food

environments. Our analysis, however, provides a consistent picture of food environments in transition, with increasing availability and affordability of nutrient-poor, energy-dense, and in some contexts, unsafe foods. Concerted efforts are needed to curb this tendency. The Brazilian National School Meals Program (PNAE), offering free healthy meals in public schools, illustrates how programmes can mitigate socioeconomic disparity in nutritious food access. At-school eating among adolescents attending PNAE-participating schools is significantly healthier (ie, associated with lower consumption of industrialised or ultra-processed salty foods and soft drinks) than at-school eating among their peers from non-PNAE-participating schools (eg, private schools).<sup>60</sup> Programmes must work with adolescents, recognising their autonomy and leveraging their agency to reverse the shift that has led to nutrient-poor, energy-dense foods embodying positive attributes. Many adolescents continue to value meals at home and empowering them with skills to make nutritious foods delicious and appealing can be a force for improving the quality of diets.

### Modern food environments

*Knowing what healthy food choices are does not necessarily lead to healthier choices*

In the single modern food environment site from the pooled analysis (England), adolescents described healthy foods as helping to maintain present and future health and supporting overall wellbeing. Salt and fat were discussed in relation to less healthy food, and protein and macronutrient balance in relation to healthy diets. Adults felt that adolescents knew they should eat healthy foods but did not behave accordingly, sometimes leading to conflicts about food. Some adolescents described trying to eat better (eg, more fruit and vegetables, fewer sweets, less fried fast food) but said that they faced temptation when people around them ate less healthy foods. The abundant literature on adolescent food choice in modern food environments similarly identifies some level of knowledge related to healthy foods, but also that this knowledge might not be an important driver of choice. In the pooled analysis, value for money was a primary reason for buying foods that adolescents acknowledged to be less healthy.

The literature and our pooled analysis illustrate that in modern food environments, adolescents have ample freedom and purchase some of their daily food (often a substantial proportion) in these unsupervised spaces. Gender did not notably determine freedoms or food choices. Evidence from the USA,<sup>61,62</sup> Canada,<sup>63</sup> Ireland,<sup>64</sup> England,<sup>65,66</sup> Australia,<sup>67</sup> and Spain<sup>68</sup> (as examples) suggests that the proximity to schools of shops and prepared food outlets selling relatively inexpensive nutrient-poor, energy-dense foods favours their regular consumption. Although some studies did not find associations between the proximity of unhealthy food environments to schools

and the dietary intake<sup>69</sup> or bodyweight<sup>70</sup> of adolescents, in several studies, adolescents themselves indicate that their choices are influenced by this proximity.<sup>67,71</sup>

### *Adolescent autonomy, agency, and the modern food environment together create circumstances that promote unhealthy diets*

Autonomy, common for most adolescents in most modern food environments, offers opportunities to express agency, but also facilitates a strong influence of peers, advertising, and promotion on food choices. Modern food environments have high levels of food advertising and promotion targeting adolescents,<sup>72,73</sup> and research has shown that exposure to advertising of nutrient-poor, energy-dense foods is linked to their preference.<sup>74–77</sup> Adolescents are exposed to food marketing through many avenues, including television, movies, videos, advergames, product placements, cross-promotions, product packaging, athlete and celebrity sponsorships, philanthropic food and beverage company donations, billboards, and social media.<sup>72,73,78,79</sup> The literature reveals evidence of socioeconomic targeting of youth-focused marketing of nutrient-poor, energy-dense foods, for example in Spain,<sup>68</sup> the UK,<sup>65</sup> and the USA.<sup>80</sup> The many diverse forms of social media<sup>81,82</sup> appeal to adolescents' growing desire for autonomy, social interaction, and identity exploration,<sup>78</sup> with both positive (eg, social connection), and negative (eg, cyberbullying) consequences.<sup>83–85</sup> For many adolescents, social media platforms provide parent-free zones for exploration.<sup>86</sup> Almost all (90%) of 16–24 year olds in the Organisation for Economic Co-operation and Development countries use social networks.<sup>87</sup> Use in LMICs is rapidly rising,<sup>88</sup> but is variable across socioeconomic groups and countries, with high usage in the Middle East and Latin America.<sup>88</sup> In our pooled analysis, social media use was ubiquitous in the modern food environment site, and essentially absent in traditional food environments.

Social media has created new youth-targeted advertising opportunities that go well beyond traditional media. Food companies pay for advertisements embedded in social media feeds that often include highly engaging and interactive content<sup>89</sup> and maintain free accounts that users can “friend” or “follow,” blurring the lines between advertising, entertainment, and social interaction.<sup>78,90</sup> Unprecedented data capture on youth engagement with brands is used to refine advertising techniques.<sup>78</sup> These techniques, and social media influencers (online personalities often paid to promote brands, including youth influencers on YouTube<sup>91</sup>) expose adolescents to marketing in covert ways.<sup>92–94</sup> One study suggests youth were more likely to like and share posts illustrating and promoting unhealthy foods than those promoting healthy foods.<sup>95</sup> However, a 2021 study identified vegan, homemade, clean, and plant-based as the words most commonly used to identify healthy food using data extracted from more than



2 million posts from 427936 unique users of a social media platform.<sup>96</sup> Vegan and vegetarian diets can put adolescents at higher risk of deficiency of several nutrients, if not carefully planned and monitored.<sup>97</sup> Social media and other forms of media could be leveraged to provide information needed to promote healthy eating generally, and nutritional adequacy for those who choose specific dietary patterns. Although examples are still few, the potential to promote healthy dietary patterns through social media is promising.<sup>98</sup> However, social media companies are self-regulated, and although some have made commitments to restrict advertising of alcohol, tobacco, or gambling, none restrict promotion of nutrient-poor, energy-dense food, and commitments to promote healthy foods and dietary patterns are lacking.<sup>99</sup>

Adolescents also directly influence each other via social media. Peer norms and judgment can be expressed quickly in quantifiable ways such as “likes,”<sup>100</sup> exploiting adolescents’ heightened social sensitivity.<sup>101</sup> Social media also creates increased opportunities to compare one’s own image to that of friends and celebrities, posing major risks for negative body image and eating concerns.<sup>102,103</sup> Cyberbullying is another worry.<sup>102</sup> Data from the USA, Iceland, Canada, and Australia show that weight is the number one perceived reason adolescents are bullied,<sup>104,105</sup> and evidence suggests a link between weight-based and appearance-based teasing and disordered eating.<sup>106,107</sup> Nevertheless, social media also offers opportunities for positive influences. For example, although, to our knowledge, it has not been evaluated for impact on eating and food choice, the body positivity movement on social media could help to mitigate the negative effects of weight and appearance pressures on self-esteem.<sup>108</sup> Social media can also be a platform to deliver positive messages, guidance, training, and peer support,<sup>109,110</sup> help with disease surveillance, and enhance health professionals’ ability to influence policy making.<sup>110</sup>

#### *Implications for policy and programmes in modern food environment contexts*

Given their autonomy and agency, there is great potential for adolescents to be active drivers of change in favour of better diets in modern food environments. However, efforts must be accompanied by strong regulation and its enforcement—including, but not limited to, foods sold in and around schools.<sup>111,112</sup> Regulation to restrict advertising and promotion of unhealthy foods on social media is urgently needed.<sup>110</sup> Further safeguards are needed among socioeconomically disadvantaged populations, among whom food insecurity persists even in modern food environments,<sup>113</sup> and for whom there is evidence of greater targeted unhealthy food marketing.<sup>90,114</sup> However, such social safety nets must be carefully designed to promote healthy eating and avoid increasing overweight and related health risks, as has been reported, for example, in adolescent recipients of the Supplemental Nutrition Assistance Program in the USA.<sup>115</sup>

## Conclusions

Dietary intake during adolescence sets the foundation for a healthy life, but adolescents are highly diverse in their dietary patterns, developmental trajectories, and in the factors that influence food choice. Contextual factors are central to food choice among adolescents, but even the interpretation of choice is highly contextual, with individual decisions inextricably linked to gendered roles and responsibilities in traditional food environments. Our findings reinforce the importance of food insecurity and the profound impact of poverty on adolescents. This situation is only being exacerbated by the COVID-19 pandemic. Early evidence suggests that more families are being pushed into food insecurity and shifting towards lower-cost, less nutritious non-perishable foods.<sup>116</sup> Even in less food-insecure contexts, social isolation is resulting in negative trends among some adolescents, such as reported weight gain, poor eating habits, and stress eating (eg, in Greece,<sup>117</sup> the USA,<sup>118</sup> and Italy<sup>119</sup>).

Regardless of context, our Series paper illustrates that adolescents are not just older children or younger adults; they are unique, with needs, risks, and opportunities related to dietary intake and food choice. To be effective, policy and programme actions must recognise the unique development trajectory, social and cultural context, and the nuanced set of roles and responsibilities that adolescents have in relation to food. Recognising adolescence as a unique life stage and designing programmes with the active input of adolescents to foster healthy dietary patterns and food choice is long overdue. One such approach in Bangladesh (the Bhalo Khabo Bhalo Thakbo campaign) has resulted in over 1 million adolescents pledging to use their pocket money to buy more nutritious food, and provides them with resources on how to do so (evaluation ongoing).

Profound change to dietary intake cannot be achieved without fundamental improvements to the food environment, implying change across all arcs of the conceptual framework<sup>4</sup> of this Series. While important evidence gaps remain, inaction is not an option. Combinations of regulatory (eg, regulation of social media, restrictions or bans on unhealthy foods in schools), and programmatic action are urgently needed. There is much room for improvement with regard to the adoption of and compliance with existing regulations, even in modern food environments. For example, Vandevijvere and colleagues<sup>114</sup> found that about 65% of foods advertised around schools in New Zealand did not comply with corresponding WHO criteria. Leveraging ongoing positive youth-generated social movements, such as climate change,<sup>120</sup> could help generate the much-needed sense of urgency regarding the current state of food environments. Interestingly, societal motives for food choice, such as the environment, were not mentioned in any of our pooled analysis sites. The

For Bhalo Khabo Bhalo Thakbo  
see <https://www.bhalokhabobhalothakbo.com/>

For the UN Food Systems Summit see <https://www.un.org/en/food-systems-summit>

environment or animal welfare concerns have been mentioned among motives for reducing animal-source food consumption or becoming vegetarian in Germany,<sup>121</sup> the USA,<sup>122</sup> Brazil,<sup>123</sup> Australia,<sup>124</sup> and New Zealand<sup>125</sup> (as examples, and reviewed by Sanchez-Sabate and colleagues<sup>121</sup>). Global efforts to transform food systems, such as the 2021 UN Food Systems Summit, and positioning healthy, sustainable diets as a right for children and adolescents<sup>126</sup> within such efforts could help build momentum in this regard; youth are actively engaged to make this happen.<sup>127</sup>

#### Contributors

LMN wrote the paper with substantial contributions from MB, PH-J, SS, SW (performed analysis and wrote the draft of the pooled qualitative analysis, and led Supplementary Annex 2); ABS (wrote the draft of the adolescent development section); CAR (wrote the draft of the literature review for modern food environments and shared in initial conceptualisation of the manuscript); AT (wrote the draft of the literature review for traditional and mixed food environments); TB (led Supplementary Annex 1); TB, AL, SR-R, TS-L, VS, ZZ (performed data analysis, prepared figures, and wrote the draft for the three-country case study of dietary intake); and KMD (led the systematic review of dietary evidence availability and prepared the map of results). All authors provided comments and suggestions to multiple versions of the manuscript and read and approved the final version. LMN holds final responsibility for its content.

#### Declaration of interests

MB reports grants from the UK Medical Research Council and grants from the UK National Institute for Health Research (NIHR), during the conduct of the study. All other authors declare no competing interests.

#### Acknowledgments

This work received funding support from Fondation Botnar and the Wellcome Trust. Neither organisation played any role in writing the manuscript or the decision to submit for publication. We gratefully acknowledge support from Mona Ghadirian, Heather Kelahan, and Jamie Marquis to the systematic review of dietary intake evidence. The data for the India case study were analysed from the Comprehensive National Nutrition Survey (CNNS) 2016–18, conducted under the leadership of the Ministry of Health and Family Welfare (MoHFW), Government of India, and Technical Advisory Committee designated by the MoHFW, in collaboration with UNICEF and the Population Council. The CNNS (a previous survey from which we extracted data for the India case study) was funded through a generous grant from the Aditya and Megha Mittal Foundation. The China National Nutrition Survey was supported by the National Natural Science Foundation of China (82073573). Mexico's National Survey of Health and Nutrition was funded by the Secretary of Health of Mexico through a grant to the National Institutes of Public Health, Mexico. We are grateful to the collaborators of the TALENT consortium for making their data available (details of the consortium in appendix). EACH-B is funded by the UK NIHR Programme Grants for Applied Research (RP-PG-0216-20004). The views expressed in this publication are those of the authors and not necessarily those of the NIHR or the Department of Health and Social Care. VS and AL note that the statements in this publication are the views of the authors and do not necessarily reflect the policies or views of UNICEF.

Editorial note: the *Lancet* Group takes a neutral position with respect to territorial claims in published maps and institutional affiliations.

#### References

- Norris SA, Frongillo EA, Black MM, et al. Nutrition in adolescent growth and development. *Lancet* 2021; published online Nov 29. [https://doi.org/10.1016/S0140-6736\(21\)01590-7](https://doi.org/10.1016/S0140-6736(21)01590-7)
- Clark H, Coll-Seck AM, Banerjee A, et al. A future for the world's children? A WHO-UNICEF-Lancet Commission. *Lancet* 2020; **395**: 605–58.
- Patton GC, Sawyer SM, Santelli JS, et al. Our future: a *Lancet* commission on adolescent health and wellbeing. *Lancet* 2016; **387**: 2423–78.
- Hargreaves D, Mates E, Menon P, et al. Strategies and interventions for healthy adolescent growth, nutrition, and development. *Lancet* 2021; published online Nov 29. [https://doi.org/10.1016/S0140-6736\(21\)01593-2](https://doi.org/10.1016/S0140-6736(21)01593-2).
- UNICEF, GAIN. Food systems for children and adolescents: working together to secure nutritious diets. Report of a global consultation co-hosted by UNICEF and GAIN. Florence: UNICEF, 2018.
- Turner C, Aggarwal A, Walls H, et al. Concepts and critical perspectives for food environment research: a global framework with implications for action in low- and middle-income countries. *Glob Food Secur* 2018; **18**: 93–101.
- Downs SM, Ahmed S, Fanzo J, Herforth A. Food environment typology: advancing an expanded definition, framework, and methodological approach for improved characterization of wild, cultivated, and built food environments toward sustainable diets. *Foods* 2020; **9**: 532.
- HLPE. Nutrition and food Systems. A report by the High-Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security. Rome: Food and Agriculture Organization of the United Nations, 2017.
- Herforth A, Ahmed S. The food environment, its effects on dietary consumption, and potential for measurement within agriculture-nutrition interventions. *Food Secur* 2015; **7**: 505–20.
- Tabacchi G, Garbagnati F, Wijnhoven TMA, et al. Dietary assessment methods in surveillance systems targeted to adolescents: a review of the literature. *Nutr Metab Cardiovasc Dis* 2019; **29**: 761–74.
- Keats EC, Rappaport AI, Shah S, Oh C, Jain R, Bhutta ZA. The dietary intake and practices of adolescent girls in low- and middle-income countries: a systematic review. *Nutrients* 2018; **10**: 1978.
- Ministry of Health and Family Welfare (MoHFW), Government of India, UNICEF, Population Council. Comprehensive National Nutrition Survey 2016–2018. New Delhi, 2019.
- Beal T, Morris SS, Tumilowicz A. Global patterns of adolescent fruit, vegetable, carbonated soft drink, and fast-food consumption: a meta-analysis of Global School-based Student Health Surveys. *Food Nutr Bull* 2019; **40**: 444–59.
- WHO. Fruit and vegetables for health: report of a Joint FAO/WHO Workshop, 1–3 September 2004, Kobe, Japan. World Health Organization, 2004.
- Story M, Neumark-Sztainer D, French S. Individual and environmental influences on adolescent eating behaviors. *J Am Diet Assoc* 2002; **102** (suppl): S40–51.
- Story M, Kaphingst KM, Robinson-O'Brien R, Glanz K. Creating healthy food and eating environments: policy and environmental approaches. *Annu Rev Public Health* 2008; **29**: 253–72.
- Pfeifer JH, Berkman ET. The development of self and identity in adolescence: neural evidence and implications for a value-based choice perspective on motivated behavior. *Child Dev Perspect* 2018; **12**: 158–64.
- Chandra-Mouli V, Plesons M, Adebayo E, et al. Implications of the global early adolescent study's formative research findings for action and for research. *J Adolesc Health* 2017; **61** (suppl): S5–9.
- Dahl RE, Allen NB, Wilbrecht L, Suleiman AB. Importance of investing in adolescence from a developmental science perspective. *Nature* 2018; **554**: 441–50.
- Crockett LJ, Crouter AC. Pathways through adolescence: Individual development in relation to social contexts. Hillsdale, NJ: Lawrence Erlbaum Associates, 1995.
- Schlegel A, Barry H 3rd. Adolescence: an anthropological inquiry. New York, NY: Free Press, 1991.
- Hadley DC, Lindstrom D, Tessema F, Belachew T. Gender bias in the food insecurity experience of Ethiopian adolescents. *Soc Sci Med* 1982 2008; **66**: 427.
- Aurino E. Do boys eat better than girls in India? Longitudinal evidence on dietary diversity and food consumption disparities among children and adolescents. *Econ Hum Biol* 2017; **25**: 99–111.
- Falconi A, Gemmill A, Dahl RE, Catalano R. Adolescent experience predicts longevity: evidence from historical epidemiology. *J Dev Orig Health Dis* 2014; **5**: 171–77.

- 25 Depauw E, Oxley D. Toddlers, teenagers, and terminal heights: the importance of puberty for male adult stature, Flanders, 1800–76. *Econ Hist Rev* 2019; 72: 925–52.
- 26 Peper JS, Koolschijn PCMP, Crone EA. Development of risk taking: contributions from adolescent testosterone and the orbito-frontal cortex. *J Cogn Neurosci* 2013; 25: 2141–50.
- 27 Cardoos SL, Ballonoff Suleiman A, Johnson M, van den Bos W, Hinshaw SP, Dahl RE. Social status strategy in early adolescent girls: testosterone and value-based decision making. *Psychoneuroendocrinology* 2017; 81: 14–21.
- 28 Galván A. The teenage brain: sensitivity to rewards. *Curr Dir Psychol Sci* 2013; 22: 88–93.
- 29 Hall KD, Ayuketah A, Brychta R, et al. Ultra-processed diets cause excess calorie intake and weight gain: an inpatient randomized controlled trial of ad libitum food intake. *Cell Metab* 2019; 30: 226.
- 30 Tremblay L, Lariviere M. The influence of puberty onset, body mass index, and pressure to be thin on disordered eating behaviors in children and adolescents. *Eat Behav* 2009; 10: 75–83.
- 31 Contento IR, Williams SS, Michela JL, Franklin AB. Understanding the food choice process of adolescents in the context of family and friends. *J Adolesc Health* 2006; 38: 575–82.
- 32 McElhaney KB, Allen JP, Stephenson JC, Hare AL. Attachment and autonomy during adolescence. In: Lerner RM, Steinberg L, eds. *Handbook of adolescent psychology*. Hoboken, NJ: John Wiley & Sons, 2009: 358–403.
- 33 Dahl RE. Adolescent brain development: a period of vulnerabilities and opportunities. Keynote address. *Ann N Y Acad Sci* 2004; 1021: 1–22.
- 34 Raman S, Srinivasan K, Kurpad A, Ritchie J, Razee H. “We have to ask and only then do”: unpacking agency and autonomy in women’s reproductive health in urban India. *Health Care Women Int* 2016; 37: 1119–37.
- 35 Herr RS. Agency without autonomy: valuational agency. *J Glob Ethics* 2010; 6: 239–54.
- 36 Anderson J. Autonomy, agency and the self. In: Fultner B, ed. *Jürgen Habermas: key concepts*. Durham: Acumen Publishing, 2011: 91–112.
- 37 Barker ME, Hardy-Johnson P, Weller S, et al. How do we improve adolescent diet and physical activity in India and sub-Saharan Africa? Findings from the Transforming Adolescent Lives through Nutrition (TALENT) consortium. *Public Health Nutr* 2020; 24: 5309–17.
- 38 Weller S, Hardy-Johnson P, Strommer S, et al. ‘I should be disease free, healthy and be happy in whatever I do’: a cross-country analysis of drivers of adolescent diet and physical activity in different low- and middle-income contexts. *Public Health Nutr* 2020; 24: 5238–48.
- 39 Blum LS, Mellisa A, Kurnia Sari E, et al. In-depth assessment of snacking behaviour in unmarried adolescent girls 16–19 years of age living in urban centres of Java, Indonesia. *Matern Child Nutr* 2019; 15: e12833.
- 40 Blum LS, Khan R, Sultana M, et al. Using a gender lens to understand eating behaviours of adolescent females living in low-income households in Bangladesh. *Matern Child Nutr* 2019; 15: e12841.
- 41 Davidson E, Edwards R, Jamieson L, Weller S. Big data, qualitative style: a breadth-and-depth method for working with large amounts of secondary qualitative data. *Qual Quant* 2019; 53: 363–76.
- 42 Hall BJ, Garabiles MR, de Hoop J, Pereira A, Prencipe L, Palermo TM. Perspectives of adolescent and young adults on poverty-related stressors: a qualitative study in Ghana, Malawi and Tanzania. *BMJ Open* 2019; 9: e027047.
- 43 World Food Programme. Formative research to inform adolescent programming in Kenya. Rome: World Food Programme, 2018.
- 44 World Food Programme. Formative research to inform adolescent programming in Uganda. Rome: World Food Programme, 2019.
- 45 Morrow V, Tafere Y, Chuta N, Zharkevich I. “I started working because I was hungry”: the consequences of food insecurity for children’s well-being in rural Ethiopia. *Soc Sci Med* 2017; 182: 1–9.
- 46 Lee J, Pelto GH, Habicht J-P, Bhuiyan MMI, S Jalal C. Identifying nutrition and health-relevant behaviors, beliefs, and values of school-going adolescent girls in rural Bangladesh: context for interventions. *Curr Dev Nutr* 2019; 3: nzz013.
- 47 Kurschner S, Madrigal L, Chacon V, Barnoya J, Rohloff P. Impact of school and work status on diet and physical activity in rural Guatemalan adolescent girls: a qualitative study. *Ann N Y Acad Sci* 2020; 1468: 16–24.
- 48 El-Ammari A, El Kazdough H, Bouftini S, El Fakir S, El Achhab Y. Social-ecological influences on unhealthy dietary behaviours among Moroccan adolescents: a mixed-methods study. *Public Health Nutr* 2020; 23: 996–1008.
- 49 Stigler MH, Arora M, Dhavan P, Shrivastav R, Reddy KS, Perry CL. Weight-related concerns and weight-control behaviors among overweight adolescents in Delhi, India: a cross-sectional study. *Int J Behav Nutr Phys Act* 2011; 8: 9.
- 50 Askari Majabadi H, Solhi M, Montazeri A, et al. Factors influencing fast-food consumption among adolescents in Tehran: a qualitative study. *Iran Red Crescent Med J* 2016; 18: e23890.
- 51 Brown C, Shaibu S, Maruapula S, Malet L, Compher C. Perceptions and attitudes towards food choice in adolescents in Gaborone, Botswana. *Appetite* 2015; 95: 29–35.
- 52 Kabir A, Miah S, Islam A. Factors influencing eating behavior and dietary intake among resident students in a public university in Bangladesh: a qualitative study. *PLoS One* 2018; 13: e0198801.
- 53 Banna JC, Buchthal OV, Delormier T, Creed-Kanashiro HM, Penny ME. Influences on eating: a qualitative study of adolescents in a periurban area in Lima, Peru. *BMC Public Health* 2016; 16: 40.
- 54 Swaminathan S, Thomas T, Kurpad AV, Vaz M. Perceptions of healthy eating: a qualitative study of school-going children in South India. *Health Educ J* 2009; 68: 94–110.
- 55 Vijayapushpam T, Menon KK, Raghunatha Rao D, Maria Antony G. A qualitative assessment of nutrition knowledge levels and dietary intake of schoolchildren in Hyderabad. *Public Health Nutr* 2003; 6: 683–88.
- 56 Weaver LJ, Tadesse Y, Stevenson EGJ, Hadley C. “I want variety!”: dietary variety as aesthetic pursuit, social signal, and nutritional vehicle in Brazil and Ethiopia. *Hum Organ* 2019; 78: 122–32.
- 57 Maxfield A, Patil S, Cunningham SA. Globalization and food prestige among Indian adolescents. *Ecol Food Nutr* 2016; 55: 341–64.
- 58 Harrell M, Medina J, Greene-Cramer B, Sharma SV, Arora M, Nazar G. Understanding eating behaviors of New Delhi’s youth. *J Appl Res Child* 2015; 6: 18.
- 59 Berger J. Identity signaling, social influence, and social contagion. In: Prinstein M, Dodge K, eds. *Understanding peer influence in children and adolescents*. New York, NY: The Guilford Press, 2008: 181–99.
- 60 Noll PRES, Noll M, de Abreu LC, Baracat EC, Silveira EA, Sorpreso ICE. Ultra-processed food consumption by Brazilian adolescents in cafeterias and school meals. *Sci Rep* 2019; 9: 7162.
- 61 Laska MN, Hearst MO, Forsyth A, Pasch KE, Lytle L. Neighbourhood food environments: are they associated with adolescent dietary intake, food purchases and weight status? *Public Health Nutr* 2010; 13: 1757–63.
- 62 Hearst MO, Pasch KE, Laska MN. Urban v. suburban perceptions of the neighbourhood food environment as correlates of adolescent food purchasing. *Public Health Nutr* 2012; 15: 299–306.
- 63 Sadler RC, Clark AF, Wilk P, O’Connor C, Gilliland JA. Using GPS and activity tracking to reveal the influence of adolescents’ food environment exposure on junk food purchasing. *Can J Public Health* 2016; 107 (suppl 1): 5346.
- 64 Kelly C, Callaghan M, Molcho M, Nic Gabhainn S, Alforque Thomas A. Food environments in and around post-primary schools in Ireland: associations with youth dietary habits. *Appetite* 2019; 132: 182–89.
- 65 Wills W, Danesi G, Kapetanaki AB, Hamilton L. Socio-economic factors, the food environment and lunchtime food purchasing by young people at secondary school. *Int J Environ Res Public Health* 2019; 16: 1605.
- 66 Palla L, Chapman A, Beh E, Pot G, Almiron-Roig E. Where do adolescents eat less-healthy foods? Correspondence analysis and logistic regression results from the UK National Diet and Nutrition Survey. *Nutrients* 2020; 12: 2235.
- 67 Ronto R, Carins J, Ball L, Pendergast D, Harris N. Adolescents’ views on high school food environments. *Health Promot J Austr* 2020; 32: 458–66.

- 68 Díez J, Cebrecos A, Rapela A, Borrell LN, Bilal U, Franco M. Socioeconomic inequalities in the retail food environment around schools in a southern European context. *Nutrients* 2019; **11**: 1511.
- 69 Gebremariam MK, Andersen LF, Bjelland M, et al. Does the school food environment influence the dietary behaviours of Norwegian 11-year-olds? The HEIA study. *Scand J Public Health* 2012; **40**: 491–97.
- 70 Green MA, Radley D, Lomax N, Morris MA, Griffiths C. Is adolescent body mass index and waist circumference associated with the food environments surrounding schools and homes? A longitudinal analysis. *BMC Public Health* 2018; **18**: 482.
- 71 Gangemi K, Dupuis R, FitzGerald E, Frasso R, Solomon S, Cannuscio CC. Youth speak out on school food environments. *J Sch Nurs* 2020; **36**: 193–202.
- 72 Harris JL, Pomeranz JL, Lobstein T, Brownell KD. A crisis in the marketplace: how food marketing contributes to childhood obesity and what can be done. *Annu Rev Public Health* 2009; **30**: 211–25.
- 73 Powell LM, Harris JL, Fox T. Food marketing expenditures aimed at youth: putting the numbers in context. *Am J Prev Med* 2013; **45**: 453–61.
- 74 Sadeghirad B, Duhaney T, Motaghipisheh S, Campbell NRC, Johnston BC. Influence of unhealthy food and beverage marketing on children's dietary intake and preference: a systematic review and meta-analysis of randomized trials. *Obes Rev* 2016; **17**: 945–59.
- 75 Harris JL, Bargh JA, Brownell KD. Priming effects of television food advertising on eating behavior. *Health Psychol* 2009; **28**: 404–13.
- 76 McClure AC, Tanski SE, Gilbert-Diamond D, et al. Receptivity to television fast-food restaurant marketing and obesity among U.S. youth. *Am J Prev Med* 2013; **45**: 560–68.
- 77 Scully M, Wakefield M, Niven P, et al. Association between food marketing exposure and adolescents' food choices and eating behaviors. *Appetite* 2012; **58**: 1–5.
- 78 Montgomery KC, Chester J, Grier SA, Dorfman L. The new threat of digital marketing. *Pediatr Clin North Am* 2012; **59**: 659–75, viii.
- 79 Bragg MA, Roberto CA, Harris JL, Brownell KD, Elbel B. Marketing food and beverages to youth through sports. *J Adolesc Health* 2018; **62**: 5–13.
- 80 Allcott H, Diamond R, Dubé J-P, Handbury J, Rahkovsky I, Schnell M. Food deserts and the causes of nutritional inequality. *Q J Econ* 2019; **134**: 1793–844.
- 81 Capurro D, Cole K, Echavarría MI, Joe J, Neogi T, Turner AM. The use of social networking sites for public health practice and research: a systematic review. *J Med Internet Res* 2014; **16**: e79.
- 82 Hagg E, Dahinten VS, Currie LM. The emerging use of social media for health-related purposes in low and middle-income countries: a scoping review. *Int J Med Inform* 2018; **115**: 92–105.
- 83 Aboujaoude E, Savage MW, Starcevic V, Salame WO. Cyberbullying: review of an old problem gone viral. *J Adolesc Health* 2015; **57**: 10–18.
- 84 O'Keeffe GS, Clarke-Pearson K. The impact of social media on children, adolescents, and families. *Pediatrics* 2011; **127**: 800–04.
- 85 Starcevic V, Aboujaoude E. Cyberchondria, cyberbullying, cybersuicide, cybersex: "new" psychopathologies for the 21st century? *World Psychiatry* 2015; **14**: 97–100.
- 86 Anderson L, McCabe DB. A co-constructed world: adolescent self-socialization on the internet. *J Public Policy Mark* 2012; **31**: 240–53.
- 87 Ortiz-Ospina E. The rise of social media. Our World in Data. Sept 18, 2019. <https://ourworldindata.org/rise-of-social-media> (accessed July 30, 2020).
- 88 Poushter J, Bishop C, Chwe H. Social media use continues to rise in developing countries, but plateaus across developed ones. Washington, DC: Pew Research Center, 2018.
- 89 Freeman B, Kelly B, Baur L, et al. Digital junk: food and beverage marketing on Facebook. *Am J Public Health* 2014; **104**: e56–64.
- 90 Fleming-Milici F, Harris JL. Adolescents' engagement with unhealthy food and beverage brands on social media. *Appetite* 2020; **146**: 104501.
- 91 Alruwaily A, Mangold C, Greene T, et al. Child social media influencers and unhealthy food product placement. *Pediatrics* 2020; **146**: e20194057.
- 92 Lou C, Yuan S. Influencer marketing: how message value and credibility affect consumer trust of branded content on social media. *J Interact Advert* 2019; **19**: 58–73.
- 93 Qutteina Y, De Backer C, Smits T. Media food marketing and eating outcomes among pre-adolescents and adolescents: a systematic review and meta-analysis. *Obes Rev* 2019; **20**: 1708–19.
- 94 Smit CR, Buijs L, van Woudenberg TJ, Bevelander KE, Buijzen M. The impact of social media influencers on children's dietary behaviors. *Front Psychol* 2020; **10**: 2975.
- 95 Murphy G, Corcoran C, Tatlow-Golden M, Boyland E, Rooney B. See, like, share, remember: adolescents' responses to unhealthy-, healthy- and non-food advertising in social media. *Int J Environ Res Public Health* 2020; **17**: 2181.
- 96 Pilař L, Stanislavská LK, Kvasnička R, Hartman R, Tichá I. Healthy food on Instagram social network: vegan, homemade and clean eating. *Nutrients* 2021; **13**: 1991.
- 97 Rudloff S, Bührer C, Jochum F, et al. Vegetarian diets in childhood and adolescence: position paper of the nutrition committee, German Society for Paediatric and Adolescent Medicine (DGKJ). *Mol Cell Pediatr* 2019; **6**: 4.
- 98 Folkvord F, Hermans RCJ. Food marketing in an obesogenic environment: a narrative overview of the potential of healthy food promotion to children and adults. *Curr Addict Rep* 2020; **7**: 431–36.
- 99 Sacks G, Looi ESY. The advertising policies of major social media platforms overlook the imperative to restrict the exposure of children and adolescents to the promotion of unhealthy foods and beverages. *Int J Environ Res Public Health* 2020; **17**: 4172.
- 100 Sherman LE, Greenfield PM, Hernandez LM, Dapretto M. Peer influence via Instagram: effects on brain and behavior in adolescence and young adulthood. *Child Dev* 2018; **89**: 37–47.
- 101 Somerville LH. Special issue on the teenage brain: sensitivity to social evaluation. *Curr Dir Psychol Sci* 2013; **22**: 121–27.
- 102 Richards D, Caldwell PH, Go H. Impact of social media on the health of children and young people. *J Paediatr Child Health* 2015; **51**: 1152–57.
- 103 Tiggemann M, Slater A. NetGirls: the Internet, Facebook, and body image concern in adolescent girls. *Int J Eat Disord* 2013; **46**: 630–33.
- 104 Puhl RM, Luedicke J, Heuer C. Weight-based victimization toward overweight adolescents: observations and reactions of peers. *J Sch Health* 2011; **81**: 696–703.
- 105 Puhl RM, Latner JD, O'Brien K, Luedicke J, Forhan M, Danielsdottir S. Cross-national perspectives about weight-based bullying in youth: nature, extent and remedies. *Pediatr Obes* 2016; **11**: 241–50.
- 106 Haines J, Neumark-Sztainer D, Eisenberg ME, Hannan PJ. Weight teasing and disordered eating behaviors in adolescents: longitudinal findings from Project EAT (Eating Among Teens). *Pediatrics* 2006; **117**: e209–15.
- 107 Menzel JE, Schaefer LM, Burke NL, Mayhew LL, Brannick MT, Thompson JK. Appearance-related teasing, body dissatisfaction, and disordered eating: a meta-analysis. *Body Image* 2010; **7**: 261–70.
- 108 Davies B, Turner M, Udell J. Add a comment ... how fitspiration and body positive captions attached to social media images influence the mood and body esteem of young female Instagram users. *Body Image* 2020; **33**: 101–05.
- 109 Korda H, Itani Z. Harnessing social media for health promotion and behavior change. *Health Promot Pract* 2013; **14**: 15–23.
- 110 Islam SMS, Tabassum R, Liu Y, et al. The role of social media in preventing and managing non-communicable diseases in low-and-middle income countries: hope or hype? *Health Policy Technol* 2019; **8**: 96–101.
- 111 Kenney EL, Barrett JL, Bleich SN, Ward ZJ, Cradock AL, Gortmaker SL. Impact of the healthy, hunger-free kids act on obesity trends. *Health Aff (Millwood)* 2020; **39**: 1122–29.
- 112 Andretti B, Goldszmidt RB, Andrade EB. How changes in menu quality associate with subsequent expenditure on (un)healthy foods and beverages in school cafeterias: a three-year longitudinal study. *Prev Med* 2021; **146**: 106456.
- 113 Coleman-Jensen A, Rabbitt MP, Gregory CA, Singh A. Household food security in the United States in 2019, ERR-275. US Department of Agriculture, Economic Research Service, 2020.
- 114 Vandevijvere S, Molloy J, Hassen de Medeiros N, Swinburn B. Unhealthy food marketing around New Zealand schools: a national study. *Int J Public Health* 2018; **63**: 1099–107.



- 115 Lee AM, Scharf RJ, Filipp SL, Gurka MJ, DeBoer MD. Food insecurity is associated with prediabetes risk among U.S. adolescents, NHANES 2003–2014. *Metab Syndr Relat Disord* 2019; **17**: 347–54.
- 116 Adams EL, Caccavale LJ, Smith D, Bean MK. Food insecurity, the home food environment, and parent feeding practices in the era of COVID-19. *Obesity (Silver Spring)* 2020; **28**: 2056–63.
- 117 Androutsos O, Perperidi M, Georgiou C, Chouliaras G. Lifestyle changes and determinants of children's and adolescents' body weight increase during the first COVID-19 lockdown in Greece: the COV-EAT study. *Nutrients* 2021; **13**: 930.
- 118 Powell PK, Lawler S, Durham J, Cullerton K. The food choices of US university students during COVID-19. *Appetite* 2021; **161**: 105130.
- 119 Orben A, Tomova L, Blakemore S-J. The effects of social deprivation on adolescent development and mental health. *Lancet Child Adolesc Health* 2020; **4**: 634–40.
- 120 Boulianne S, Lalancette M, Ilkiw D. "School Strike 4 Climate": social media and the international youth protest on climate change. *Media Commun* 2020; **8**: 208–18.
- 121 Sanchez-Sabate R, Sabaté J. Consumer attitudes towards environmental concerns of meat consumption: a systematic review. *Int J Environ Res Public Health* 2019; **16**: 1220.
- 122 Neff RA, Edwards D, Palmer A, Ramsing R, Righter A, Wolfson J. Reducing meat consumption in the USA: a nationally representative survey of attitudes and behaviours. *Public Health Nutr* 2018; **21**: 1835–44.
- 123 Hargreaves SM, Nakano EY, Zandonadi RP. Brazilian vegetarian population—influence of type of diet, motivation and sociodemographic variables on quality of life measured by specific tool (VEGQOL). *Nutrients* 2020; **12**: 1406.
- 124 Trethewey E, Jackson M. Values and cognitive mechanisms: comparing the predictive factors of Australian meat intake. *Appetite* 2019; **142**: 104386.
- 125 Kemper JA, White SK. Young adults' experiences with flexitarianism: the 4Cs. *Appetite* 2021; **160**: 105073.
- 126 EAT, UNICEF. Diets of children and adolescents: unlocking current and future gains for human and planetary health. 2020.
- 127 UN Food Systems Summit. Youth movement leads the charge worldwide for food systems transformation ahead of UN summit. <https://www.un.org/en/food-systems-summit/press/youth-movement-leads-charge-worldwide-food-systems-transformation-ahead-un> (accessed April 10, 2021).

Copyright © 2021 Elsevier Ltd. All rights reserved.