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Commentary on South Africa's syndemic of undernutrition, obesity, and climate change

Significance:

The 2019 Lancet Commission on Obesity describes the clustering of three global problems – undernutrition, obesity, and climate change – as the Global Syndemic. The syndemic holds major health and economic consequences for South African individuals, their families and society as a whole. In this Commentary, we discuss how the syndemic presents itself in South Africa, how it arises in the context of the broader food system, and what can be done about it.

What is the problem?

Malnutrition in all forms continues to be the most preventable cause of ill health globally. The *2018 Global Nutrition Report* shows that 88% of countries (124 out of 141) had a double burden of malnutrition (i.e. the co-occurrence of two of the three main forms of malnutrition: overnutrition, undernutrition, micronutrient deficiency) and 29% (41 countries) faced a triple burden of malnutrition.[1]

This compounding burden is concentrated in low- and middle-income countries (LMICs)[2] that are experiencing rapid urbanisation and a shift towards consumption of ultra-processed food and beverage products[3]. This nutrition transition coincides with an increase in motorised transportation and contributes to the growing prevalence of obesity[4], as well as increases in greenhouse gas (GHG) emissions fuelling climate change[5]. While LMICs produce the fewest GHG emissions[6], they are disproportionally affected by the negative impact of climate change on food production and the productivity of croplands that further constrains their already low levels of nutrition and food security and consequent high rates of malnutrition[7].

In 2019, The Lancet Commission on Obesity described the clustering of three global problems – undernutrition, obesity, and climate change – as the Global Syndemic.[8] In contrast to previously siloed perceptions of undernutrition, obesity, and climate change, the Global Syndemic model calls for a systemic understanding of these problems that co-exist in time and place, actively interact with each other, and have common underlying societal drivers. Using a systems approach has been recognised as helpful when looking at addressing the intersection of these challenges. The food system is a main factor which underpins the interaction of undernutrition, obesity, and climate change, and alone contributes to one third of anthropogenic GHG emissions.[9] It gathers all the elements and activities that relate to land use for agriculture, production, processing, distribution, and waste management around food (summarised as the food supply chain, food environment, and consumer behaviour).[10] While food systems are the backbone of human health, the currently 'broken' global food system is costing us not only a healthy environment, but also healthy and productive years of our lives.

The syndemic holds major health and economic consequences for individuals, their families and society. In South Africa, the combined cost of undernutrition (ZAR62 billion per year)[11] and obesity (ZAR33 million per year)[12] is ZAR62 330 million per annum while climate change modelling shows that the effect of rising temperatures on labour availability and productivity will cost up to 20% of per capita GDP[13].

The 2020 Economic and Recovery Plan for South Africa provides a summary of the multiple socio-economic challenges that the country faces. These include gender inequality, a high unemployment rate, widespread poverty, declining economic growth and declining investment.[14] These challenges are further compounded by a debt burden that sits around 80% of the country's GDP.[14] Resources are clearly limited, hence, addressing the intertwined issues presented by the syndemic requires common strategies.

This Commentary focuses on how the Global Syndemic manifests in South Africa, and on one of its major common drivers, the food system.

Manifestation of the syndemic

Food and nutrition insecurity are serious challenges and the natural environment in the context of climate change is a significant contributor.[15] South Africa is experiencing comparatively more severe impacts than average in terms of temperature and rainfall variability.[16] There has also been increasing drought, flooding, and changes in the timing of the rainy season.[17] Agriculture contributes around 2.5% to South Africa's GDP[18], but it utilises around 6% of the total labour force – a significant labour market in a country with high rates of unemployment[19].

Despite well-developed agricultural, food and nutrition policies, in 2019 around 10 million South Africans (17.3%) were affected by food insecurity. This figure worsened to around 1 in 5 (23.6%) due to COVID-19 and its impact on the food system.[20] Food and nutrition insecurity manifests in the high levels of the triple burden of malnutrition. With 68% prevalence of overweight and obesity in adult women, 31% in adult men, and 13% in children[21], South Africa has the highest obesity prevalence in sub-Saharan Africa[22]. Obesity and overweight occur simultaneously with high rates of stunting among children under 5 (27%)[21], and even within the same households. At least one obese adult was found in 45% of households with stunted children.[23] Regarding micronutrients, 40% of children under 5 have zinc deficiency and 44% have vitamin A deficiency. Iron deficiency affects 61% of children and 31% of adult women.[24]

Climate change related crop failure and loss of livestock is anticipated to lead to food shortages, and a consequent increase in food prices, which will perpetuate high rates of the triple burden of malnutrition.[25]

Why is this happening?

To understand the key drivers of the syndemic and their interaction, we conceptualised a model (Figure 1) using Downs et al.'s[26] food environment typology. Figure 1 summarises the interaction between the elements in the food environment typology and climate change, and provides an opportunity to identify entry points for action. In this section we unpack Figure 1 by discussing how the issue of poor nutrition is driven by diet, how diet is influenced by the food environment, how the food environment subsequently forms part of and is influenced by the food system, and how the food system and climate change have a bi-directional impact on one another.

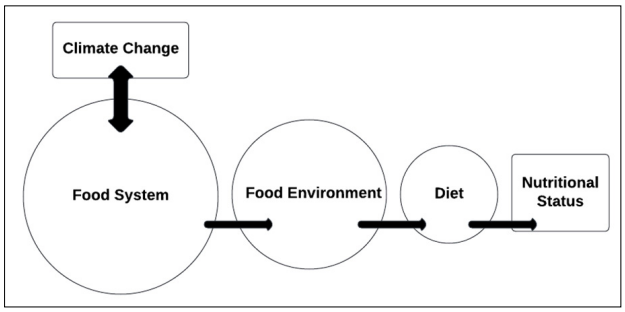

Figure 1: Conceptual model of the food environment typology and its elements driving the syndemic.

Nutritional status is determined by diet

South African diets are characterised by high fat and sugar intakes, with 40% of children in Grades 8–11 regularly consuming food high in fat (cakes, biscuits) and 50% consuming sugary beverages.[23] One quarter of South Africans' dietary intake consists of sugar, alcohol or fat.[27] The mean per capita sugar and salt intake exceeds the amount recommended by the World Health Organization, while the reverse is true for fruit and vegetable intake.[28] Furthermore, in 2017, 36% of households were categorised as having a low dietary diversity score with 60% in rural areas and 47% in urban slums.[29]

Diet is determined by food environment

How people make decisions about which foods to acquire, prepare and consume is determined by the food environment[26], which at its core is the physical, socio-cultural, economic, and political context in which individuals engage with the food system[30]. In other words, what people eat is dependent on what food is affordable, accessible, available, and desirable. These elements of the food environment are discussed in the sections below.

Price

One key driver of dietary patterns is the price of healthy foods compared to highly processed foods.[31] South Africans have been facing a worsening food environment and compromised purchasing power for healthier diets, which cost almost 70% more than less healthy alternatives.[32] In turn, a lower than recommended consumption of fruits and vegetables is partly explained by their high cost, which has risen more rapidly than that of other foods.[33] The Pietermaritzburg Economic Justice and Dignity Group's Household Affordability Index study (2021) showed how the cost of a basic nutritional food basket for a lower-income family increased by around 7% from September 2020 to August 2021.[33] This period coincides with a three-year drought in South Africa as well as the COVID-19 pandemic – potential reasons for disruptions to food production and consequent price increase.

Availability

Unhealthy dietary patterns of high intake of fat, sugar and salt are also influenced by the proximity to and the number or fast-food outlets. A 2016 study found that in Gauteng, South Africa's most densely populated province, fast-food outlets (n=1559) vastly outnumbered their healthier counterparts, formal grocery stores (n=709).[34] Furthermore, the distribution of food availability followed a social gradient, where grocery stores were predominantly available in higher socio-economic areas, while fast-food outlets were concentrated in areas with lower- to middle-income and predominantly black South African communities. A similar trend was reported for Cape Town.[35]

Manufactured demand

Food marketing has been shown to be a major influence on food attitudes, choices and literacy without cognitive effort or awareness.[36] Food marketing also socialises consumers to form emotional connections with food or develop consumption behaviour outside of traditional meal times.[37] Evidence suggests that industry practices (including food placement on shelves)[38,39] and in-store location marketing[39], subconsciously skews consumer choices towards less nutritious food options[40]. This phenomenon has been well documented and shown to form lifelong consumer behaviours, particularly among children who are the most vulnerable to persuasive messaging.[41] Unhealthy food marketing in South Africa has also been observed at alarming rates in settings where children gather, such as schools.[42] This has been observed even where the food and beverage industry actors have made public pledges to desist from such practices.[42,43] Child directed marketing of unhealthy foods and beverages, in violation of South African law regulating fair marketing practices in relation to infant and young child food products, is another example of concerning marketing practices.[44,45] Beyond children, marketing of unhealthy food and beverages have also been shown to target vulnerable socio-economic classes. For example, a study reporting on marketing practices found that food producers target advertisements of starchy food to poorer black South Africans.[46]

The food environment is determined by the food system

The choices that consumers make about food in their environment is dependent on the food systems that create these environments (Figure 1). Globally, and in South Africa, the food system (which is made up of the food environment, food supply chain and consumer behaviour) has been designed for two main purposes: to feed (but not necessarily nourish) people who can afford it, and to provide profits for those involved in food provision.[47] This makes our food system fundamentally an economic model, with inadequate focus on strengthening the other two key dimensions – social and environmental – of sustainable development. This is despite South Africa's commitment to the United Nation's 2030 Agenda for Sustainable Development and the associated Sustainable Development Goals (SDGs) including goals to end all forms of hunger and malnutrition (SDG 2), create responsible frameworks for the consumption and production of food (SDG 12), and address climate change (SDG 13).[48] While SDG 2 and SDG 13 address issues relating to the syndemic, SDG 12 specifically mentions the issues of wastage in the food system and encourages transitions towards more sustainable food systems.[49]

Food system is determined by and contributes to climate change

The bi-directional relationship between the food system and climate change in Figure 1 relates to two key elements in the food system, the food supply chain and underlying consumer behaviour. A helpful start in explaining how consumer behaviour influences the climate is Bennett's Law in agricultural economics, which states that "as people become wealthier, they switch from simple starchy plant-dominated diets to a more varied food input that includes a range of vegetables, fruit, dairy products, and especially meat"[50]. The consumer-driven diversification of food supply, a trend well documented in developing countries[51], requires more resources to produce, with negative consequences on the environment and climate. These consequences include the loss of natural ecosystems due to increased demand for land conversion for agricultural production[52], and twice as much carbon emissions from meat production than that of vegetables[53,54]. While consumer behaviour has a clear impact on the environment, the reverse is also true. Climate change influences consumer behaviour as it decreases the potential kilocalorie production and hence the quantity of food available and ultimately consumer choice.[55]

Further, climate change-induced decrease in crop yields across the globe influences food supply chains, forcing nations to retain food production and production capabilities for regional purposes.[56] While South Africa is a net exporter of agricultural products, it is dependent on the imports of inputs (such as fertiliser and plant-protection chemicals) required to produce this surplus that is exported.[57] As such, the indirect impact of climate change on the international food supply impacts South Africa.

Food systems are affected by changes in agricultural practices, forced migration due to climate change and destruction of food infrastructure due to climate-related hazards. While the increasing numbers of floods and droughts in South Africa already pose a severe economic threat to the agriculture sector and its ability to provide food[58], the Intergovernmental Panel on Climate Change (IPCC) estimates that agricultural productivity will further decline from 21% to 9% in sub-Saharan African by 2080 due to climate change[7]. Unless the negative impacts of climate change on food production are anticipated and mitigated, climate change will only serve to worsen food security for South Africans, further increasing under- and overnutrition.[25]

While production in the food supply chain is impacted by climate change, there are also elements in the supply chain which impact the environment. For example, South Africa generates around 10.2 million tonnes of food waste each year, which has both environmental effects due to resulting GHG emissions during decomposition and also increases food insecurity through wastage being factored into food prices.[59]

What can be done?

The 2018 Global Nutrition Report Executive Summary emphasises five critical steps to tackle this syndemic.[60] These steps below provide a good starting point to address the syndemic in South Africa and transform the food system so that it promotes environmental sustainability, human health, social equality, and economic prosperity.

Step 1: Breaking down of silos and *developing comprehensive programmes*. Efforts should focus on double or triple duty actions that simultaneously address the common drivers of two or more issues of the syndemic. In doing so, researchers, policymakers, and donors all need to strive to identify an evidence base of systemic drivers and actions. Engagement with all stakeholders is critical – including those affected by the challenges (people living with obesity, in an obesogenic food environment), those who intentionally or unintentionally create the unhealthy systems, and those who are trying to change these systems.

Step 2: Prioritising and investing in the data needed and capacity to use it. By better understanding and investing in geospatial data, the impact of climate change on the food system and its links to malnutrition and obesity can be better assessed.

Step 3: Scaling up and diversifying financing for nutrition. Fiscal policies, such as the sugar-sweetened beverage (SSB) tax[61], are great examples of triple duty actions. These can both incentivise consumers to make better nutritional choices and generate revenue that can be used to finance the sustainable transformation of the food system. Evidence from New Zealand shows how a junk-food and SSB tax was estimated to not only reduce GHG emissions but also provide potential savings for the health system.[62] Besides broader-scale nutrition financing initiatives like the one in New Zealand, solutions also exist on a smaller scale. For example, the provision of financial incentives and support schemes for small-scale farmers in South Africa could facilitate job creation, increase financial and food security, and could help reduce the effects of international food supply shortages by diversifying the food environment available to South Africans. Furthermore, small-scale farming systems are often more environmentally sustainable as farmers have more of a vested interest in the long-term productivity of the land, and local production helps reduce the climate emissions generated from the food import-export industry.[63]

Step 4: Focusing on healthy diets to drive better nutrition. Government measures play a critical role in reducing the consumption of ultra-processed foods, which not only fuels obesity and nutrition-related non-communicable diseases but also contributes to stunting and micronutrient deficiencies by displacing more nutritious whole foods[8], and reducing climate change and biodiversity damage linked to its globalised supply chains[64]. Evidence-based and tested policy recommendations such as marketing bans of unhealthy food and beverage products to children, and easy to decipher front-of-pack warning labels are needed.[8]

Step 5: Improving the targets and commitments that are driving actors. Strong governance of actors in the food system is essential to prevent any further damage to health systems and the food environment. Governments should introduce mandatory evidence-based restrictions rather than allowing industries to self-regulate. There is no evidence that voluntary actions by the food and beverage industry safeguard public health.[65] The introduction of the SSB tax (known as the Health Promotion Levy) in South Africa in 2016 is an example of how the government can drive actors and incentivise nutrition – in this case, the tax decreased the average number of SSBs being consumed per individual.[66] While this is a step in the right direction, increasing the tax to the recommended 20% (as opposed to the current approximately 10%) will be necessary to magnify its effects. Moreover, given that the agriculture sector is a key determinant in both climate change and nutrition, additional work needs to be done by the government to translate their commitments to the IPCC into measurable targets that the agricultural system can commit to.

Why is action not happening?

Despite continuous endorsement by international organisations, there has been patchy progress in implementing evidence-based policies in South Africa. This has been explained by what the Lancet Commission on Obesity calls policy inertia[8] – the combined effects of strong industry opposition to policies that attempt to regulate or modify commercial actives, and inadequate political will and government reluctance to take up the battle with industry and enact regulatory and fiscal policies. This is particularly relevant in South Africa, where trade liberalisation and the prioritisation of economic growth promotes a favourable political environment for industry actors.[67] This talks to *Step 5* in the proposed strategies above – stronger efforts are required to address the current incentive system for players in the food system.

One example of the latest opposition concerns the South African sugar industry that has attempted to influence government policies through its political practices. The industry has continuously distorted the scientific evidence linking SSBs to obesity[68], promoted ineffective voluntary actions[42], and weakened and delayed evidence-based policies including the SSB tax and front-of-pack nutritional labelling[68,69].

Despite civil society organisations and public opinion polls that suggest support for fiscal policies, such as the SSB tax, these have not translated into adequate public demand for enhanced policy action. There continues to be a lack of fiscal and regulatory policies, including taxes on unhealthy foods, and strengthening the existing tax on sugary drinks which has not been increased in rate and scope since its implementation in 2018.

Conclusion

This Commentary only touches the surface of the numerous issues surrounding the syndemic of undernutrition, obesity and climate change in South Africa. However, with increasing malnutrition and worsening climate, costing billions of rands annually, this is an opportune time to review the drivers of these major challenges and search for comprehensive and efficient approaches in tackling complexities of the syndemic. The causes of these issues are not singular in nature as they arise from several issues including pricing, marketing, and the availability of nutritious food. There is a wide range of double and triple duty policy options to simultaneously tackle the syndemic; these include the breaking down of silos of action, improving the collection and utilisation of data, scaling up nutrition financing, focusing on healthy diets in the systems, and improving the governance structure for actors in the food system. Actions will demand a more coherent policy action and breaking down of current incentive structures between industry actors and their governance.

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Competing interests

We have no competing interests to declare.

References

1. 2018 Global nutrition report. Bristol: Development Initiatives; 2018. Available from: https://globalnutritionreport.org/reports/global-nutrition-report-2018/
2. Dobbs R, Sawers C, Thompson F, Manyika J, Woetzel J, Child P, et al. Overcoming obesity: An initial economic analysis [document on the Internet]. c2014 [cited 2022 Sep 01]. Available from: https://www.mckinsey.com/~/media/mckinsey/business%20functions/economic%20studies%20temp/our%20insights/how%20the%20world%20could%20better%20fight%20obesity/mgi_overcoming_obesity_full_report.ashx
3. Popkin BM, Adair LS, Ng SW. The global nutrition transition: The pandemic of obesity in developing countries. Nutr Rev. 2012;70(1):3–21. https://doi.org/10.1111/j.1753-4887.2011.00456.x
4. Hoffman D. Obesity in developing countries: Causes and implications. Food Nutr Agric. 2001;28:35–44.
5. Seferidi P, Scrinis G, Huybrechts I, Woods J, Vineis P, Millett C. The neglected environmental impacts of ultra-processed foods. Lancet Planet Health. 2020;4(10):E437–E438. https://doi.org/10.1016/S2542-5196(20)30177-7
6. Chancel L. Global carbon inequality over 1990–2019. Nat Sustain. 2022;5(11):931–938. https://doi.org/10.1038/s41893-022-00955-z
7. Solomon S, Intergovernmental Panel on Climate Change, editors. Climate change 2007: The physical science basis: Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge / New York: Cambridge University Press; 2007.
8. Swinburn BA, Kraak VI, Allender S, Atkins VJ, Baker PI, Bogard JR, et al. The Global Syndemic of obesity, undernutrition, and climate change: The Lancet Commission report. The Lancet. 2019;393(10173):791–846. https://doi.org/10.1016/S0140-6736(19)30310-1
9. Crippa M, Solazzo E, Guizzardi D, Monforti-Ferrario F, Tubiello FN, Leip A. Food systems are responsible for a third of global anthropogenic GHG emissions. Nat Food. 2021;2(3):198–209. https://doi.org/10.1038/s43016-021-00225-9
10. 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. Report no. 12. Rome: Committee on World Food Security; 2017. Available from: https://www.fao.org/fileadmin/user_upload/hlpe/hlpe_documents/HLPE_Reports/HLPE-Report-12_EN.pdf
11. Jamieson L, Berry L, Lake L, editors. South African Child Gauge 2017. Cape Town: Children's Institute, University of Cape Town; 2017. Available from: http://www.ci.uct.ac.za/sites/default/files/image_tool/images/367/Child_Gauge/South_African_Child_Gauge_2017/Child_Gauge_2017_lowres.pdf
12. Boachie MK, Thsehla E, Immurana M, Kohli-Lynch C, Hofman KJ. Estimating the healthcare cost of overweight and obesity in South Africa. Glob Health Action. 2022;15(1), Art. #2045092. https://doi.org/10.1080/16549716.2022.2045092
13. Shayegh S, Manoussi V, Dasgupta S. Climate change and development in South Africa: The impact of rising temperatures on economic productivity and labour availability. Clim Dev. 2021;13(8):725–735. https://doi.org/10.1080/17565529.2020.1857675
14. Parliament of the Republic of South Africa. South African Economic Reconstruction and Recovery Plan. 2020. p. 38.
15. Chersich M, Wright C, Venter F, Rees H, Scorgie F, Erasmus B. Impacts of climate change on health and wellbeing in South Africa. Int J Environ Res Public Health. 2018;15(9):1884. https://doi.org/10.3390/ijerph15091884
16. Wolski P. Twice the global rate [webpage on the Internet]. c2019 [cited 2022 Jun 13]. Available from: https://www.csag.uct.ac.za/2019/09/25/twice-the-global-rate/
17. Roffe SJ, Fitchett JM, Curtis CJ. Classifying and mapping rainfall seasonality in South Africa: A review. South Afr Geogr J. 2019;101(2):158–174. https://doi.org/10.1080/03736245.2019.1573151
18. South African Department of Agriculture, Land Reform and Rural Development. Economic review of the South African agriculture [document on the Internet]. c2020 [cited 2022 Sep 09]. Available from: https://www.dalrrd.gov.za/Portals/0/Statistics%20and%20Economic%20Analysis/Statistical%20Information/Economic%20Review%202020.pdf
19. GCRF Agricap. South Africa's agriculture and food system: A scenarios analysis [document on the Internet]. Pretoria: GCRFAFRICAP; 2018 [cited 2022 Sep 08]. Available from: https://www.namc.co.za/gcrf-africap-participatory-scenarios-workshop-report-rsa-2018/
20. Stats SA. Measuring food security in South Africa: Applying the Food Insecurity Experience Scale [document on the Internet]. c2020 [cited 2022 Sep 05]. Available from: http://www.statssa.gov.za/publications/Report-03-00-19/Report-03-00-192020.pdf
21. National Department of Health, Stats SA, SAMRC. South Africa Demographic and Health Survey 2016 [document on the Internet]. c2016 [cited 2021 Sep 04]. Available from: https://dhsprogram.com/pubs/pdf/FR337/FR337.pdf
22. Jayawardena R, Jeyakumar DT, Misra A, Hills AP, Ranasinghe P. Obesity: A potential risk factor for infection and mortality in the current COVID-19 epidemic. Diabetes Metab Syndr Clin Res Rev. 2020;14(6):2199–2203. https://doi.org/10.1016/j.dsx.2020.11.001
23. Health Promotion Research and Development Unit. The 2nd South African National Youth Risk Behaviour Survey 2008 [document on the Internet]. c2008 [cited 2022 Jun 14]. Available from: https://granthaskin.files.wordpress.com/2012/06/youth-risk-behaviour-survey-2008_final_report.pdf
24. Harika R, Faber M, Samuel F, Mulugeta A, Kimiywe J, Eilander A. Are Low intakes and deficiencies in iron, vitamin A, zinc, and iodine of public health concern in Ethiopian, Kenyan, Nigerian, and South African children and adolescents? Food Nutr Bull. 2017;38(3):405–427. https://doi.org/10.1177/0379572117715818
25. Mugambiwa SS, Tirivangasi HM. Climate change: A threat towards achieving 'Sustainable Development Goal number two' (end hunger, achieve food security and improved nutrition and promote sustainable agriculture) in South Africa. Jàmbá J Disaster Risk Stud. 2017;9(1), Art. #350. https://doi.org/10.4102/jamba.v9i1.350
26. 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(4):532. https://doi.org/10.3390/foods9040532
27. Nutrition Division. The double burden of malnutrition. Case studies from six developing countries. Rome: Food and Agriculture Organization of the United Nations; 2006. Available from: https://www.fao.org/3/a0442e/a0442e.pdf
28. Mchiza Z, Steyn N, Hill J, Kruger A, Schönfeldt H, Nel J, et al. A review of dietary surveys in the adult South African population from 2000 to 2015. Nutrients. 2015;7(9):8227–8250. https://doi.org/10.3390/nu7095389
29. Jonah CMP. Evidence of the existence of socioeconomic-related inequality in South African diets: A quantitative analysis of the 2017 General Household Survey. World Nutr. 2019;10(4):27–42. https://doi.org/10.26596/wn.201910427-42
30. Swinburn B, Sacks G, Vandevijvere S, Kumanyika S, Lobstein T, Neal B, et al. INFORMAS (International Network for Food and Obesity/non-communicable diseases Research, Monitoring and Action Support): Overview and key principles: INFORMAS overview. Obes Rev. 2013;14:1–12.
31. Michimi A, Wimberly MC. The food environment and adult obesity in US metropolitan areas. Geospatial Health. 2015;10(2). https://doi.org/10.4081/gh.2015.368
32. Temple NJ, Steyn NP. The cost of a healthy diet: A South African perspective. Nutrition. 2011;27(5):505–508. https://doi.org/10.1016/j.nut.2010.09.005
33. Pietermaritzburg Economic Justice & Dignity Group [PMBEJD]. 2021 Household Affordability Index [webpage on the Internet]. c2021 [cited 2021 Sep 06]. Available from: https://pmbejd.org.za/index.php/household-affordability-index/
34. Ndlovu N, Day C, Sartorius B, Aagaard-Hansen J, Hofman K. Assessment of food environments in obesity reduction: A tool for public health action. South Afr Health Rev. 2018;2018(1):115–123. https://hdl.handle.net/10520/EJC-144dca8702

35. Battersby J, Peyton S. The geography of supermarkets in Cape Town: Supermarket expansion and food access. Urban Forum. 2014;25(2):153–164. https://doi.org/10.1007/s12132-014-9217-5

36. Chandon P, Wansink B. Does food marketing need to make us fat? A review and solutions. Nutr Rev. 2012;70(10):571–593. https://doi.org/10.1111/j.1753-4887.2012.00518.x

37. Wansink B, Sobal J. Mindless eating: The 200 daily food decisions we overlook. Environ Behav. 2007;39(1):106–123. https://doi.org/10.1177/0013916506295573

38. Wilson AL, Buckley E, Buckley JD, Bogomolova S. Nudging healthier food and beverage choices through salience and priming. Evidence from a systematic review. Food Qual Prefer. 2016;51:47–64. https://doi.org/10.1016/j.foodqual.2016.02.009

39. Glanz K, Bader MDM, Iyer S. Retail grocery store marketing strategies and obesity. Am J Prev Med. 2012;42(5):503–512. https://doi.org/10.1016/j.amepre.2012.01.013

40. Erasmus MG. Proposed strategies for South African supermarkets to increase healthier food choices: A literature review. Am J Prev Med. 2019;4:11.

41. Boyland EJ, Halford JCG. Television advertising and branding. Effects on eating behaviour and food preferences in children. Appetite. 2013;62:236–241. https://doi.org/10.1016/j.appet.2012.01.032

42. Erzse A, Christofides N, Stacey N, Lebard K, Foley L, Hofman K. Availability and advertising of sugar sweetened beverages in South African public primary schools following a voluntary pledge by a major beverage company: A mixed methods study. Glob Health Action. 2021;14(1), Art. #1898130. https://doi.org/10.1080/16549716.2021.1898130

43. Moodley G, Christofides N, Norris SA, Achia T, Hofman KJ. Obesogenic environments: Access to and advertising of sugar-sweetened beverages in Soweto, South Africa, 2013. Prev Chronic Dis. 2015;12, Art. #140559. https://doi.org/10.5888/pcd12.140559

44. Lake L, Kroon M, Sanders D, Goga A, Witten C, Swart R, et al. Child health, infant formula funding and South African health professionals: Eliminating conflict of interest. S Afr Med J. 2019;109(12):902. https://doi.org/10.7196/SAMJ.2020.v110i4.14611

45. Yamoah DA, De Man J, Onagbiye SO, Mchiza ZJ. Exposure of children to unhealthy food and beverage advertisements in South Africa. Int J Environ Res Public Health. 2021;18(8):3856. https://doi.org/10.3390/ijerph18083856

46. Abrahams Z, Temple NJ, Mchiza ZJ, Steyn NP. A study of food advertising in magazines in South Africa. J Hunger Environ Nutr. 2017;12(3):429–441. https://doi.org/10.1080/19320248.2016.1227757

47. Igumbor EU, Sanders D, Puoane TR, Tsolekile L, Schwarz C, Purdy C, et al. "Big Food," the consumer food environment, health, and the policy response in South Africa. PLoS Med. 2012;9(7), e1001253. https://doi.org/10.1371/journal.pmed.1001253

48. South African Government. South Africa's Implementation of the 2030 Agenda for Sustainable Development [document on the Internet]. c2019 [cited 2022 Aug 30]. Available from: https://sustainabledevelopment.un.org/content/documents/23402SOUTH_AFRICA_RSA_Voluntary_National_Review_Report_Final__14_June_2019.pdf

49. United Nations. SDG 12 Responsible Consumption and Production [webpage on the Internet]. [cited 2022 Aug 30]. Available from: https://www.un.org/sustainabledevelopment/sustainable-consumption-production/

50. Gouel C, Guimbard H. Nutrition transition and the structure of global food demand. Am J Agric Econ. 2019;101(2):383–403. https://doi.org/10.1093/ajae/aay030

51. Popkin BM. The nutrition transition in the developing world. Dev Policy Rev. 2003;21(5–6):581–597. https://doi.org/10.1111/j.1467-8659.2003.00225.x

52. Godfray HCJ. Food for thought. Proc Natl Acad Sci USA. 2011;108(50):19845–19846. https://doi.org/10.1073/pnas.1118568109

53. Poore J, Nemecek T. Reducing food's environmental impacts through producers and consumers. Science. 2018;360(6392):987–992. https://doi.org/10.1126/science.aaq0216

54. Pye A, Bash K, Joiner A, Beenstock J. Good for the planet and good for our health: The evidence for whole-food plant-based diets. BJPsych Int. 2022;19(4):90–92. https://doi.org/10.1192/bji.2022.7

55. Kabubo-Mariara J, Mulwa RM, Di Falco S. The impact of climate change on food calorie production and nutritional poverty: Evidence from Kenya. Gothenburg: Environment for Development Initiative; 2016. http://www.jstor.org/stable/resrep15061

56. De Guzman C. Climate crisis is driving food nationalism and changing global trade. Time. 12 July 2022 [cited 2022 Jul 20]. Available from: https://time.com/6195984/climate-change-food-security-trade/

57. Campbell R. South African agriculture is dependent on imports for key inputs. Engineering News. 01 May 2020 [cited 2020 Jul 20]. Available from: https://www.engineeringnews.co.za/article/south-african-agriculture-is-dependent-on-imports-for-key-inputs-2020-05-01

58. World Bank. World Bank Climate Change Knowledge Portal [webpage on the Internet]. No date [cited 2022 Aug 30]. Available from: https://climateknowledgeportal.worldbank.org/

59. South African Department of Environment, Forestry and Fisheries (DEFF), CSIR. Food waste prevention & management: A guideline for South Africa. Report no. 1. Pretoria: DEFF, CSIR; 2021.

60. 2018 Global nutrition report: Executive summary. Bristol: Development Initiatives; 2018. Available from: https://globalnutritionreport.org/reports/global-nutrition-report-2018/

61. World Health Organization. Fiscal policies to promote healthy diets: Policy brief [webpage on the Internet]. c2022 [cited 2022 Jun 28]. Available from: https://www.who.int/publications-detail-redirect/9789240049543

62. Grout L, Mizdrak A, Nghiem N, Jones AC, Blakely T, Ni Mhurchu C, et al. Potential effect of real-world junk food and sugar-sweetened beverage taxes on population health, health system costs and greenhouse gas emissions in New Zealand: A modelling study. BMJ Nutr Prev Health. 2022;5(1):19–35. https://doi.org/10.1136/bmjnph-2021-000376

63. Houngbo. Why small farms are key to the future of food - and how we can support them [webpage on the Internet]. c2020 [cited 2022 Sep 03]. Available from: https://www.ifad.org/en/web/latest/-/blog/why-small-farms-are-key-to-the-future-of-food-and-how-we-can-support-them

64. Fardet A, Rock E. Ultra-processed foods and food system sustainability: What are the links? Sustainability. 2020;12(15):6280. https://doi.org/10.3390/su12156280

65. Erzse A, Karim SA, Foley L, Hofman KJ. A realist review of voluntary actions by the food and beverage industry and implications for public health and policy in low- and middle-income countries. Nat Food. 2022;3(8):650–663. https://doi.org/10.1038/s43016-022-00552-5

66. Stacey N, Edoka I, Hofman K, Swart EC, Popkin B, Ng SW. Changes in beverage purchases following the announcement and implementation of South Africa's Health Promotion Levy: An observational study. Lancet Planet Health. 2021;5(4):E200–E208. https://doi.org/10.1016/S2542-5196(20)30304-1

67. Thow AM, Abdool Karim S, Mukanu MM, Ahaibwe G, Wanjohi M, Gaogane L, et al. The political economy of sugar-sweetened beverage taxation: An analysis from seven countries in sub-Saharan Africa. Glob Health Action. 2021;14(1), Art. #1909267. https://doi.org/10.1080/16549716.2021.1909267

68. Abdool Karim S, Kruger P, Hofman K. Industry strategies in the parliamentary process of adopting a sugar-sweetened beverage tax in South Africa: A systematic mapping. Glob Health. 2020;16(1):116. https://doi.org/10.1186/s12992-020-00647-3

69. Kanter R, Vanderlee L, Vandevijvere S. Front-of-package nutrition labelling policy: Global progress and future directions. Public Health Nutr. 2018;21(8):1399–1408. https://doi.org/10.1017/S1368980018000010