



Title: Understanding the Nourishment of Bodies at the Centre of Food and Health Systems – Systemic, Bodily and New Materialist Perspectives on Nutritional Inequity

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More details/abstract

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Review article

Understanding the nourishment of bodies at the centre of food and health systems – systemic, bodily and new materialist perspectives on nutritional inequity



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ABSTRACT

That nutritional inequalities continue to proliferate at a global level requires new insight from all disciplines, given their formation at the intersection of broader inequities in food, health and other systems. This paper argues that critical social scientific perspectives are needed to supplement public health and food focused approaches, which, while helpful, tend to reduce research and intervention to remedial action on malnourished bodies or on food production. A number of alternative perspectives draw on work on both bodies and on systems which are reviewed here. Because both the causes and the impacts of poor nutrition are simultaneously embodied and systemic, our understanding is weakened without considering both sets of literature simultaneously. New-materialist, assemblage or posthuman approaches represent an evolution of these literatures which can reflect on dissolving socio-natural boundaries within contemporary (nutritional) science, whilst retaining a critical edge. Together, the various approaches within this paper help consider the conditions of everyday existence for those living with malnutrition and the range of bodily and systemic factors which assemble their condition.

1. Introduction

How are we to understand the large disparities in nutritional status that exist between people and within communities worldwide? This is a question that has been concerning public health professionals for decades (UNICEF, 1990; Black et al., 2013; Global Nutrition Report et al., 2018) but is also a question which requires critical insight from social science, as evidence points to stark nutritional inequalities stemming from entrenched inequities in access to food and health systems and basic resources (Friel et al., 2015; Nisbett et al., 2014; Vollmer et al., 2017; Perez-Escamilla et al., 2018).

This paper joins existing literature within critical food studies, public health nutrition and health equity in arguing that we need new ways to understand the everyday experience or silent and long-term 'structural violence' (Farmer et al., 2004) of such inequities without reducing them to the immediate bodily experience requiring curative intervention. I ask how are existing concepts, frameworks and systems framings guiding understanding and action on nutrition and what might be learnt from expanding our repertoire of concepts and approaches when borrowing further from critical social science.

In the second section of the paper, following this introduction, I sketch

the ways in which public health nutrition and food and agriculture researchers view the determinants of nutrition, alongside critical alternatives such as food sovereignty. Most frameworks consider the various ways in which one's location within or access to local, regional or global health and food systems becomes a determinant of nutritional and health status (Friel and Ford, 2015; Kanter et al., 2015; UNICEF, 1990). Taken together they help us understand that inequities in food and health and other systems are experienced as embodied (Krieger, 2001; Scheper-Hughes and Lock, 1987): the social, political and environmental drivers of food and health access are experienced in very real and bodily ways.

But these bodily and systemic relationships are complex. At a bodily level, health and immune status determine nutritional needs, appetite and ability to absorb nutrients just as nutritional status can impact on the body's immune response (Black et al., 2013). But the health and food and other systems responsible for such feedback are also complex in their own right. They share some of the same actors, driving forces (social, political, economic, historical) and technologies and interact in multiple, nonlinear and unpredictable ways. This includes with other systems (water, sanitation, climate etc.) and over different timescales (Black et al., 2013; Tirado et al., 2010; Sobal et al., 1998; Kanter et al.,

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2015; Friel et al., 2015).

Grappling with such complexity entails spending less time minutely specifying each systemic component, but thinking conceptually about how systems function and have evolved holistically, with nutritional disparities considered as ‘emergent’ and resilient outcomes of systems rather than the product of individual relationships (Diez Roux, 2011; Friel et al., 2017). In the third section of the paper, therefore, I outline such approaches to ‘complex adaptive systems’ and consider the ways in which they have been applied to nutritional equity.

In any conceptual depiction—whether simple or complex—there is a need to frame or model the system or otherwise delineate its boundaries. This has significant impacts on both knowledge and action: prefiguring or closing off various policy solutions to nutrition and obscuring more deep-seated determinants. Further sections of the paper pay more attention to these framings, both of systems (*the fourth section of the paper*), and of bodies (*the fifth section*), with the fifth section also considering what critical literature on the body's conception, social representation and political treatment can tell us about the nutritional status of bodies.

The natural extension of these earlier approaches to bodies and to systems is the literature discussed in the sixth and final review section of the paper, which describes new-materialist (Coole and Frost, 2010), post-human (Braidotti, 2013) or assemblage based (Anderson and McFarlane, 2011) approaches. These continue the questions raised in earlier body/system literature regarding science's enlightenment assumptions of the boundaries between nature and society, mind and the body, people and things. Perspectives from this literature are only slowly being applied to nutritional inequity outside of critical obesity. New-materialist perspectives offer novel ways of bringing together social theory with current advances in natural and biomedical sciences, all the while preserving a critical lens (see e.g. Landecker (2011)). In the concluding section, I return to broader reflections on how understandings of nutritional inequity or health disparities are advanced by use of the various frameworks and concepts discussed here.

2. Food and nutrition systems – dominant and alternative frameworks

Two interrelated and dominant conceptual frameworks still guide the majority of research and policy work on food and nutrition. Public health and international development specialists use a conceptual framework devised by UNICEF (Black et al., 2013: 490; UNICEF, 1990). Within agricultural research and food and agriculture policy, nutritional outcomes are subsumed within a set of models focusing on food security.

The UNICEF framework derives causes for child and maternal nutritional status at ‘immediate’, ‘underlying’ and ‘basic’ levels. These correspond, respectively, to: the immediate bodily interactions of nutrient intake and immunity; underlying drivers located within households and communities (food, care and sanitation/health); and wider socio-economic and political drivers (UNICEF, 1990).

Given most people do not look beyond the clear and obvious relationship between food intake/production and nutrition, the UNICEF model has played a critical role in the equivalency it awards non-food drivers. These broader determinants include maternal physiological and nutritional status, which affect foetal development and birth outcomes; the role of breastfeeding, which is a critical determinant of immune and nutritional status in the early years; and broader environmental and health conditions, which affect both immune status (which modulates nutrient needs, absorption and appetite) and long term gut health (also associated with child growth) (Black et al., 2013).

As well as considering multiple levels of nutrition's causes, the UNICEF framework and associated public health literature are helpful in considering the temporality of nutritional status. Nutrition in early life is associated with health outcomes in later life, whilst the health of undernourished mothers determines the birth size and future health

outcomes of their children (Black et al., 2013; Perez-Escamilla et al., 2018). In sharing socio-structural determinants as well as being inherited from maternal nutrition, malnutrition can therefore be considered as an *intergenerational* form of embodied poverty: a key way of transmitting the conditions of poverty through the generations (Nisbett et al., 2014; Wells, 2010).

The UNICEF framework has become a central reference point for research and policy – adopted by the recent Lancet series on nutrition (Bhutta et al., 2013) and used in the work of international organisations such as the Scaling Up Nutrition movement. But it is notable that the UNICEF model is just one of several families of models mapped in a recent review (Kanter et al., 2015), which lists 37 models of nutritional change, most of which follow a more mainstream food security orientation.

Histories of food security concepts have detailed how researchers started with ‘productivist’ concerns to increase crop yields and produce more food (i.e. making more food *available*). Work by Amartya Sen and others led to more focus on the socio-economic and political barriers to food *access* and *utilisation* (Maxwell and Slater, 2003; Ingram, 2011:419). Utilisation is meant to reference nutritional needs and outcomes, while *stability* of supply is also stressed in relation to the seasonality both of production and of hunger (Devereux et al., 2013), alongside fluctuation in prices.

This definition of food security (availability, access, utilisation, stability) has been adopted by the FAO and other international actors (see e.g. (FAO, 2008)) though productivism remains central to most global food narratives, to the detriment of concerns such as nutritional and production diversity (Foran et al., 2014; Lang and Barling, 2012). Alternative frameworks have developed in critical tension with the assumptions underlying such models. One review compares approaches drawn from agroecology, agricultural innovation systems, social-ecological systems and political ecology (Foran et al., 2014). Agroecology and related food sovereignty traditions, the most prominent of these, have criticised mainstream approaches as leaving food systems dependent on industrialised and capital intensive agriculture and export-led monoculture, with profound social and ecological consequences (Edelman, 2014; Patel, 2009; Altieri and Toledo, 2011; McMichael, 2014). Agro-ecological practices attempt to maximise positive ecological feedbacks between a variety of crops and local soil conditions and nutrient cycles, avoiding industrialised inputs of fertilizers or pesticides (Altieri, 2018; Gliessman, 1990; Pretty, 2006; Wezel and Soldat, 2009).

Consideration of nutrition as a specific set of outcomes varies across such mainstream and alternative food-based approaches, but is rarely a primary focus. There are exceptions within each type of food system framing. Within the mainstream there is a growing body of work attempting to analyse and improve the ‘nutrition-sensitivity’ of existing agricultural systems – such as considering the gendered burden of labour and care, or encouraging community or homestead gardens (Kadiyala et al., 2014; Ruel et al., 2018; Fan and Pandya-Lorch, 2012; Gillespie et al., 2019). Agro-ecology or food sovereignty approaches have advocated countering agro-industrial concentration and commercialisation as ways of increasing food and dietary diversity, whilst radically restructuring the politics of local and national food systems to focus on more holistic ideas of what constitutes healthy eating in tune with local, traditional and indigenous food cultures (Maluf et al., 2015; Rocha, 2017; Pimbert and Lemke, 2017).

Other prominent models concerned with diets and nutrition describe a dietary transition associated with industrial food systems leading to diets over-abundant in calorific dense staples and processed products, animal products and other foods rich in added sugars and salt (Popkin, 1994). Coupled with a transition to a more sedentary lifestyle, such factors have been associated with high levels of adult overweight and obesity and related non-communicable diseases (Friel and Ford, 2015; Popkin, 1994; Perez-Escamilla et al., 2018). Compared to mainstream food security models, public health obesity frameworks share ground with food sovereignty in including more critical reference

to a broader range of factors driving such ‘obesogenic environments’ (Blouin et al., 2010; Friel and Ford, 2015; Swinburn et al., 1999; Swinburn et al., 2011; though c.f. Guthman, 2012b). These include macroeconomic policy factors (the way that agricultural subsidies, trade policy or private investment might favour higher value refined carbohydrates, or highly processed foods over traditional staples and crops), as well as broader factors such as access to secure livelihoods (Friel and Ford, 2015). Obesity scholars have also focused in particular on the way that private sector actors have engaged in aggressive demand creation for nutritionally detrimental products, and on the multiple forms of lobbying which occurs to avoid controls on any such activities (Moodie et al., 2013; Buse et al., 2017).

3. Understanding systemic complexity – from ecological models to complex adaptive systems approaches to health, food and nutrition

In addition to mainstream and alternative approaches already mentioned, Kanter et al. (2015) describe a variety of other frameworks in their review of models of nutritional outcomes, incorporating e.g., the impacts of climate change (see e.g. Fig 6.1 in Haddad et al. (2015); Tirado et al. (2010)) or trade policy (Thow, 2009; Friel et al., 2013). Further consideration can be given to exploring connections between nutrition and the provision of adequate sanitation (Perez et al., 2012), or the gendered circumstances of infant care (Rollins et al., 2016).

An earlier review of food systems models (Sobal et al., 1998) recognises these connections by picturing the food and nutrition system as immersed within the influence of these other systems (Fig. 1). Other such ‘ecological’ models, including those that take a ‘biocultural’ perspective (Himmelgreen et al., 2014; Pelto and Pelto 1983), similarly place diet and nutritional status at the centre of a complex ecology of social, cultural, biological and political factors. An ecological framing of food systems was recently adopted by the Global Panel on Agriculture and Food Systems for Nutrition (2016).

Ecological framings can also be seen in related fields, including health systems (Kim et al., 2013), and environmental change (Ingram, 2011; Ericksen, 2008a). These framings have been used to consider some of the wider systemic interactions driving food inequities: allowing nutrition to be viewed as a complex product of spatial, temporal and socio-economic relationships between health and food and other systems including those as diverse as family welfare, labour policy and housing. (Friel et al. 2015, 2017; Marmot et al., 2008).

Work on complex adaptive systems (CAS) (frequently also referred to as systems science, complex systems or systems thinking) has spread from the natural and biological sciences to social sciences to help

understand such complex dynamics (Hall and Clark 2010; Ramalingam et al., 2008; Scoones, 1999). Here, complex refers not only to multiple agents, things or parts acting together at different levels (Friel et al., 2017; Gatrell, 2005), but to the fact that we cannot explain a systems behaviour or outcomes “by analysis of its parts or elements in isolation; attention to the dynamics between parts is fundamental” (Friel et al., 2017: 2; Hall and Clark 2010; Gatrell, 2005; Diez Roux, 2011). The words adaptive or dynamic reference the ever changing nature of systems (Hall and Clark 2010: 311). Such dynamics include negative and positive feedbacks and interrelations across different spatial and temporal scales, including nonlinear relationships, leading to ‘emergent’ patterns of outcomes (Gatrell, 2005: 2662; Diez Roux, 2011: 1627). Though fluid, dynamic and evolutionary, so long as a system is reasonably coherent in maintaining relationships between its parts we consider it as possessing ‘resilience’ (Hall and Clark 2010: 311).

CAS concepts provide a number of useful ways of reconceptualising nutritional disparities as dynamic and emergent properties of multiple systems acting in concert (Diez Roux, 2011; Friel et al., 2017), rather than the result of single relationship or causal chains between, say, food intake and nutrient absorption. Most systemic depictions are atemporal and few studies have undertaken the type of detailed historical and spatial analysis required to understand the sequence of political/policy decisions which led to current system states (Scoones, 1999; Friel et al., 2017). But this can be helpful in moving from a dominant narrative which naturalises large-scale chronic and acute nutritional deficiencies (Nisbett et al., 2014: 422). That health disparities such as malnutrition possess stubborn system resilience, resisting intervention, is in part due to the “possibility [...] that the underlying and structural causes [...] have not been addressed” (Diez Roux, 2011: 1631). Therefore, “[s]ystems approaches can help create compelling evidence to address these causes, which may be quite distant in space and time from health” (ibid.).

The state a system has reached will determine how further processes acting on it will affect it, even where processes are similar (Paina and Peters, 2012: 367). Research triangulating correlates of nutritional change over time (Headey et al., 2017) with policy and community level analysis implicitly supports this perspective of ‘path dependency’, with nutritional change linked to a steady evolution of policy and programmatic decisions and broader political willingness to tackle nutrition or related food and health inequities (Gillespie and van den Bold, 2017).

Notably, models in the tradition of socio-ecological systems already employ a range of CAS concepts to consider the interaction of social and natural systems together (Allen and Prospero, 2016; Ericksen, 2008a; Hammond and Dubé, 2012; Ingram, 2011). The Global Environmental Change and Food Systems project explicitly models feedbacks between social welfare and natural capital alongside standard food security outcomes. Thinking specifically about how these feedback loops operate over time and space helps “move from a household-level understanding of food security dynamics to a broader, more systemic analysis that links food security outcomes to processes that drive or create vulnerability, even as these processes manifest themselves differently across spatial and temporal levels” (Ericksen, 2008b: 14). Political ecology perspectives also recognise such socio-natural systems, though view them as a product of political processes which simultaneously seek to control the landscape, its access and representation – including the possibilities for food production (Scoones, 1999; Robbins, 2011).

Complex systems modelling can also result in “complex, messy and potentially overwhelming” diagrammatic representations (Friel et al. (2017) see also Finegood et al. (2010)). But the benefit of such exercises lies in the process of bringing together a range of stakeholders to discuss a problem crossing standard systemic boundaries (Friel et al., 2017). This is particularly helpful and necessary for considering today’s complex socio-biological issues and other such ‘wicked problems’ (Finegood et al., 2010): amenable neither to pat policy solutions nor scientific expertise alone (Scoones, 1999: 494–96). By being forced to think of the

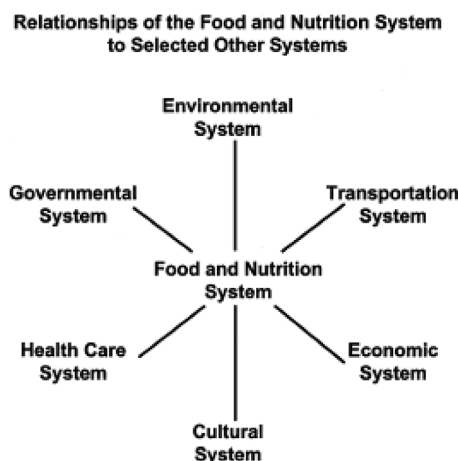


Fig. 1. Relationships of the food and nutrition system to selected other systems (Sobal et al., 1998).

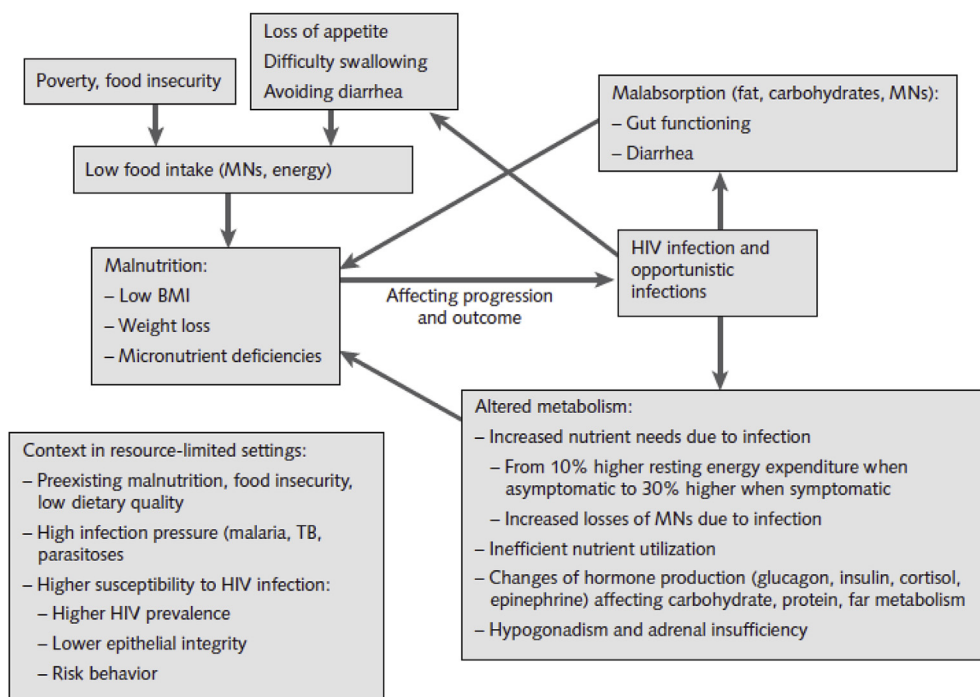


Fig. 2. Relationship between HIV infection and malnutrition - De Pee and Semba, 2010.

interconnections, actors developing a healthy eating disparities model were encouraged “to consider the ways in which actions in one sector can reinforce or undermine actions in other sectors” and identify points of intervention (Friel et al., 2017: 12), including in non-food systems such as welfare support/social protection and housing.

4. Interrogating dominant framings of food and nutrition

Though not framed by a CAS perspective, it is possible to find further examples within the public health literature that consider the interactions between socio-economic context (including food security) and nutrition related disease. These pose CAS-like questions on where the boundaries between system and agent (system and body) actually lie (Scoones, 1999: 492–94; Gatrell, 2005). This includes, for example, risk factors for both HIV transmission and treatment adherence. Fig. 2 (De Pee and Semba, 2010) is an example from this literature, depicting at its heart the interactions between antiretrovirals, metabolism, hunger and treatment adherence—all influenced by the broader food and nutrition environments; policy and available treatment services.

Whilst implicitly illustrating such structure-agency system-bodily interactions, the exclusions from such public health treatments of socio-biological complexity are also telling. Both the ‘context’ structuring conditions such as poverty and food insecurity and the factors that lead to health or sexual behaviour being socially and biologically risky are highly contingent on any number of local or global factors which might include, in different circumstances, religious prohibitions on contraception use, or the World Bank’s historic influence in imposing user-fees on health care in African states (Yates, 2009). In a paper considering metabolism-adherence we might reasonably expect the authors to draw the boundaries somewhere—mentioning broader socio-political determinants but acknowledging that expertise on these topics lies elsewhere. Guides to CAS approaches similarly acknowledge that where authors draw their systemic boundaries stems from disciplinary assumptions, interests and biases (Erickson, 2008a: 235; Friel et al., 2017: 13–14; Diez Roux, 2011: 1632). But these exclusions are not without consequence: a critical approach to such systems frames “allows attention to the many ways in which system boundaries, dynamics, functions and outcomes are open to multiple, particular, contextual,

positioned and subjective assumptions, methods, forms of interpretation, values and goals” (Leach et al., 2010: 371).

Each of the earlier framings – public health nutrition, food security and their alternatives, or nutrition transition or obesity focused models can result in quite different outcomes. In some cases, the model itself may suggest or close off various options in terms of its focus or exclusions. For example, mainstream food security approaches and related ‘value-chain’ approaches tend to focus on capital-intensive agricultural development, private sector led product development and reducing the barriers to trade. It is in opposing such framings that food sovereignty approaches have become popular. But alternative models of food systems are criticised as carrying their own set of contradictions and problematic assumptions regarding gender, race and cultural appropriation (see e.g. Edelman, 2014; Guthman, 2008; Slocum, 2007; Agarwal, 2014; Edelman et al., 2014; Bernstein, 2014) as are public health representations of obesity (see below).

In other cases, a framework’s reception and use by various professional/epistemic communities also prefigures its impact, even where other interpretations are possible. For example, the way the UNICEF model is used in practice is often framed primarily in terms of biomedical factors, or agricultural and public health interventions considered at the underlying level, whilst leaving political factors untouched (Gillespie et al., 2013, Nisbett et al. 2014). The model is frequently reproduced as a graphical representation but this leaves aside a key part of the 1990 UNICEF narrative: a more radical message, that “most underlying causes are themselves the result of the unequal distribution of resources in society” (UNICEF, 1990, pp. 20–21) stemming from “existing property relations, the division of labour and power structures” including “the subordination of women” (UNICEF, 1990: 20–21) (for more on histories of international nutrition policy, the development of public health nutrition and the use of the UNICEF framework see (Gillespie and Harris, 2016; Levinson, 2003; Pelletier, 2003; Harris, 2017)).

5. Nutrition’s embodied biopolitics

The exclusion of basic resource inequities in most public health applications of the UNICEF model is telling of the tendency to favour

action amenable to immediate, technical and apolitical interventions within mainstream nutrition (Nisbett et al., 2014; Gillespie et al., 2013; Kimura, 2013). Medical anthropologists have argued for the need to decode and counter this ‘medicalisation’ of approaches to bio-social problems and further engage with the ‘biopolitical’ aspects of the way in which the representation, categorisation and intervention of and on bodies is itself a key means of political control (Lock and Nguyen, 2018; Scheper-Hughes and Lock, 1987).

Such perspectives are increasingly being applied to engage with the underlying framings of nutrition in dominant models. “Nutritionism” (Scrinis, 2008) (also “hegemonic nutrition”: Hayes-Conroy and Hayes-Conroy, 2013) has been defined as a “nutritionally reductive approach to food” that “has come to dominate, to undermine, and to replace other ways of engaging with food and of contextualizing the relationship between food and the body” (Scrinis, 2008:39). Within obesity, nutritional reductionism has been blamed for multiple blindspots and a tendency for public health interventions to focus on individual ‘behavioural change’ (Sanabria, 2015: 130; Guthman, 2012b). This is a contention shared by public health obesity approaches, but critical nutrition scholars have gone further in questioning the measurement, representation and control of people categorised as overweight and obese: calling out contested areas of evidence within obesity science, obscured within mass applications of measures such as the body-mass index (Colls and Evans, 2014; Guthman, 2012b, 2012a). ‘Deviance’ in bodily size and eating disorders are reframed in critical approaches as an attempt to resolve the contradictions of capitalism (consume more, be fit, thin, productive, take responsibility etc) and the reality of inadequate food environments within people’s bodies (Crawford 1985 cited in Scheper-Hughes and Lock (1987), (Guthman and DuPuis, 2006).

Focusing more on such difference between bodies also leads to reflections on the heavily racialized or colonial assumptions behind the application of standardized nutrition or dietary recommendations. Simplistic views of the improvements that would result from more ‘civilised’ dietary models rooted in idealised versions of European behaviour (such as the Mediterranean diet) leave little space for alternatives forged from the cultures and foods marginalised outside the white European mainstream (see papers in Hayes-Conroy and Hayes-Conroy (2013)).

Many critical approaches to nutrition and the body are also in debt to feminist work, which has long considered treatment and representations of the female body and behaviour as both a yardstick of wider societal structures (i.e. patriarchy), and as site of societal/political control resulting from that patriarchy (as in restrictions on female sexuality, diets, breastfeeding, intra-household consumption) (Scheper-Hughes and Lock, 1987). Such controls extend even to the spaces and times for women to excrete (Desai et al., 2015). Drawing on such scholarship, the Hayes-Conroys highlight the body’s own neglected agency in shaping our food and eating experience. This viscerality: “the realm of internally-felt sensations, moods and states of being, which are born from sensory engagement with the material world”, “may be seen to shape (and be shaped by) all manner or socio-political actions”, particularly with regard to food (Hayes-Conroy and Hayes-Conroy, 2008: 462).

Perspectives on gendered bodies have been applied to infant feeding, for example, to consider how “women’s decisions on how they use their bodies to nurture their children are framed by attitudes towards their bodies and their breasts that may have nothing to do with breastfeeding” (Van Esterik, 2002). Women are increasingly making such decisions while reconciling multiple forms of advice, social pressure, practical considerations and emotional and affective responses to breastfeeding (Faircloth, 2013).

Most biopolitical approaches to nutrition focus on dietary conditions and framings of prominence in western contexts, with less work on countries with lower economic development. Exceptions include nuanced scholarship on the framing of nutrition and obesity in

Guatemala (Yates-Doerr, 2015), India (Solomon, 2016) and micro-nutrient promotion in Indonesia (Kimura, 2013) and Peru (Gillespie, 2017). Disciplinary histories of nutrition have also outlined its central role in exporting American and Western European ideas about standardized diets and metabolism (Guthman, 2014; Landecker, 2011), wrapped up in broader political projects of colonialism and militarism (Lock and Nguyen, 2018). Reductive practices of emergency and humanitarian nutrition aimed at rapid measurement, standardisation and treatment of affected populations leave the discipline rooted to the biopolitics of humanitarian famine relief and broader aid (Scott-Smith, 2015; Scott-Smith 2013; Redfield, 2005; Lock and Nguyen, 2018).

6. Thinking both bodily and systemically– the new materialisms and nutrition

Biopolitical and CAS approaches both share a concern to upend enlightenment dualisms regarding systems and bodies and the boundaries between them (Scheper-Hughes and Lock, 1987). Advocates of CAS theory highlight its potential to see phenomena, including health, as a “fusing of the natural or material and the social [...] [as] hybrids of physical and social relations, with no purified sets of the physical or the social” (Gatrell, 2005: 2663; see also Scoones, 1999: 486–88).

Socio-material hybrids have reached further prominence in theoretical approaches labelled new-materialist (Coole and Frost, 2010) or post-human (Cohn and Lynch, 2017). These share an interest with actor-network theory (Latour, 2005), earlier indigenous ontologies (TallBear, 2017; Todd, 2016) and political ecology (Scoones, 1999) on the way that non-human agency – simply, the *ability to affect changes* on other materials and phenomena – is as important as human agency in the socio-natural phenomena we study. The use of ‘post-human’ also references the need to interrogate the elite, white male assumptions behind supposedly ‘universal’ enlightenment values (Braidotti, 2013; Cohn and Lynch, 2017), but also the move beyond the exclusive focus on human language, social structures and representations which has dominated post-structuralist social theory (Coole and Frost, 2010) (and they are ‘new-materialist’ so as to differentiate from the earlier materialisms in which material conditions played a deterministic role in shaping social structure, though the prefix is also frequently dropped).

The term assemblage is central to many of these posthuman approaches in filling some of the gaps between systemic and bodily approaches. An assemblage is simply a collection of “heterogeneous elements that may be human and non-human, organic and inorganic, technical and natural” (Anderson and McFarlane, 2011: 124). Assemblage also references its verbal form – how elements assemble together in agentic relationships (acting on each other), in terms recognisable to systems thinking that invoke “emergence, multiplicity and indeterminacy” (ibid.:124). A key difference with more positivist applications of CAS and new-materialist positions is that the latter recognise human ideas, beliefs and representations as important relational components (just not the only ones of note); and that they tend to look to particular instances of these relations rather than imagining their organisation in discrete systems (Cohn and Lynch, 2017).

Bennett for example, has described the “active vitality” of matter “within an agentic assemblage that includes among its members my metabolism’s cognition and moral sensibility” (Bennett, 2007: 145). As she explains (echoing the CAS concept of path dependency) “particular fats, acting in different ways in different bodies and with different intensities, even within the same body at different times, may produce patterns of effects but not in ways that are fully predicable – for a small change in the assemblage may issue in a significant disruption of the pattern.” (Bennett, 2007: 137).

Bennet’s analysis of fats and obesity are representative of how critical food studies have employed materialist perspectives in critical tension with new scientific understandings of nutrition, which extends to epigenetics (the link of gene expression to environmental exposure) (Landecker, 2011), the gut’s non-human biome (Landecker, 2016) and

the ways in which the body's myriad sensorial and metabolic systems regulate food intake (Sanabria, 2015). As Landecker writes: “[t]he physical act of eating becomes an incorporation point of bioactive molecules that are simultaneously material and social. We cannot help but ingest and in the act of ingestion and digestion are drawn into the social, technical and political networks of food production, regulation and consumption” (Landecker, 2011: 187). However, Landecker and others warn of a biologically determinist backlash emerging from epigenetic and dietary science, including an obsession with ‘manipulating long-term health through diet’, with food envisaged ‘as a kind of molecular delivery system to be incorporated into social engineering’ (Landecker, 2011: 179). Once again, individual choices over nutritional intake – ie of pregnant mothers – become urgent sites for external actors to intervene in behaviour (see also Goodman (2016: 4–5), Guthman and Mansfield (2013: 494–95)).

Materialist perspectives have been put to practical use in another sociological account of obesity interventions, in which the assemblage of material conditions, human desires, private sector interests, marketing, retail availability of foods, public health education and metabolic impacts of foods might be subtly altered between a “becoming fat” status quo assemblage and a “becoming slim” public health assemblage (Fox et al., 2016). Public health interventions tend towards failure because all the other elements in the “becoming fat” assemblage (foods, desires, retail, marketing, socio-economic drivers) stay the same (ibid.).

Fox and colleagues' focus on everyday examples of such assemblages exhibits a tenet of much of new materialist thinking: seeing broader processes and structures as imbued in everyday practice rather than structure being something ‘out there’ – a flat or ‘monist’ view of structure (ibid.:3; Anderson & Macfarlane 2011:125). Rather than rejecting structure entirely, “monism's rejection of ‘another level’ of structure or mechanisms means that, analytically, it is important that what may seem like a ‘local’ event is often part of a much broader assemblage, mediated through the multiplicity of each relation's affective connections” (Fox et al., 2016:5).

The implications of monism are methodological, requiring research into everyday instances of malnutritional embodiment as part of particular instances of these broader assemblages. Whilst new materialist or posthuman approaches have only been sparsely applied to under-nutrition in settings of low human development, there is potential to reinterpret existing contexts via a materialist lens. One potential might be to adapt feminist studies on breastfeeding in wealthier contexts to re-examine the merging of socio-material and environmental conditions of poverty with the ideologies and practices of a public health intervention. This would entail more attention to the ways in which certain material substances – breastmilk, colostrum, water, honey, pathogens, infant formula - come together in different ways to produce certain effects in certain infant bodies; and the human beliefs and decisions and ideologies that led to their coming together in the first place (Schwab, 1996; Holt, 2017). Such studies lead us to look more critically at public health assumptions about how infant ‘care’ ought be to provided and at what level responsibility lies (Smyth, 2012; Stearns, 2013). Charting different empirical cases represents a means to chart particular assemblages leading to particular embodied outcomes (infants that are breastfed, infants that are not); their dynamic feedbacks not only into behaviour but into public health regulation and control; and their overarching implications for embodied health and wellbeing through the lifecourse.

7. Concluding remarks: on concepts, frameworks, bodies and systems

Models and systems models are assumed in some disciplines to be modelling reality (e.g. Trochim et al. (2006: 540) and (Mabry et al., 2010)). But most perspectives described here would probably be classed better as employing concepts, or conceptual frameworks: “system [s] of concepts, assumptions expectations, beliefs and theories that support

[s] and inform [s]” our approaches (Maxwell, 2012: 39). They are heuristic (imperfect or ‘good-enough’) tools to help us think.

Heuristic frameworks dealing with the causes of malnutrition are, like systems, in a constant state of evolution as they catch up with the world(s) they depict. Because we cannot extend systemic boundaries indefinitely, concepts borrowed from systems theory have been helpful to look across systemic characteristics or emergent behaviours. This can be used to highlight the dangers of over-simplified versions of reality which still structure approaches to nutrition in many domains (‘eat better’, ‘more vitamin A’, or ‘grow more food’).

Despite its potential for resolving social science and natural science dualisms (Scoones, 1999; Gatrell, 2005), mainstream applications of systems science still owe their origins to a more mechanistic view of society, even while allowing for the more indeterminate, organic forms of nature. Such systems exhibit, therefore, a tendency to exclude people, their ideas and beliefs, bodily dispositions and visceral affects. Biopolitical approaches to the body and nutrition reviewed here, help “reinscribe” the primary of the social onto otherwise medicalised conceptions of bodies and their systems (Hayes-Conroy and Hayes-Conroy, 2008: 466) and are helpful in considering the representations and management of malnourished bodies as objects of political discourse and control.

Notably, systems depicted without bodies and such biopolitical influences are systems more amenable to medicalisation and biocultural control. But even public health conceptions of embodiment risk collapsing systemic experience into bodily experience, as Yates-Doerr writes of clients of nutrition clinics in Guatemala, who “are reminded that the social environment is accruing in their bodies ‘each and every day’ (in every bite of food, with every movement) and, as a result, encouraged to change their bodies by changing their social practice” (Yates-Doerr, 2017: 150). A posthuman or new materialist perspective “attempts to dissolve the human [or bodily] centrality by recognising relationships are dispersed and distributed, leading to a conceptualisation of health as a diffuse quality across diverse entities that include the human, but cannot be attributed solely to the human” (Cohn and Lynch, 2017: 287). Such perspectives can be seen as having mainstream parallels, for example in the recent Lancet series which considers ‘planetary health’ to be a distributed socio-natural phenomenon (Yates-Doerr, 2017: 154).

By this point, the appeal to new concepts is likely to exhaust most casual observers, echoing earlier discussion that CAS approaches provide endless opportunity for conceptual navel gazing (Hall and Clark 2010). This is not helped by the way new theories borrow from, appropriate and colonise a diverse range of theories and concepts, including non-western theories of nature/culture hybrids (Scheper-Hughes and Lock, 1987; Todd, 2016), making the philosophical territory both intricate and ripe for missteps and misapprehensions.

Notwithstanding these risks, when viewed as heuristics, posthuman, new materialist and assemblage perspectives reviewed here may offer something simply because they “conceive of issues in radically new ways so that different aspects might fall under scrutiny” (Cohn and Lynch, 2017). While one criticism of such approaches is that they also simply end up describing many things that relate together (Anderson & Macfarlane 2011:125), it matters that they do relate in an ‘affective’ relationship in which each element influences each other at that particular moment, something beautifully illustrated earlier in Bennet's examination of the ‘emergent causality’ of fats. Others have written similarly of finding “the patterns of difference that make a difference” (Barad 2007 cited in Solomon 2016: 182; see also Yates-Doerr, 2015: 231–2 citing Mol 2012). This may still make uncomfortable reading for some in undertaking the ontological, epistemological and political shifts from “identifying certainties, or defending absolutes [...] [to] opening up new spaces and relationships for engagement” (Cohn and Lynch, 2017: 289) but given the inadequacies of ‘solutions’ that have opened up so far, there is little choice but to embrace more diverse thinking about the causes of nutritional inequity.

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