Chapter 8

The 'Moral Paradox' of DOHaD

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8.1 Introduction

Knowledge of the molecular and physiological mechanisms of the Developmental Origins of Health and Disease (DOHaD) is no longer confined to the lab and/or to research. Rather, the idiom of DOHaD is part and parcel of a scattered landscape of policy initiatives; that is, endeavours directed at translating DOHaD's central tenets into political discourses, programmatic statements, as well as implemented public health measures. Policy initiatives around DOHaD both inspire new policy approaches in public health [1, 2] and cast a new outlook on several policy domains in our societies – crafting, in some cases, previously overlooked links between existing policies and novel opportunities for intergenerational health promotion [3].

Yet, the central policy messages of DOHaD research are not devoid of criticism, especially on the side of the social sciences and/or ethical, legal, and social aspects (ELSA) analyses. The reason is that translating DOHaD messages into policy means walking a difficult tightrope. On the one hand, the field has the political potential to illuminate the temporal extension and far-reaching implications of the social determinants of health [4]. What happens during the developmental period has ramifications that extend to the lifecourse of parents (not just the pregnant mother-to-be), much like to the relational, social, and material environment of gestating bodies, or the structural patterning of health inequalities in our societies. If anything, DOHaD is – to this reading – only a demonstration that social inequalities hit harder in developmental times. As such, DOHaD policies would be expected to lean towards a syndemic approach to health; that is, to affirm a holistic conception of health, which considers risks as biosocial complexes emerging at the intersection of biological predispositions as well as social and environmental modulators of disease [5]. On the other hand, scientific literature and circulating evidence often provide a rather different take-home message from DOHaD research. This message affirms the importance of maternal–offspring dynamics for the programming of adult health and only recently has expanded into a broader focus on periconceptional and family-related dynamics, including effects following the paternal line [6]. Key to the enactment of DOHaD findings is – to this alternative reading – behaviour change, parental (and especially maternal) lifestyles, and more generally responsible actions based on literacy of developmental effects. In a nutshell, the key policy objectives of DOHaD research are highly idiosyncratic and taken in a tension. What could be called the 'moral paradox' of DOHaD is the idea that, while the scope, foundations, and

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practical implications of DOHaD research call for structural interventions addressing social determinants of health over the lifecourse, DOHaD messages can at times boil down to simplistic claims of individual responsibility [7, 8].

In what follows, we attempt an explanation of these paradoxical implications of DOHaD research. We do so by offering a comprehensive analysis of claims towards *individual responsibilities* in the DOHaD literature. The chapter draws from a systematic literature review documenting the whole spectrum of policy and normative discourses in DOHaD research. Within this diverse set of policy interventions, the chapter unpacks the often-underlying normative claims pointing to the responsibilities of individuals (e.g. parents, parents-to-be, etc.). Complementing previous publications from our group [9–11], the literature review highlights the complexities of scientists' engagements with the moral and societal aspects of DOHaD research. Systematically analysing scientific publications allows us to unpack the intricate processes that bring about an economy of individual-oriented norms, responsibilities, and obligations [12] to the detriment of other ethical orientations of the field. DOHaD scientists, we argue, hardly make any straightforward argument in favour of individual responsibilities for health. The 'moral paradox' of DOHaD rather arises from an ambiguous stance on the possibilities of health promotion strategies inspired by DOHaD. This stance mixes up the current practical possibilities of the field with its policy framing, opportunities, and political ambitions.

By clarifying the normative scope and limitations of policy debates around individual responsibility in DOHaD research, we hope to prompt a deeper appreciation of the political ramifications of DOHaD knowledge and concepts. A higher awareness of the normative ambiguities and moral idiosyncrasies that raise critique of DOHaD research may help redefine the boundaries, priorities, objects, and representations of this research. In the discussion, we elaborate on how knowing the modalities and emergence of the 'moral paradox' of DOHaD calls into question the policy advocacies currently animating the field and points to the need for finally embracing the social justice framing of the field David Barker had hypothesised [2].

8.2 The Hyper-responsibilisation Critique of DOHaD Research

Several critiques have addressed normative and policy discourses in DOHaD research or the way its concepts and evidence circulate in the wider society. Anthropologist Megan Warin and colleagues have followed the genealogy of obesity discourses in Australia and highlighted the gender inequalities 'squeezed out' of Barker's hypothesis. How did his research programme – inaugurated with the discovery of a gendered socio-economic patterning of undernutrition and its effects on adult health – end up paradoxically reinforcing the social acceptability of a gendered stigma for obesity [13]? Along the same lines are those critiques that underline the reduction of the maternal body in DOHaD research to a 'vector' [14], or a 'capital' holder [15] for the healthy development of the child. According to these scholars, there is a risk that DOHaD research inspires a hyper-responsibilisation of women in contemporary societies [16]. Not only does DOHaD evidence replicate narratives of responsibilisation for women [17], but it also adds an ethics of stewardship and responsibility for future generations, which virtually extends over multiple generations [8, 18] (see also the chapters by Valdez and Lappé as well as Warin and Moore).

Others have shifted the focus of normative critique of DOHaD to studies of the epigenetic mechanisms of inheritance via the gametes – hence potentially *both* from the

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paternal and the maternal lines [10]. This line of research reaches beyond the intrauterine environment to include epigenetic predispositions via both parental gametes. While the increasing role assigned to paternal influences partly counterbalances 'the tendency to pin poor outcomes on maternal behaviour' [19], these attempts are not devoid of criticism. Besides raising questions as to their stereotypical treatment of paternal roles and responsibilities,[1] studies of *parental* effects still tend to support over-simplistic attributions of individual responsibilities. In fact, they only mark a switch to an extended version of gendered claims of individual responsibilities for health, which includes the environments, behaviours, life trajectories, and actions of the father (and fathers-to-be). In other words, the 'moral paradox' of DOHaD holds even without an exclusive gendered emphasis on women's bodies. We could in fact reformulate it as follows, by including also the injunction to protect one's gametes that virtually applies to *all* individuals of reproductive age: how did a research field founded on the socio-economic patterning of parental influences over development end up promoting discourses of individual behaviour change, *parental* responsibilities, and health literacy to promote the health of future generations? Let us turn to a tentative answer drawn from scientists' treatment of these normative matters in the DOHaD literature.

8.3 Methods and Materials

The literature review draws from peer-reviewed publications indexed on Web of Knowledge and follows the PRISMA guidelines for systematic literature reviews and meta-analyses [20]. Data collection took place between October 2020 and January 2021; source consultation and analysis were led by Luca Chiapperino (LC) and Cindy Gerber (CG) between March 2021 and December 2021. Francesco Panese (FP) and Umberto Simeoni (US) intervened later in data analysis. We searched Web of Knowledge for papers including the phrases '1000 days', 'developmental origin*', 'DOHaD', and 'fetal origin*', each accompanied by the specific search term 'polic*'. The star at the end of search terms allowed us to include papers using any derivative of these terms (e.g. in plural and singular forms). This database query returned different kinds of articles: reviews, editorial papers, perspective articles, commentaries, and theoretical discussions, much like empirical studies (n = 287). The substantive number of duplicate records across the different combinations of search terms (n = 93) hints at the evidence that '1000 days', 'DOHaD', or 'fetal origins' are often used interchangeably within the literature. After these duplicate items were removed from the database, CG and LC proceeded independently with the screening of records through abstract reading. This excluded a set of articles as out-of-topic items (n = 33). Either these articles did not inscribe themselves within DOHaD literature (e.g. they mentioned DOHaD for comparison, or in opposition to their subject matter) or they mentioned policy/policies in ways unrelated to translations of DOHaD in society (e.g. the manuscript mentioned policies on animal research or, more broadly, ethics policies governing research). The remaining records retrieved (n = 161) were grouped and imported into Nvivo for coding and analysis.

[1] Paternal influence is often confined to sperm-mediated effects, which calls into question how these studies may reconfigure gendered figurations of parental influences in DOHaD. We called this experimental and social construct the 'father-as-sperm' (10).

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A preliminary screening of sample records (n = 20) conducted by LC and CG revealed that some papers included a mention of policies that was rather abstract or rhetorical. With this, we mean papers that offered only a generic appeal to the 'need to bring DOHaD evidence closer to policy-making' without really expanding on the reasons, motives, nor the strategies and objectives to be achieved through these translations. We excluded these papers (n = 50) due to their poor informational value for the present analysis. This iterative screening, selection, and analysis retained a total of 111 articles, which were coded through Nvivo. Within this set of papers, 50 offered at least one reference for coding to potential policies and interventions addressed at individuals (e.g. behaviour change, lifestyle change, ensuring breastfeeding, and health responsibilities) or made an explicit mention of 'mothers, fathers and families' as 'critical agents for change in setting up healthier trajectories for their children' (e.g. [21]).

8.4 The 'Paradox' Explained: Ambiguities and Difficulties of Translating DOHaD into Policy

All papers included in the analysis argue – through different formulations and to different degrees – for 'a process of broad societal engagement' ensuring that individuals adopt 'DOHaD-informed practices as feasible, positive and lifelong options' [21]. Of note, even the articles offering a substantively individual-centred rhetoric (e.g. putting a strong emphasis on the need to inform/educate mothers-to-be about healthy lifestyles) still acknowledge that choices and lifestyles of individuals are tied to broader 'political or financial incentives' that could motivate people to 'change modifiable risk factors for adverse health outcomes' [22]. In simpler terms, the main result of our review is that *DOHaD researchers do not make straightforward arguments in favour of individual responsibilities for health*. We did not find a paper treating individual obligations to adopt a healthy lifestyle in the periconceptional period in isolation from the need to target institutional or collective factors. Rather, individual and collective, public and private actors eminently mix and overlap as those responsible for a societal implementation of DOHaD research. Some, for instance, plead for the 'establishment of properly functioning economic and financial structures which supports children from underprivileged households' [23]. Others argue for the reduction of exposures to environmental chemicals found in the air, water, and soil [24]. Researchers from the Global South argue that 'nutrition-sensitive agricultural investments' are required to achieve 'income generation and nutrition outcomes' [25]. Finally, even marketing regulation is a widely recommended measure by DOHaD researchers [22, 26].

Thus, the 'moral paradox' of DOHaD is partly explained at least by the ambiguities and challenges scientists face in elaborating these normative claims. DOHaD authors do recognise that the developmental patterning of health inequalities largely depends on structural configurations of our societies. However, when turning these considerations into values, norms, and expectations, they still reproduce figurations, claims, and expectations that situate action at the individual level. None of the articles we analysed dwells in fact on a simplistic injunction towards behaviour or lifestyle change to be promoted with policies that, for instance, 'simply [recommend] a "good diet" to optimizing nutrient delivery for the developing child' [27]. Rather, scientists' policy thinking often acknowledges the need to consider 'direct education, social marketing, and policy, systems, and environmental changes' that could accompany the promotion of 'healthy diets for mothers, infants, and young children in the first 1000 days' [27]. What seems to

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be missing from these different policy articulations of DOHaD is a recognition one could easily draw from the fairly developed body of social sciences and/or ELSA scholarship on these matters [8, 9, 28]. Healthy eating, lifestyle changes, and healthy behaviours during this crucial time – or, in normative terms, individual responsibilities to act on DOHaD knowledge – cannot really be separated from social, economic, and political structural conditions of agency – much like, it should be added, from other material determinants of programming such as genetic variation and stochasticity [11]. The responsibilities for epigenetic and developmental predispositions to disease can therefore hardly be handled individually, or 'easily' translated into practice through 'modifiable behaviours that can be targeted during pregnancy' such as 'diet and exercise' [29].

Of interest is how DOHaD authors guard their work against simplistic responsibility claims [1]. The publications we analysed often situate the objective of acting on the determinants of developmental programming, such as, for instance, maternal nutrition, within 'multisectoral and broad double-duty actions by policymakers' [26]. Yet, in most cases, these articles fail to advocate straightforwardly in favour of addressing these responsibilities as a collective matter. The 'moral paradox' of DOHaD thrives therefore in the following ambiguity: failing to underline and prioritise social and political interventions – instead of individual behaviour change – as critical instruments of health promotion policies. This is the reason, we argue, policy translations of DOHaD research lend themselves to critiques alleging them to reinforce the idea we are morally accountable for these predispositions as individuals. In what follows, we draw from our literature review to offer several illustrations of this ambiguous stance as it touches upon a) reflections on the actors in charge of enacting DOHaD knowledge; b) the concrete policy proposals DOHaD should inspire; and c) the kind of health promotion interventions derived from DOHaD knowledge.

8.4.1 Mothers, Fathers, Families, and Society: Who Are the Actors of Change?

A first striking ambiguity in DOHaD researchers' writing on public health policy and intervention relates to the actors they designate for social change and for producing the public health benefits of this knowledge. Reflections on the scale and distribution of agency inspired by DOHaD research are fundamentally blurred, and the discourses of scientists often waver on *who should be the bearer of responsible action* over evidence of developmental programming of health.

For instance, a recent review by clinical scientists Birgit Arabin and Ahmet Alexander Baschat [30] draws insights from research on the 'Barker hypothesis' and 'reverse Barker hypothesis' into reflections on intervention and public health policy. The former is the typical knowledge claim of DOHaD research: that is, the recognition that poor maternal health conditions accelerate the risks and susceptibility to chronic diseases in the offspring. The latter is instead the idea that evidence of health issues in pregnancy predicts also the mother's future health or even the grandparents' risk for chronic diseases. This knowledge base, the authors argue, positions pregnancy as a unique window of opportunity to protect the future health of the mother and the child, revealing that the 'disease risks' of 'today and tomorrow' are fundamentally linked [30].

If anything, one could read the evidence Arabin and Baschat mobilise as a demonstration that the *origins* of intergenerational health inequalities largely extend beyond pregnancy. These rather stem from the multi-generational reproduction of patterns of

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inequality that affect family units – see [31] for an example of DOHaD researchers developing this perspective. And, in fact, Arabin and Baschat do recognise that DOHaD and epigenetic 'findings relate to questions of social and environmental justice and not only to individual responsibility' [30]. However, at the same time, their article forecloses this normative and political reflexivity by putting forward suggestions for primary prevention that can be resumed into 'personalized care paths for mothers and infants' (p. 13). The social and historical processes patterning health inequalities through the developmental period get here evacuated to give way to an implementation of DOHaD as 'sentinel risk profiles', 'lifestyle interventions', and maternal health 'passports' – if they do not consist in explicitly leveraging the 'fact that pregnant women are more sensitive for healthcare advices' as 'a chance to intervene' during pregnancy (p. 13).

Reducing practical options for implementing DOHaD evidence to the actions and behaviours of pregnant women has consequences for the political potential of the field. We do not mean to suggest that we expect clinical scientists to formulate a coherent community-based or intergenerational social policy strategy for primary prevention of developmental susceptibilities to diseases. Nor are we focusing on Arabin and Baschat's paper because we consider it particularly problematic compared to others (see [6, 32]). Our point is a different one. As DOHaD gains relevance in policy settings, it becomes crucial that scientists adequately consider the complexity of the contextual and social dimensions of DOHaD effects. While we agree that pregnancy is an underestimated window of opportunity, we also warn DOHaD researchers against the conceptual slippage of mixing up those who are mostly *affected* (mothers and children) with those who *should act* upon the social, individual, and biological determinants of developmental programming. The risk is not simply of making advice inert and unspecific; that is, turning the complex temporal and socio-environmental ramifications of health into banal advice towards balanced lifestyles in preconception and pregnancy. Rather, this unwarranted conceptual move risks tanking the political implications of DOHaD for health promotion. Can the multi-generational effects of the social determinants of health be simply translated into an injunction towards responsible behaviours of parents-to-be? How are matters of families, communities, and the wider society, which have often also longer histories than the people affected, to be solved just through individual action?

8.4.2 Education, Education, and Education: How Effective Is It?

Education is the most frequent individual-level intervention discussed by DOHaD researchers. Although educational policies take many different forms, they often invite the translation of DOHaD-inspired health 'recommendations into simple messages provided through an attractive graphical format' [33]. This effective communication is the pivot of this kind of DOHaD translation, targeting 'specific consumer [and] groups' and inspiring behaviour change [33]. As a corollary, this also raises the question as to who should oversee this communication most effectively. For instance, nurses are at the centre of these debates, as arguments abound that claim that they are in a unique position 'to disseminate information and promote maternal and infant mental health at every level of policy advocacy, public education, primary prevention, screening and intervention' [34].

Health literacy and effective communication are also an issue DOHaD researchers problematise as part of scientific practices (e.g. making sure one's research reaches out to

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critical actors for change; [21]), or as crucial activities of scientific societies. This is, for instance, the case of the 'DOHaD Society of Australia and New Zealand' (DOHaD ANZ), which has established several working groups (WGs) – including one on 'Translation, Policy and Communication' – to promote the 'collective identity' of the field and advance its agenda in science and society. Educating at-risk individuals is one of the core strategies the society has given itself 'to decrease the incidence and severity of noncommunicable diseases in Australia and New Zealand' (p. 438). The WG 'Translation, Policy and Communication' reports on its activities in 'three broad areas: knowledge synthesis, communicating this knowledge and translating this knowledge' (p. 438). The point for its policy uptake, translation, and communication is just to keep the DOHaD message simple and present it consistently by taking into account 'the mindset of each user group' [35].

It could be questioned whether mass communications directed at individuals are an effective strategy of health promotion – and, incidentally, a good way to bring DOHaD closer to societal action, whether individual or collective. Although a body of work on 'right messages' in health communication is built on intuitive assumptions about the receptiveness of intended audiences, a whole social epidemiology literature exists on what some call 'communication inequalities' [36]. These inequalities result from social determinants (e.g. class, social networks, education access and quality, neighbourhood, and built environment) that act on health literacy – much like they do on the individual capacity to be an actor for change in one's health. Health literacy and its translation into responsible health-related behaviours go therefore *beyond the process of tailoring the right message to the right individual*: rather, literacy demands the empowerment of the individuals concerned and entails an interactional process between them and their social environments [37–39].

The issue of DOHaD-related education requires therefore that language, metaphors, and arguments adequately consider such multi-level and integrated views of literacy and behaviour change for health. A nuanced critique of the centrality of behaviour change for DOHaD-related policymaking can be found in a paper by DOHaD researchers Luseadra McKerracher and colleagues [40]. They show that DOHaD knowledge translation (KT) can be made compatible to different degrees with an emphasis towards social, community, and institutional change. First, they put forward the 'pragmatic and moral reasons' against DOHaD KT. Educational interventions, they argue, could be detrimental to mothers-to-be by placing 'yet another layer of psychological responsibility (essentially blame) on the[ir] shoulders' (p. 424). To prevent this outcome, DOHaD KT should take into consideration that individuals or communities 'of lower socioeconomic status' are often simply 'unable to prevent nutritional shortfalls, to avoid environmental contaminants, or to avoid (or reduce) psychological and/or physiological stress in the environments' (p. 424). It is thus 'morally arbitrary' to expect that improving the health literacy of parents-to-be suffices as a policy translation of this field.

Second, the authors plead for the centrality of DOHaD KT to individuals in the policy agenda of the field and consider it a duty 'to actively disseminate crucial information regarding pregnancy nutrition' (p. 424). There are, they maintain, a few 'teachable moments' (p. 423) at different life stages (e.g. adolescence and pregnancy) where the dissemination of health-related information may be effective. This is due to a combination of higher individual information-seeking and higher receptiveness and will to engage in behavioural change. The fact, the authors conclude, that 'expecting mothers/couples, or people planning pregnancies are not being targeted' represents 'a surprising

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gap' in current programmes. As problematic as DOHaD KT may be, the authors recommend to multiply and reinforce KT strategies in more receptive populations: access to information is a pillar of the policy translation of DOHaD [40].

McKerracher and colleagues attempt to formulate a balanced view concerning the importance of sustaining direct-to-public KT efforts. They underline the importance of KT all while ensuring 'that public institutions hold the lion's share of moral responsibility for ensuring environmental nutrition/health equity' (p. 425). Their strategy starts from the recognition that DOHaD researchers, much like the concerned individuals, cannot change the structural factors that shape 'developmental environments, developmental trajectories, disease risks over the lifecourse and long-term health outcomes' (p. 425). It also puts at the centre the importance of KT initiatives: parents-to-be, especially prospective mothers, ought to be informed while also being reassured about the fact that their 'capacity to improve their children's developmental environments, their bodies and behaviours' is just 'a small piece of a large and complex environmental puzzle' [40]. In the words of another DOHaD author critically addressing the field's emphasis on literacy and education, this issue should be treated with a nuanced view of what actions are really available to a given person in a given context: 'having information about healthier diets and some of the skills does not necessarily mean that choosing the healthier options is easy in today's society' [41].

8.4.3 Behaviour Change for the Sake of Pragmatism

Another conspicuous source of ambiguity in the policy discourses of DOHaD scientists stems from a mismatch between tools, ways of knowledge-making, and the scope of a clinical and/or public health science like DOHaD. While some pursue the line of research inaugurated by Barker's hypothesis (focusing on the populational effects of geographical and socio-economic conditions), current epigenetic studies of developmental programming in, for instance, a mother–child cohort often cast a far narrower outlook on these issues. This understanding of aberrant developmental effects during pregnancy is located in women's bodies, and the corresponding interventions are putatively supported by this evidence within the sphere of individual action and/or behaviour change. Thus, when presenting their results and their relevance for public health, DOHaD researchers often need to make multiple conceptual leaps: from the evidence produced at the individual level to a concept developed at the populational level; from the molecular mechanisms of developmental processes to the social and epidemiological factors that influence them; or even from the animal models providing mechanistic knowledge of developmental programming to the humans at the centre of clinical/primary prevention practice. Holding these multiple layers of evidence – and potential policy interventions – together is a difficult task. While awareness of the need to consider how all these factors interact is not lacking in the literature, a whole different task is to produce compelling evidence to intervene in these complex biosocial processes [42].

The challenge of holding together the individual and the collective, the clinical and the populational, the behavioural and the structural constitutes a third (and last) way DOHaD researchers end up legitimising – perhaps unwillingly – individual responsibilities for health. Take, for instance, a series of papers by influential DOHaD researchers – and contributors to this handbook – Mark Hanson, Peter Gluckman, and Lucilla Poston [1, 42, 43]. The complex social ramifications of DOHaD could not be stated in a clearer way in

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their work: 'if the result is a culture of blame or shame, the resistance to change induced [by DOHaD] will make the battle against NCD[s] even harder' [43]. And yet, these authors also affirm that there are 'pragmatic' reasons to support and promote lifestyle improvements in 'women and young girls', much like in 'men' and 'adolescents' [43].

With pragmatism, Hanson, Gluckman, and Poston have in mind an argument we partly encountered already above: there exist 'teachable moments' during anyone's lifetime that are a promising opportunity for an investment into health literacy with long-term consequences. Educating adolescents could have a dramatic impact on individual 'self-efficacy' and capacity 'to make decisions about lifestyle themselves' [43]. Therefore, although 'sensitivity' and a 'focus on empowerment' are paramount [43], translations of DOHaD knowledge into policy cannot afford to give up on the promotion of behaviour change and healthy lifestyles in vulnerable populations. The challenge for DOHaD scientists is striking the right balance between the need to offer 'evidence-informed strategies and where possible [also] pragmatic solutions' [1]. More than formulating a theory of DOHaD-inspired health justice, the challenge of DOHaD researchers is what can be 'back [ed] with impunity' [1], or what 'policy interventions may be most efficacious' [44].

While tapping into the political potential of DOHaD would encompass 'population-based complex interventions', the efforts of DOHaD researchers are limited by available evidence and the affordances of the science they practice. Policy translations that support lifestyle changes for women and their partners are often simply 'a more immediate message' [1], which they can offer with assurance and factual support. This raises the question of what DOHaD scientists can do from where they stand. In the absence of a complex, systems-based approach to the multi-generational mechanisms of developmental programming and the social determinants of health, the promotion of individual responsibilities for health – although tempered by DOHaD scientists' own critical reflexivities – appears to be a policy option with strong practical hold.

8.5 Discussion

Our systematic and critical review reveals that DOHaD scientists are no less concerned than public health advocates or ELSA scholars with the pathogenic environments and the social determinants of health that modulate developmental predispositions to adult disease. While they do not lack awareness of the relevance of these complex and multi-level processes for DOHaD thinking, they also know too well that reordering those socio-material circumstances is beyond their reach. As one gets closer to the ways DOHaD scientists write about individual agencies, parental behaviours, maternal/paternal lifestyles, and periconceptional health promotion, one cannot but notice their difficult position. On the one hand, they deplore the social, environmental, and multi-generational inequalities that pattern developmental exposures and reproduce health inequities in our societies. On the other hand, they lack the evidence (validated knowledge), tools, and influence to fully take issue with the complex biosocial origins of developmental programming and act upon the structural problems that interfere with periconceptional health behaviours, gestational lifestyles, or infant health. In the face of this situation, what remains open to these practitioners is the possibility to address DOHaD knowledge and advice to parents-to-be, pregnant women, prospective fathers, or couples in a reproductive project. Hence, the primary finding of our critical review is that the 'moral paradox' of DOHaD gets in part explained by *the challenges scientists face*

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when elaborating upon the policy options backed up by their research and practice. A thorough appreciation of their situatedness reveals that appeals towards individual responsibility in DOHaD are far from being (yet) another neoliberal disciplining strategy for health promotion. Quite the contrary, they are a suboptimal compromise. It is the necessity of tailoring the complex policy messages of DOHaD to the concrete opportunities for action and change available to most periconceptional health practitioners. To them, what is better, rather than worse, in the absence of an opportunity for structural change, is to encourage and educate prospective parents to become the actors for change and protect the health of their future children.

This does not mean that the hyper-responsibilisation critique we highlighted above is misplaced or unfounded. The truth is that, although grounded on pragmatic reasons, the public policy strategies of DOHaD researchers often boil down to providing mothers, fathers, and families with the 'right' information and to warning them about the long-term health consequences of their lifestyles and behaviours. In this respect, social scientists and ELSA scholars hit the right note when writing about (what we call) the 'moral paradox' of DOHaD. By foreclosing the reflexivity on the syndemic and multi-level implications of their knowledge, DOHaD scientists offer an ambiguous societal uptake of this evidence. This paradoxically ends up reinforcing problematic discourses of individual responsibility for health, especially in their uneven, gendered version that overburdens pregnant women and mothers-to-be. By targeting health behaviours as a main interventional strategy within their reach, DOHaD authors hamper the production of more elaborate policy imaginaries flowing out of their field. Thus, the hypothesis by David Barker that gestational socio-economic hardship translates into an unequal distribution of non-communicable adult disease turns into an admonishment to individuals on how to behave 'best', urging them to take the kind of control over their health that may simply be unaffordable to them from their own social and environmental positionality. Here lies our second conclusion: the 'moral paradox' of DOHaD represents an ambiguous normative stance that mixes up the pragmatic possibilities of clinical and public health sciences with the policy discourses, practical ambitions, and political potential of a scientific field.

So, what can scientists do to avoid this situation? Taking scientists' situatedness seriously, no ready-made solution exists to complexify DOHaD knowledge and its policy translations. This notwithstanding, scientists could at least embark upon two kinds of concrete actions that might defuse the 'moral paradox' of DOHaD. *First*, they could make explicit the tensions highlighted above at the core of their research: between the individual intervention and the social aetiology of a condition, between the behavioural recommendation and the need for political/structural change, between the tools and knowledge of biomedical sciences and the possibilities of populational health research, or, finally, between mechanistic knowledge and the need to remove the so-called 'causes of the causes' of diseases [4]. When discussing their data, presenting their results, and, especially, when positioning their science's implications for policy and society, they could explicitly acknowledge that what can be proven in the context of their research does not capture the complex biosocial dynamics that bring about these phenomena in the real world. DOHaD scientists could – as some of the authors we studied have already done – clearly state in their writing that the individual 'capacity to improve . . . children's developmental environments, their bodies and behaviours' is just 'a small piece of a large and complex environmental puzzle' [40]. While the knowledge they produce is of immense value to shed light on bits and pieces of this puzzle, they can advocate caution

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in extrapolating general solutions from partial knowledge. If such a provision were systematically part of the discussion sections of DOHaD papers investigating any of the biological, behavioural, relational, social, structural, and environmental dimensions of early-life programming (studied in conjunction, as much as in isolation – as they often are), there would be little doubt about the policy framings of DOHaD research. The 'moral paradox' of DOHaD would simply be dispelled.

Second, another opportunity to counter the 'paradox' is to ensure that explanations, interventions, and policy discourses support or initiate social interventions in relevant developmental windows and biosocial pathways of disease. This is, of course, easier said than done, as detailed by sociologist Michael Penkler in the context of DOHaD studies of social-biological transitions [45] leading to diseases [46]. The challenge is not simply identifying early-life predictive (epigenetic) biomarkers of relevance to adult disease [47]. Rather, it resides also in the identification of the structural 'windows of plasticity' and intervention in body–environment interactions [48]. Resilience and reversibility of programming processes at different life stages are also largely unexplored corollaries of DOHaD evidence; a far more complex biopsychosocial approach to early life in research settings is in order for the proliferation of different DOHaD policy discourses.

The present work has tried to sketch a few points of normative ambiguity in scientific writing as potential paths of improvements for the social and political circulation of DOHaD research. In the wish to make social science critique instructive of novel avenues of biosocial research, these suggestions should be read as no more than an analytical contribution to finally dispel the 'moral paradox' of DOHaD. And, perhaps, also as a contribution to a collaborative push to unleash DOHaD's full political potential for social reform, development, and change.

References

1. Hanson MA, Poston L, Gluckman PD. DOHaD – The challenge of translating the science to policy. Vol. 10, Journal of Developmental Origins of Health and Disease. Cambridge: Cambridge University Press; 2019. pp. 263–7.
2. Jacob CM, Hanson M. Implications of the Developmental Origins of Health and Disease concept for policy-making. Current Opinion in Endocrine and Metabolic Research. 2020 1 Aug;13:20–7.
3. Goodman JM, Boone-Heinonen J, Richardson DM, Andrea SB, Messer LC. Analyzing Policies Through a DOHaD Lens: What Can We Learn? Vol. 15, International Journal of Environmental Research and Public Health. Basel: MDPI; 2018: Article 2906.
4. Marmot M. Inclusion health: Addressing the causes of the causes. The Lancet. 2018 20 Jan;391(10117):186–8.
5. Singer M, Bulled N, Ostrach B, Mendenhall E. Syndemics and the biosocial conception of health. The Lancet. 2017 Mar;389(10072):941–50.
6. Soubry A. POHaD: Why we should study future fathers. Vol. 4, Environmental Epigenetics. Oxford: Oxford University Press; 2018. https://academic.oup.com/eep/article/4/2/dvy007/4987171
7. Meloni M, Testa G. Scrutinizing the epigenetics revolution. BioSocieties. 2014;9(4):431–56.
8. Penkler M, Hanson M, Biesma R, Müller R. DOHaD in science and society: Emergent opportunities and novel responsibilities. Journal of Developmental Origins of Health and Disease. 2018;10:268–73. www.cambridge.org/core/

https://doi.org/10.1017/9781009201704.010 Published online by Cambridge University Press

journals/journal-of-developmental-origins-of-health-and-disease/article/dohad-in-science-and-society-emergent-opportunities-and-novel-responsibilities/A8395958BF322CE66429E1D2728AA6E6

9. Chiapperino L. Epigenetics: Ethics, politics, biosociality. British Medical Bulletin. 2018 1 Dec;128(1):49–60.
10. Chiapperino L, Panese F. Gendered imaginaries: Situating knowledge of epigenetic programming of health. Sociology of Health & Illness. 2018 1 Sep;40(7):1233–49.
11. Chiapperino L. Luck and the responsibilities to protect one's epigenome. Journal of Responsible Innovation. 2020;7(2):S86–S106. www.tandfonline.com/doi/full/10.1080/23299460.2020.1842658.
12. Fassin D. Moral economies revisited. Annales Histoire, Sciences Sociales. 2009 1 Dec;64th Year(6):1237–66.
13. Warin M, Moore V, Zivkovic T, Davies M. Telescoping the origins of obesity to women's bodies: How gender inequalities are being squeezed out of Barker's hypothesis. Annals of Human Biology. 2011 Jul;38(4):453–60.
14. Richardson SS, Stevens H, editors. Postgenomics: Perspectives on Biology after the Genome. Durham, NC: Duke University Press; 2015. 294 p.
15. Wells JCK. Maternal capital and the metabolic ghetto: An evolutionary perspective on the transgenerational basis of health inequalities. American Journal of Human Biology. 2010 Jan;22(1):1–17.
16. Richardson SS. The Maternal Imprint: The Contested Science of Maternal–Fetal Effects. Chicago: University of Chicago Press; 2021. 318 p.
17. Pentecost M, Ross F. The first thousand days: Motherhood, scientific knowledge, and local histories. Medical Anthropology. 2019 4 Apr;0(0):1–15.
18. Pentecost M, Meloni M. The epigenetic imperative: Responsibility for early intervention at the time of biological plasticity. The American Journal of Bioethics. 2018 2 Nov;18(11):60–2.
19. Richardson SS, Daniels CR, Gillman MW, Golden J, Kukla R, Kuzawa C, et al. Society: Don't blame the mothers : Nature News & Comment. Nature. 2014 14 Aug;512:131–2.
20. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. BMJ. 2021 29 Mar;372:n71.
21. Norris SA, Daar A, Balasubramanian D, Byass P, Kimani-Murage E, Macnab A, et al. Understanding and Acting on the Developmental Origins of Health and Disease in Africa Would Improve Health across Generations. Vol. 10, Global Health Action. Abingdon: Taylor & Francis Ltd; 2017.
22. Arabin B, Timmesfeld N, Noever K, Behnam S, Ellermann C, Jenny MA. How to improve health literacy to reduce short- and long-term consequences of maternal obesity? Vol. 32, Journal of Maternal-Fetal & Neonatal Medicine. Abingdon: Taylor & Francis Ltd; 2019. pp. 2935–42.
23. Akombi BJ, Agho KE, Hall JJ, Merom D, Astell-Burt T, Renzaho AMN. Stunting and severe stunting among children under-5 years in Nigeria: A multilevel analysis. BMC Pediatrics. 2017 13 Jan;17:1–16.
24. Barouki R, Gluckman PD, Grandjean P, Hanson M, Heindel JJ. Developmental origins of non-communicable disease: Implications for research and public health. Environmental Health. 2012 20 Jun;11: Article number 42. https://ehjournal.biomedcentral.com/articles/10.1186/1476-069X-11-42#citeas.
25. Albert J, Bogard J, Siota F, McCarter J, Diatalau S, Maelaua J, et al. Malnutrition in rural Solomon Islands: An analysis of the problem and its drivers. Maternal and Child Nutrition. 2020 Apr;16(2):1–12.
26. Schott W, Aurino E, Penny ME, Behrman JR. The double burden of malnutrition

https://doi.org/10.1017/9781009201704.010 Published online by Cambridge University Press

among youth: Trajectories and inequalities in four emerging economies. Economics & Human Biology. 2019 Aug;34(SI):80–91.

27. Schwarzenberg SJ, Georgieff MK, Nutr C. Advocacy for improving nutrition in the first 1000 days to support childhood development and adult health. Pediatrics. 2018 Feb;141(2):e20173716. https://doi.org/10.1542/peds.2017-3716
28. Dupras C, Saulnier KM, Joly Y. Epigenetics, ethics, law and society: A multidisciplinary review of descriptive, instrumental, dialectical and reflexive analyses. Soc Stud Sci. 2019 Oct 1;49(5):785–810.
29. Bansal A, Simmons RA. Epigenetics and developmental origins of diabetes: Correlation or causation? American Journal of Physiology-Endocrinology and Metabolism. 2018 Jul;315(1):E15–28.
30. Arabin B, Baschat AA. Pregnancy: An Underutilized Window of Opportunity to Improve Long-term Maternal and Infant Health-An Appeal for Continuous Family Care and Interdisciplinary Communication. Vol. 5, Frontiers in Pediatrics. Lausanne: Frontiers Media SA; 2017.
31. Lewis AJ, Galbally M, Gannon T, Symeonides C. Early life programming as a target for prevention of child and adolescent mental disorders. Vol. 12, BMC Medicine. London: BMC; 2014.
32. Barnes MD, Heaton TL, Goates MC, Packer JM. Intersystem implications of the developmental origins of health and disease: Advancing health promotion in the Twenty-first century. Healthcare. 2016 Sept;4(3).
33. Koletzko B, Brands B, Grote V, Kirchberg FF, Prell C, Rzehak P, et al. Long-term health impact of early nutrition: The power of programming. Annals of Nutrition and Metabolism. 2017;70(3):161–9.
34. DeSocio JE. Epigenetics, maternal prenatal psychosocial stress, and infant mental health. Vol. 32, Archives of Psychiatric Nursing. Philadelphia, PA: W B Saunders CO-Elsevier INC; 2018. pp. 901–6.
35. Prescott SL, Allen K, Armstrong K, Collins C, Dickinson H, Gardiner K, et al. The establishment of DOHaD working groups in Australia and New Zealand. Vol. 7, Journal of Developmental Origins of Health and Disease. Cambridge: Cambridge University Press; 2016. pp. 433–9.
36. Viswanath K, Emmons KM. Message effects and social determinants of health: Its application to cancer disparities. Journal of Communication. 2006 1 Aug;56(suppl_1):S238–64.
37. Tengland PA. Empowerment: A goal or a means for health promotion? Medicine, Health Care and Philosophy. 2007 Jun;10(2):197–207.
38. Tengland PA. Empowerment: A conceptual discussion. Health Care Analysis. 2008 Jun;16(2):77–96.
39. Ishikawa H, Kiuchi T. Health literacy and health communication. Biopsychosoc Med. 2010 Nov 5;4:18.
40. McKerracher L, Moffat T, Barker M, Williams D, Sloboda DM. Translating the Developmental Origins of Health and Disease concept to improve the nutritional environment for our next generations: A call for a reflexive, positive, multi-level approach. Vol. 10, Journal of Developmental Origins of Health and Disease. Cambridge: Cambridge University Press; 2019. pp. 420–8.
41. Levy LB. Food policy and dietary change. Proceedings of the Nutrition Society. 2009 May;68(2):216–20.
42. Gluckman PD, Hanson MA. Developmental plasticity and human disease: Research directions. Vol. 261, Journal of Internal Medicine. Malden, MA: Wiley-Blackwell; 2007. pp. 461–71.
43. Hanson MA, Gluckman PD. Developmental origins of health and disease: Moving from biological concepts to interventions and policy. International Journal of Gynaecology and Obstetrics. 2011 Nov;115 Suppl 1:S3–5.

https://doi.org/10.1017/9781009201704.010 Published online by Cambridge University Press

44. Gluckman PD, Hanson MA, Low FM. Evolutionary and developmental mismatches are consequences of adaptive developmental plasticity in humans and have implications for later disease risk. Vol. 374, Philosophical Transactions of the Royal Society B-Biological Sciences. London: Royal Soc; 2019: Article number: 20180109. https://royalsocietypublishing.org/doi/10.1098/rstb.2018.0109.

45. Blane D, Kelly-Irving M, D'Errico A, Bartley M, Montgomery S. Social-biological transitions: How does the social become biological? Longitudinal and Life Course Studies. 2013;4(2):136–46.

46. Penkler M. Caring for biosocial complexity. Articulations of the environment in research on the Developmental Origins of Health and Disease. Studies in History and Philosophy of Science. 2022 Jun;93:1–10.

47. Shanthikumar S, Neeland MR, Maksimovic J, Ranganathan SC, Saffery R. DNA methylation biomarkers of future health outcomes in children. Molecular and Cellular Pediatrics. 2020 9 Jul;7(1):7: Article number 7. https://molcellped.springeropen.com/articles/10.1186/s40348-020-00099-0.

48. McEwen BS. Allostasis and the epigenetics of brain and body health over the life course: The brain on stress. JAMA Psychiatry. 2017 Jun 1;74(6):551–2.

https://doi.org/10.1017/9781009201704.010 Published online by Cambridge University Press