

6-1-2021

Translating developmental origins of health and disease in practice: health care providers' perspectives.

Monica L Molinaro

Marilyn Evans

Timothy Regnault
Western University, tim.regnault@uwo.ca

Barbra de Vrijer
barbra.devrijer@lhsc.on.ca

Follow this and additional works at: <https://ir.lib.uwo.ca/paedpub>




Part of the [Pediatrics Commons](#)

Citation of this paper:

Molinaro, Monica L; Evans, Marilyn; Regnault, Timothy; and de Vrijer, Barbra, "Translating developmental origins of health and disease in practice: health care providers' perspectives." (2021). *Paediatrics Publications*. 2781.

<https://ir.lib.uwo.ca/paedpub/2781>

Translating developmental origins of health and disease in practice: health care providers' perspectives

Monica L. Molinaro¹ , Marilyn Evans², Timothy R.H. Regnault^{3,4,5}
and Barbra de Vrijer^{4,5,6}

Original Article

Cite this article: Molinaro ML, Evans M, Regnault TRH, and de Vrijer B. (2021) Translating developmental origins of health and disease in practice: health care providers' perspectives. *Journal of Developmental Origins of Health and Disease* **12**: 404–410. doi: [10.1017/S2040174420000483](https://doi.org/10.1017/S2040174420000483)

Received: 22 August 2019
Revised: 1 May 2020
Accepted: 5 May 2020
First published online: 23 June 2020

Keywords:

Developmental Origins of Health and Disease; qualitative; counselling; knowledge translation

Address for correspondence:

Barbra de Vrijer MD, FRCSC, Maternal Fetal Medicine Consultant, Associate Professor, Western University, Associate Scientist, Children's Health Research Institute, Division of Maternal Fetal Medicine, Department of Obstetrics and Gynaecology, London Health Sciences Centre, Victoria Hospital, 800 Commissioner's Road E, Room B2-412, London, Ontario N6A 3B4, Canada. Tel: 519 6858500, Ext: 64052; Fax: 519 6466213.
Email: Barbra.deVrijer@lhsc.on.ca

¹Graduate Program in Health and Rehabilitation Sciences, Western University, London, Ontario, Canada; ²Department of Nursing, Western University, London, Ontario, Canada; ³Department of Physiology and Pharmacology, Western University, London, Ontario, Canada; ⁴Department of Obstetrics and Gynecology, Schulich School of Medicine and Dentistry, Western University, London, Ontario, Canada; ⁵Children's Health Research Institute, London, Ontario, Canada and ⁶Lawson Health Research Institute, London, Ontario, Canada

Abstract

Currently, there is limited knowledge on how health care providers perceive and understand the Developmental Origins of Health and Disease (DOHaD), which may impact how they inform patients and their families throughout the perinatal period. This qualitative descriptive study explored if and how health care providers counsel on in utero programming and future health outcomes with parents, both preconception and during pregnancy. One-on-one, semi-structured interviews were conducted with 23 health care providers from varying health disciplines including obstetrics and gynaecology, midwifery, paediatrics, endocrinology and internal medicine. Audiotaped interviews were transcribed verbatim and analysed using inductive thematic analysis. Three themes were identified: Knowledge about DOHaD, Counselling on DOHaD in Practice Settings and Impact of DOHaD on Health. Health care providers not only expressed excitement over the potential health benefits of DOHaD counselling but also indicated barriers to knowledge translation, including a lack of knowledge among providers and a disconnect between basic scientists and practitioners. All health care providers expressed concerns on how and when to introduce the concept of DOHaD when counselling patients and called for the development of practice guidelines. Counselling on DOHaD needs to be framed in a way that is empowering, minimising the potential of coercion and guilt. More interaction and collaboration are needed between health care providers and researchers to identify strategies to support knowledge translation generated from DOHaD research into practice settings.

Introduction

The period from conception to early childhood is considered critical for human growth and development.^{1–3} Specifically, the first 1000 d after conception form the basis of a child's future risk for obesity, diabetes, cardiovascular disease and other non-communicable diseases (NCD). This concept is commonly known as the Developmental Origins of Health and Disease (DOHaD).^{4–8} Currently, there are many public health initiatives based around NCDs that could be amalgamated by applying the DOHaD perspective.⁹ However, in many health care professions, there is a dearth of DOHaD research and knowledge.^{9,10} Knowledge translation or 'the process of communicating research-based knowledge to the people and organisations positioned to use such knowledge in their private lives, in their work or in the formation/reformation of policies in institutions' (Canadian Institutions for Health Research¹¹ found in McKerracher *et al.*¹² p. 421) has been highlighted as imperative for understanding DOHaD-related topics.^{3,13} In particular, the growing body of research evidence on developmental programming calls for training of physicians and other health professionals about the importance of DOHaD,^{3,13} and identifying barriers and facilitators to translation and use of this knowledge in practice settings.

Best approach for front-line clinicians to use for counselling expectant families on DOHaD has yet to be determined. Counselling on complex topics such as DOHaD has been a perpetual object of inquiry in health education research.^{14–17} Health care providers have expressed difficulty counselling patients due to factors such as time constraints, administrative expectations and lack of communication skills to discuss sensitive topics, such as smoking cessation, weight gain and gestational diabetes.^{15,17–20} Other challenges include a lack of uniformity in counselling among physicians, or whether physicians counsel at all.^{21–23} Some qualitative research has been conducted to understand the concerns of health care providers counselling pregnant women and their families on perinatal concerns, and has highlighted barriers to counselling such as willingness and capability to make changes, time constraints and a lack of clinical guidelines.^{24,25} However, these studies are typically on a specific group of health care providers²⁵ or focus on

specific topics (e.g., obesity) within the DOHaD paradigm.^{24,26,27} Our study, thus, aimed to understand a variety of health care providers' perspectives on developmental programming, and how best to facilitate practitioners' uptake of DOHaD and related issues to apply in clinical practice.

Increased understanding of health care providers' knowledge and perception of DOHaD and its implementation into clinical practice can serve to inform strategies for effective knowledge translation and counselling practices from a variety of disciplines. The purpose of this study was to explore from the health provider perspective how DOHaD knowledge can be effectively integrated in clinical practice. The objectives of this study were to explore: 1) how clinicians providing care to patients from preconception to the first 2 years of life and treating chronic diseases like to learn about DOHaD; 2) what factors influence counselling on developmental programming to patients; and 3) how knowledge translation about DOHaD can be enhanced in reproductive health care practice.

Methods

Ethics approval was obtained from Western University's Health Science Research Ethics Board (REB 109157) prior to starting the study. This study followed a naturalistic paradigm and used a qualitative descriptive design²⁸ to collect rich data on health providers' perceptions about DOHaD and how they counsel patients on the topic. Qualitative descriptive design offers a flexible method well suited to reveal and describe at a manifest level individuals' experiences with less emphasis on abstraction than other qualitative methodologies.^{29,30}

Sample

A purposive sample of health care providers was invited to participate in the study. Eligibility criteria included being a licensed and registered health care provider in the province of Ontario, over 18 years of age, providing care in reproductive health or NCD and being fluent in English orally and in writing. Participants were recruited via departmental emails which outlined the purpose of the study. Referrals to the study via word of mouth and through snowball sampling were also used.³¹ Interested participants contacted the researcher directly via email.

Data collection

One-on-one semi-structured interviews were scheduled at a convenient time and place for the health care provider. Written informed consent was obtained from all participants prior to data collection. Interviews lasted approximately 60 min and were conducted in-person at the offices of the providers (19) or by phone (4) between July and November 2017. Using an interview guide (Table 1), topics such as knowledge of DOHaD, concerns regarding counselling and perceived barriers to knowledge translation were covered. The interviews were open and conversational in style and prompts were used as needed to generate further in-depth information from participants. The interviews were digitally recorded and transcribed verbatim by trained typists at Transcript Heroes™. Identifying information was removed from the transcripts.

Data analysis

Thematic analysis, as described by Braun and Clarke,³² was used for data analysis and supported by NVivo™ 11.4.3 software (QRS International Proprietary Limited, Doncaster, Victoria, Australia). Data collection and data analysis occurred concurrently, and recruitment continued until it was determined no new themes emerged and data saturation was reached.³³ All transcripts were initially read while listening to the audiotapes to ensure accuracy and completeness. They were subsequently read in their entirety to gain a sense of familiarity with what was stated. Two research team members (MM, ME) read and re-read the transcripts and independently engaged in open line by line coding of the transcripts, identifying and labelling words or phrases.

The first author (MM) who has experience using different qualitative methodologies and the second author (ME) an expert on qualitative research, discussed, compared and modified the initial codes and similar codes were then grouped into preliminary themes. The research team reviewed and modified the preliminary themes, and through group consensus, the final themes were identified. The transcripts were re-read to then highlight direct quotes from the participants which reflected the themes. To establish the study's integrity, trustworthiness was ensured throughout the study.³⁴ This was done through investigator triangulation in the analysis process and reflective journaling to capture ideas, thoughts, insights and biases of the researchers. Multivocality³⁵ was also emphasised by collecting and highlighting the perspectives of multiple health care providers, further establishing the study's rigour.

Results

Participants

The final sample consisted of 23 health care providers who practiced in Southwestern Ontario: four obstetrician/gynaecologists (OB/GYN), four family physicians (FAM), three midwives (MidW), two endocrinologists (ENDO), two internal medicine generalists (IntM), four maternal fetal medicine specialists (MFM) and four paediatricians (PED).

Themes

Three themes were identified which together describe the health providers' knowledge, perception and experience of incorporating DOHaD topics into practice settings.

Theme 1: knowledge about DOHaD

This theme concerns the health care providers' level of knowledge about developmental programming and their perceptions of what their patients know. Some mentioned their knowledge of DOHaD and its related topics was due to educational opportunities relevant to their discipline, while others commented having limited or no training on the topic. One midwife stated that 'there isn't any focus on, developmental origins of health in midwifery curriculum'. (MidW1).

The participants contended that providers' expertise and specialty, clinical interest, proximity to an academic institution and patient characteristics (i.e., a child or pregnant person) contribute to varying levels of knowledge about DOHaD-related topics. Although the level of knowledge on DOHaD varied among the

Table 1. Interview questions

Interview question	Probes
1. To start, could you tell me a bit about your practice? For instance, what kind of a practitioner are you?	a. What kind of individuals do you typically see? b. What kind of settings do you work in?
2. What do you know about how the health of the parents before, during and after pregnancy affects the health of the baby?	a. Do you feel you know enough about this? b. If not, do you have any ideas on why this knowledge has not been translated into clinical practice? c. How informed do you think that your colleagues or other individuals in your position are informed about developmental origins?
3. What do you think patients know about how the health of the parents affects the health of their baby before, during and after pregnancy?	a. How do you think patients obtain this information? b. How do you think it affects their life and the choices they make?
4. What impact does the subject of developmental origins and your comfort level with the subject have on you and the way you counsel patients?	a. Do you ever counsel your patients about how their health before and during pregnancy and in the first 2 years of the baby's life affects the risk for obesity, diabetes and cardiovascular disease? b. If so, how do you frame it for your patients; 1) before, 2) during, or 3) after pregnancy? c. Do you struggle with this type of counselling, and if so, why? d. Have you ever consciously decided not to counsel patients about this and if you have, why did you make this decision? e. What impact does the subject of developmental origins and your comfort level with the subject have on you and the way you practice?
5. In your opinion, in which ways does developmental origins and your comfort level with the subject have on you and the way you counsel patients?	a. What do you believe are the consequence and the severity of these consequences? b. Are there any other individuals who may be affected?
6. What excites you about developmental origins?	
7. What worries you about developmental origins?	
8. Is there anything else you would like to mention that you think is of importance?	

participants, all stated that they were willing and interested in learning more.

The health care providers claimed expectant parents' knowledge regarding DOHaD topics and developmental programming as 'at a superficial level' (MFM1) and that many do 'not really understand the necessary implications for later on in life with childhood or adulthood' (MFM3). Women were described as being more concerned about their health during pregnancy, but 'I don't know that they necessarily have an understanding of some of the pre-conceptual things that might be important, or the things that they can't actually modify during the pregnancy' (MFM1). Others mentioned that parents' concerns about the well-being of the fetus and the pregnancy were more immediate than on future developmental outcomes for their expected child. Overall, participants considered developmental programming to be a 'difficult concept' (MFM3) for most people to understand.

Some providers reported pregnant women's knowledge of DOHaD to be dependent on pre-existing medical conditions or past pregnancy experiences, such as pregnancy complications or high blood pressure. However, one obstetrician-gynaecologist highlighted a lack of knowledge regarding obesity and pregnancy: 'Um, obesity would be an extremely good example of how moms don't know what the impact of their personal obesity has on their baby' (OB/GYN2).

Participants mentioned that although women ask questions about making necessary lifestyle modifications during pregnancy, it is difficult to know if they understand the long-term implications for their child. This point was reiterated by a maternal fetal medicine specialist, who also stressed that pregnant women may only grasp the immediate health implications of a pregnancy complication for the fetus rather than future outcomes for their child.

I don't think they necessarily translate that to: is your child later on in life going to be at risk of developing hypertension or having growth problems because their endocrine system has been reprogrammed in some way to deal with a lack of nutrient delivery and a stressful environmental hypoxia, and they're going to develop differently going forward. (MFM3)

Incorporating evidence about developmental programming into practice was revealed as a challenge. Providers described current research on DOHaD is still emerging and 'we don't know what the magnitude is or what we can actually modify' (MFM1). One obstetrician felt uninformed on the latest evidence and expressed the need for constant updates on the topic. Participants mentioned that their knowledge needs regarding DOHaD have begun to be addressed by research; however, clinical research regarding pregnant women was considered sparse.

The providers also expressed that current knowledge translation strategies for DOHaD are inadequate for knowledge uptake: '... all the information isn't necessarily in the most practitioner friendly formats, so there's a ton of it, especially in journals but, you know, primary care people don't read specialty journals. And second is it's not taught very well' (PEDS2). Many also suggested that there needs to be more collaboration between basic researchers and clinicians to address the gap between basic research and practice.

Theme II: counselling on DOHaD in practice settings

Counselling patients on DOHaD was perceived as difficult for a variety of reasons. The first concern was prioritising a discussion of DOHaD topics with patients; in particular, providers mentioned being considerate of other aspects of patients' health that were 'imminently more at hand, you know you've got a patient who's coming in depressed and that's really the focus of the visit'

(FAM4). The providers emphasised the need to address more pressing matters affecting patients in the short term before considering counselling on developmental programming. One participant mentioned having to focus on intimate partner violence and women's safety:

I had one patient who didn't have a lock on her door. That was all we worked on. We didn't do sugar screening 'cause we just had to keep her safe . . . she was not worried about what was gonna happen to her adult child. We were just focused on her not getting beat up in the pregnancy. (OB/GYN1)

Providers also expressed feeling pressured by time constraints, high patient loads and being unable to 'spend the appropriate amount of time with the patients' (OB/GYN4). Others mentioned tending to be 'reactive and not proactive' (PEDS2), 'running over time' (OB/GYN4) and only able to discuss one issue at each appointment. Furthermore, some providers do not see their patients preconception and may 'have missed a window period of treatment' (MFM4) to counselling their patients on DOHaD.

Many providers stated patients were more focused on their immediate pregnancy and how their current health might impact their well-being and that of the fetus, instead of the long-term health outcomes for the child, creating challenges to counselling on developmental programming. As one provider explains:

. . . I think the majority of patients respond more concernedly to the acute problems; they see the concern that the baby is going to be big or their baby's going to have to spend time in the NICU, the baby's going to have metabolic, um, you know, sugar management problems immediately after birth, that are going to put the baby at risk. As opposed oh 10 years down the road your baby might have a higher chance of developing diabetes. (MFM3)

Health care providers also commented on the futility of counselling on DOHaD as patients often have non-modifiable risk factors and 'may [find] out that there are some things that happen in baby and then you can't ever undo it because of whatever happened to the modelling in you' (ENDO1). Some opined there was no point in counselling on DOHaD because 'what's done is done' (OB/GYN2). Providers mentioned informing patients about risks but facing challenges of discussing 'certain things that they can't do much about' (MFM1). Some also expressed the concern that counselling on a topic in which patients have little or no control may cause undue stress and anxiety and that some individuals might be 'doomed to fail because of the extrauterine environment that they're raised in' (OB/GYN1). Participants were cognisant of and highlighted the difficulties associated with making lifestyle changes for some people even after being counselled and provided with information, as the ability to make change is based on their personal context.

Providers described how the complexity of DOHaD and related health issues made it difficult to fully 'sort out' (PEDS2) what health outcomes are the result of developmental programming, rather than environment, or genetics.

I don't think that there's one cause and effect for the diseases that we say are from in utero exposure or it may – again it's multimodal. It may be all from that but I don't know that we can say that 'cause there's just so many other confounding variables (FAM1).

Many expressed the challenges of addressing modifiable and non-modifiable factors when addressing developmental programming.

Multiple concerns were raised about the negative impact a discussion on developmental programming during pregnancy might have on pregnant women. An endocrinologist mentioned that women are already anxious while pregnant and counselling on

developmental programming could 'overwhelm' and 'scare them' (ENDO1). The providers discussed that pregnancy can be stressful; to have an uneventful pregnancy, an uncomplicated birth and a healthy child are often primary aims for expectant parents. The potential for 'blaming the parents' (MFM1) and/or instilling 'guilt' (OB/GYN2) was a concern raised by many participants. One participant believed telling pregnant women who try to stay healthy that they still might contribute to long-term health problems for their child could be 'a really, really detrimental thing to mental health and to bonding with their children and to their relationships, and, to self-esteem' (MFM1).

Health care providers argued counselling on DOHaD must use an empowering and non-directive approach to avoid undue guilt or added stress. Overall, there was consensus among the participants that counselling must be supportive, patient-centred and considerate of social context. Patient-centred care, in this context, emphasises collaboration, shared decision-making and partnership between patients and healthcare providers and acknowledges patients' specific needs and desired health outcomes in providing care. They identified a need for practice guidelines on how to effectively introduce the topic with patients. By creating guidelines for implementation in practice, providers stated they would be more likely to counsel on DOHaD and feel more 'comfortable' (MFM3) discussing it with patients.

Theme III: impact of DOHaD on health

Participants described a 'domino/ripple effect' (ENDO1) and remarked on the potential impact of DOHaD on health of patients, their families and society at large. They argued if patients made behavioural changes after learning about DOHaD, it could increase self-efficacy and the potential for them to make further lifestyle changes. The DOHaD long-term impact of health at individual and societal levels was described by many as 'really cool that if we could actually change the health of somebody going into a pregnancy that we may actually get long term benefits for health in society' (FAM1). A midwife described the implications of DOHaD for health across the lifespan: 'If we can make healthy children . . . they'll have a healthier teenaged life, they'll have a healthier adult life and the more healthy we are, the better life is' (MidW1) and further explained the health care system will also benefit. Providers expressed excitement for patients and their ability to potentially modify factors that would have transgenerational effects. One participant described the area of developmental programming as 'completely mind-blowing' (ENDO2).

Some providers mentioned that sharing this knowledge could empower and motivate people to make changes for themselves, their children and future generations. One provider suggested that understanding developmental programming, its impact on fetal development and how risk factors might be modified is 'incredibly motivating to try and provides someone a better pregnancy experience and better pregnancy outcomes' (OB/GYN2). One paediatrician stated how fascinating and exciting it was that one could make a huge difference by making changes 'so quickly and so soon into creation of a being' (PEDS3).

Although the health care providers had concerns, all mentioned it was important to learn about and subsequently counsel patients on developmental programming, as the benefits outweighed the concerns. Furthermore, they recommended more emphasis be placed on translating DOHaD knowledge into clinical practice to improve the health of future generations.

Discussion

The level of DOHaD-related knowledge varied across the health disciplines and was largely dependent on area of specialty, pre-service education, primary focus of care and proximity to an academic setting. A general lack of knowledge among the various professionals about the concept, poor knowledge translation from bench to bedside and a lack of clinical practice guidelines were identified as barriers to health providers' knowledge uptake on DOHaD. Knowledge generation and its dissemination is insufficient to ensure the application of knowledge in practice settings,²⁸ and limited uptake of research evidence in practice has hindered the development of clinical practice guidelines.^{36–38} Critique of knowledge translation strategies indicate that clinical research evidence is primarily disseminated via academic conferences and overly complicated, dense and jargon-rich research articles that are often not attended or read by frontline health care providers.^{37,38} Our findings were similar and providers suggested information about developmental programming be presented in a format that is easily accessible to the intended users. This is in conjunction with May³⁹ and Barker *et al.*¹⁷ who contend that DOHaD-related interventions or knowledge must be useable and understandable. To improve the uptake of evidence concerning developmental programming, there is a need for tailoring messages through other methods, such as practice guidelines and recommendations on developmental programming implementation into clinical practice. Furthermore, more teaching around the principles of DOHaD is required to enhance professional competencies on how to effectively provide information to patients about the long-term implications of health conditions.

The health care providers also reported a lack of knowledge among pregnant women about developmental programming and its implications for their children and future generations. Pregnant women's level of knowledge about DOHaD was considered to be related to their personal context and specific circumstances. Painter⁴⁰ has argued that, should the long-term health effects on their children be known, patients would prefer to be made aware of developmental programming. This is in concert with the arguments of patients with gestational diabetes mellitus (GDM) in Jelsma *et al.*²⁴ study, who reported that if preventative information was available by way of counselling from their health care provider, they would prefer to know to try and implement changes during their pregnancy.²⁴

The health providers reported struggling with how to counsel patients on its related health issues and offer precautionary advice that is empowering, non-judgmental and patient-centred. Concerns were raised regarding potentially eliciting additional guilt or stress among pregnant women when counselling them about developmental programming, particularly for those who had non-modifiable risk factors (e.g., age, family history). Indeed, others^{20,41–44} have suggested research on developmental programming highlights the primacy of maternal effects and has the potential to reinforce the unfair assumption that mothers are responsible for the health outcomes of future generations. Previous literature on obesity counselling in obstetrics, gynaecology and family medicine has echoed these concerns.^{26,27} The providers might have highlighted these concerns as many of their patients come from social positions that often impact their ability to make lifestyle changes needed to make a noticeable difference. These concerns are in contrast with what women in previous research have indicated as their preference with regards to counselling about healthy behaviours. In studies on counselling women

on weight^{26,27} and diabetes,²⁴ women have articulated that they would prefer an advocate approach to counselling.

In counselling patients on DOHaD, there needs to be a delicate balance between being assertive about the modifiable risk factors (e.g., smoking behaviours, physical activity and dietary habits) while being tactful and attuned to patient's needs.^{13,45,46} To do this, and in concert with the providers in our study, Dupras and Ravitsky⁴⁷ have argued that a person-centred approach is most appropriate. The responsibility of changing modifiable risk factors is not to be solely placed on individuals (particularly pregnant women), as epigenetic mechanisms are ambiguous and influenced by a variety of factors. Previous literature has also highlighted that focusing attention on individual patients diverts attention away from the influence of structural barriers (e.g., employment, wealth distribution and food production) that influence access to resources.^{12,48–50} Therefore, we recommend that counselling on DOHaD and related topics should inform patients that they have some capacity to make change and support them in making changes; however, their personal behaviours are only a small piece of an epigenetic and environmental puzzle.^{12,51,52}

Time constraints, prioritisation of patients' immediate needs and fertility were revealed as additional barriers to counselling patients on DOHaD. Health care providers play a critical role by partnering with their patients to deliver holistic, comprehensive and individualised care. Being an empowering advocate for patients is important when counselling pregnant women on risk factors that could affect future generations. However, as our findings indicate, the message may be difficult or impossible to translate to the individual patient, suggesting educating people about DOHaD health-related issues may be best served in the public health realm. Our results indicate that patients often have other issues that need immediate attention when seeking care. Integrating the influence of social and cultural issues across the life course is warranted to address environmental factors many patients experience.⁵³

To our knowledge, there are few knowledge translation strategies for incorporating DOHaD and related topics into practice and public health initiatives within Canada. Our providers opined that knowledge translation must branch beyond academic journals and conferences and could be integrated into practice guidelines. Furthermore, based on our findings, it was apparent that in order to facilitate an understanding of DOHaD among their patients, an upstream approach to education is also needed. This is consistent with literature on developing DOHaD-based interventions^{9,59} that contend that upstream approaches help mitigate structural barriers that may impede individuals' ability to seek care or make healthy choices. Participants suggested that a more effective way to translate this knowledge to more members of the general public could be through public health initiatives. Public health translation of DOHaD brings a wider awareness to social determinants of health and also is underlined with an acknowledgement that many individual's choices are constrained or determined by these influences. Thus, public health initiatives may make this information more widely accessible and may be more effective as they shift from individual blaming and bring focus on the socioecological factors that have bearing on decision-making surrounding DOHaD.

Adolescence has also been suggested as an optimal period of primary prevention intervention with DOHaD concepts as many life-long health behaviours are established during this period.^{54–57} Although adolescence is often a time still distant from pregnancy, the health behaviours developed during this time will eventually have bearing on their preconceptual and periconceptual health,

therefore having a generational effect on health outcomes for their children.^{54,58} There have been DOHaD translation programmes developed and evaluated in recent years that have shown promise for population-level knowledge translation, specifically in regard to educating adolescents.^{54,58,59–62} These interventions focus on establishing partnerships between the scientific community and educators, in which health literacy is developed and emphasised, so that an understanding of the biological underpinnings of DOHaD is paired with a critical awareness of the social and environmental determinants of health.^{54,58} Such an approach establishes an understanding that developmental programming is multifaceted and contextualised.^{54,58} Further research should involve discussions with women on the barriers and facilitators to making changes to modifiable risk factors, in order to inform public health policies and ensure strategies are tailored towards their needs and maintain a person-centred approach.²⁰

Our findings indicate that developmental programming is an exciting emerging area of research with far reaching potential for improving health at individual and societal levels. The transfer of knowledge on DOHaD and its associated topics could lead to the 'domino effect' with each individual, family and society benefiting from knowing and understanding the implications. The health care providers perceived that women who, once informed about the implications of developmental programming on the future health of their children, might be motivated to make changes, but more research is warranted to determine if such knowledge acquisition impacts behaviour changes at the individual level. Our study results also suggest the developmental programming in reproductive health offers an upstream approach to health promotion and disease prevention. Our findings support concentrating on fundamental social environmental factors that place some people at risk for disease and health inequities and reflect the shift in practice settings to encompass wider determinants of health rather than individual behaviour. Health care providers see the merit of implementing principles of DOHaD in reproductive health at the individual, family and societal levels. However, more research is needed to identify strategies to translate DOHaD evidence in the area of reproductive health and has positive impact of the health of future generations.

A significant amount of the previous research on DOHaD is primarily based on animal models and highlights the biological and metabolic mechanisms behind developmental programming. More evidence on human perspectives on DOHaD and methods for implementation into clinical practice or public health initiatives is warranted. Our results provide insight on how to improve knowledge uptake of developmental programming in practice as well as how to best counsel patients on the topic using empowering and supportive person-centred approach.

Strengths and limitations

There are some limitations to this study that warrant mention. Participants were recruited from Southwestern Ontario; the perspectives of health care providers from other regions may differ. Furthermore, the providers were from an academic centre with a DOHaD research group and their knowledge surrounding DOHaD would likely differ from those who do not. We also did not collect any demographic information about our participants, such as their years of experience, which could have bearing on their understanding of DOHaD. However, a strength of our research was the recruitment of a variety of health care providers from differing disciplines and providing them an opportunity to share their experience.

Conclusion

This qualitative descriptive study provided insight into the health care providers' knowledge of DOHaD and perception of its translation into clinical practice to counsel women both preconception and while pregnant. DOHaD is an exciting area of research and has the potential to be a far-reaching public health initiative for reproductive health. Knowledge among health care providers is currently lacking and better knowledge translation strategies are needed to ensure effective counselling of patients in practice settings.

Acknowledgements. The authors would like to thank Jennifer Ryder for her unwavering support and assistance throughout all aspects of this study: from applications to data collection, analysis and the preparation of any and all materials created from this project. The authors would also like to thank all providers who participated in the study and shared invaluable perspectives on DOHaD.

Financial Support. This work was supported by the CIHR/IHDCYH/SOGC Clinician-Investigator Teams in Obstetrics & Maternal-Fetal Medicine (MFM-146443), Western University (R3948A11), Children's Health Research Institute (R3948A12), Women's Development Council (LHSC, R3948A13), Department of Obstetrics and Gynaecology.

Conflicts of Interest. None.

Ethical standards. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national guidelines on human experimentation (Health Canada) and with the Helsinki Declaration of 1975, as revised in 2008, and has been approved by the institutional committees (Western University Research Ethics Board).

References

- Balbus JM, Boxall AB, Fenske RA, McKone TE, Zeise L. Implications of global climate change for the assessment and management of human health risks of chemicals in the natural environment. *Environ Toxicol Chem*. 2013; 32(1), 62–78.
- Gluckman PD, Hanson MA, Low FM. The role of developmental plasticity and epigenetics in human health. *Birth Defects Res C Embryo Today*. 2011; 93(1), 12–18.
- Hanson MA, Gluckman PD. Developmental origins of health and disease – global public health implications. *Best Pract Res Clin Obstet Gynaecol*. 2015; 29(1), 24–31.
- Barker DJ, Osmond C. Infant mortality, childhood nutrition, and ischaemic heart disease in England and Wales. *Lancet*. 1986; 1(8489), 1077–1081.
- Barker DJ, Osmond C, Forsen TJ, Kajantie E, Eriksson JG. Trajectories of growth among children who have coronary events as adults. *N Engl J Med*. 2005; 353(17), 1802–1809.
- Hales CN, Barker DJ, Clark PM, et al. Fetal and infant growth and impaired glucose tolerance at age 64. *BMJ*. 1991; 303(6809), 1019–1022.
- Lumey LH, Ravelli AC, Wiessing LG, Koppe JG, Treffers PE, Stein ZA. The dutch famine birth cohort study: design, validation of exposure, and selected characteristics of subjects after 43 years follow-up. *Paediatr Perinat Epidemiol*. 1993; 7(4), 354–367.
- Whincup PH, Kaye SJ, Owen CG, et al. Birth weight and risk of type 2 diabetes: a systematic review. *JAMA*. 2008; 300(24), 2886–2897.
- Barnes MD, Heaton TL, Goates MC, Packer JM. Intersystem implications of the developmental origins of health and disease: advancing health promotion in the 21st Century. *Healthcare (Basel)*. 2016; 4(3), 45. doi:10.3390/healthcare4030045.
- Thiele DK, Anderson CM. Developmental origins of health and disease: a challenge for nurses. *J Pediatr Nurs*. 2016; 31(1), 42–46.
- CIHR. Knowledge Translation 2016 Available from: <http://www.cihr-irsc.gc.ca/e/29418.html>.
- 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. *J Dev Orig Health Dis*. 2019; 10(4), 420–428.

13. Hanson M, Gluckman P. Commentary: developing the future: life course epidemiology, DOHaD and evolutionary medicine. *Int J Epidemiol*. 2016; 45(4), 993–996.
14. Lown BA. Difficult conversations: anger in the clinician-patient/family relationship. *South Med J*. 2007; 100(1), 33–39; quiz 40–42, 62.
15. Orgel E, McCarter R, Jacobs S. A failing medical educational model: a self-assessment by physicians at all levels of training of ability and comfort to deliver bad news. *J Palliat Med*. 2010; 13(6), 677–683.
16. Mazor KM, Ockene JK, Rogers HJ, Carlin MM, Quirk ME. The relationship between checklist scores on a communication OSCE and analogue patients' perceptions of communication. *Adv Health Sci Educ Theory Pract*. 2005; 10(1), 37–51.
17. Barker M, Baird J, Tinati T, et al. Translating developmental origins: improving the health of women and their children using a sustainable approach to behaviour change. *Healthcare (Basel)*. 2017; 5(1), 17. doi:10.3390/healthcare5010017.
18. Poskiparta M, Kasila K, Kiuru P. Dietary and physical activity counselling on type 2 diabetes and impaired glucose tolerance by physicians and nurses in primary healthcare in Finland. *Scand J Prim Health Care*. 2006; 24(4), 206–210.
19. Schindler BA, Novack DH, Cohen DG, et al. The impact of the changing health care environment on the health and well-being of faculty at four medical schools. *Acad Med*. 2006; 81(1), 27–34.
20. Vears DF, D'Abramo F. Health, wealth and behavioural change: an exploration of role responsibilities in the wake of epigenetics. *J Community Genet*. 2018; 9(2), 153–167.
21. Fortmann SP, Sallis JF, Magnus PM, Farquhar JW. Attitudes and practices of physicians regarding hypertension and smoking: the stanford five city project. *Prev Med*. 1985; 14(1), 70–80.
22. Levy BT, Williamson PS. Patient perceptions and weight loss of obese adults. *J Fam Pract*. 1988; 27(3), 285–290.
23. Ockene JK, Quirk ME, Goldberg RJ, et al. A residents' training program for the development of smoking intervention skills. *Arch Intern Med*. 1988; 148(5), 1039–1045.
24. Jelsma JG, van Leeuwen KM, Oostdam N, et al. Beliefs, barriers, and preferences of European overweight women to adopt a healthier lifestyle in pregnancy to minimize risk of developing gestational diabetes mellitus: an explorative study. *J Pregnancy*. 2016; 2016, 3435791.
25. Mazza D, Chapman A, Michie S. Barriers to the implementation of preconception care guidelines as perceived by general practitioners: a qualitative study. *BMC Health Serv Res*. 2013; 13, 36.
26. Huepenbecker SP, Wan L, Leon A, et al. Obesity counseling in obstetrics and gynecology: provider perceptions and barriers. *Gynecol Oncol Rep*. 2019; 27, 31–34.
27. Leverence RR, Williams RL, Sussman A, Crabtree BF, Clinicians RN. Obesity counseling and guidelines in primary care: a qualitative study. *Am J Prev Med*. 2007; 32(4), 334–339.
28. Straus SE, Tetroe J, Graham I. Defining knowledge translation. *CMAJ*. 2009; 181(3–4), 165–168.
29. Sandelowski M. Whatever happened to qualitative description? *Res Nurs Health*. 2000; 23(4), 334–340.
30. Sandelowski M. What's in a name? Qualitative description revisited. *Res Nurs Health*. 2010; 33(1), 77–84.
31. Creswell JW. *Qualitative Inquiry & Research Design: Choosing Among the Five Approaches*, 2013. Sage Publications, California.
32. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol*. 2006; 3(2), 77–101.
33. Morse JM. The significance of saturation. *Qual Health Res*. 1995; 5(2), 147–149.
34. Lincoln Y, Guba EG. *Naturalistic Inquiry*, 1985. Sage, Newbury Park, CA.
35. Tracy SJ. Qualitative quality: eight 'Big-Tent' criteria for excellent qualitative research. *Qual Inq*. 2010; 16(10), 837–851.
36. Davis D, Evans M, Jadad A, et al. The case for knowledge translation: shortening the journey from evidence to effect. *BMJ*. 2003; 327(7405), 33–35.
37. Backer TE, Liberman RP, Kuehnel TG. Dissemination and adoption of innovative psychosocial interventions. *J Consult Clin Psychol*. 1986; 54(1), 111–118.
38. Henderson JL, MacKay S, Peterson-Badali M. Closing the research-practice gap: factors affecting adoption and implementation of a children's mental health program. *J Clin Child Adolesc Psychol*. 2006; 35(1), 2–12.
39. May C. Agency and implementation: understanding the embedding of healthcare innovations in practice. *Soc Sci Med*. 2013; 78, 26–33.
40. Painter RC. Applying developmental programming to clinical obstetrics: my ward round. *J Dev Orig Health Dis*. 2015; 6(5), 407–414.
41. Sharp GC, Schellhas L, Richardson SS, Lawlor DA. Time to cut the cord: recognizing and addressing the imbalance of DOHaD research towards the study of maternal pregnancy exposures. *J Dev Orig Health Dis*. 2019; 11(1), 1–4.
42. Hedlund M. Epigenetic responsibility. *Mediaev Stud*. 2012; 3, 171–183.
43. Kenney M, Müller R. Of rats and women: narratives of motherhood in environmental epigenetics. *BioSocieties*. 2016; 12, 1–24.
44. Richardson SS, Daniels CR, Gillman MW, et al. Society: don't blame the mothers. *Nature*. 2014; 512(7513), 131–132.
45. Eriksson JG. Developmental origins of health and disease – from a small body size at birth to epigenetics. *Ann Med*. 2016; 48(6), 456–467.
46. Barouki R, Gluckman PD, Grandjean P, Hanson M, Heindel JJ. Developmental origins of non-communicable disease: implications for research and public health. *Environ Health*. 2012; 11, 42.
47. Dupras C, Ravitsky V. The ambiguous nature of epigenetic responsibility. *J Med Ethics*. 2016; 42(8), 534–541.
48. Patel R. *Stuffed and Starved: Markets, Power and the Hidden Battle for the World Food System*, 2008. Melville House Publishing, Hoboken, NJ.
49. Ivers LC, Cullen KA. Food insecurity: special considerations for women. *Am J Clin Nutr*. 2011; 94(6), 1740S–1744S.
50. Tarasuk VS, Beaton GH. Household food insecurity and hunger among families using food banks. *Can J Public Health*. 1999; 90(2), 109–113.
51. Winett LB, Wulf AB, Wallack L. Framing strategies to avoid mother-blame in communicating the origins of chronic disease. *Am J Public Health*. 2016; 106(8), 1369–1373.
52. Pentecost M, Ross FC, Macnab A. Beyond the dyad: making developmental origins of health and disease (DOHaD) interventions more inclusive. *J Dev Orig Health Dis*. 2018; 9(1), 10–14.
53. Heindel JJ, Balbus J, Birnbaum L, et al. Developmental origins of health and disease: integrating environmental influences. *Endocrinology*. 2015; 156(10), 3416–3421.
54. Bay JL, Morton SM, Vickers MH. Realizing the potential of adolescence to prevent transgenerational conditioning of noncommunicable disease risk: multi-sectoral design frameworks. *Healthcare (Basel)*. 2016; 4(3), 39. doi:10.3390/healthcare4030039.
55. Craigie AM, Lake AA, Kelly SA, Adamson AJ, Mathers JC. Tracking of obesity-related behaviours from childhood to adulthood: a systematic review. *Maturitas*. 2011; 70(3), 266–284.
56. Steinberg L. Cognitive and affective development in adolescence. *Trends Cogn Sci*. 2005; 9(2), 69–74.
57. Alberga AS, Sigal RJ, Goldfield G, Prud'homme D, Kenny GP. Overweight and obese teenagers: why is adolescence a critical period? *Pediatr Obes*. 2012; 7(4), 261–273.
58. Bay JL, Vickers MH. Adolescent education: an opportunity to create a developmental origins of health and disease (DOHaD) circuit breaker. *J Dev Orig Health Dis*. 2016; 7(5), 501–504.
59. Gore DM, Kothari AR. Getting to the root of the problem: health promotion strategies to address the social determinants of health. *Can J Public Health*. 2013; 104(1), e52–e54.
60. Bay JL, Mora HA, Sloboda DM, Morton SM, Vickers MH, Gluckman PD. Adolescent understanding of DOHaD concepts: a school-based intervention to support knowledge translation and behaviour change. *J Dev Orig Health Dis*. 2012; 3(6), 469–482.
61. Grace M, Woods-Townsend K, Griffiths J, et al. Developing teenagers' views on their health and the health of their future children. *Health Education*. 2012; 112(6), 543–559.
62. Bay JL, Yaqona D, Tairea K, et al. The healthy start to life education for adolescents project: indicators of early success in adaptation for use in small Island developing states. *J Dev Orig Health Dis*. 2015; 6(S2), S77.