Journal of Developmental Origins of Health and Disease

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Editorial

Cite this article: Bansal A and Morrison JL (2020) The Journal of Developmental Origins of Health and Disease (JDOHaD) celebrates the contribution of women in DOHaD on International Women's Day. *Journal of Developmental Origins of Health and Disease* **11**: 97–98. https://doi.org/10.1017/S2040174420000070

Received: 17 January 2020
Accepted: 21 January 2020

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CAMBRIDGE UNIVERSITY PRESS

The Journal of Developmental Origins of Health and Disease (JDOHaD) celebrates the contribution of women in DOHaD on International Women's Day

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Welcome to our first themed issue dedicated to the celebration of International Women's Day! Developmental Origins of Health and Disease (DOHaD) encompasses research on the health and well-being of women and men and their babies as well as the health of all throughout life. Many of the researchers in the field of DOHaD are women and this issue aims to celebrate their contributions to our field. The issue was Guest Edited by Dr Amita Bansal (Chair of Early Career Researchers Committee, International DOHaD Society) and Prof Janna Morrison, with peer review support from Prof Mary Barker (Chair of Education Committee, International DOHaD Society), Dr Mina Desai and Associate Prof Deborah Sloboda (Secretary of the International DOHaD Society).

We are honoured to have received invited commentary, review and perspectives from leading women scientists in DOHaD, who recall its origin and evolution over the past three decades. Professor Lucilla Poston is the President of the International DOHaD Society, who elegantly narrates the prevalence of inequalities between men and women globally and how this impacts DOHaD research objectives. She highlights the importance of empowering women as well as the need for continuous support from the DOHaD Society in achieving this. Finally, she provides thoughtful insights into what takes to be a women leader in science and DOHaD Society's commitment in enhancing the experience and involvement of women in DOHaD research (Poston). Professor Rebecca Simmons recalls her first experience with the Barker hypothesis, as DOHaD was known in the early days, and the twists and turns that her research career has taken as she has pursued an understanding the mechanisms underpinning DOHaD, despite the scepticism of her senior colleagues (Simmons). She highlights the importance of mentoring in her role as a scientist. Professor Tessa Roseboom has provided great insight into DOHaD through her studies of the health outcomes of adults whose mothers gestated them during the Dutch Hunger Famine in the World War II. Here, she provides a coherent rationale for the role of gender equity in the health of future generations (Roseboom), an issue of relevance on International Women's Day. However, she makes the clear point that gender equity is not a women's issue, it is a human issue for the betterment of our species. Professor Elena Zambaro discusses the challenges she faced as an early career researcher, when she commenced her DOHaD journey. Her perspective includes advice and support that she has received from her research mentors, her contribution in establishing the Latin American DOHaD chapter and her contributions in uncovering mechanisms underlying phenotypic observations. Finally, she discussed the challenges of juggling motherhood and academic scientist duties simultaneously – an experience which resonates with most women in DOHaD and academia at large (Zambrano).

These invited commentaries and perspectives are followed by selected articles that were accepted for publication in JDOHaD in 2019 by August, and where first author is a female researcher. The selection criteria highlighted the breadth of research in DOHaD and included a combination of original articles, reviews and brief reports; different species; different countries; same generation or multi/transgenerational effects; observation cohorts, randomised trial, basic science evidence and interventions. DOHaD research provides advice to women about optimal health prior to conception. As such, many women exercise before and during pregnancy. Fragoso *et al.*[1] used a rat model of pregnancy to show that active exercise prior to and during pregnancy increased maternal food intake and weight gain in the very active group. Furthermore, there was an increase in growth hormone gene expression in the brain of the mother but not of the foetus.

Princess Catherine's first pregnancy raised international awareness of hyperemesis gravidarum. The negative impact of this disease on the mother is clear, but it was not clear if there was an impact on the foetus that persisted into childhood. Mothers with hyperemesis gravidarum have less weight gain during pregnancy and many DOHaD studies have shown a relationship between maternal undernutrition and poor health in their offspring. Interestingly, a study of

almost 5000 pregnancies in the Netherlands by Poeran-Bahadoer *et al.*[2] found a relationship between daily vomiting and higher body fat mass in childhood but not cardiovascular risk factors. More studies should be performed in this area to replicate the results and to determine the degree of risk relative to other forms of maternal undernutrition or stress during pregnancy.

In a cluster-randomised trial in rural Nepal (an undernourished population), Palmer *et al.*[3] observed that 9 to 13 years old children, whose mother received weekly β-carotene supplementation from preconception through lactation, had higher thymulin concentration than placebo group. As thymus is a primary lymphoid organ that undergoes substantial remodelling *in utero*, the authors postulate that perturbing 'thymic education' might alter body's T-cell repertoire. These speculations are intriguing, however, the authors neither assessed thymic size/function (thymulin concentration was used as a surrogate for size and function) nor enumerated T-cell number. Future studies in this cohort are required to validate these hypotheses.

Eshriqui *et al.*[4] asked a group of healthy premenopausal women to recall their duration of breastfeeding and related this to their ability to adhere to a dietary pattern. Interestingly, those women who reported a longer duration of breastfeeding were more likely to adhere to a prudent dietary habit.

While nutritional status is a well-established factor that impacts life-long health, multiple studies from around the world have reported that exposure to environmental chemicals (endocrine disrupting chemicals) during critical periods of development has long-term health consequences also. Consistent with this, Teleken *et al.*[5] observed that, in mice, maternal exposure to glyphosate-ROUNDUP (herbicide) during pregnancy and lactation is associated with delayed testicular descent, fewer spermatozoa in the cauda epididymis and shorter seminiferous epithelium in 150 days old male mice offspring.

In a brief report, Dupont *et al.*[6] report that altered birth weight is not only associated with later-life metabolic disorders (common DOHaD observation), but also impacts fertility in women. In their ALIFERT prospective observational case–control cohort study, in France, authors observed that infertile women had higher body weight at birth, but not length, compared to fertile women. Thus, higher ponderal index at birth was associated with infertility in women in the cohort. However, the data were obtained from a small cohort of 51 infertile and 74 fertile women. These findings need to be validated in larger prospective cohort studies.

Many DOHaD studies include outcome measures of pregnancy status or interventions during pregnancy during adolescent or across the life course. In Wistar rats, Terra *et al.*[7] report that maternal exercise in preconception period (21 days of age to 12 weeks of age; dams mated at 12 weeks of age) mitigated the impact of maternal high-fat/high-sucrose feeding (preconception until weaning) on metabolic health of the first- and second-generation offspring. In humans, these findings may be complicated by variability in the timing of onset of puberty within the study population. Walker *et al.*[8] provide evidence-based guidelines for appropriate assessment of pubertal stage that can be used to improve the validity of outcome measures. These longitudinal studies hold a wealth of data and could be a key in understanding inter- and transgenerational effects in the context of DOHaD; however, few have attempted this enormous feat to date. In Bogalusa Heart Study, Harville *et al.*[9] show that it is feasible to contact and enrol adult offspring in new studies where their mothers were involved in the earlier studies. And the challenge is on!

JDOHaD and the International DOHaD Society are motivated to continue empowering women, and we hope to see ongoing contribution from female researchers in achieving DOHaD objectives – a life course approach to being and staying healthy.

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https://doi.org/10.1017/S2040174420000070 Published online by Cambridge University Press