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## Time to adopt Developmental Origins of Health and Disease (DOHaD) science in Pakistan

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The paradigm of developmental origins of health and disease (DOHaD), first familiarized by Sir David Barker in 1986,<sup>1</sup> has established its roots among the global scientific community. DOHaD reiterates that the environment in which the trio of embryo, foetus and child nurture plays an important role in determining the likelihood of short-term (child's growth and neurodevelopment) and long-term health outcomes (non-communicable diseases (NCDs)).<sup>2</sup> It is known that maternal undernutrition leads to foetal malnutrition and subsequently these neonates born undernourished are at risk for cardio-metabolic diseases such as diabetes, obesity and hypertension later in life.<sup>3</sup> Interestingly, the milieu in which sperm and ova mature underline the importance of pre-conception period and links it further with DOHaD concept. The paradigm of DOHaD encompasses life course approach including pre-conception, pregnancy (embryonic and foetal stage), neonate, infantile, childhood, adolescence and adulthood periods.<sup>4</sup> These levels provide a 'window of opportunity' for well-timed intervention, though the outcome impact of these interventions vary depending upon how soon in the life cycle the intervention is implemented.

Being the sixth most populous country in the world, Pakistan is facing a daunting challenge to address the triple burden of malnutrition, communicable and NCDs problems as a result of transition in health profile of the population, changing life style and continued economic progress.<sup>5,6</sup> According to the National Nutrition Survey (2011), prevalence of underweight (33%), stunting (44%), wasting (15%) and anaemia (50%) among Pakistani under five children are alarming, indicating unsatisfactory improvement in nutritional indicators compared to other developing nations.<sup>7</sup> At the same time, NCDs such as cardiovascular diseases (including stroke and heart disease), diabetes, mental health disorders, cancers, and

chronic airway diseases are emerging rampantly. The evidence suggests a staggering prevalence of obesity (46%),<sup>8</sup> coronary artery disease (29.6%),<sup>9</sup> diabetes mellitus (26.3%),<sup>10</sup> hypertension (18.9%),<sup>11</sup> and high cholesterol (12.6%).<sup>12</sup> This burden of NCDs is estimated to rise by 10-15% in the coming decade with associated increase in economic burden from 152 million USD (2010) to 296 million USD (2025).<sup>6</sup> These healthcare expenditures will not only bring harm to human capital, but will also lead to less productivity, and eventually financial turmoil.

Hence, it is important to understand the underlying causes of NCDs to define strategies for its prevention. Predominantly, four main modifiable risk factors; tobacco smoke, alcohol consumption, unhealthy diet and physical inactivity are linked to its etiology. More recently, a STEPwise approach to surveillance survey was conducted between 2014 and 2015 in Punjab and Sindh provinces of Pakistan to ascertain the risk factors of NCDs. The study findings revealed high prevalence of risk factors for NCDs including tobacco consumption (19.7%), < 5 servings of fruits and vegetable per day (96.5%), low physical activity (41.5%), overweight/obesity (26.3%/14.9%) and high blood pressure (stage I, 37% and stage II, 15.9%). Interestingly, the percentage of subjects with no NCD risk factor was just 0.6% while 3 to 5 NCD risk factors were present in 40%.<sup>13</sup> However, these risk factors alone do not fully explain the emerging pattern of NCDs in low middle income countries (LMICs) that bear 85% of the global burden of NCD morbidity and mortality<sup>14</sup> and where NCDs manifest at an early age and reveal a fast disease progression accounting for greater proportion of premature deaths compared to developed countries.<sup>15</sup>

Since high cost curative model is not a viable solution to address NCDs, National Action Plan (2004) recommends an integrated framework for action using disease domain, action level and system level integration. It promotes a behavioural change model addressing common and specific risk factors for NCDs.<sup>12</sup> Given the

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escalating burden of NCDs, we further recommend a planned shift from a curative and behavioural modification approach focused at adulthood towards that encompassing the multi-disciplinary DOHaD framework of disease prevention and health promotion using life course approach.

Establishment of Pakistan DOHaD Society in September 2016 through the platform of Aga Khan University is an encouraging move to promote education, research and advocacy about DOHaD-related concepts through building local capacity in academia and in communities.<sup>16</sup> However, promotion, dissemination and implementation of DOHaD strategies need its inclusion in nation-wide public health agenda. As highlighted by Norris et al. (2017),<sup>17</sup> adoption of life course approach may include:

1. At the pre-conception phase, counseling of couples so as to help them make informed decisions regarding pregnancy such as ideal time for pregnancy, promoting physical activity, healthy weight gain, optimal nutrition, positive mental health for both partners, micronutrient supplementation and refrain from smoking and substance abuse;
2. During peri-conception period, optimization of maternal nutrition, regular antenatal visits, maintaining optimal blood pressure and glucose levels, promotion of healthy weight gain and healthy mental state, and abstinence from smoking, and substance abuse for both partners;
3. During early postnatal period, emphasizing the importance of exclusive breastfeeding to lessen the morbidity and mortality from infectious diseases, promote healthy food choices and establish healthy gut microflora after birth;
4. During childhood, beside promoting proper nutrition including avoidance of consumption of fast food and sugared drinks and regular physical activity, promotion of child-parent bonding and responsive interaction to stimulate brain systems for enhanced emotional and psychosocial well-being; and
5. During school age, child-focused enrichment, encouraging healthy weight gain, preventing stunting and provision of micronutrient supplement.

There is a dire need to act promptly and proactively using multidisciplinary approaches for adopting DOHaD framework in Pakistan. Having a predominantly youth

population structure comprising largely of future parents, it is vital to introduce DOHaD guided practices in improving life style and behavioral changes in adolescence to break the transgenerational cycle of NCDs burden.<sup>17-19</sup> It is equally important for scientists and researchers to generate local evidence examining the attributable effects of early-life exposures on NCDs burden during adulthood and determining the preventable fraction of adopting DOHaD framework in attaining sustainable development goals (SDGs). Policy makers need to be informed of the cost-benefit analysis of NCDs prevention using DOHaD framework of early-life intervention compared to disease management in later life. Curricula of health care professionals and educators needs to include first 1000 days of life as a window of opportunity for intervention to create a critical mass of new generation of scientists and work force engrossed in DOHaD concept. Funding agencies agenda for LMICs need to prioritize the DOHaD related proposals. Community-based projects should engage families and communities in DOHaD-based practices through use of innovative strategies to mass awareness through media and mobile health. Health care practitioners should provide DOHaD related counselling during their consultations. These collective efforts using DOHaD informed knowledge, practices and programmes would not only curb the upscaling NCDs burden in the country and the region but would complement agenda of SDGs.

In conclusion, DOHaD science has the potential to transform life course trajectory in Pakistan. Translating science of DOHaD to attain SDGs would require multidisciplinary life course approaches aimed at nationwide awareness and inclusion of DOHaD science in national health policies and action plans.

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