At STIAS, the ‘Health in Transition’ theme includes a programme to address the epidemic rise in the incidence of non-communicable diseases (NCDs) such as Type 2 diabetes, hypertension, obesity, coronary heart disease and stroke in Africa. The aim is to advance awareness, research capacity and knowledge translation of science related to the Developmental Origins of Health and Disease (DOHaD) as a means of preventing NCDs in future generations.

Application of DOHaD science is a promising avenue for prevention, as this field is identifying how health and nutrition from conception through the first 1,000 days of life can dramatically impact a developing individual’s future life course, and specifically predicate whether or not they are programmed in infancy to develop NCDs in later life.

Prevention of NCDs is an essential strategy as, if unchecked, the burden of caring for a growing and ageing population with these diseases threatens to consume entire health budgets, as well as negatively impact the quality of life of millions.

Africa in particular needs specific, focussed endeavours to realise the maximal preventive potential of DOHaD science, and a means of generating governmental and public awareness about the links between health in infancy and disease in adult life.

This volume summarises the expertise and experience of a leading group of international scientists led by Abdallah Daar and brought together at STIAS as part of the ‘Health in Transition’ programme.
ENSURING HEALTHIER TRAJECTORIES THAT START IN EARLY LIFE TO ASSIST NON-COMMUNICABLE DISEASE PREVENTION IN AFRICA: A LIFE-COURSE APPROACH

Shane A Norris

Non-communicable diseases are increasing globally, particularly in low- and middle-income countries. For countries on the African continent, this is of particular concern as the combination of a persisting burden of infectious disease coupled with a burgeoning of non-communicable diseases could cripple already strained health care systems. The current paradigm subscribes heavily on detection, treatment and management of patients with non-communicable diseases. This perspective is important, but a more balanced approach that strengthens prevention efforts is also needed.

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Prevention should start early – adult prevention efforts may be too late given the evidence from developmental origins of health and disease (DOHaD) science. A life-course perspective, which views preconception, pregnancy, infancy, childhood and adolescence as windows of opportunity to nudge health and development trajectories in a beneficial direction is useful to consider when contemplating strategies to promote prevention. Furthermore, framing prevention efforts across the life course stages to optimise health and nutrition may have significant shorter- and longer-term, and intergenerational benefits. Successful prevention will not only curb the non-communicable diseases epidemic but also has the potential to impact human capital development.

Non-communicable disease burden

WHO has identified non-communicable diseases as one of the ten leading threats to global health, resulting in 41 million people dying each year (71 per cent of deaths) (Figures 2.1 and 2.2). While previously more common in high-income countries and rare in low- and middle-income countries, cardiovascular disease and type 2 diabetes are now plateauing/decreasing in high-income countries and rapidly rising in low- and middle-income countries. Mortality rates from non-communicable diseases in many low- and middle-income countries have now exceeded those in high-income countries; are occurring at younger ages and more aggressively in low- and middle-income countries; are creating crippling economic, societal and personal costs, with worse still to come.

In Africa, communicable diseases still overshadow the continent’s disease burden, but a recent study has shown a significant increase in non-communicable diseases between 1990 and 2017. The authors concluded that within the current decade, non-communicable diseases would surpass communicable, maternal, neonatal, and nutritional diseases as the leading cause of ill-health and death in sub-Saharan Africa. The implications of this conclusion have profound consequences for health

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5 Bloom, D.E., Cafero, E.T., Jané-Llopis, E., Abrahams-Gessel, S., Bloom, L.R.,
systems across Africa buckling under the current strain of infectious diseases and severely compromised by a growing epidemic of non-communicable diseases. Both Gouda and colleagues (Charlson, Sorsdahl, Ahmadzada, Ferrari, Erskine, Leung, Santamauro, Lund, Aminde, Mayosi, Kengne, Harris, Achoki, Wiysonge, Stein and Whiteford, 2019) and the accompanying commentary by Bigna and Noubiap highlighted that the estimates are ‘not optimal’.6 They recommended the need for improved epidemiological health data in sub-Saharan Africa. A concern with such data is that it only captures the recent history, perhaps before the rapid transition effects underway (persisting undernutrition during the first 1 000 days, burgeoning obesity in later life, and chronic infectious disease exposure) in sub-Saharan Africa have fully manifested. These estimates could, consequently, be grossly underestimated.7

The double burden of malnutrition and developmental origins of health and disease

A recent Lancet series has highlighted the ‘double’ burden of the malnutrition reality in African and other low- and middle-income countries – i.e. the simultaneous existence within individuals, families and communities of both undernutrition and overweight/obesity.8 The urban transition is fuelling obesity in low- and middle-income countries (diets become less diverse, more energy-dense and processed,

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and intakes of wholegrain foods, fresh fruit and vegetables, decline) against a background of generations of nutritional deprivation and co-existing with persisting food insecurity, micronutrient deficiencies and anaemia. These factors, directly or in combination with adiposity, may increase susceptibility to cardiovascular disease and type 2 diabetes.9 Indeed, nutrition-related risk factors, such as impaired glucose control, obesity, poor diets and micronutrient deficiencies, significantly contribute to global mortality (Figure 2.3).

The double burden of malnutrition emerges across the life course with a more frequent scenario in Africa the undernutrition in fetal life and infancy followed by later overnutrition (excess weight gain in childhood and adolescence, and adult obesity). Research in the field of DOHaD has shown that undernutrition in early life increases adult non-communicable disease risk.10

![Figure 2.1](https://doi.org/10.18820/9781928357759/02)

**Figure 2.1** Globally, over time, the communicable disease has been declining.11

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11 IHME Global Burden of Disease. 2017. Disease burden from communicable, maternal,
Ensuring healthier trajectories that start in early life

Globally, over time, the non-communicable diseases burden is surpassing communicable disease.\(^{12}\)

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Figure 2.3  Nutrition-related risk factors contribute significantly to global mortality estimates.\textsuperscript{13}

Initial evidence from studies shows lower birth weight (a proxy for fetal undernutrition) associates with an increased risk of adult cardiovascular disease and type 2 diabetes.\textsuperscript{14} Animal studies showed that under-nourishing pregnant mothers led to fetal growth restriction, multiple changes in the adult offspring (low muscle mass, increased adiposity, abnormal pancreatic, liver and kidney structure, altered secretion of and sensitivity to insulin and other hormones) as well as diabetes and hypertension.\textsuperscript{15} These studies suggest that early life undernutrition disrupting the development of critical metabolic tissues results in permanently reduced metabolic ‘capacity’. In human populations, the highest risk of cardiovascular disease and type 2 diabetes is in men and women who were light and thin at birth and in


infancy (having the lowest metabolic capacity) but gained the highest body mass index as children or adults (developing the greatest metabolic ‘load’).

These effects, whereby insults occurring in critical ‘plastic’ periods of early development have long-term consequences, are known as developmental programming. DOHaD research suggests that non-communicable disease risk is influenced not only by exposure to the well-known load factors such as obesity but also by the capacity acquired during early development – a missing link in understanding non-communicable disease trends in low- and middle-income countries.

It is now known that early life exposures, other than undernutrition, programme an increased non-communicable disease risk. Fetal ‘overnutrition’, the excess transfer to the fetus of glucose, lipids and other fuels when the mother is obese, gains excess weight during pregnancy, or develops gestational diabetes mellitus, causes fetal hyperinsulinism and adiposity (macrosomia, high birth weight) and this is another dominant cause of later life obesity and type 2 diabetes.

Data from the Birth to Twenty Plus cohort showed that if a girl was obese by age five years, she is 45 times more likely to be an obese adult. Also, low birth weight was associated with a 10 per cent higher risk of adult impaired fasting glucose (a precursor to diabetes), and excessive weight gain from age four to the end of adolescence had a 32 per cent greater risk of impaired fasting glucose. Therefore, ‘developmental programming’ in early life is an important contributing determinant of an individual’s biological trajectory and their long-term health.


What is the Life-Course Health and Development Framework?

Life-course frameworks have their roots in sociological research, for example, Elder’s studies on the development of children affected by the Great Depression in America in the 1930s. The central thesis of this life-course framework is that “the life course of individuals is embedded in and shaped by the historical times and places they experience over their lifetime”, and that “the developmental impact of a succession of life transitions or events is contingent on when they occur in a person's life”. The Life Course Health and Development Framework (‘the Framework’) brings both these approaches in focus with the biopsychosocial model. The Framework is particularly useful for child and adolescent science as it recognises the complex, dynamic interaction between our biology (our genes, systems and organs) and environmental cues (our nutrition, physical and social environment).

The Framework provides public health with a powerful lens to identify opportunities for interventions and policies that can optimise life-course trajectories (see Figure 2.4). We can minimise the risk of disease (accumulative damage over time) and promote a healthier life-course trajectory, by optimising parental (both men and women) preconception health. Peak biological capacity during childhood and adolescence, for example, minimised growth faltering, maximised cognitive potential, and optimised body composition (bone, lean and fat mass) must be promoted. Peak capacity during mid-adulthood must also be maintained, and the decline in older adults (for example, maintaining healthy bone mineral density and muscle mass) minimised.

Life-course approach: implication for Africa

A life-course framework underscores intergenerational susceptibility to diseases such as obesity and non-communicable diseases. A startling recent meta-analysis demonstrated that, if a mother is obese before conceiving a baby, then her child has almost three times greater risk of being obese. Consequently, there is a growing appreciation that a life-course framework can assist us to not only understand the origins of non-communicable diseases but, more importantly, identify

22 Lundeen et al., 2016.
opportunities for prevention\textsuperscript{24} – such as the period of preconception (including adolescence), pregnancy and infancy to avert non-communicable disease-risk in men and women and their offspring.

\textbf{Figure 2.4} Life-course approach to optimising health and development.\textsuperscript{25}


Conclusion

The interaction between socio-environmental cues and our biology, particularly in the earlier years, shapes our health across the life course. Better policies, healthier cities, and positive individual behavioural choices during sensitive periods of biological development can help firm up a strong foundation that will shape health across generations. To realise this possibility in Africa, we need more investment in:

- Programmes that optimise maternal, paternal and child nutrition and health, as one strategy to offset obesity and non-communicable diseases risk;
- Multisectoral collaborations across governments, civil society, academia, funding agencies and NGOs to identify solutions to complex health challenges across the life course;
- Research to identify and test solutions that build up the evidence base to bolster prevention strategies.