



EARLY ORIGINS OF DIABETES

Diabetes is a global health and development crisis. Today 366 million people are living with diabetes worldwide and by 2030 this number is expected to rise to 552 million if nothing is done.¹ For low- and middle-income countries, where 3 out of 4 people with diabetes now live, the human and financial costs threaten to overwhelm health systems and undermine national economic progress.

Yet type 2 diabetes is largely preventable or can be delayed. To date, the focus of diabetes prevention has been placed on lifestyle interventions to modify adult behaviour, particularly obesity related unhealthy diets and physical inactivity. But a compelling body of evidence now indicates that many of the risks leading to type 2 diabetes originate in the very early stages of life, influenced by maternal under- or over-nutrition, diabetes in the mother and the fetal and post-natal environment.

THE RELATIONSHIP BETWEEN MATERNAL AND FETAL NUTRITION AND DIABETES

A combination of epidemiology studies in human populations and a better understanding of the epigenetic process (See box 1) now indicates that diabetes may be triggered by events in the womb. Early life influences, such as maternal under- or over-nutrition, low birthweight and newborn over-feeding, increase the risk of obesity and associated diseases such as diabetes and cardiovascular disease in the offspring later in life.

BOX 1: DEFINITION OF EPIGENETICS

Epigenetics is the study of changes in gene activity that do not involve alterations to the genetic code but still get passed down to at least one successive generation

Longitudinal studies into the effects of famine on the risk of disease in adult life have provided compelling evidence. The Dutch Famine Birth Cohort Study showed that children of Dutch mothers who were pregnant during the 'Hunger Winter' of 1944, suffered higher rates of obesity, diabetes and cardiovascular disease in adult life than those born a year or two earlier². Observations from the Chinese famine, and more recently Cambodia have confirmed this phenomenon. Records of low birthweight in China, America, Europe and the Middle East have also been linked to higher incidence of diabetes, but recent research has shown perinatal influences can act across the whole birthweight range. Children of mothers with gestational diabetes (GDM) – diabetes that is onset or first recognised during pregnancy – also have a greater propensity to developing type 2 diabetes as adults.

And the story does not end at birth. The risk of future disease is further increased if there is a mismatch between the fetal and adult environment. The mother, in effect, gives the fetus a 'forecast' of the nutrition it can expect at birth. The fetus is then 'programmed', largely due to epigenetic changes, to match that environment. If the nutritional environment in childhood and adult life differ sharply from that experienced within the womb, obesity and diabetes can result.³

Therefore, the prevention of diabetes must start with a healthy pregnancy. The health of mothers before and during pregnancy, and nutrition and growth in fetal and early postnatal life, have profound effects on vulnerability to diabetes later in life.

AN ALARMING PICTURE IN EMERGING COUNTRIES

For many emerging countries, this new evidence may explain the already catastrophic diabetes numbers. For example China has over 92 million people with diabetes, or 1 in 10 of the adult population, and the numbers are rising fast. Economic development and a nutritional transition is fueling an environment where under-nutrition and chronic hunger co-exist with affluence, greater access to energy-dense food, improved transport systems and increased sedentary lifestyles.

Another example is India. Rapid economic growth has lifted millions of people out of extreme poverty, and with this growth has come urbanisation and changing dietary patterns. Yet the nation is still grappling with chronic hunger and maternal undernutrition. One fifth of the population is chronically hungry, one in three women are undernourished, and 40% of all low birth-weight babies in the developing world are born in there.² Many infants therefore get a poor start in life, followed by excess nutrition and inadequate physical activity in adulthood. This is likely to be one reason why India has 50 million people already living with diabetes and why that number is rising rapidly.

DIABETES IS MORE THAN A 'LIFESTYLE DISEASE'

Evidence is growing on the genetic, epigenetic, environmental and biological factors contributing to diabetes, starting before conception. These effects may be intergenerational, passed down from grandmother, to mother to baby. Most of these factors are outside the control of the individual, thereby alleviating any 'blame' that their own lifestyle caused their disease.

This evidence also points to an important new approach to diabetes prevention, with a focus on the behaviour (smoking and drinking habits), nutrition and health of mothers and young children as effective points of intervention. A life course approach is imperative to reduce the intergenerational transmission of diabetes. More details of maternal and fetal interventions are detailed in table next page.

Tackling the socio-economic determinants of the poor nutritional status of girls and young women is critical, particularly in low- and middle-income countries. Gender inequality and discrimination, poverty and poor educational attainment are significant drivers of social disadvantage.

This evidence also confirms the critical importance of early diagnosis and treatment for type 2 diabetes. In low- and middle-income countries the onset of type 2 diabetes is typically among people of working age and more recently, in adolescents. Early diagnosis and treatment with cost effective oral medication can avoid progression to premature death and complications such as renal failure, cardiovascular disease, blindness and amputation.

"A life course approach is imperative to reduce the intergenerational transmission of diabetes"

WINDOWS OF OPPORTUNITY ACROSS THE LIFE COURSE

Phase	Intervention
Infancy and Childhood	<ul style="list-style-type: none"> • Promote exclusive breastfeeding for the first six months • Educate and support the mother on appropriate nutrition for the infant child • Promote exercise and healthy eating in pre-school- and school-aged children (including the provision of nutritional education)
Preconception	<ul style="list-style-type: none"> • Educate women that pregnancy can be a risk factor for the development of diabetes • Advocate balanced nutrition with respect to macro and micronutrients • Measures to help pregnant women and their partners stop smoking and refrain from alcohol • Provide education and awareness to support and reinforce these initiatives in adolescent girls
Pregnancy	<ul style="list-style-type: none"> • Improve maternal nutrition through appropriate supplementation to avoid under- and over-nutrition and 'fetal programming' of adult disease • Improve management of gestational diabetes to reduce transmission of type 2 diabetes to the offspring • Postnatal follow up for low birthweight offspring and mothers with gestational diabetes and their offspring

LINKING DIABETES TO THE GLOBAL DEVELOPMENT AGENDA

Achieving the Millennium Development Goals (MDGs) and reducing the burden of diabetes are intimately related. The current MDG focus on poverty reduction, gender equality and maternal and child health can be built upon to reduce the global diabetes epidemic in future generations. But at the same time, diabetes is a significant driver of poverty, disability, maternal morbidity and mortality and infectious diseases that requires focused strategies and investment to reduce the impact. As a major and growing public health issue for developing countries, diabetes and the related NCDs must be included in the international development goals that succeed the MDGs after their 2015 end date.



WHAT NEEDS TO BE DONE:

- Diabetes prevention strategies must focus on maternal health and nutrition and other health behaviours before and during pregnancy, as well as infant and early childhood nutrition.
- Existing maternal health programmes should integrate diabetes prevention and awareness.
- Efforts to increase awareness of the importance of the early origins of diabetes, particularly among policy makers, need to be combined with guidance on appropriate strategies.



- The United Nations Development Programmes (UNDP) should work with UNFPA, UN Women, the UN's Children's Fund (UNICEF), the UN's Food and Agriculture Organization (FAO) to ensure strategies for the 'early origins' of diseases such as diabetes are addressed in UN coordination plans for low- and middle-income countries with high incidence.
- Existing strategies on women and children's health can be built upon to support the prevention of diabetes, including the WHO Global Strategy for Infant and Child Nutrition and the UN Global Strategy for Women and Children's Health.
- Policies need to tackle the social determinants and inequalities that contribute to the poor nutrition of girls and women, guided by the principles in IDF's International Charter of Rights and Responsibilities of People with Diabetes.
- More research is needed into the early origins of diabetes, particularly into the epigenetic process and the identification of high-risk infants to prevent future diabetes.

References

- 1 International Diabetes Federation, *Diabetes Atlas - 5th Edition*, Brussels, International Diabetes Federation, 2011 (forthcoming)
- 2 A C J Ravelli, J H P van der Meulen, R P J Michels, C Osmond; et al. *Glucose tolerance in adults after prenatal exposure to famine*, The Lancet, Vol. 351, Issue 9097, 1998
- 3 P D Gluckman, M A Hanson, C Cooper, K L Thornburg, *Effect of In Utero and Early-Life Conditions on Adult Health and Disease*, N Engl J Med 2008; 359:61-73
- 4 UNICEF/WHO, *Low Birthweight: Country, regional and global estimates*, The United Nations Children's Fund and World Health Organization, 2004

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