# The preconception period as a platform for preventing diabetes and non-communicable diseases

Dr Chandni Maria Jacob1, Prof Mark Hanson1,2

1. Institute of Developmental Sciences, School of Human Development and Health, Faculty of Medicine, University of Southampton, Southampton, United Kingdom
2. Southampton NIHR Biomedical Research Centre, University Hospital Southampton, United Kingdom

Corresponding author: c.m.jacob@soton.ac.uk

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## Introduction

Pre-existing maternal non-communicable diseases (NCDs) such as diabetes, or pregnancy-related conditions such as gestational diabetes, have been shown to amplify the passage of NCD risk to the next generation.1 Such risk factors in the periconceptional period have been shown to impact neonatal outcomes such as birthweight (both large for gestational age or macrosomia, and low birth weight), small for gestational age and preterm births – all of which are associated with a higher risk of NCDs in adulthood. 2-5

Adults born preterm have three times the risk of developing metabolic syndrome, and nearly double that of developing Type 2 diabetes and cardiovascular diseases such as hypertension and stroke.6,7 In parallel with the growing recognition that fixed genetic variants account for only a small fraction of NCD risk at the population level, research fro the field of Developmental Origins of Health and Disease (DOHaD) has demonstrated the importance of epigenetic processes in the underlying mechanisms of such risk and moving beyond associations towards causal pathways.3,8 Moreover, economic and the accompanying nutritional transitions in low-middle income countries have led to a mismatch between the early environment and diet and health behaviours in adulthood, increasing the risk of NCDs. 9,10

Increasing evidence now shows that risk factors for NCDs can originate in the preconception period - usually defined as “3 months before conception”.2 However, some definitions of this period consider “a minimum of 1-2 years before the initiation of any unprotected sexual intercourse that could result in a pregnancy”.11 These definitions do not enable easy identification of target populations for preconception interventions. Alternative perspectives to conceptualise preconception include – 1. the biological perspective (days to weeks before embryo development); 2. the individual perspective (a conscious intention to have a baby, which could be weeks to months before conception); 3. the public health perspective (months to years for a programme to improve health outcomes); and 4. the life course perspective (the importance of preconception care for all individuals from an early age).5,12 Although the world health organisation has defined preconception care as the provision of biomedical, behavioural and social health interventions to women and couples before conception, it also includes interconception care, extending between pregnancies and including post-partum care.13 Nonetheless, these alternative perspectives adopt a long-term view and aim to improve both maternal and neonatal outcomes in wider populations.

In this article, we summarise the latest evidence on risk factors for NCDs in the preconception period, with a particular focus on diabetes, and their long-term effects on maternal and child health, clinical interventions for engaging women and the barriers, opportunities, and practical tools to provide effective preconception care.

## Preconception Risk Factors and Interventions for preventing NCDs in the next generation

While early studies focused on the longer-term consequences of risk factors before and during pregnancy leading to low birth weight (due to intrauterine growth restriction alone or in combination with preterm birth), recent research has demonstrated the importance of a wide range of maternal exposures, including over- and undernutrition (including micronutrient deficiencies), obesity, stress, smoking, environmental toxins, air pollution and alcohol or drug abuse.2,5 While ethnicity, maternal age and family history of type 1 or type 2 diabetes are non-modifiable risk factors, Body Mass Index (BMI), diet, physical activity and polycycstic ovarian syndrome are modifiable or preventable risk factors, and show strong associations with risk of Gestational diabetes Mellitus (GDM).14 They can have adverse effects on the developing embryo and fetus during early stages pregnancy, with increased risk of congenital anomalies and effect on birthweight.4 Data from multiple European birth cohorts shows that outcomes such as childhood obesity were more strongly associated with preconception BMI than gestational weight gain.15 Preconception paternal factors such as unhealthy paternal nutrition and lifestyle are now also implicated in affecting the offspring’s development, particulary by affecting sperm DNA.2 Figure 1 shows key stages in the life course during which risk factors for diabetes can occur in both parents and offspring. BMI is particularly relevant here as the risk of GDM increases progressively across the categories of overweight, obese, and severely obese before pregnancy, with overweight women three times and obese women five times more likely to develop GDM compared with women with a healthy BMI.16 In the offspring, maternal GDM is also associated with a higher risk of allergies, asthma and neurodevelopmental outcomes – although the evidence for the latter is inconclusive. 17

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**Figure 1. Overview of pre-pregnancy factors involved in NCD risks across the life course**

These risk factors for GDM and Type 2 diabetes long term for the mother and baby are connected with other risks for NCDs such as hypertension in pregnancy. On the other hand, factors such as physical activity before pregnancy are associated with a reduced risk of pre-eclampsia and GDM.18 Table 1 below summarises the evidence for preconceptional risk factors for NCDs and their impact on pregnancy and the offspring.

**Table 1 Common risk factors related to nutrition in parents in the preconception period and possible outcomes during pregnancy, childbirth and childhood.**

|  |  |  |
| --- | --- | --- |
| PRECONCEPTIONAL RISK FACTORS FOR FUTURE NCDs | INCREASED RISK OF COMPLICATIONS DURING PREGNANCY AND CHILDBIRTH | RISK TO BABIES |
| **Overweight and obesity** | * Before pregnancy: reduced fertility, polycystic ovarian syndrome
* During pregnancy: pregnancy loss, GDM, pre-eclampsia, gestational hypertension, higher risk of Caesarean or instrumental delivery, induction of labour, thromboembolic disorders, preterm birth
* Post-partum: Unsuccessful breastfeeding
 | Low birthweight, small for gestational age, macrosomia, congenital anomalies (e.g. neural tube and cardiac defects), childhood obesity, higher risk of adult chronic disease. Allergy and immune dysfunction in offspring (e.g. atopic dermatitis) |
| **Underweight/ undernutrition** | Complications during pregnancy and delivery, associated nutrient deficiencies  | Preterm birth, low birth weight, stillbirth, type 2 diabetes, neurodevelopmental issues, and cardiovascular disease in later life |
| **Pre-existing conditions e.g., Diabetes mellitus****High blood pressure** | Spontaneous abortion, preterm labour, caesarean section, hypertension in pregnancy, preeclampsia,GDM | Birth defects, stillbirth, macrosomia with shoulder dystocia/nerve palsy if delivered vaginally, hypoglycaemia after birth, type 2 diabetes in later life |
| **Micronutrient deficiencies e.g., Iron, Folic acid, Vitamin D, Calcium, Iodine** | Eclampsia/ Pre-eclampsia, Preterm birth, Pregnancy loss, stillbirth, increased risk of maternal morbidity and mortality | Neural tube defects and other birth defects, Increases risk of neonatal/ infant mortality, Low birth weight, Low child cognition (intelligence quotient) |
| **Risky behaviours e.g.,** **Smoking, alcohol** | Poor fetal growth, Preterm birth | Low birthweight, fetal alcohol syndrome, childhood obesity, impaired neurodevelopment |
| **Paternal factors such as suboptimal nutrition and obesity, smoking, advanced paternal age** | Reduced fertility, greater risk of pregnancy loss | Cardiometabolic disease risk |

Poor mental health before pregnancy has also been implicated in risk of GDM19 and long-term exposure to stressors accumulates through the life course and could potentially have a cumulative effect leading to increased risk during pregnancy.

## Interventions to deliver preconception care for the prevention of diabetes and NCDs

A recent study showed that less than 30% of women took folic acid supplements before a first or subsequent pregnancy in England,20 and low levels of folic acid supplementation before pregnancy have been seen in other high-income countries.21 Additionally, globally over half women of reproductive-age women now have overweight or obesity.22 With rising rates of NCDs in high and low-middle income countries, interventions and policies to prevent NCDs during the preconception are needed urgently, to prevent the transgenerational passage of risk, healthcare expenditures and increased perinatal complications leading to maternal and neonatal mortality or morbidity.

Alhough results for trials in pregnancy have shown mixed results for diabetes-related outcomes23,24 most interventions still focus predominantly on the pregnant woman. This could be because of easier access through antenatal visits, and increased motivation among women and couples for behaviour change at this time.25,26 However, achieving a healthy BMI and improving diet quality and physical activity level before pregnancy, or between pregnancies, can reduce the risk of GDM, improve fertility, and reduce the risk of pre-eclampsia, macrosomia and stillbirth.27-30 It may be more realistic to achieve than during pregnancy, and measuring BMI is a simple method to identify high-risk women at this time.30,31 Physical activity, and indeed any leisure-time physical activity has shown benefit for the prevention of GDM.32,33 Aerobic exercise, resistance training, yoga, and digital interventions to improve physical activity have all shown improvement in glucose metabolism. For women with a history of GDM, interventions with a focus on diet, physical activity and supporting breastfeeding in the early postpartum period are beneficial in prevention of diabetes.34

High-quality evidence for preconception interventions is however lacking, as few randomised controlled trials have focused on this period.35 A recent international multicentre trial of a nutritional supplement containing Myo-inositol (an insulin sensitising compound), probiotics and multiple micronutrients showed a reduced incidence of preterm birth, although no significant effect was seen for GDM, birthweight or gestational age at birth.36 Finally, it must be noted that although biological and environmental risk factors have a key role in the risk of GDM and type 2 Diabetes, increasing evidence on socio-economic inequalities and poor health behaviours highlights the need for population-wide strategies and policies for prevention, looking beyond individual behaviour change interventions. 20

A key barrier in delivering recommendations is the high proportion of unplanned pregnancies – in the UK and similar globally.37,38 The high levels of NCD risk factors among the general reproductive-aged population further highlights the need to identify couples who may conceive in the near future.39 International organisations have hence recommended delivering preconception care at every opportunity, and screening potential candidates for pregnancy intention routinely. 40

## Role of healthcare professionals across disciplines for prevention of GDM and Type 2 DM

While most preconception interventions have targeted maternity care services and clinicians in that domain, other routine services accessed by reproductive-aged women and couples also present an important opportunity to screen for and manage risk factors such as obesity or uncontrolled diabetes for a woman’s life-course health. It has been recommended that professionals from a range of clinical pathways such as pharmacists, endocrinologists, sexual and reproductive health clinics, contraception clinics, general practitioners, diabetes specialists, community health workers and health visitors, who have the opportunity to discuss pregnancy intentions and could provide appropriate counselling or referrals. 39,40 If pregnancy is not desired, appropriate contraceptive counselling can also be provided to address unmet reproductive health needs. The inter-conception and postpartum periods also provide a window of opportunity for addressing contraception to prevent unplanned pregnancy and any nutritional or NCD risk factors not discussed during pregnancy, as well as preparing for the next pregnancy if desired. This is particularly important as follow-up rates for testing HbA1C in women with a history of GDM are often very low.41

However, whether such recommendations are acceptable to the general public is unclear. While the benefits of routine screening, such as normalising fertility discussion and preventing high-risk pregnancies, have been expressed in recent guidelines, arguments against routine discussion of pregnancy intentions highlighted the importance of considering patients’ values, respecting their choices and privacy, and preventing unintentional emotional triggers for those with a history of pregnancy loss.42,43 Alhough the predictive value of screening techniques for pregnancy intention such as “one key question” and the “desire to avoid pregnancy scale” have shown correlations with women’s reproductive health behaviours, 44 Healthcare practitioners (HCPs) will need to guide subsequent conversations appropriately, considering the range of responses that could be elicited. Overall, these findings suggest that HCPs should first assess if patients want to engage in a conversation before simply posing the question as a routine activity. They should also involve male partners in the discussion.

Several barriers to discussing preconception issues exist – particularly for discussing weight management and nutrition, with HCPs reporting low confidence in discussing nutrition and a lack of resources to conduct non-stigmatising conversations. This is worsened by structural barriers such as short consultation times, lack of structured guidelines for management and inadequate training.45 Women, on the other hand, prefer and trust information received from HCPs, but report that they are not offered the opportunity or encouraged to discuss their pregnancy intentions, preconception health 46-48or weight status. 49

To help overcome such barriers, the International Federation of Gynecology and Obstetrics (FIGO) recently developed guidelines for the management of maternal obesity and prevention of preconception risk factors and developed a simple clinical tool in the form of a nutrition checklist for universal screening of nutritional status.30,40,50 The checklist can be used in non-maternity care services too for preconception women and adapted based on national dietary guidelines. Studies in Ireland, Hong Kong and Italy have shown that the checklist is acceptable to both patients and clinicians, and is feasible and valid.50-52 Screening for pregnancy intention and nutritional risk factors influencing maternal and offspring health is particularly relevant for diabetologists who meet women with diabetes routinely.

Although discussion of weight status is important, clinically significant weight loss is difficult to achieve at this time in the life course.30 Training HCPs with techniques such as Healthy Conversation Skills and motivational interviewing techniques have been recommended to promote lifestyle behaviour change and to improve HCP’s confidence in discussing a range of topics such as smoking and weight loss with patients.35,53

## Conclusions

The preconception period presents an opportunity to prevent NCDs such as diabetes in three generations – the woman, the long-term health and fertility of her offspring, and that of her offspring’s future children. HCPs – both within and outside perinatal care – such as physicians, diabetologists and endocrinologists play a crucial role in identifying couples planning to conceive and can help them to reduce risks by delivering appropriate advice and interventions. Though ample opportunities exist for the prevention of GDM and diabetes through healthcare, the communication of risk needs to consider the wider socioeconomic determinants of health. The impact of the food industry and government policies on factors such as obesity can have knock-on effects on conditions such as GDM, so clinical care needs to be supplemented by appropriate public health policies.

To overcome the challenge of unplanned pregnancies, routine screening has been recommended by some organisations. However, this needs to be conducted sensitively and using a patient (person)-centred approach. Training of HCPs in healthy conversation skills and continued professional development in the use of diet and nutrition guidelines would complement the delivery of information through simple checklists, although follow-up conversations are needed post-consultation. Incorporating training in preconception care in the educational curriculum for medical and allied health professions is also imperative. Timely interventions before conception would of course need to include adolescents and young adults, thus using a wider public health prevention strategy, outside healthcare and including schools and community programmes is increasingly recommended.

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