

## Chapter 5

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# Life stage: Pre-conception and pregnancy

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### Key statistics

- In 2011, the number of infants dying before their first birthday (i.e. the infant mortality rate) in England and Wales was 4.2 per thousand live births: an all-time low. For comparison, the rate was 11.1 per thousand in 1981.<sup>1</sup> Immaturity due to preterm birth remains the commonest cause of death in the first year.
- Infant deaths, however, are not evenly distributed across society. The 2011 rate was 2.5 per thousand in children born to fathers in higher professional occupations and 4.9 per thousand in children born to fathers in semi-routine occupations.<sup>1</sup>
- In 2010 in England and Wales, 7.1% of births were preterm: 5.5% of these occurred between 32 and 36 weeks' gestation and 1.2% before 32 weeks.<sup>2</sup>
- In 2010 in England, the proportion of babies breastfed at birth was 84% and a third were still breastfed at 6 months of age. The highest rates were in babies from minority ethnic groups and the lowest rates were in babies whose mothers are from lower socio-economic groups.<sup>3</sup>
- In 2010 in the UK, around a quarter of women smoked during pregnancy. However, the figure was 57% among those aged below 20.<sup>3</sup>
- Around 6% of women in the UK have a body mass index of 35 (obese) or over during pregnancy.<sup>4</sup>
- In 2010, about 40% of women drank alcohol during pregnancy. Alcohol consumption is more likely in mothers aged 35 or over (52%) and in mothers from managerial and professional occupations (51%).<sup>3</sup>
- In 2010 in the UK, 37% of women reported taking folic acid before they were pregnant and 79% reported taking it during the first three months of pregnancy.<sup>3</sup>
- In 2010, the rate of stillbirths in England and Wales (at or after 28 weeks of gestation) was 3.8 per thousand live births. This rate is relatively high compared with other European countries (almost double the rate for Iceland and the Czech Republic, for example).<sup>5</sup>
- Extremes of maternal age are associated with poorer outcomes for babies including increased risks of stillbirth and neonatal death. England has a relatively high proportion of teenage mothers (around 5%) and mothers aged 35 or older (around 20%) compared with other European countries.<sup>5</sup>

## Overview

### The central importance of pregnancy for future child health

Helping women make healthy choices during pregnancy is a central policy objective.<sup>6</sup> National and local policy makers in health, public health and beyond have important roles to play. *Fair Society, Healthy Lives* (2010) stated as its Policy Objective A 'Give every child the best start in life'.<sup>7</sup> To achieve this, the report highlighted the need to prioritise pre and postnatal interventions that reduce adverse outcomes of pregnancy and infancy. During pregnancy most women want to do 'the best for baby' and this heightened motivation can provide leverage for tackling unhealthy lifestyle choices and promoting healthy ones; for example, helping women to stop smoking when pregnant and encouraging them to breastfeed following the birth.

However, a woman's social circumstances can constrain her from making healthy choices which may in turn be reflected in poorer outcomes of pregnancy and subsequent child development. Policy makers and service providers must therefore also address women's choices during pregnancy in their social context. Fundamental to achieving healthy pregnancies is the role of the midwife. Health promotion programmes through which health and care professionals engage with young pregnant women from poor backgrounds, such as the Nurse-Family Partnership<sup>8</sup> pioneered in the USA (and evaluated as the Family Nurse Partnership model in England<sup>9</sup>), have demonstrated the effectiveness of promoting healthy choices and enhancing access to care during pregnancy on future child development. More broadly, the effects of the Nurse-Family Partnership on improving mothers' return to employment and reducing future offending behaviour in their children point to the potential for inter-sectorial gains beyond health for maternal health policies. Conversely, the influence of maternity leave entitlement policy on maternal health points to the importance of policy initiatives beyond health in improving pregnancy outcomes.<sup>10</sup>

**The effect of a mother's mental health on the subsequent health of her child is equally important as her physical health**, and we are only now beginning to properly investigate this influence on child development (see Table 5.1). At the extremes, we sometimes refer to 'maternal mental illness' or 'maternal stress', but these terms fail to capture **the complex picture of the accumulated influences of being brought up in poverty, sometimes living hand to mouth, having low self-esteem and associated feelings of being socially excluded and hopeless about the future. Evidence is emerging that these influences affect mental health and are**

**also associated with biological changes which can be transmitted to the fetus and can adversely affect future child health and development.** This is referred to as 'fetal programming'. It is central to understanding future child development and is a main strand of the scientific foundation justifying Marmot's approach to tackling inequality from conception.



***Funky Pineapple: Created by primary-aged children to show how exciting fruit and vegetables can be.***

*Source: Kids Company*

# What science tells us: risks, interventions, context and mechanisms

## Main modifiable risk factors during pregnancy for future child health

Certain behaviours, circumstances and events, if they occur during pregnancy, increase the risk of poor outcomes for either the pregnancy or future child health or both. These risk factors, such as smoking or obesity, are also known as 'exposures'. 'Prevalence' of an exposure is defined as the proportion of a population (e.g. pregnant women in England during 2012) who are exposed to a given risk factor (e.g. smoking). Some risk factors cannot be prevented or altered, but those which can are called 'modifiable'. However, demonstrating that a risk factor is truly a 'cause' of a poor outcome rather than incidentally linked is a difficult task. As for some factors it is not yet entirely clear whether the identified causal factor may not actually be casual rather than linked to other factors (e.g. social deprivation) which are causal.

Table 5.1 lists the main modifiable risk factors during pregnancy, citing evidence of their effects in humans. The effects of physical illness on pregnancy outcomes, although important, and non-modifiable risk factors are not included here.<sup>11</sup>

## Intervening to improve future child health

Many of the risk factors appearing in Table 5.1 'cluster together' in certain groups of women. For example, the opiate user is more likely than not to smoke, have poor nutrition, and be mentally ill, poor and stressed. This suggests that targeting risk factors individually is unlikely to be the best approach. Generally, a multifaceted approach (such as the Nurse-Family Partnership) which permits simultaneous engagement with a number of risk factors embedded in the social context is likely to be more appropriate than offering non-integrated interventions for each risk factor separately. In Table 5.2, the evidence for interventions targeting specific risk factors and for multifaceted interventions is summarised.

## Case study

### Perinatal Support Project – Family Action

Family Action's Perinatal Support Project (PSP) is an innovative low-cost, high-impact service. It trains and supports volunteer befrienders to work with women at risk of ante and postnatal depression, providing a vital service for women who are not eligible for acute perinatal depression support services. With significant referral numbers coming from health visitors and midwives, the PSP works alongside local agencies to ensure a joined-up, integrated approach to the referral and provision for mothers-to-be, new mothers, their partners and children.

The PSP:

- helps mothers with moderate mental health difficulties to overcome social isolation and depression
- assists mothers in developing a stronger bond with their babies
- safeguards the development of vulnerable babies.

The PSP was piloted in Southwark in London and subsequently extended to four additional sites – all achieving outstanding outputs and outcomes and with a well-received national evaluation undertaken by Warwick University which highlighted significant improvements in anxiety and depression, social support and self-esteem. There was also a significant improvement in the mother's relationship with the baby in terms of warmth, but not invasiveness.

The PSP has exceeded expectations – particularly when service users have progressed to become volunteers within Children's Centres and volunteer befrienders have begun further training or employment in health and social care.

**Table 5.1 Main modifiable risk factors during pregnancy and their effects in humans**

Risk factor	Evidence
<b>Tobacco</b>	Of all the harmful exposures in pregnancy, it is arguably smoking which causes the greatest harm. Not only does it cause impaired fetal growth, low birth weight and preterm birth, it is also associated with an increased risk of miscarriage, stillbirth, neonatal death and sudden infant death syndrome (SIDS). <sup>12</sup> Furthermore, smoking prevalence during pregnancy remains unacceptably high in the UK. Evidence of causal effects on neurodevelopment remains unclear. <sup>13</sup>
<b>Alcohol</b>	Heavy alcohol consumption during pregnancy causes a birth defect called fetal alcohol syndrome. <sup>14</sup> It may also damage the fetal brain without affecting other organs or tissues. <sup>15</sup> Evidence that drinking at low-to-moderate levels causes harm during pregnancy is equivocal. <sup>16</sup>
<b>Obesity</b>	Apart from increased risks to the mother's health (e.g. through gestational diabetes) obesity is also associated with large-sized babies (macrosomia). <sup>17</sup> Children of obese mothers are at an increased risk of later obesity themselves. <sup>18</sup> The relative contributions of genetic factors, the effect of the obesity on the fetal environment <sup>19</sup> (fetal programming) and of poor eating habits/nutrition in childhood remain unclear but all are likely to be important.
<b>Diet</b>	Maternal under-nutrition in pregnancy is associated with the development of heart disease in the adult offspring. <sup>20</sup> There may even be effects transmitted to future generations. <sup>21</sup> This finding (another example of fetal programming) is a very active area of research at the moment.
<b>Illicit drugs</b>	Particular concerns have been expressed about the effects of illicit drugs such as heroin, cocaine, cannabis and ecstasy on the fetus. <sup>22</sup> Use of illicit drugs is associated with problems in child development. Where the mother is a regular drug user there will often be other complex social factors involved and it is therefore difficult to tease apart the toxic effects of the drugs from the effects of being brought up in the frequently chaotic life circumstances of a drug-using mother (and possibly her partner) and the effects caused by the mother's often poor physical and mental health. Studies in humans have shown that, when adjusted to take account of other risk factors, many of the effects seem more related to the environment the child is brought up in rather than direct toxicity from the drugs. <sup>23</sup>
<b>Mental illness</b>	<p>Although the role and relative contributions of mental illness during pregnancy, drug treatment and the effects of postnatal continuation of mental illness remain unclear, a substantial body of research documents the adverse impact of maternal depression during pregnancy on birth outcomes,<sup>24</sup> on continuing depression in the postnatal period<sup>25</sup> and on infant development and later child outcomes.<sup>26</sup></p> <p>In addition to depression other less commonly occurring mental illnesses can have an impact on pregnancy and birth outcomes.<sup>27</sup></p>
<b>Low socio-economic status</b>	Low socio-economic status is associated with poorer outcomes in children: data from the UK Millennium Cohort Study indicate that a significant socio-economic gradient in children's development is already evident by 3 years of age. <sup>28</sup> Several adverse pregnancy outcomes including preterm birth <sup>29</sup> and stillbirth are linked to lower socio-economic status. <sup>30</sup> Preterm birth in particular is responsible for a high proportion of later neurodisability. <sup>31</sup> A sizeable proportion of the effects of low socio-economic status on birth outcomes may be due to a greater smoking prevalence in poorer populations. <sup>32</sup>
<b>Psychosocial stress</b>	One area which has been of particular interest for child development is how maternal psychosocial stress could operate during pregnancy to influence pregnancy outcomes, the child's development and later risk of disease. <sup>33</sup> Although a compelling idea with some supportive evidence from studies in humans, <sup>34</sup> there seems to be a low correlation in some studies between reported stress symptoms and the assumed biological processes involved. <sup>35</sup> Furthermore, there is no substantial evidence base yet on how or in what ways stress could be modified in this population of pregnant women. Further research on interventions is needed.

**Table 5.2 Interventions for modifiable risk factors**

Intervention	Evidence
<b>Smoking cessation</b>	Behavioural interventions can increase smoking cessation rates during pregnancy and reduce low birth weight and preterm birth. <sup>36</sup> However, the evidence for the effectiveness of nicotine replacement therapy in pregnancy has been equivocal with better quality studies showing little or no effect on fetal outcomes. <sup>37,38</sup> There is a need for interventions that can penetrate the so-called 'hard-to-reach' groups where smoking prevalence remains high and standard interventions may not work as well. Although somewhat controversial, the case for using financial and other incentives to promote smoking cessation in pregnancy has been proposed. <sup>39</sup> Using the technology favoured by teenage smokers, such as mobile phones and social media, may be a user-friendly way to promote cessation, as well as using social marketing, e.g. the Stoptober campaign. <sup>40</sup>
<b>Interventions for reducing alcohol consumption in pregnant women</b>	A Cochrane review in 2009 found limited evidence to support the effectiveness of interventions for reducing alcohol consumption in pregnant women. <sup>41</sup> It remains unclear which type of intervention to recommend. Further trials are needed.
<b>Interventions to reduce gestational weight gain</b>	There have been no trials to evaluate the effectiveness or safety of trying to reduce weight in obese pregnant women. <sup>42</sup> Interventions in pregnancy to manage weight gain can result in reduced weight gain during pregnancy <sup>43,44</sup> but may not affect the risk of macrosomia in the baby. Evidence of the effects of interventions on long-term child outcomes is lacking.
<b>Improving maternal nutrition</b>	Folate supplementation given around the time of conception and continued through early pregnancy has been shown to reduce the risk of birth defects such as spina bifida. It is recommended that women take 400 micrograms of folic acid each day during this time. The Scientific Advisory Committee on Nutrition is also considering the role of iodine, having looked at fortification of flour with folic acid.  Vitamin D supplementation in pregnancy is officially recommended: interim advice is that pregnant and breastfeeding women should take a daily supplement containing 10 micrograms of vitamin D. However, the evidence of effects on bone health remains equivocal <sup>45,46</sup> and little is known about the effects on other outcomes related to pregnancy. More research is needed on the effects of vitamin D supplementation in pregnancy: <sup>47</sup> an independent advisory committee is reviewing current recommendations on vitamin D and will report in 2014.
<b>Managing the use of illicit drugs</b>	Guidance on the best management of women who continue to use illicit drugs during pregnancy is provided by the National Institute for Health and Care Excellence (NICE). <sup>48</sup> A systematic review of psychosocial interventions for pregnant women in outpatient illicit drug treatment programmes found weak evidence of effect on retention in treatment but more evidence is required. <sup>49</sup>
<b>Perinatal mental illness and psychosocial stress</b>	Since stress may be a manifestation of an underlying psychiatric disorder such as depression or anxiety, pregnant women complaining of symptoms of stress and women with other symptoms of psychiatric illness should be evaluated in accordance with the NICE guideline on antenatal and postnatal mental health. <sup>50</sup> For stress which is not related to an underlying disorder then relaxation, exercise or counselling may be beneficial but there has been no clear evidence on how best to intervene. Hence this is another area where intervention evaluation is needed.
<b>Promoting breastfeeding</b>	Breastfeeding has been shown to have important effects on child health including neurodevelopment. <sup>51</sup> The World Health Organization recommends that infants should be exclusively breastfed until 6 months of age. Yet breastfeeding initiation is low in more disadvantaged groups of women. Interventions to promote initiation of breastfeeding are effective <sup>52</sup> as are interventions to prolong the duration of time for which a woman breastfeeds. <sup>53</sup>

Intervention	Evidence
<b>Multifaceted interventions</b>	Work in the USA identified the importance of starting an early childhood programme during pregnancy in order to give a child the best start in life. The Nurse-Family Partnership programme specifically aims to improve pregnancy outcomes by helping pregnant women to engage with prenatal care, improve their diets, and reduce smoking, alcohol and illicit drug use. Forty years on, the programme's effects have been evaluated in three randomised controlled trials and substantial benefits across multiple domains for both mothers and children have been demonstrated. <sup>8</sup> A more recent innovation in the USA has been group prenatal care where women receive their care in groups rather than individually. Evidence suggests that women receiving group care have equivalent or improved pregnancy outcomes compared with traditional prenatal care. <sup>54</sup> Some sites in the UK are implementing group antenatal care and evidence is due. These models may also be effective in ensuring continuity of care and developing peer support during pregnancy.
<b>Pre-conception care</b>	Pre-conception care is very important for women with established medical or psychiatric disorders. For women who are otherwise well it provides an opportunity to encourage healthy choices and establish folate supplementation. <sup>55</sup>

### The importance of context: why interventions may fail or be less effective

Holistic approaches to health emphasise the importance of working with pregnant women to assess their psychological, physical and social needs as well as capitalising on their assets and empowering them to make the health and care choices they desire. However, this approach does not always fit well with health service delivery models and may be part of the reason why some apparently effective interventions seem to work less effectively with certain social groups and hence worsen health inequalities – so-called ‘intervention-generated inequalities’.<sup>56</sup> The apparently intractable problem of the continuing high prevalence of smoking in pregnant teenagers provides an illustration. Hilary Graham<sup>57</sup> has pointed out

how the emphasis on changing behaviour combined with stigmatisation of smokers has led to an impasse and that viewing tobacco control policy through a social class and social inequalities lens is likely to be more helpful. One implication of the context-specific nature of effectiveness is the importance of carrying out effectiveness trials in disadvantaged groups or making sure that trials aimed at the general population can be analysed to show effects in disadvantaged sub-groups of the population.

Another area where context has been important is in trying to tackle the higher infant mortality rate and prevalence of some birth defects seen in certain minority ethnic groups in England. Periodic emotive calls to ban cousin marriages have caused alarm and concern among these communities. Instead, there is a need to commission enhanced antenatal, paediatric and genetic services for these communities both to improve awareness of risk and to help to care for the increased number of children with birth defects.<sup>58</sup>



***This sculpture uses the wardrobe as a metaphor to explore feelings about family, home and identity.***

Source: Kids Company



*Child's drawing from Kids Company's gallery*

Source: Kids Company

### Mechanisms: what basic science tells us

Plausible mechanisms exist to explain the effects of a number of risk factors on the developing fetus and on the fetal brain in particular. For example, the effects of toxins in cigarette smoke, illicit street drugs and alcoholic drinks on organs, tissues and cells have been studied extensively in animal models and, to a limited extent, in humans. Full consideration of the basic science is beyond the scope of this report but the following important principles have been established:

- Both nature and nurture are important: the complex interplay of both genetic and environmental factors<sup>59</sup> is fundamental in determining exposure to risk, susceptibility to risk and future outcomes. In particular, some pregnant women will be much more susceptible to the effects of certain risk factors than others.

- Certain risk factors during pregnancy (e.g. starvation, obesity, smoking and alcohol consumption) can change the expression of certain genes during development resulting in longer-term effects on child and adult health.<sup>60</sup> This is now generally referred to as **fetal programming**.<sup>61</sup>

**This mechanism can help to explain why some risks during pregnancy (e.g. under-nutrition) can be transmitted to the following generation.**

### What we still need to find out

There is still a lot we do not understand about brain development and, although the scientific basis of fetal programming is becoming clearer, there is still no evidence that interventions are able to alter the process. While pregnancy is undeniably an important period in development, so are later periods in childhood and adolescence. Furthermore, even the best constructed of the multifaceted interventions do not protect against the experience of being brought up in poverty.

There is much that we still need to find out including:

- The relative importance of fetal programming to later problems such as neurodevelopmental problems or childhood obesity and whether it can be altered to improve outcomes.
- How the relationship between humans and the microorganisms (principally bacteria) which live in or on them<sup>62</sup> can become perturbed during pregnancy<sup>63</sup> potentially causing disease, and how the development of healthy gut microorganisms early in a child's life can be affected by breastfeeding and potentially by dietary supplements of bacteria (probiotics).<sup>64,65</sup>
- In developing countries severe iodine deficiency in pregnancy is associated with neurodevelopmental health problems in the offspring.<sup>66</sup> Recent evidence suggests that, in the general population of UK women, even mild deficiency of iodine during pregnancy may be an important determinant of changes in child cognition.<sup>67</sup> These findings reinforce the need for a balanced diet in pregnancy but also support iodine supplementation during pregnancy.<sup>68</sup> Further work in this area is required.
- While the cause of preterm birth can be established in some cases, in most the cause is not fully understood. This may be part of the reason why interventions to date have had limited success. Therefore, further work is needed to investigate the causes of preterm birth and how to prevent it.
- Despite promising work in the new science of epigenetics,\* we still do not understand exactly how poverty 'gets under the skin' to cause problems during pregnancy and in later child development. In particular, the extent to which some of the problem might be mediated by psychosocial stress as opposed to material deprivation needs to be elucidated.<sup>69</sup>
- How we can better engage with disadvantaged groups of women both pre-conceptionally and during pregnancy to support them to make healthy choices. To what extent do we need to target health services to certain groups in order to improve outcomes and which services would be better provided universally?

\* Epigenetics is the understanding of how chemical modification of DNA or the histone protein cover of DNA affects the switching on or off of genes. This allows effects to be passed along generations – work done on nicotine exposure in pregnant rats showed that not only do their offspring develop asthma, so do future generations.

- What interventions are helpful for women to improve and optimise mental health during pregnancy? New mindfulness group-based stress reduction programmes appear promising but need further evaluation in this context.

Some of this will require more work on the basic science and possibly new and more robust research methods<sup>70</sup> in humans. The long period between pregnancy and the development of adult disease makes large intervention trials such as those done by Olds a very challenging and expensive option.<sup>8</sup> Animals such as rodents have much shorter life spans and we can control aspects of the environment as well as genetic variation to create models of the human situation. However, the extent to which findings from these models can be translated to humans remains open to debate. The large birth cohort studies conducted in the UK such as the Avon Longitudinal Study of Parents and Children,<sup>2</sup> the Millennium Cohort Study<sup>71</sup> and the newly established Life Study<sup>72</sup> will continue to be extremely valuable resources allowing researchers to follow up children from birth and through childhood to adult life. In the meantime, it is important to make sure that we implement what we already know works and to ensure that it works in an equitable manner in all groups of the population.

### Key messages for policy

- In order to achieve giving 'every child the best start in life', policy makers need to prioritise interventions that reduce adverse outcomes of pregnancy. This will require a greater investment in research and expansion of services for pregnancy and the early years. This needs to address the quality of both universal care and support and of services which provide a more targeted approach, and not one at the expense of the other.
- Pregnancy is the very start of child development and a time when women are often more motivated to make healthy choices. Most women are in contact with services and hence there is the potential to intervene and make a difference.
- The science of fetal programming demonstrates that exposure during pregnancy to poor nutrition, obesity, smoking, alcohol and stress can adversely affect later health as a child and adult. Some of these effects are likely to be transmitted to subsequent generations.
- Optimising maternal mental health during pregnancy needs to be given equal prominence to optimising maternal physical health in policy as it is a major influence on future child development and outcomes. Linking the pregnancy and public mental health policy agendas would be an excellent first step. This should be done at all levels – from local Health and Wellbeing Boards through to Public Health England and the Department of Health. Furthermore, implementation of guidance in terms of identification, referral support, appropriate treatments and further education and training for those who work with pregnant women and new mothers is fundamental.
- Social factors including poverty may constrain a woman's ability to make healthy choices and result in inequalities in pregnancy outcomes. Tackling social disadvantage early in pregnancy can lead to major improvements in child health outcomes.
- Health interventions during pregnancy may have benefits for other sectors beyond health. It is important to consider the costs to education, justice and social services which can be averted by increased investment in the antenatal period.
- Disadvantaged groups of pregnant women may better engage with less stigmatising approaches to health promotion, for example smoking cessation. There is an opportunity for innovative approaches to reduce this health inequality through the newly established local authority public health departments working with their partners in health.
- Multifaceted intervention programmes such as the Nurse-Family Partnership which help disadvantaged mothers to engage with multiple health behaviours at the same time hold great promise.
- Preterm birth causes a considerable amount of neurodisability; we still do not know the cause or how to prevent it in most cases.
- Policy makers should continue to ensure that care for mothers is holistic and integrated both vertically and horizontally.

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