

# Stress pre-birth

## How the fetus is affected by a

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In this inaugural issue of the Journal, we introduce the key themes that we will be focusing on. The first of these is 'The Unborn Baby'. A recent report from The WAVE Trust, whose work we feature later, notes that 'it is now known that the developing brain of the baby adapts itself, on a neurobiological level, to the quality of the caregiving environment' (The Age of Opportunity:69). The first 'caregiving environment' is the womb. In this article, Graham Music presents the accumulating evidence that underpins the work of all practitioners who are striving to educate and support women and men across the transition to parenthood.

### The fetus: both autonomous and vulnerable

Parenting is a sufficiently guilt-laden process these days, and it might seem harsh to add to this burden by focussing on the powerful psychobiological impact of a mother's emotional states on her unborn child. However, recent research findings have described a range of powerful effects of prenatal experiences, particularly stress, on the growing fetus, many of which last well into the life-course. Armed with this information we can try to ensure that robust services and support structures are in place to minimise some of the worst risks to the developing fetus and the future child and adult.

The fetus is, of course, not just a passive victim of influences, and is very much its own being, with its own rhythms, urges and biological expectations. Its arrival transforms the mother's body into an effective host, and once plugged into the uterine wall it intervenes with its mother's control mechanisms, leading some to liken it to a cosmonaut in charge of a spacecraft. The fetus determines which way it will lie in pregnancy, the timing of the birth, and which way it will present for the birth. It has feeling, responds to painful stimuli by turning away (Goodlin and Schmidt, 1972) and has demonstrated a surprisingly clear capacity for choice. Indeed, observations using ultrasounds of fetuses have shown clear personality traits developing (Piontelli, 1992).

Neurons in the cortex are already firing in response to events at 20 weeks (Moore et al., 2011). As early as 1937, experiments showed that after adding saccharin to the amniotic fluid fetuses swallowed more, whereas foetal drinking rates crashed after the injection of bitter substances (Bradley & Mistretta 1975). The fetus can learn to get used to unsettling stimuli. For example, the first time it encounters a vibrating stimulus it might move, but on subsequent

occasions it pays less attention (van Heteren et al., 2001). By eight to ten weeks it is moving its limbs, and rather than being an inert cell collection blissfully bathing in amniotic fluid, it is active and responsive.

The fetus is nonetheless profoundly influenced by its milieu. A fetus responds to musical signals, moving in synchrony to a rhythm and even continuing to move after the music has stopped (Sallenbach, 1993). As early as the first trimester the fetus will jump if touched by an amniocentesis needle, turn away from the light of a doctor's fetal stethoscope (Goodlin and Schmidt, 1972), and fetal heart rates increase when pregnant mothers smoke cigarettes. Fetuses have been shown to respond to stimuli such as loud noises by making facial expressions such as grimacing, pain and what looks like crying (Reissland et al., 2013). Already we see a nature/nurture interaction; the fetus is its own being but also is being socialised. It learns to recognise sounds and words that it later prefers after birth (Moon et al., 2012), while culturally influenced tastes and flavour preferences are also being learnt (Trout and Wetzel-Effinger, 2012).

### Perfect harmony?

A mother's state of mind influences the prenatal environment, for example, via the release of hormones. When a small acoustic/vibrational sound stimulus is administered, ultrasounds reveal that fetuses of depressed and non-depressed mothers react differently. Heart rates of the fetuses of depressed mothers are higher than the norm anyway, and after the stimulus they can take 3.5 times as long to return to their normal baseline. Fetuses of non-depressed mothers react more responsively, and also calm down more quickly (Dieter et al., 2001). This is uncannily similar to chronically anxious or stressed older children and adults, who tend to recover more slowly from alarming stimuli. Field presented research (2006) which showed not only that foetal movement is higher when a mother is depressed, but also that a fetus moves differently *in utero* depending on the *form* of the mother's depression. The fetuses of mothers whose later, post-natal, depression resulted in a more intrusive rather than withdrawn maternal style, were the fetuses that moved around less than those of mothers who had a more withdrawn form of depression.

# mother's state of mind

## Where does parental influence start? The meeting of biology and psychology

It is interesting to think about when parental mental states begin to influence a baby's future. A pregnant mother's state of mind is, we know, predictive of an infant's behaviours a year or more after birth. In a famous experiment undertaken by Howard and Miriam Steele (Fonagy et al., 1991) pregnant first time mothers were given the Adult Attachment Interview which asks about parents' own childhood memories. Their interviews predicted with surprising accuracy the future attachment status of their as yet unborn child. Such interviews reveal less about a mother's actual childhood and more about her ability to reflect on her own emotional experiences. Typically an adult who produces a coherent narrative and self-reflective story tends to have a child who at a year is classified as securely attached. Mothers whose stories are more chaotic or inconsistent, or who are emotionally cut-off, tend to have insecurely attached children. Thus, extraordinarily, the psychological capacities of a pregnant mother predict how her unborn child will react to stressful situations such as separation a year after birth. It is a mother's sensitivity to emotional life, her own and others', which seems to lead to this effect. Presumably such findings imply continuity between a mother's states of mind during and after pregnancy.

However, prenatal experiences have lasting influences in themselves, irrespective of a mother's state of mind after birth. A well-known example comes from the Second World War in Holland where a cohort of mothers did not have enough food to eat; many were starving and even resorted to eating tulips (Lumey et al., 2007). The fetuses of the starving mothers grew into children and adults with 'thrifty' metabolisms who stored more fat, despite the food shortage disappearing after birth. Indeed if nutrition is uncertain, the fetus 'decides' whether it needs to store more fat, adjusting the balance of blood flow to the liver and the brain accordingly (Godfrey et al., 2012). This kind of research describes what is called 'fetal programming', whereby unborn babies learn lessons to prepare for life later. In this case, such thrifty metabolisms led to difficulties such as heart disease and diabetes, as well as higher rates of psychiatric illness, in many of the starved babies who grew into adults living in a more plentiful world.

An extreme form of this might be seen from studies of

pregnant women exposed to trauma where the stress has a profound effect. Women who happened to be present at the World Trade Centre on 9/11, who later showed Post Traumatic Stress symptoms, also had children with altered stress responses and cortisol levels (Yehuda et al., 2005). Being close to a hurricane in pregnancy hugely increases stress responses, as well as the likelihood of serious effects for the baby such as being on a ventilator or meconium aspiration syndrome after birth (Currie & Rossin-Slater, 2013). Indeed, exposure to stressors such as a rocket attack even leads to increasing numbers of spontaneous abortions (Wainstock et al., 2013).

Obviously there is little we can do in the face of huge unexpected calamities, but there are lessons to be learnt from them about the toxic effects of stress. Generally the social causes of stress such as poverty or interpersonal trauma are the most prevalent, and maternal stress levels might be best seen as a signifier of social, political, economic and cultural disadvantage.

## Low birth weight

Low birth weight is often linked with prenatal stress, and is also a predictor of illness decades later. Records of over 13,000 men born in Yorkshire showed that those with lower birth weight were more likely to suffer from conditions such as strokes, diabetes and heart disease as far ahead as 50 years of age (Barker et al. 2001). Indeed, if born weighing less than 2.5 kgs, they had a 50% higher chance of developing heart disease, even accounting for socioeconomic circumstances.

Such seemingly purely physiological matters as birth weight in fact often have psychological as well as physiological elements. There is consistent evidence that high stress levels in pregnancy increases the likelihood of both birth complications and low birth weight (Wadhwa, 2005) as well as affecting a fetus' capacities for memory and habituation (getting acclimatised to new experiences) – effects that persist after birth. Cortisol, the best known stress hormone, crosses the placental wall and affects the fetus: there are correlations between maternal and fetal cortisol levels (Glover & O'Connor 2002). When a mother becomes fearful her heartbeat alters, often leading to reduced oxygen flow to the fetus (Monk et al., 2000), speeding up its heart rate and reducing nutrient flow. Mothers with bipolar disorder, a huge study in Sweden found, are far more likely to have premature and/or low birth-weight babies, irrespective of

## Aggression and other behavioural problems are also more likely in low birth-weight children

whether they were being treated (Bodén et al., 2012). Similarly depressed mothers also tend to have smaller babies (El Marroun et al., 2012).

Being born small is predictive of a range of later mental health issues, and for example low birth weight (less than 2.5 kgs) predicts a host of adult psychological problems from depression to mood disorders (Nosarti et al., 2012). Low birth-weight babies are three times more likely to suffer from anxiety or mood disorders in adolescence (Burnett et al., 2011). Aggression and other behavioural problems are also more likely in low birth-weight children, and here the mediating factor seems to be poorer language skills (Vaske et al., 2012). We know that the size of a newborn's placenta, a good indicator of weight, is also predictive of mental health problems up until adolescence (Khalife et al., 2012), while not surprisingly the brains of adolescents born very prematurely tend to show a whole range of abnormalities (Taylor et al., 2011).

### Lasting effects, social effects

Prenatal stress affects not only birth-weight but also stress levels after birth, and even has an effect on the way particular genes are expressed (Mulligan et al., 2012). Indeed it lowers a new-born's immune functioning (Howerton and Bale, 2012), even for example predicting iron deficiency (Armony-Sivan et al., 2013). Severe antenatal stress affects hormones that regulate mood, such as dopamine and serotonin and is linked to a range of childhood emotional and behavioural problems such as ADHD. Such influences hold firm after screening out factors such as gender, parental educational level, smoking in pregnancy, birth-weight and post-natal maternal anxiety (Van den Bergh et al., 2007).

A big question is why we should see such profound effects. Many of the most rigorous researchers argue for an evolutionary perspective. Vivette Glover, maybe Britain's foremost researcher in this area, suggests that it makes sense to be more vigilant, hard to soothe and jumpy if the likelihood is that one will be born into a stressful or scary environment in which one has to be much more vigilant and wary (Glover, 2011). Jay Belsky suggests that our bodies 'choose' a different life-course, either a faster, more stressful one or a slower, more relaxed one, depending on the kinds of stressors encountered as early as prenatal life (Pluess and Belsky, 2011). This all suggests that stress hormones are, in effect, programming the developing fetus for later life.

Stress responses in the newborn might increase the likelihood of survival but they also have serious health consequences. Our immune systems are badly compromised by stress, and people exposed to high levels of prenatal

stress tend to have premature cell ageing, or in other words they get old faster (Entringer et al., 2011). We are increasingly learning how such stressful experiences have profound effects at a cellular and indeed a genetic level. Adolescents of women exposed to violence in pregnancy have, for example, been found to have altered expression of genes central to behaviour and emotional regulation (Radtke et al., 2011). Indeed women with high blood pressure and other signs of prenatal stress have children with less cognitive capacity 70 years later (Pesonen et al., 2013). These are serious effects.

Some stress can derive from one-off rather than chronic experiences, such as a mother experiencing bereavement during pregnancy. In such cases, if good support is available the impact on the infant will be lessened by other more positive influences. More tragic are over-determined causative factors such as a highly stressed mother born into poverty, who is the victim of violence, and has little social support. She might be more likely to have a low birth-weight baby, have birth complications, which in turn can lead to difficulties in bonding. If one then adds the likelihood of intrusive medical attention, a decreased likelihood of breastfeeding, less attuned interaction, poor housing, little support, then a baby's prognosis worsens exponentially.

### Summary

Although I have shown how maternal stress leads to low birth-weight and a host of serious issues later on, we can on no account blame stressed mothers for the physical and emotional health of their offspring. This research takes us far beyond the responsibilities of the individual mother. Stress, anxiety, depression and other psychological issues are more likely if one is socially and economically marginalised, particularly if one is poor in an unequal society (Wilkinson 2005) or has low social status (eg the victim of racism) or if one is the victim of domestic violence or abuse, or socially isolated.

Although it is important not to place blame on mothers, if we want to alter trajectories then we cannot downplay what the research finds. Maternal stress and anxiety not only influence birth weight, but are a precipitating factor in birth complications and prematurity. High stress levels can alter the fetus' brain structure and functioning, and contribute to later mood and anxiety disorders (Talge et al., 2007). The fetus is programmed by such early pre-natal experiences, as if the unborn baby is trying to work out what kind of world to prepare for. Low birth-weight babies born to very anxious mothers are likely to have higher cortisol levels throughout their lifespan and a permanently altered stress response system (Phillips 2007). Adults who at birth are of low birth-weight are more susceptible to the physiological effects of

stress caused by factors such as poverty and unemployment (Barker et al. 2001).

This article has demonstrated how maternal influences begin well before birth. Swathes of influences affect the fetus' physiological, psychobiological and psychic being, and appear to have a role in programming it in preparation for the world it is likely to encounter. The fetus is also an active being from the start, responding to stimuli and actively initiating events. However, is also directly affected by the psychological state of its mother. Not only do stress hormones

and other chemicals such as alcohol cross the placenta and affect the developing fetus, but also the mother's capacity to process emotional experience predicts what her unborn baby's attachment status will be a year later. Emotional support for mothers makes pregnancy easier and can also make the birth process considerably smoother, again showing the importance of psychological well-being from the very beginning of the lifecycle. Such research should support arguments for providing psychological and social support for pregnant mothers. ♦

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