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EVIDENCE BRIEFS 2021–2022

Intergenerational disadvantage

Screen time

Executive functions

Parent-child bonding

The father's biological role

Perinatal mental distress





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Authors



Dr Felicia Low is a Research Fellow at Koi Tū: The Centre for Informed Futures where she leads the Knowledge Hub for Maternal and Child Health.

✉ f.low@auckland.ac.nz



Chloe Wilkinson is a Research Assistant at Koi Tū: The Centre for Informed Futures, University of Auckland.

✉ chloe.wilkinson@auckland.ac.nz



Distinguished Professor Sir Peter Gluckman is the Director of Koi Tū: The Centre for Informed Futures and the President of the International Science Council.

✉ pd.gluckman@auckland.ac.nz



Professor Richie Poulton is Director, Dunedin Multidisciplinary Health and Development Research Unit, Co-Director of the National Centre for Lifecourse Research at the University of Otago, and an associate member of Koi Tū: The Centre for Informed Futures.

✉ richie.poulton@otago.ac.nz

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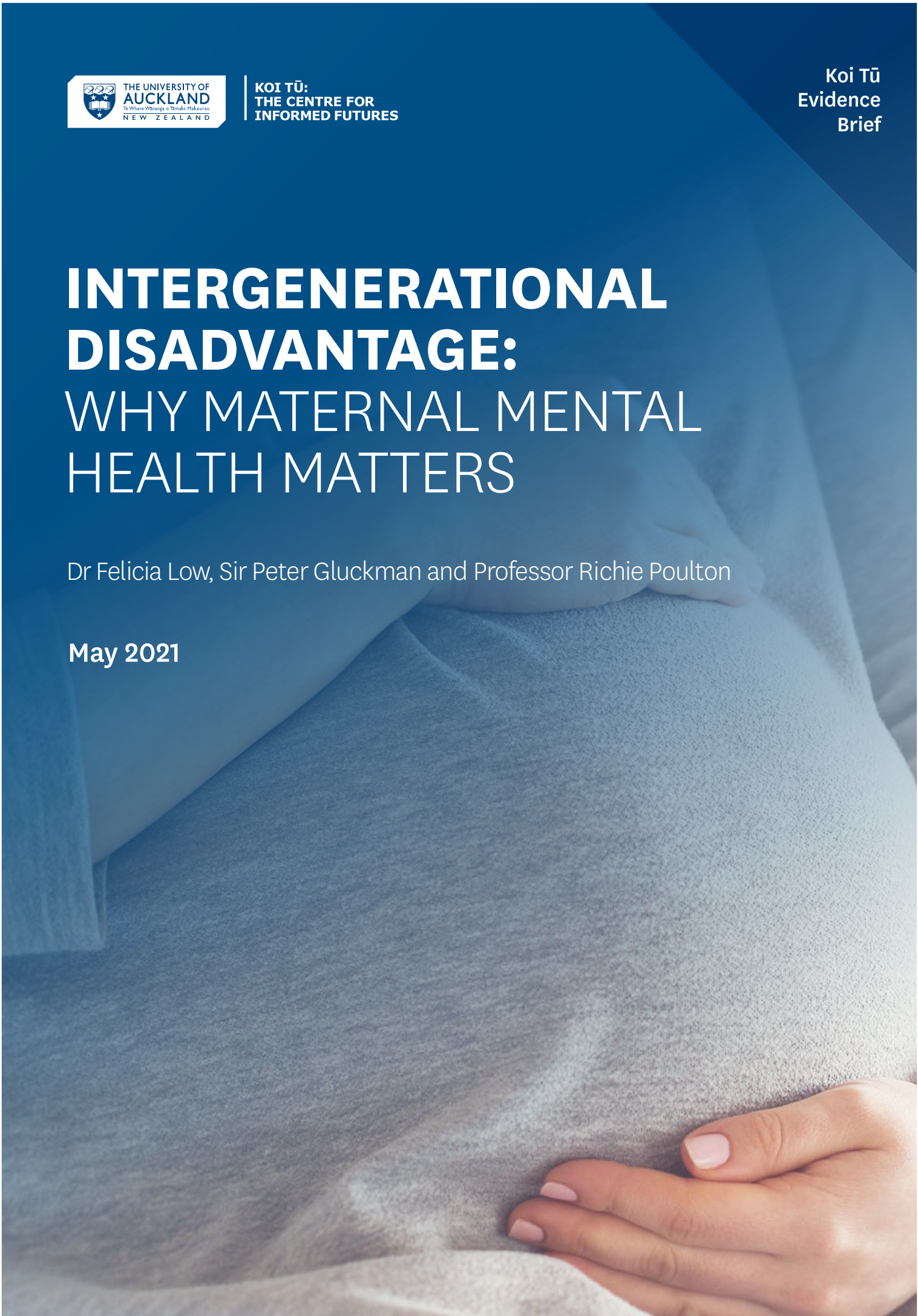
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INTERGENERATIONAL DISADVANTAGE: WHY MATERNAL MENTAL HEALTH MATTERS

Dr Felicia Low, Sir Peter Gluckman and Professor Richie Poulton

May 2021



INTERGENERATIONAL DISADVANTAGE: WHY MATERNAL MENTAL HEALTH MATTERS

Key points:

- Intergenerational disadvantage in New Zealand is driven in large part by poverty and other environmental factors
- Executive function is critical for successful passage through life, and its impairment places the individual at lifelong disadvantage
- New research shows that stress during pregnancy – even at mild to moderate levels – can affect development of the child’s executive function
- This suggests that there is a biological contribution to how intergenerational disadvantage arises and becomes embedded
- This requires a rethink in how the cycle of intergenerational disadvantage can be broken
- Interventions need to focus on the mother and infant, with parental needs being supported even before the child is born

Intergenerational disadvantage in Aotearoa New Zealand

Intergenerational disadvantage refers to the impact of parental socioeconomic and other limitations on the child, leading to disadvantages such as poverty and reduced educational and future employment opportunities. This may in turn impact on the next generation when that child becomes a parent, and so on.¹ Intergenerational disadvantage is arguably one of the most important social issues facing our future. It tends to become reinforced in a vicious cycle, its severity and social repercussions are likely to be cumulative, and yet successive policy interventions, both fiscal and social, have had limited effectiveness in reducing its presence or impact.

Intergenerational disadvantage is generally regarded as being underpinned by low socioeconomic status, although other factors such as the educational attainment, skills, emotional capacities and behaviours of the parents also play a role. During the late 1980s and 1990s, the rates of child poverty in New Zealand more than doubled and have not declined since (Figure 1). Māori and Pacific children are considerably overrepresented in these statistics.

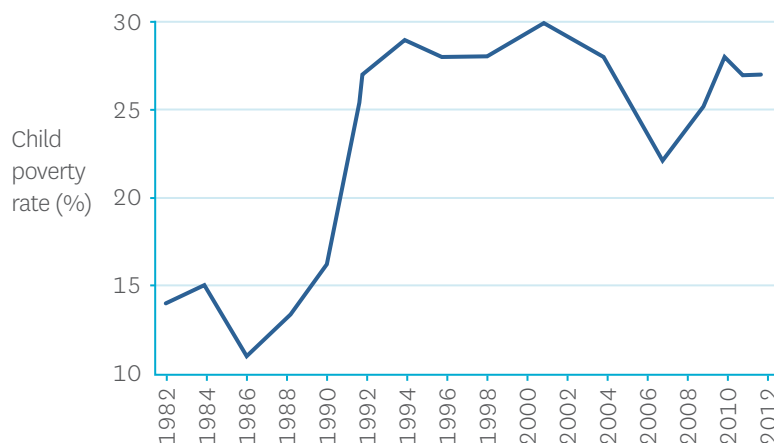


Figure 1: Child poverty rates in New Zealand, 1982–2012, as measured by residence in households with <60% of median income after housing costs. Adapted from Boston & Chapple 2014.²

Children born in the 1990s have now reached the typical age of parenthood, suggesting that our society now contains a greater percentage of people whose early development has been disadvantaged for at least one generation and probably more. In 2019, more than one-third of children (36%) lived in a low- or very-low-income household.³

High levels of deprivation, in the context of the wider social milieu, are an irrefutable cause of intergenerational disadvantage. However, emerging research over the last few years now strongly supports the idea that in addition to environmental factors, there is also a *biological* basis in how intergenerational disadvantage becomes manifest and is perpetuated. New evidence shows that moderate or even mild stress during pregnancy can have adverse outcomes on a child's neurodevelopment and emotional and cognitive outcomes. While the broader environmental context exerts an obvious postnatal influence, a growing body of research points to pregnancy as a critical window during which the foundations of a child's emotional and behavioural developmental pathways are built.

This new appreciation underscores the need to rethink how the cycle of intergenerational disadvantage can be broken, beyond the current minimally effective remedial approaches. More specifically, the research suggests that interventions should focus primarily on the **mother and infant**, particularly regarding maternal mental health and the development of executive function in the child.

The importance of executive function

Executive function refers to the ability to consciously control behaviour in working towards a goal. It involves a set of high-level neurocognitive processes such as flexible thinking, the ability to regulate attention and emotion, goal setting, planning and organisation, and the operation of working memory.⁴ The foundations for these processes are laid in the first 1,000 days after conception, and are mostly complete by age 5.

Executive function is absolutely central to the ability to learn. It helps with acquiring knowledge and solving problems, and is therefore critically important in school, work, and other aspects of daily life. Furthermore, it is protective against adversity by promoting psychological resilience.⁵ Accordingly, any impairments to executive function will have lifelong costs in the form of greater risks of disorders in learning, mental health, school failure, poor relationships and antisocial behaviour, reduced earnings, and interactions with the justice and welfare system. The Dunedin Multidisciplinary Study has shown that nearly 80% of adult economic burden could be attributed to just 20% of study participants, highlighting the disproportionate contribution of a small population group to overall societal costs.⁶ Notably, the risk of a participant ending up in the high-cost group could be predicted by indicators of executive function at age 3, and other childhood risks such as socioeconomic deprivation.

Executive function is the most important higher brain function for successful passage through life. This strongly suggests that ensuring its optimal development **early in life** is the best way to reduce the risks of lifelong downstream disadvantages. Given that neurodevelopmental pathways generally become less easily reversible as a child gets older, interventions need to occur early in the life course – in fact, as early as during pregnancy and the early postnatal period.

The importance of maternal mental health

Many women experience stress, anxiety or depression during and after pregnancy. In New Zealand, studies suggest that 12–18% of pregnant women are clinically depressed,^{7,8} while an unknown but likely considerably larger proportion (perhaps 30%) fall within the sub-clinical (less severe) range.ⁱ Poor maternal mental health is associated with poor obstetric outcomes, but also has major consequences beyond that. Having depressive symptoms and/or anxiety during pregnancy has now been shown to affect the child's brain development, not only in terms of its structure and connectivity,^{11, 12, 13} but also in terms of its functional outcomes including measures of executive function such as working memory, attention and sensory processing. All of these aspects affect school readiness and the child's subsequent journey through school and society.^{14, 15}

For example, children whose mothers experienced depression during pregnancy had differences in both the microstructure of their amygdala, a brain region known to be vulnerable to environmental adversity, as well as the amygdala's connectivity to the brain circuitry controlling emotional regulation.¹² These findings suggest the potential transmission of vulnerability for mood problems from mother to child. Recent research has also linked low mood *during* (not after) pregnancy to impaired learning readiness and literacy skills in the child.¹⁵ Importantly, some long-term impairment is seen in children whose mothers experienced sub-clinical levels of mood disturbance. This means that the total proportion of affected pregnancies is potentially high.^{9, 15}

The finding that a child's development is mediated by maternal prenatal mood indicates that the observed effects are being exerted through biological rather than environmental mechanisms, although we note that postnatal maternal mood remains an important component. There are plausible biological mechanisms to explain the association between a mother's mood and her child's brain development. Stress-related maternal hormones and other signaling molecules may cross the placenta and reach the fetus, potentially affecting neurodevelopmental pathways responsible for the regulation of socioemotional responses and cognitive development.

On the other hand, research also suggests that having a positive mood during pregnancy (that is, not just an absence of low mood) has beneficial effects on the child's brain development and function.¹⁶ This makes the point that good mental health is not merely defined by an absence of illness; critically, it also underscores the value of universal promotion of mental health among all pregnant women, in addition to targeted interventions on those needing support.

Given the life-changing nature of pregnancy, some degree of emotional impact is inevitable for all women. Whether that manifests with positive or negative effects depends on many contextual factors, such as the level of support they receive from their partner, family and whānau. However, stress can be further compounded by low socioeconomic status. Indeed, statistical analyses suggest that the mood of mother during pregnancy is a significant factor in determining how socioeconomic status affects executive function.¹⁵ This again highlights a clear interaction between biological (prenatal) and sociological (postnatal) factors in impacting on a child's executive function. It also suggests that groups such as Māori and Pacific women, who are more likely to experience difficult socioeconomic circumstances, are also likely to bear a greater emotional burden during pregnancy.ⁱⁱ A survey found that the prevalence of depression or anxiety was greater among pregnant Māori women than pregnant non-Māori women, with 1 in 4 Māori women experiencing depressive symptoms and more than half identifying significant life stress.⁷

i Based on cohort studies, the prevalence of pregnancies falling in the high sub-clinical range is relatively high in Australia (30%) and Singapore (29%),^{9, 10} and is expected to be reasonably similar in New Zealand.

ii A study has found that further risk factors for depression during pregnancy were being of Pacific or Asian ethnicity, and perceived stress.¹⁷

Intergenerational disadvantage, maternal mental health, and executive function are all cyclically linked

Taken collectively, the existing and emerging research demonstrates that children born to mothers who are stressed and have suboptimal mental health are at risk of impaired executive function and lower psychological resilience. If these children in turn become pregnant later as they progress to adulthood, then their impaired emotional resilience may manifest as greater stress in pregnancy. In turn, their child’s neurodevelopment is also likely to be adversely affected, potentially to a greater extent than what they had experienced themselves. Thus, a self-reinforcing feedback loop is created, and over time intergenerational disadvantage leads to greater adversity and worse community outcomes (Figure 2).

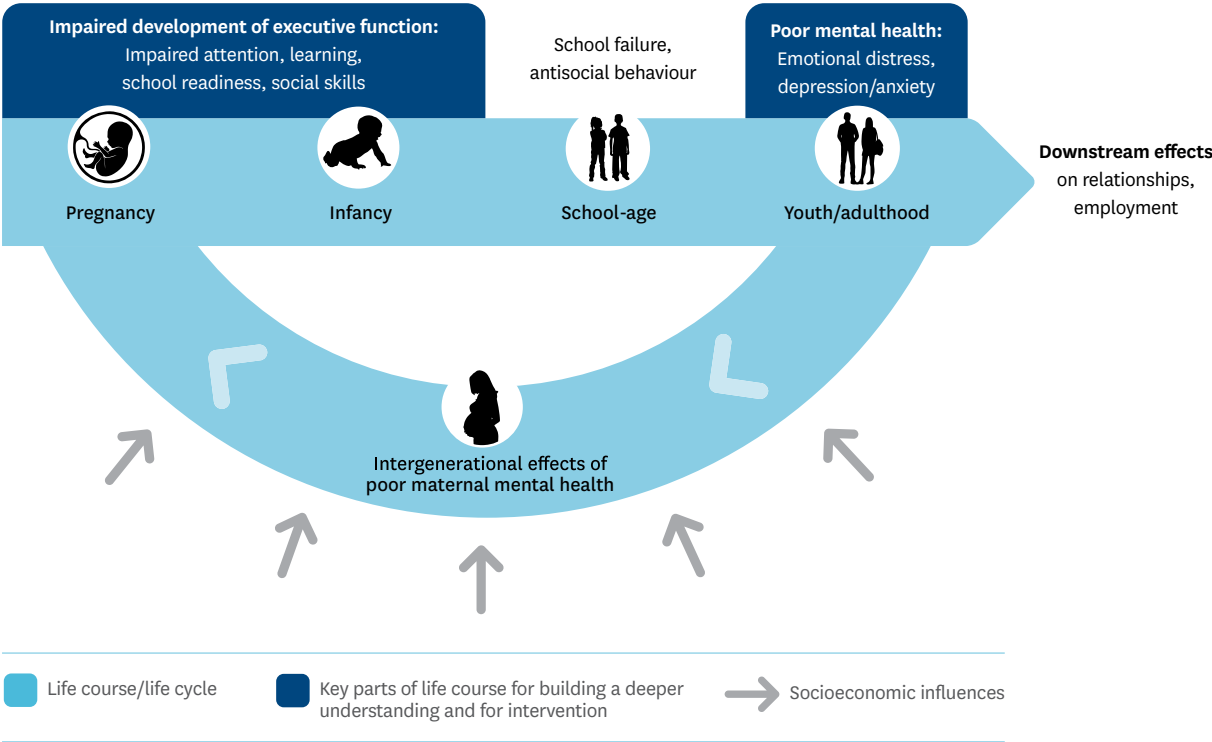


Figure 2: The cycle of intergenerational disadvantage and the contributing roles of poor maternal mental health and impaired executive function. The cycle operates under the broader influences of multiple socioeconomic factors.

In this context, it is troubling to note increasing rates of poor mental health among New Zealand youth, with female youth of all ethnicities more likely to have significant symptoms of depression and less likely to report good emotional wellbeing than male youth (Figure 3).¹⁸

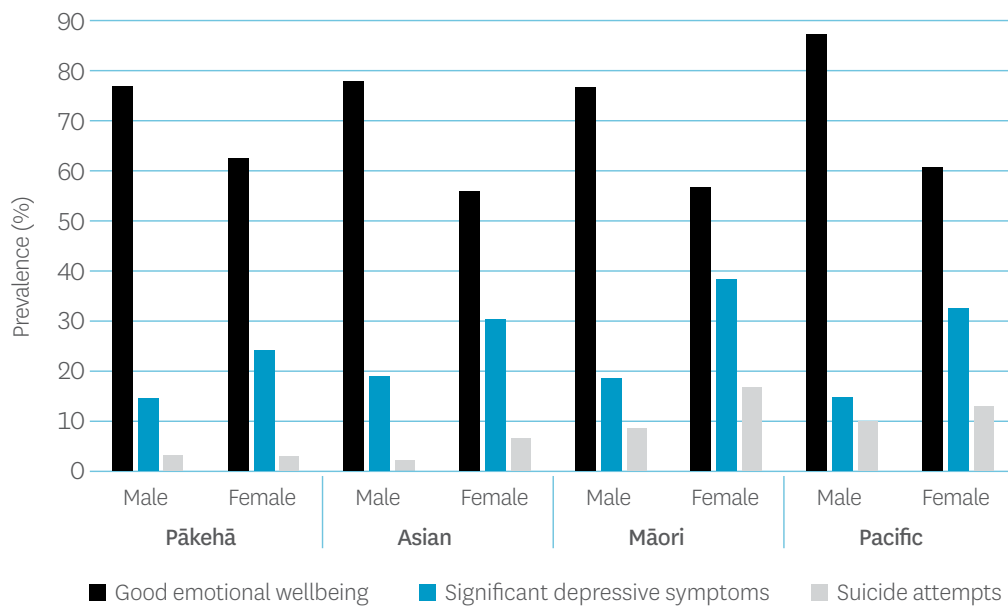


Figure 3: Indicators of mental health by sex and ethnicity, 2019. Data compiled from Fleming et al 2020.¹⁸

Studies show that anxiety or depression before pregnancy is a key risk factor for antenatal mood disorders.^{19, 20} Therefore, the current explosion of mental health concerns in young New Zealanders is likely to give rise to the prospect of new generations of women who are at greater risk of poor mood during pregnancy, further exacerbating the rates of intergenerational disadvantage.

Implications for policy and for service provision

Given the biological basis for how intergenerational disadvantage can become embedded, there are very clear implications for when in the life cycle preventive interventions could be most effectively carried out to break the cycle: the focus must be on women's mental wellbeing from **before pregnancy through to after birth**.

Appropriate supportive interventions should therefore span pre-conceptual services through to peripartum and early infancy support. Specifically, all pregnant women should be formally screened for their mood state, and in particular for depression/anxiety. Those whose symptoms fall within the sub-clinical range should not be ignored; they merit support to alleviate whatever is contributing to that state. Such strategies are justified given the vast sums now expended without success in addressing intergenerational disadvantage.

Remarkably, there is currently no formal screening programme for depression in the perinatal period in New Zealand,²¹ with mothers dependent on being proactively screened and referred to mental health services by their healthcare provider. This tends to focus largely on those who need formal psychological assistance.

There are concerns at the grassroots level that pregnant women with mild to moderate mood disorders face barriers to accessing available services, as they tend to be considered lower priority than those with more severe conditions.²² It is now becoming evident that it is equally important for this group of women to receive mental health services too.²³

Beyond these measures, there are many other ways society could assist in reducing stress of vulnerable women during pregnancy. While psychiatric interventions have their place, they tend to be best suited to individual treatment and need not be the primary approach. Instead, scalable, population-based

approaches such as social, educational and fiscal support to help reduce emotional and psychological stresses on women, especially those of lower socioeconomic status, should be emphasised. Where appropriate, fiscal assistance, mentorship, community/whānau support, and extended leave might all be part of a comprehensive toolbox. This shift in priority requires a considerable reassessment of how maternal health care should be approached.

New Zealand and international research strongly suggests that population segments at potential risk of contributing to a large economic burden later in life may be identified in early childhood, and that effective interventions could have very large returns on investment.⁶ From an economic standpoint, it is indisputable that investing in disadvantaged young children benefits not only the children, but also successive generations and society at large.²⁴ Strengthening the foundations for the optimal development of executive function by improving maternal mental health is, arguably, the most logically, morally and economically sound way of breaking the cycle of intergenerational disadvantage and advancing New Zealand society.

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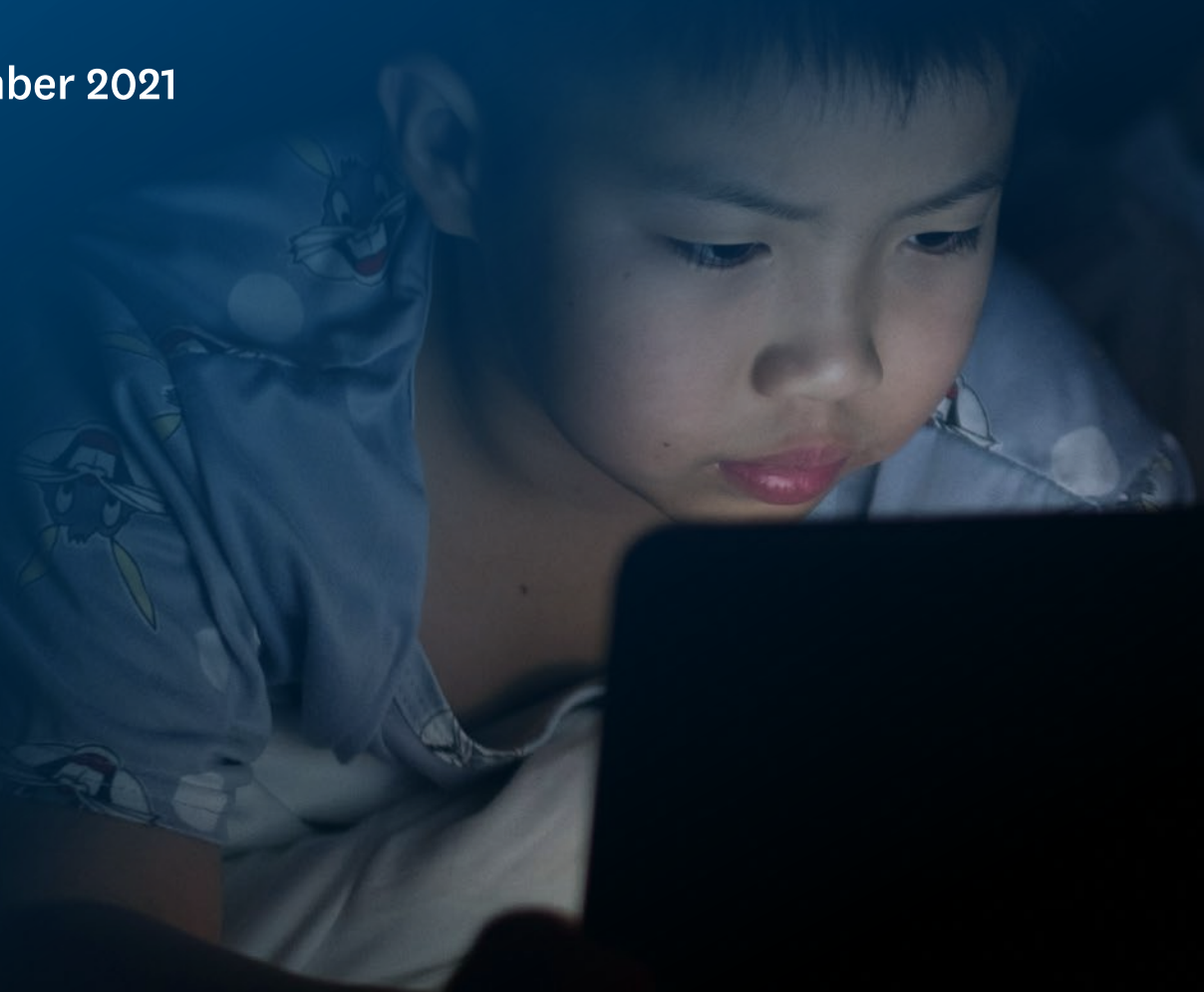
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SCREEN TIME: THE EFFECTS ON CHILDREN'S EMOTIONAL, SOCIAL, AND COGNITIVE DEVELOPMENT

Chloe Wilkinson, Dr Felicia Low, Sir Peter Gluckman

September 2021



SCREEN TIME IN NEW ZEALAND CHILDREN

Key points:

- New Zealand children are using digital devices for recreation daily, and only one in eight are meeting Ministry of Health screen time guidelines.
- The influence of non-educational screen time on brain and behavioural development is complex and not well understood. However, there is accumulating evidence of potential negative associations particularly with children's ability to focus their attention and regulate their behaviour and emotions.
- Harmful associations are generally mild but appear strongest when children use non-interactive, non-educational media instead of talking and playing with people and objects around them.
- While recommendations to limit or avoid screen time without specifying the type of screen use may appear advantageous, such blanket time limits do not reflect contemporary New Zealand family life. There is insufficient scientific evidence to determine how much screen time is harmful.
- It may be more helpful to differentiate between the various available forms of electronic media and focus recommendations around engaging with screens in ways that minimise the chance of adverse effects and maximise the positive opportunities they can provide.
- Recommendations include prioritising interactive screen time, balance between screen time and other family activities, and monitoring content children are exposed to. Full recommendations are on page 7.

Rapid global technological change has seen electronic media become ubiquitous in modern society. Time spent using any electronic device with a screen, including computers, tablets, television, game consoles, and smartphones, is widely referred to as 'screen time'. Over recent years, the proliferation of such devices has led to growing concern about the impact of growing up in a digital world on children's development.^{1,2} The foundations for executive functionsⁱ are laid in early childhood. Therefore, the influence of screen time on children's emotional, social, and cognitive development is of great interest to both parents and researchers. Public concern is fuelled by media reports connecting screen time with various behavioural and attention problems in children.

Children may use digital technology for schoolwork in class and at home. This report focuses on recreational screen time such as watching television, using social media platforms, and playing games. The Ministry of Health recommendations for children's recreational screen time suggest zero use for children under two years of age, less than one hour per day for children aged two to five, and less than two hours per day for children aged five to 17.^{4,5} New Zealand children across all age groups use screens daily and exceed these time limits, some by a large degree. The 2019/20 New Zealand Health Survey reports that 88 percent of children aged under one to 14 exceed the recreational screen time guidelines.⁶ In 2021, data from the Growing Up in New Zealand study show over 80 percent of two-year-olds typically have the television playing in the same room as them, and 12 percent are exposed to more than six hours of television daily.⁷ The likelihood of excessive recreational screen time increases with age, with approximately 60 percent of two to four-year-olds, 80 percent of five to nine-year-olds, and over 90 percent of 10 to 14-year-olds watching screens for more than two hours per day (Figure 1).⁶

i Executive functions refer to the set of cognitive processes that enable us to work towards a goal. They involve skills such as planning and organisation, flexible thinking, focusing our attention, using information in our working memory, and being able to inhibit impulsive behaviours. They are highly predictive of lifelong success in social, emotional, behavioural, and academic functions.³

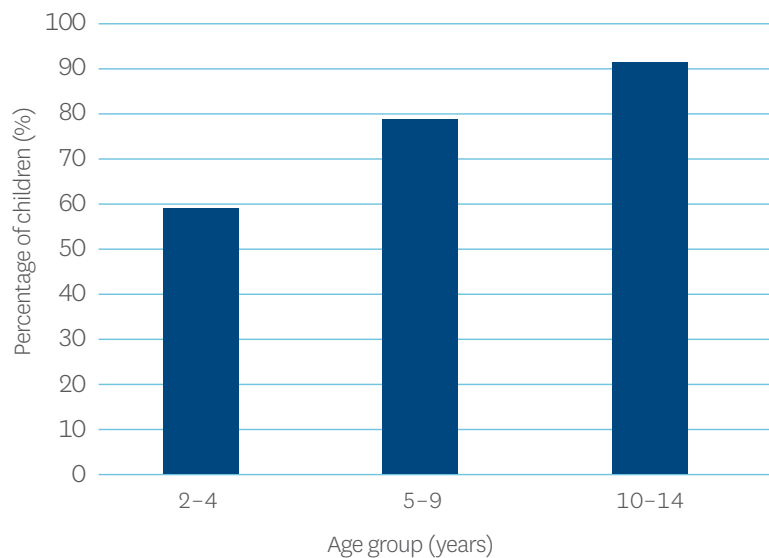


Figure 1: Percentage of New Zealand children exposed to high levels of screen time (usually watching screens for two or more hours per day, excluding use for school or homework). Adapted from the 2019/20 New Zealand Health Survey.⁶

EFFECTS ON EMOTIONAL, SOCIAL, AND COGNITIVE DEVELOPMENT

Infancy (age under two years)

Screen time in children under two years of age mostly takes the form of background television exposure where the television is playing in the room but the child is not paying attention to it.^{7, 8} Infants only look at screens for a few seconds at a time and the state of their brain development does not allow them to learn well from two-dimensional media. In addition, images on screens lack important three-dimensional features and learning cues such as depth, making it difficult for the child to transfer what they see represented on a screen to real life.⁹⁻¹² Therefore, screen time in this age group is mostly a passive activity and should not be considered educational despite the availability of products marketed as such.

There is consensus that the effects of screen time during infancy on executive functions measured in early childhood are generally negative. Young children who had regular daily exposure to screens as infants score higher on measures of demanding behaviours like fussiness, do less well on questionnaires about thinking, problem solving, and language ability, and demonstrate more difficulty controlling their emotions.¹³⁻¹⁶ However, the study designs used make it difficult to filter out other influences or prove causation, and there is variation in the aspects of executive functions that appear to be affected. For example, one study recently found that children in the United Kingdom, the United States, and the Netherlands regularly exposed to screens at four months of age found it more difficult to resist touching a tempting object when tested at 14 months, but did not have any problems with memory or flexible thinking tests.¹³ However, a population study in Singapore reported that higher television exposure among 12 to 18-month-old children was linked to lower cognitive skills and poorer social development at age four.^{17, 18}

Since infants are incapable of engaging meaningfully with screens and learn best from live interactions, the negative effects of screen time in this age group are thought to be a result of background television

replacing adult-child talk and play.⁸ This is likely due to parents and caregivers watching adult-directed programming with their child in the same room, or screen time being used as a passive distraction so caregivers can do other activities. The link most commonly reported between infant screen time and development is moderately impaired language development.^{16, 19, 20} Parents tend to speak fewer words to their children when the television is on, and children exposed to background television vocalise less and have smaller vocabularies.²¹⁻²³ However, children whose mothers interact verbally with them during television watching do better.²⁴ Caregivers being mindful of the impact of their own screen use and actively engaging with their young child may reduce the negative effects of screen time in children under two.

Early childhood (age two to five years)

By around age two and a half, children can comprehend more of what they are watching and screen time is more of an interactive pursuit. The associations between screen time and development in this age group are complex, which is reflected in the available evidence. For instance, recent New Zealand research using data from the Growing Up in New Zealand study found that more screen time predicted poorer performance in a task designed to test resistance to temptation in four-year-olds. However, it did not predict performance in a cognitive task or a measure of inattention/hyperactivity.²⁵ Meanwhile, a Ministry of Social Development report that used Growing Up in New Zealand data reported a slightly increased risk of hyperactivity.²⁶ In addition, while some large-scale studies have reported associations between exceeding screen time guidelines and increased likelihood of behavioural problems (especially inattention), part of this could be explained if children who already display challenging behaviours are viewing screens more often because their caregivers use them as a calming tool.^{27, 28}

Findings within and between studies can be somewhat ambiguous; nevertheless, taken together, the overarching trends do allow some broad conclusions to be drawn. Generally speaking, letting preschoolers regularly watch screens without adult involvement has negative effects on development but these negative effects are mostly mild. Content and presentation appear to be driving factors and non-educational and/or fantastical programmes (e.g. cartoons) may negatively affect executive functions, particularly in areas of self-regulation and attention, possibly because trying to process unrealistic and surprising events can be overwhelming for developing brains.^{29, 30} At the same time, preschoolers can learn early literacy, mathematics and science skills, as well as positive social behaviours from educational content designed to be interactive and appropriately paced, such as certain games played on touchscreen devices and television programmes including Sesame Street.^{8, 30-32}

The negative effects observed from non-educational screen time may be due to children adapting to constant 'stimulation overload' from noisy and colourful media, making it harder to focus attention on the relatively mundane real life, or it may be that time spent on screens is substituting other activities better suited to developing focused attention such as toy play.²⁹ There is emerging evidence of structural brain changes in areas associated with executive functions, language, and literacy that are associated with increased screen use.³³ There is also some indication that boys are more strongly affected than girls in regards to social development, possibly due to more time spent playing games on the devices rather than engaging in deliberately prosocial content designed to promote care and concern for others.³⁴

In addition to content, attentive adult involvement is important. Children who watch screens unsupervised are more likely to show issues with attention and social interaction than those who are supervised,³⁵ and caregiver co-viewing and interaction has consistently been shown to maximise children's learning from both television and touchscreen media.³⁶⁻³⁸ As with infants, screen time in children aged two to five years is heavily influenced by caregivers' screen behaviours.³⁹

Primary-intermediate school years (age five to 12 years)

As children get older, they have more control over the content of their screen time. Activity in this age group starts to involve more independent internet use, social networking, and video gaming, so the ways children engage with screens become more diverse. Broad associations with executive functions and behavioural problems such as inattention and hyperactivity have been shown, but results are heavily reliant on the type and content of screen time. Generally, passive screen time such as television and movie watching is believed to have negative effects, but interactive use of computers and similar media does not and may have positive influences.⁴⁰⁻⁴⁴ For example, one study reported negative correlations between television and video screen time and mathematics achievement, executive functioning, and social development in primary school children. However, interactive smartphone or computer use was associated with better science and language achievement.⁴¹

Television viewing, movie watching, and video gaming for several hours per day are implicated in aggression, poor attention skills, and hyperactivity in seven to ten-year-olds, perhaps due to exposure to age-inappropriate adult-directed content.^{42, 43, 45} However, there is some evidence of a bidirectional effect (i.e. children with more attention problems subsequently spend more time playing video games, and vice versa),⁴⁶ and outcomes from gaming are not always negative. Children who play video games have been shown to acquire superior cognitive skills in certain areas such as switching between tasks and ignoring distractions, compared with non-gamers.⁴⁷

School-based electronic device use is an additional contributor to screen time in this age group. An increasing number of schools expect children to use electronic media at school and supply their own devices (known as 'Bring Your Own Device' or BYOD). A detailed discussion of school-based screen use and BYOD is outside the scope of this evidence brief, but it should be recognised that school-based use factors into a child's overall screen exposure. A 2019 synthesis of international evidence reported modest beneficial impacts of school-based device use on mathematics, science, and literacy. However, results were mixed and some studies have reported no evidence of benefit.⁴⁸ Research in this area typically focuses on academic achievement only, but a New Zealand investigation into digital technology access at school and social development concluded there are both positive and negative effects on socio-emotional skills like self-control, collaboration, and persistence, and that outcomes critically depend on how teachers design and implement screen-based activities.⁴⁹

The timing of recreational screen use is relevant for children in this age group who are gaining independence around managing their leisure time. Gaming and television watching are associated with reduced sleep,⁴³ and general screen time before bed can have detrimental effects on academic performance.⁵⁰ Inadequate sleep is itself a predictor of poor behaviour. While it is difficult to isolate the effects of screen time from the child's wider routine and environment, the type of content being consumed and the interaction between screen time and sleep is important.

Adolescence

The type of screen time during adolescence that is of most concern to researchers is internet and social media use and its impact on emotional and social development. The internet features heavily in daily life. The average 15-year-old in New Zealand spends more than three hours a day, and almost one-quarter spend more than six hours a day on the internet outside of school.⁵¹ Studies have consistently found inverse U-shaped correlations between internet use and wellbeing – some internet use is better than none but multiple hours per day has mildly detrimental effects on mood, levels of anxiety, and self-esteem (Figure 2).^{52, 53} This is dubbed the 'Goldilocks hypothesis' where, like finding the perfect

temperature of porridge, both too little and too much internet is undesirable but a moderate amount is 'just right'.⁵⁴ Just how much is too much remains controversial, with reports ranging from two to more than seven hours daily.

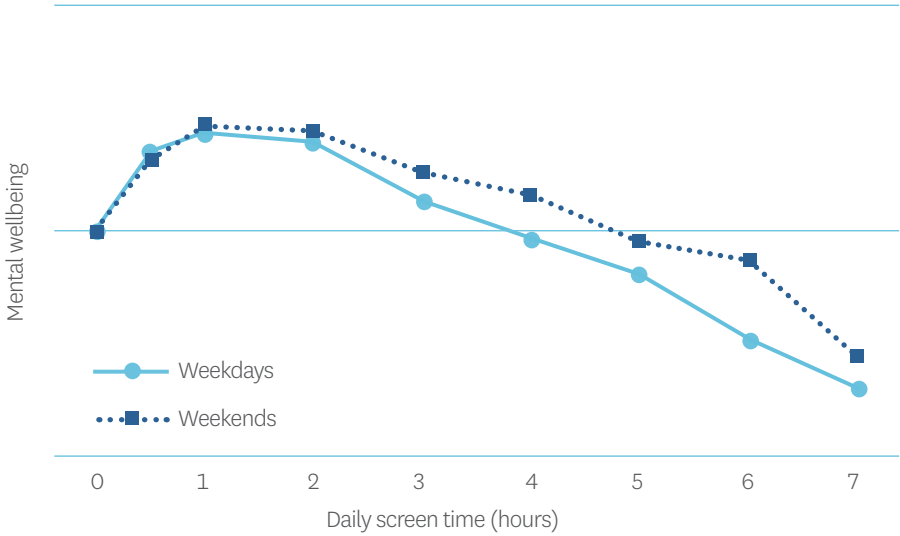


Figure 2: Illustration of the Goldilocks hypothesis. Mental wellbeing (incorporating psychological and social functioning, happiness, and life satisfaction) and its relationship to daily recreational computer time. Television and movie watching, video gaming, and smartphone use all show similar patterns. Adapted from a study by Przybylski & Weinstein.⁵⁴

Social media use amongst adolescents has been the subject of much public scrutiny with the rise of platforms such as TikTok and Instagram and the concurrent increase in the prevalence of depression and anxiety reported in teenagers. Adolescence is a time of rapid social and psychological change when relationships with peers become paramount. Social media has become a normative part of building relationships, forging connections, and staying in touch. Sharing comments, messages, and ‘likes’ is associated with boosted self-esteem, better-perceived closeness, reduced stress, less loneliness, and a more positive mood.⁵⁵ Teenagers can also join online communities which foster belonging and provide support, particularly for minority groups such as LGBTQ+ youth.^{55, 56}

However, there are also several avenues where social media is thought to have negative effects. Comparison with unrealistic standards set by carefully edited images has been linked with body dissatisfaction. It may reduce wellbeing through ‘FOMO’ (‘fear of missing out’ on positive things peers are perceived to be doing or having). Social status can become defined by the number of responses a post receives and teens can feel compelled to check their posts constantly, which can feed anxiety. Adolescents can also be exposed to sexualised, violent, or otherwise inappropriate content and may experience hateful speech and cyberbullying.⁵⁵⁻⁵⁷

Both positive and negative associations between wellbeing and social media use have been identified. However, much of the research measures negative outcomes only and implies that social media is the cause, even though it is inappropriate to draw such conclusions from the study designs used.⁵⁸ Mental health and social media use are both complex phenomena, and findings from newer longitudinal studies better designed to investigate causation have largely failed to show consistent evidence of any significant effect.^{56, 57, 59} The notable exception is cyberbullying, for which there is strong evidence of serious consequences, including suicidal ideation and suicide attempts.⁵⁷ Aside from this, while it is plausible that more typical everyday social media exposure has wide-ranging impacts simply due to its

extensive presence in young people's lives, the measurable strength of these impacts remains uncertain at this stage.

Excessive internet (or social media) activity combined with addictive, impulsive and/or compulsive elements that interfere with daily functioning is termed problematic internet use (or problematic social media use). It is associated with impaired cognitive development in areas relating to attention, memory and decision-making.⁶⁰ Multiple studies of problematic internet use have found links with anxiety and depression, as well as sleep disturbance.⁶¹⁻⁶⁴ Whether problematic internet use is a cause or a symptom of these issues remains unknown. There is significant debate about whether there is enough high-quality evidence to justify any formal classification as a psychiatric disorder.⁶⁵

It is difficult to isolate the developmental impacts of school-based screen time for adolescents because educational and recreational use have become so intertwined. For example, New Zealand has seen a rapid increase in secondary school device use over the last decade. We now have one of the highest levels of school device use in the OECD, but this has not been accompanied by a corresponding increase in academic performance.⁵¹ Further, the digital divide was clearly apparent for many during the COVID-19 lockdowns.⁶⁶ Reasons for the lack of improvement are multifactorial and likely extend beyond screen time. One theory is that the widespread use of social media, which favours surface-level, bite-sized texts, is changing the way students engage with and process more extended writing.⁶⁷ This kind of interplay between recreational social media use and academic achievement makes intuitive sense because teenagers spend large amounts of time on screens outside of schoolwork.

SUMMARY AND RECOMMENDATIONS

Although there is some evidence of harm relating to certain screen time practices, the detrimental effects are not as clear-cut as sometimes portrayed in popular media. Existing thinking relies heavily on associations reported from observational research. This means it is difficult to separate the effects of screen time from the multitude of other factors influencing a child's development or demonstrate a causative relationship between screen time and the cognitive, emotional, and/or social outcomes being measured. Furthermore, much of the available evidence is based on studies of television watching (a passive form of screen time) rather than newer technologies such as smartphone applications with interactive elements, or options which deliberately encourage physical activity like geocaching or Pokémon Go. In addition, although the widespread uptake of the internet and social media has been blamed for the rise in anxiety and depression among adolescents in recent years, there is also evidence of positive benefits. It is not yet well understood whether the observed relationships between internet use and mood are causal.^{58, 65}

A recent OECD report highlighted similar shortcomings in the evidence and concluded that current knowledge is insufficient to support any evidence-based guidelines on optimal daily amounts of screen time.⁶⁵ Existing New Zealand government recommendations sit within overarching advice around the importance of physical activity. The recommendations align with the equivalent World Health Organization guidelines, which conflate screen time with sedentary behaviour and are designed to reduce known health problems associated with reduced physical activity, such as obesity. Be that as it may, screens are well entrenched in our lives and our homes. Now that children are born into a world where technology is the norm, it may do them a disservice to apply blanket limitations instead of advice on how to engage with screens positively.

Screen-specific recommendations released by the United States and the United Kingdom are examples of policy approaches that address this problem. They are both comparatively less restrictive and more

nanced than the New Zealand Ministry of Health guidelines. The American Academy of Pediatrics distinguishes between the various types of screen time and suggests choosing interactive educational content alongside promoting strategies to enhance children’s learning, such as co-viewing.⁶⁸ The UK Royal College of Paediatrics and Child Health also suggests that the evidence of ill effects is overstated, and families should determine their own limits depending on whether screen time is interfering with other activities and with sleep.⁶⁹ New Zealand families may benefit from an approach that acknowledges the various types of screen time that exist, and supports parents and caregivers to teach children to engage with electronic media in age-appropriate ways that minimise the potential for harm.

SCREEN TIME RECOMMENDATIONS:



Avoid passive screen time for children under two years of age. Be mindful of caregivers’ own device use and whether it interrupts adult-child interaction.



Choose educational content for preschool-aged children and join in with their viewing whenever possible.



Monitor the content older children are exposed to, particularly with adult-rated movies and games, investigate parental controls on devices, and prioritise interactive screen time such as computer use over more passive options such as television.



Encourage and role model balance between screen time and other activities. Place limitations around screens where needed, for example, no screen use near bedtime and no devices in bedrooms.



Discuss the pitfalls of social media with adolescents, such as the potential for cyberbullying and the unrealistic editing of images. Check in with teens regularly, and be vigilant for any mood changes.

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EXECUTIVE FUNCTIONS: A CRUCIAL BUT OVERLOOKED FACTOR FOR LIFELONG WELLBEING

Dr Felicia Low, Sir Peter Gluckman and Professor Richie Poulton

November 2021



EXECUTIVE FUNCTIONS: A CRUCIAL BUT OVERLOOKED FACTOR FOR LIFELONG WELLBEING

Key points:

- The skills of executive functions enable us to achieve basic tasks such as learning, solving problems, controlling our impulses and interacting harmoniously with others.
- Executive functions are underpinned by the development of specific brain pathways *in utero*, in infancy and in childhood.
- Impairments in components of executive functions place a person at greater risk of negative lifelong consequences, including school failure, poorer mental/physical health, job instability, antisocial behaviours and poorer quality of life.
- Impairments in executive functions impose a large societal burden and have intergenerational effects.
- Risk factors for compromised executive functions include low-socioeconomic status, poor maternal mood during pregnancy, parental insensitivity and neglect, toxic stress, high levels of non-educational screen time and unbalanced postnatal nutrition.
- Early intervention to assist all children to reach their full potential in executive functions is key to supporting their lifelong wellbeing.
- Confronting the challenges of compromised executive functions requires whole-of-government and whole-of-society thinking, as this issue cuts across multiple sectors.

What are executive functions?

Executive functions are the set of cognitive and emotional processes that enable us to work towards a goal. The skills that involve executive functions include planning and organisation, flexible thinking, focusing our attention, using information in our working memory, and being able to inhibit impulsive behaviours.¹ They are essential for learning and help with successful reasoning, problem solving and long-term planning. Executive functions therefore provide the most basic building blocks for meeting challenges across the life course and are highly predictive of success in social, emotional, behavioural and academic functions. Although the full capacities of executive functions are reached only in young adulthood, the foundations are laid during pregnancy and infancy through to the age of about six.²

Why are they important?

The many skills that involve executive functions help us to perform well, both individually and as a productive member of wider society, and the outcomes can have intergenerational effects (from parent to child). Executive functions are therefore fundamentally important to everyday life and wellbeing (Figure 1).

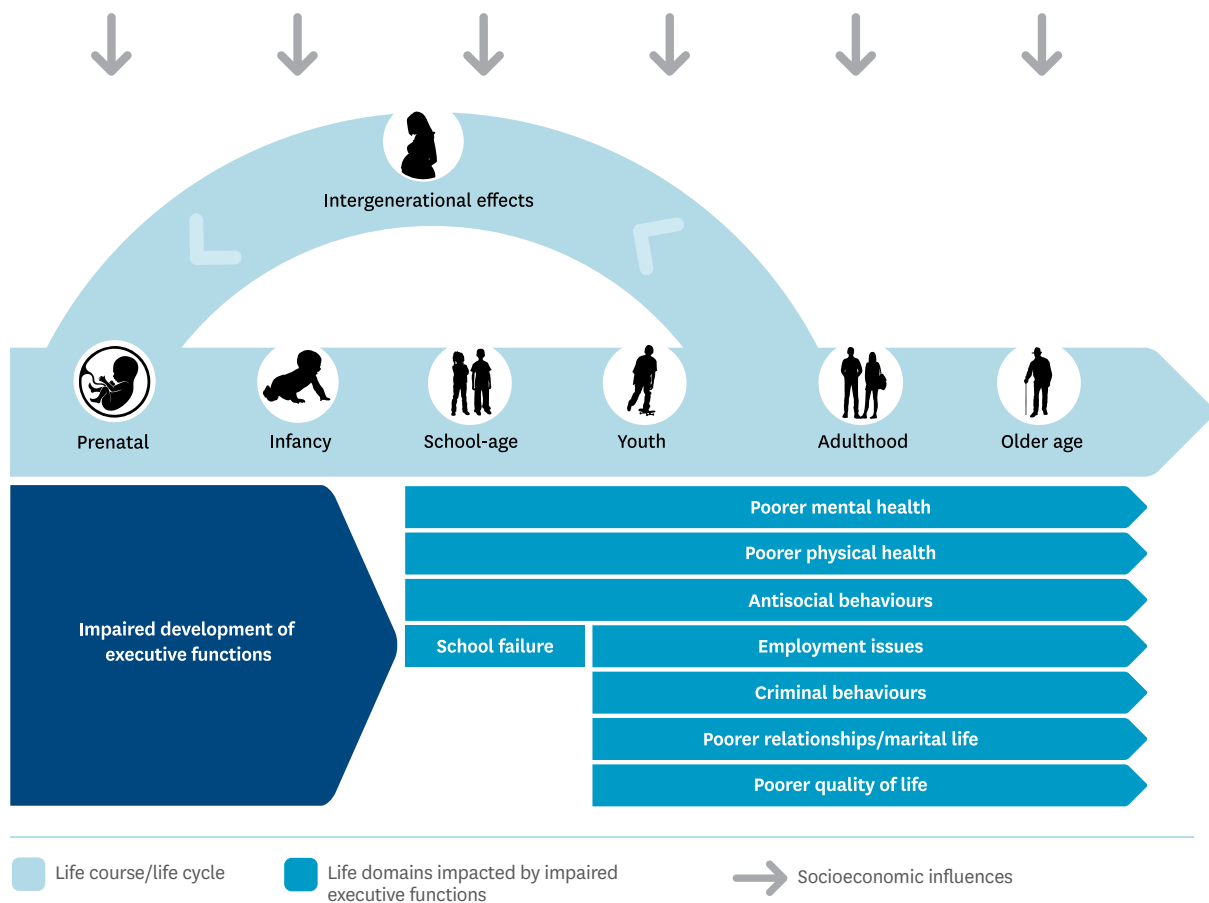


Figure 1: The lifelong consequences of impaired executive functions. Suboptimal development of executive functions, especially following conception and during the first few years of life, is a risk factor for impaired school readiness. This, in turn, increases the risk of school failure, employment issues and financial instability. Lower resilience has downstream effects on poor mental health, and impairment in social skills and impulsivity are risk factors for antisocial or criminal behaviours, poorer interpersonal relationships with others, and a poorer quality of life overall. The disadvantages may be passed on to subsequent generations in a vicious cycle via suboptimal parenting. Socioeconomic factors influence these outcomes through the life course. Although portrayed here as discrete domains for simplicity, the affected life domains are interrelated and underpinned by a common determinant: suboptimal executive functions.

School success – Effective executive functioning is indispensable for the ability to learn. It enables schoolchildren to be attentive, resist distractions, follow instructions, plan and organise activities and problem solve. Accordingly, executive *dysfunctions* will lead to greater risk of disruptive behaviours in childhood, learning disorders and, consequently, school failure.^{3, 4} Not completing formal education has lifelong financial consequences associated with being less likely to find or hold down a job and having reduced earnings.

Youth wellbeing – The ability to control impulsivity and regulate one’s emotions is critical to successful passage through adolescence. During adolescence, young people’s authority figures shift from their caregivers to their peer group. At the same time, their incomplete brain maturation, particularly in the regions that govern self-control, leads to riskier behaviours.⁵ In that context, executive dysfunctions will manifest as psychopathology, distress and excessive risk taking.⁶ Compromised executive functions are linked to antisocial tendencies such as delinquency, aggression, and poor interpersonal relationships, all of which generally persist into adulthood.⁷

Executive functions promote psychological resilience and protect against the effects of stressful events that impact mental health.^{8,9} Poor mental health generally emerges during early adolescence, and New Zealand youth have been experiencing a rapid decline in mental wellbeing over the past decade.¹⁰ There are many complex reasons underlying this trend, but this decline highlights the importance of optimal executive functions in mitigating the risks of developing poor mental health. Indeed, stress itself may disrupt the operation and development of executive functions, creating a vicious cycle.¹¹

Success in adulthood – Poorer executive functions are associated with reduced productivity and the inability to hold down a job.¹² Employment difficulties may then worsen an individual's mental health challenges and reduce compliance with social norms.

Physical health may also be affected: there is a link between poorer executive functions and obesity throughout the life course, from childhood through to adolescence and adulthood, reflecting lower levels of self-control.¹³ There is also strong evidence for higher rates of substance abuse and poorer adherence to treatment.

Having low childhood self-control or poor emotional regulation is associated with a greater likelihood of becoming a single parent and lower levels of skilled parenting, as characterised by reduced levels of thoughtful and consistent discipline, and warm, sensitive and stimulating interactions between parent and child.^{14,15} A lack of focused attention and responsiveness to a child's needs in turn affects the development of the child's own executive functions. The parent with impaired executive functions tends to have compromised mental health, which is in turn a core influence on all aspects of the child's neurodevelopment. This shows how the negative effects of impaired executive functions can be transferred across generations.

Mid/late-life wellbeing – The effects of executive dysfunctions extend well into later life. The Dunedin Multidisciplinary Study, a longitudinal birth cohort study tracking the development of New Zealand residents born in 1972–1973, has shown that children with poorer executive functions (as measured by poor self-control) grew up to display more biological, clinical, and neurological features typically associated with faster ageing at the age of 45.¹⁶ In addition, poorer self-control in childhood correlated not only with being less prepared to handle health, social and financial demands in later life, but also with having lower life satisfaction.

Among older people, having better executive functions may help improve their mobility within their community, as well as their health-related quality of life.^{17,18}

Societal impact – Having impaired executive functions comes at a substantial societal cost. The Dunedin Multidisciplinary Study has analysed the contribution of participants to multiple health and social measures of economic burden, including the duration on a social welfare benefit, the number of criminal convictions, and hospital stays. It was shown that just 20 percent of study participants accounted for nearly 80 percent of adult economic burden. That is, overall societal costs were disproportionately incurred by a small group.¹⁹ Most compellingly, participants were more likely to end up in the high-cost group if they had shown poorer executive functions and experienced other childhood adversities such as socioeconomic deprivation at age three.

The finding of a small, high-needs group posing disproportionate societal burden has also been replicated in nationwide data from 1.7 million New Zealanders. In analysing each measure of economic burden, it was found that the top 10 percent of highest-need New Zealanders used 73 percent of welfare benefits, occupied 86 percent of nightly hospital stays, and accounted for 100 percent of all criminal convictions.²⁰ When the nationwide data was integrated with the Dunedin data, it was again found that having poorer executive functions could predict whether individuals would end up in the highest-needs groups later in life.

Individuals with higher societal impact are likely to pass on similar socioeconomic, educational and other limitations to their children, who are in turn at greater risk of also imposing heavy burdens on society. This form of intergenerational disadvantage tends to become reinforced in a feedback loop with cumulative effects. Therefore, to help break the cycle, it is important to reliably identify and appropriately support children at risk of poor executive functions by using proven interventions.²¹

Risk factors for suboptimal executive functions

Socioeconomic status – Lower socioeconomic status is a consistent predictor of poorer performance on measures of executive functions during childhood.²² Lower socioeconomic status is also a well-known risk factor for emotional and behavioural disorders in children and young people,²³ and it is clear that having impaired executive functions is a major mechanism underlying this relationship.⁷ Impaired executive functions also explains how child poverty can disrupt long-term academic success.^{24, 25} Collectively, this demonstrates that impaired executive functions and low socioeconomic status are interwoven drivers of intergenerational disadvantage.

Nonetheless, it should be noted that the development of executive functions is influenced not only by the economic circumstances in which a child grows up, but also by their broader social and cultural environment. These factors include the strength of their cultural/spiritual identity and, for Māori, the impact of colonialism on hauora.²⁶ All these aspects may interact with economic challenges to interfere with the development of optimal executive functions.

Maternal mental health – Recent research has shown that a woman’s mental wellbeing during pregnancy plays an important role in the development of her child’s executive functions.²⁷ Children whose mothers had depression or anxiety while pregnant tend to show differences in brain structure and connectivity at birth, and later display impaired executive functions as reflected in poorer school readiness and literacy skills.²⁸ Once they reach adulthood, these children may in turn be more susceptible to poor mental health during pregnancy, adversely affecting their own children’s development of executive functions. The result is a vicious intergenerational cycle of women with compromised executive functions having children similarly affected and enduring a lifetime of disadvantage. Impaired executive functions are also seen in children whose mothers experienced milder depressive symptoms, suggesting a large proportion of pregnancies may be affected.^{28, 29} However, this also means that even modest improvements in maternal mental health may have meaningful positive impact on their child’s executive functions.

Other risk factors – Other factors linked to development of impaired executive functions include exposure to toxic substances and/or nutrition *in utero*; psychosocial stressors during early childhood, such as psychological and physical abuse; and conflictual family dynamics.³⁰ These factors are themselves deeply interwoven with low socioeconomic status and poor maternal mental health. High exposure to passive, non-educational screen time, an issue of increasing concern in New Zealand,³¹ is linked to poorer emotional control and inattention in young children; these effects are likely context dependent, as supervised use of appropriate digital tools may, in fact, promote self-regulation.ⁱ There is also growing research that dietary intake of micronutrients such as iron and omega-3 fatty acids may facilitate brain development and promote executive functions.³³ This suggests children whose nutrition is unbalanced may also be disadvantaged.

i The effects of screen time on children’s socioemotional and cognitive development are discussed in more detail in another Kōi Tū report.³²

HOW CAN WE PROMOTE OPTIMAL EXECUTIVE FUNCTIONS?

Early intervention is key

Executive functions are critical for prosocial behaviour and academic success, and hence their compromise has pervasive effects on almost every aspect of daily life. Nevertheless, executive functions are malleable and responsive to treatment, and although they can be improved later in life, early intervention is clearly the most logical and cost-effective approach to reduce the risks of lifelong downstream disadvantages.³⁴

The effect of maternal mental health on the development of executive functions shows that the foundational pathways begin to be established *in utero*, and that interventions should begin as early as during pregnancy and the early postnatal period. We have previously discussed the need for all pregnant women to be formally screened for their mood, and for those who are affected to a mild/moderate extent to be provided with support.²⁷

Both universal and targeted interventions during infancy and childhood can also confer sizeable benefits. A large body of research over the past two decades has focused on early childhood development of executive functions and outcomes in the high school and subsequent years. Intensive preschool intervention programmes for young children at risk of school failure, such as the High/Scope Perry Preschool Study in the US, have been remarkably effective and led to increased rates of high school completion, greater levels of employment, higher income, and reduced criminal activity and welfare reliance.³⁵ In New Zealand, a randomised controlled trial is under way to evaluate the effect of two evidence-based programmes involving games, exercise and high-quality adult-child interactions on children's self-regulation and oral language skills.³⁶ Good oral language skills predict improved self-regulation and lower risk of psychopathology (mental disorders and the resulting behaviours) over time.³⁷

A new way of thinking about a significant problem

Unlike specific clinical disorders that can be formally diagnosed and treated with medication, impairments of executive functions require a very different understanding to address the problem.ⁱⁱ

These impairments are likely to be far more pervasive than commonly thought, so addressing this requires a population health approach involving universal interventions that not only prevent impairments, but also enhance executive functions throughout the population. Hence, the focus should be on promoting brain health, including the quality of mental health and wellbeing, so that every child reaches their maximum capacity for learning, creativity and productivity – the essence of human capital, and a prerequisite to social capital.

Therefore, a whole-of-society, whole-of-government recognition of the importance of optimising executive functions is required. Specific consideration is needed across all domains of policy development, including health, social development, education and justice. Evidence suggests that the priority issues to address are: prevention of impairment, identification of the most at-risk children for early intervention, and development of evidence-informed policies on remediation.

ii While this applies to most individuals with impaired executive functions, the exception is attention deficit hyperactivity disorder (ADHD), which reflects the extreme end of poor executive functions and can be partially treated with medication.

Although this evidence brief has described the cumulative effect of disadvantage over the life course, the same applies to the advantages gained from early intervention. It has been pointed out that “investing in disadvantaged young children is a rare public policy with no equity-efficiency tradeoff” – that is, the investment both reduces the inequalities experienced by a child simply by accident of birth, and raises the productivity of wider society, with no tradeoffs being incurred.³⁸ Therefore, in addition to the moral imperative, there is a compelling economic argument to invest in young children and provide the opportunity for proper development of executive functions, as this benefits not only the children themselves, but also wider society and future generations.

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BONDING: A BRILLIANT BRAIN BUILDER

The importance of supporting parents to bond with their child from the earliest years

Dr Felicia Low

May 2022



BONDING: A BRILLIANT BRAIN BUILDER

The importance of supporting parents to bond with their child from the earliest years

Overview

Although it has long been acknowledged that children benefit from a strong bond with their parents, the precise ways bonding helps the child – through improved brain development and building specific skills necessary for lifelong wellbeing – are only now becoming clearer. New evidence also reveals specific ways parents can interact with their child to help promote bonding. These new insights demonstrate the critical need to develop social policies around ways to support parents in caring for children, such as through improved paid parental leave.

Key points:

- The brain develops rapidly *in utero* and during infancy, and optimal early life brain development helps children achieve lifelong success.
- Strong bonds between children and their parents/caregivers, facilitated by a supportive and nurturing parenting style, help promote early brain development, including a set of skills known as executive functions.
- Conversely, the absence of a strong parent-child bond may negatively affect brain development, with lifelong consequences.
- The development of a warm, secure relationship between parent and child is also affected by the family/whānau context and broader environmental factors.
- Bonding should involve the people most important in the child's life, but despite the desire, many fathers are less able to engage in early life bonding due to lack of structural support.
- Factors such as paid parental leave, screen time of parents and children, parental mental health and greater paternal involvement warrant special attention.

Dramatic brain development occurs in the early years

The early years of life are inarguably the most important period for brain development. From the time of conception through to infancy and early childhood, children's brains undergo massive growth, with potentially more than a million new neural connections being formed every second.¹ This rapid neurological growth serves to establish key physiological and behavioural functions and capacities, including sensory abilities, early language skills, learning and memory, and cognitive and socioemotional development.²

The period between conception to the age of two – often denoted the first 1,000 days – is particularly crucial. Substantial brain growth occurs *in utero*, and at birth babies' brains are just over a quarter the size of the adult brain. By the first year, the brain has already more than doubled in volume, and it reaches 80% of adult size by the age of two (Figure 1).³

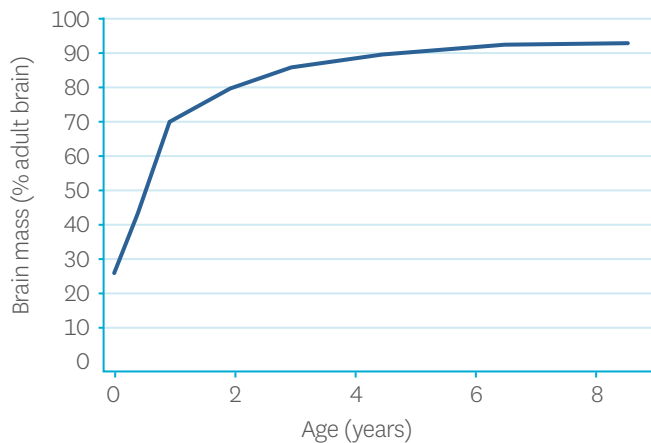


Figure 1: Brain mass shows tremendous growth by the age of two, and growth rates gradually slow as the child gets older. Data compiled from Dekaban & Sadowsky.³

Optimally developed brains provide the best foundation for lifelong wellbeing

Most of the brain architecture established in early life comprises the primary structures and connectivities that support fundamental aspects of brain function. These aspects serve as the scaffold on which more complex brain circuitry can later be laid down. Because of this, optimal brain development in early life provides a strong foundation for lifelong wellbeing and success.^{4, 5}

Of special importance is the development of the complex brain circuitry that includes a set of cognitive processes collectively known as executive functions. These processes help with paying attention, planning ahead, working towards goals and restricting impulsive behaviours; they are therefore essential for success in school and working life, and for maintaining good relationships with others.⁴ It is well established that experiences during early life, including receiving warm, responsive and sensitive parenting, enhance executive functioning.⁶

Given that the human brain is most malleable to change ('plastic') during early life, there is tremendous opportunity to help children develop to their full potential by providing them with appropriate experiences. Conversely, adverse exposures may lead to suboptimal brain development, which can lead to snowballing impacts throughout life in the form of school failure, losses in work productivity, poorer mental and physical health, and poorer interpersonal relationships.

The importance of parent-child bonding

To survive, children require basic necessities such as food, water, clothing and shelter. However, in order to *thrive*, children also require emotional security, for which they depend almost entirely on their parents (or primary caregivers).ⁱ Humans are social creatures, and infants are born to innately seek meaningful relationships. Having a secure relationship with a parent provides a child with a safe and secure base from which they can explore their environments and to which they can return in times of distress.⁷ Importantly, this has physiological benefits through brain growth, as well as psychological benefits through improved socioemotional development, cognitive coping skills and resilience mechanisms. Psychological resilience helps to act as a critical buffer against stress and poor mental health later in life.⁸

ⁱ While the term 'parent' is used for simplicity throughout this brief, this may also refer to other primary caregivers who are the people consistently closest to the child during their early life, regardless of biological relationship.

The strength of the parent-child bond, and in turn a child’s socioemotional development, depends on a range of factors relating to the individual child, their family/whānau, and wider environmental factors including the social and cultural milieu (Figure 2).^{9, ii} A child raised in a nurturing and supportive environment is more likely to have secure parental attachment and thus thrive, compared to a child exposed to emotional neglect, physical abuse, household conflict and other toxic stressors.¹¹ A chaotic home environment characterised by greater disorganisation and instability impacts negatively on parental responsiveness.¹² Additionally, parental stress can affect their capacity to responsively care for their children, and some parents facing mental health issues or relationship difficulties may also find it harder to be responsive or provide a loving and secure environment.^{13, 14}

The family/whānau environment itself is situated within the broader context of the wider environment. Socioeconomic status, the availability of appropriate social support, and supportive workplace or government policies can all feed into the ability of parents to establish a strong bond with their child.

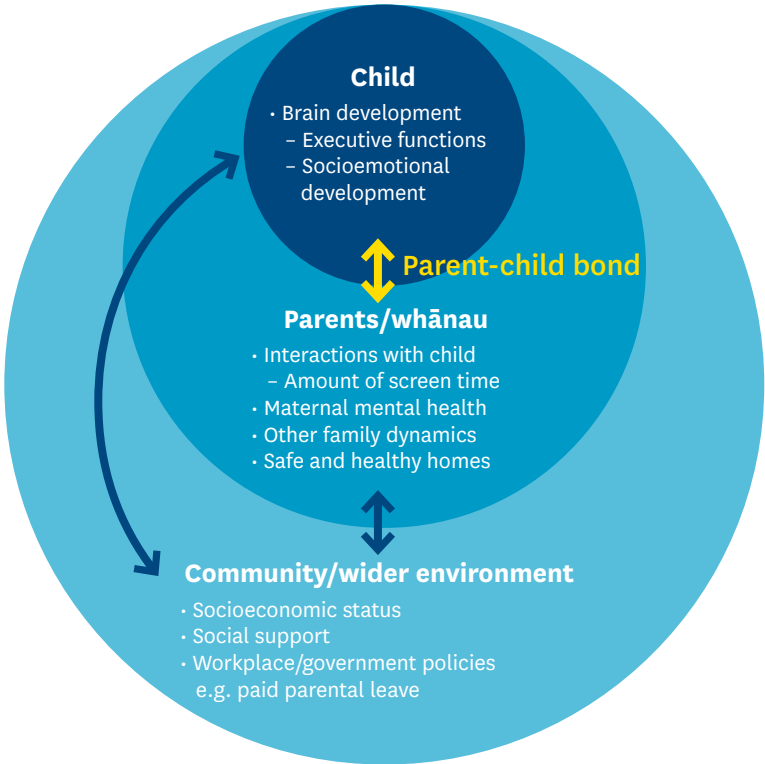


Figure 2: Multiple factors impact on the quality of parent-child bonding. A child’s emotional security and brain development occur within the wider context of their family/whānau, the broader environment and the interplay between each setting (arrows).

Poor bonding disrupts brain development and long-term wellbeing

Emotional neglect is a form of child maltreatment that involves poor bonding. It refers to the failure by the parent, within the limits of their resources, to attend to the child’s emotional needs, as reflected through emotional unresponsiveness and limited interactions with the child. Its estimated global prevalence is about 18%.¹⁵ New Zealand data are sparse, although a nearly 50-year-old analysis from the longitudinal Dunedin Multidisciplinary Health and Development Study found that 16% of 3-year-old children experienced maternal behaviours such as indifference and being unaware or unresponsive to their needs.¹⁶

ii This brief focuses on the social, psychological and environmental contexts; however, bonding is also influenced by biological factors such as the child being born prematurely or having some types of chronic illnesses.¹⁰

The adverse impact of emotional neglect on a child’s immediate and longer-term health is well established.¹⁷ Much of the research is centred on children who had been previously placed in institutionalised care, with limited responsive caregiving, one-on-one interaction and cognitive stimulation. Previously institutionalised children have been found to exhibit persistently poorer executive functioning skills.¹⁸ The Christchurch Health & Development study found that higher levels of exposure to emotional neglect were associated with a higher risk of psychosocial adjustment problems at age 18, including anxiety and substance abuse.¹⁹ More recent data from the 2019 New Zealand Family Violence Survey has linked childhood emotional abuse (another form of child maltreatment) to an increased risk of a wide range of poor health outcomes in adulthood such as heart disease, psychological and cognitive disability, depression, anxiety and other mental health conditions.²⁰ Other studies that specifically measured the adult’s reported feelings of a low level of support and love experienced as a child have similarly found adverse impacts on mental health.²¹ On the other hand, children with more secure parent-child relationships report experiencing greater positive emotions such as hope, love and gratitude in middle childhood.²²

Brain imaging data, which provides biological evidence of brain developmental dysfunction, has shown that children who remain in institutionalised care have relatively immature brain activation patterns during adolescence, and among those placed in foster care, those who experienced more disruption through multiple placements had altered brain activity.²³ Experience of early institutionalisation has also been reported to be linked to smaller total brain volume, decreased volumes of gray matter and white matter, and reduced cortical thickness, with associated changes in behaviour.^{24, 25} Other imaging studies involving people who experienced low to moderate levels of childhood emotional neglect have shown that associated depressive symptoms could be partly explained by disruptions in brain circuitry involved in reward responsiveness.²⁶

Building the bond

Building an emotionally secure relationship with a child depends on early engagement that is frequent and meaningful, beginning as early as the prenatal period (Figure 3).

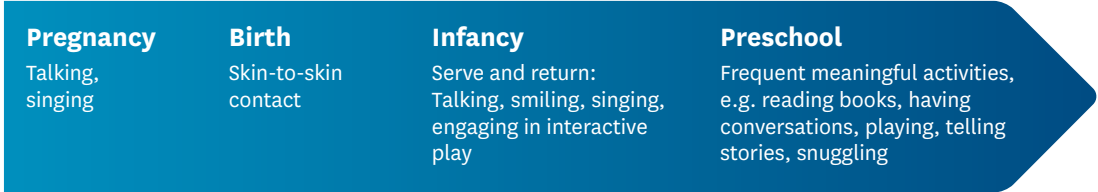


Figure 3: Ways to promote parent-child bonding during early life.

Prenatal

Many components of the fetus’ hearing system are functional by the second trimester, and there is evidence that sound recognition and learning occur *in utero*. For example, newborns tend to prefer their mother’s voice to a stranger’s, their mother’s native language to another language, and even a story that had been read aloud during gestation compared to a new story.²⁷

Neonatal

After birth, repeated skin-to-skin contact (also known as kangaroo care for premature infants) stimulates many physiological changes in both mother and newborn that help establish bonding immediately and in the longer term.²⁸ Skin-to-skin care promotes the release of maternal oxytocin, a hormone that plays a role in social interaction and bonding by countering stress responses and

promoting growth.²⁸ Breastfeeding may help with bonding, with more months of breastfeeding associated with greater maternal sensitivity (responsiveness to the baby and its cues) even up to a decade later.^{29, 30} Non-breastfed babies can be bottle fed with skin-to-skin contact to also promote bonding.

Infancy (0 to 2 years)

Consistent affectionate touch from a parent has established benefits for the infant, including regulating stress responses and immune function, and promoting psychosocial development and secure attachment.³¹

Parent-infant bonding can also be strengthened by exposing the growing infant to an environment rich in so-called ‘serve-and-return’ interactions.³² This sporting metaphor describes how children continually seek interaction from their caregivers through ‘serves’ – in infants, these cues include vocalising, facial expressions and crying – which prompt the adult to respond with eye contact, reassuring words or a hug (‘returning the serve’). Adult-child play inherently provides opportunities for serve-and-return exchanges. For young infants, simple games such as copycat, peekaboo and naming objects can help to focus attention, use working memory, build language connections, develop self-control and build trust in the adult.³³

Serve-and-return interactions involve a high level of *sensitivity* from the parent in recognising and responding promptly to the needs of the child. They reinforce the bond between adult and child, promote optimal emotional development and psychological resilience, and fulfill the innate need for the infant/young child to establish meaningful connections.³⁴ The absence of such connections can cause stress and confusion, and over a sustained period may impede brain development and disrupt the child’s learning processes.

Multiple neuroimaging studies have demonstrated how the back-and-forth nature of serve-and-return interactions helps build neural connections in brain regions important for executive functions including learning, self-regulation and impulse control. For example, a longitudinal study found that greater levels of a mother’s sensitivity to her five-month-old infant are associated with higher brain activity and development as measured by resting electroencephalography at age 10 months and again at 24 months.³⁵ Other longitudinal studies have also shown that maternal sensitivity is associated with forming specific functional connections in the limbic system by age four or six.^{36, 37} The limbic system, which includes the hippocampus and amygdala, is responsible for learning and memory, and for regulating behavioural and emotional responses. Neuroanatomical changes appear to be stable at least into late childhood, with another study finding that maternal sensitivity at one year of age could predict amygdala and hippocampal volume at age 10.³⁸ Studies are now beginning to directly link brain morphology changes to poorer socioemotional functioning.³⁹

Consistency in parental cues is emerging as another important factor. One-year-old infants exposed to more unpredictable maternal interactions demonstrated poorer cognitive development at age two and poorer memory at age six, and this was independent of maternal sensitivity or socioeconomic status.^{40, 41}

Importantly, the described neuroimaging studies involved infants who received care levels within the normal range, not extreme parental neglect. This highlights the sensitivity of the developing brain to subtle differences in experience.

Early childhood (2 to 5 years)

Spending meaningful time with a young child in a way that involves their growing interests helps promote bonding. A good example is shared book reading. This can provide numerous serve-and-return

experiences if the parent and child together review the book content during the process with questions, answers and comments.

Reading together during the early years benefits children’s brain development and is a powerful tool to improve language skills. For example, a longitudinal cohort study of Singaporean children showed that being read to by their parents for just 10 minutes a day markedly improved their literacy skills at age four, especially among those of lower socioeconomic status.⁴² A large OECD study of five-year-olds in England, the United States and Estonia showed that the more frequently parents read with their children, the more likely it was that the children showed better socioemotional skills and prosocial behaviour. A gradient was seen across the range of reading frequencies – that is, every extra day or two of being read to had a measurable effect on socioemotional skills, and children who were read to the most (five to seven days a week) scored substantially higher than those who were read to one to two days a week or less (Figure 4).⁴³

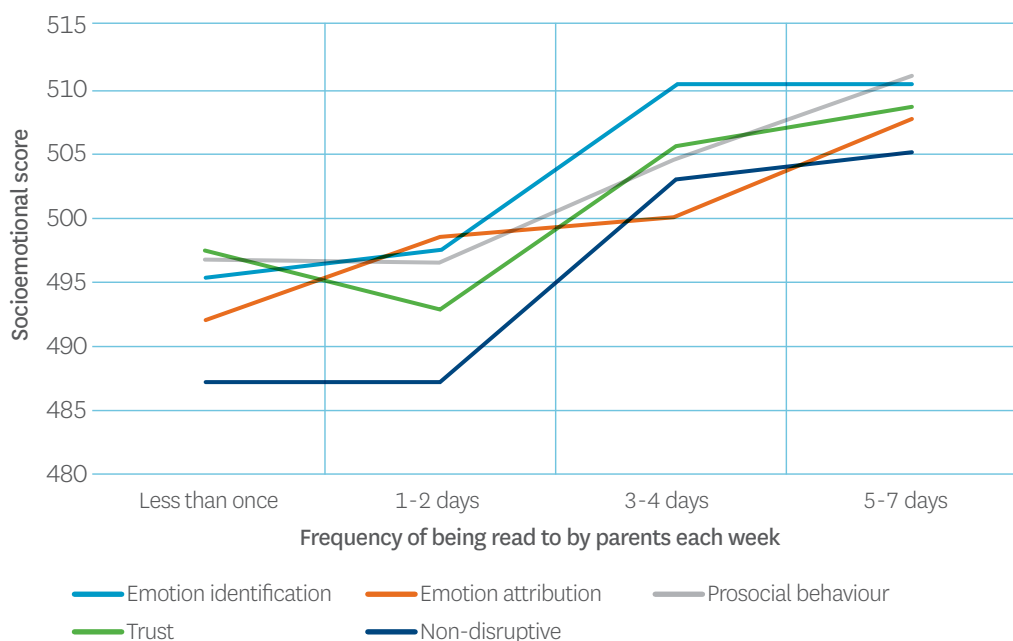


Figure 4: Being read to five to seven times a week by a parent is associated with higher mean scores on a range of socioemotional measures, even after accounting for socioeconomic status. Data compiled from OECD.⁴³

Having meaningful conversations with a child also strengthens bonding. Indeed, a greater number of conversations with parents has been directly linked to greater activation of Broca’s area (the brain region responsible for processing language) in four to six-year-old children, independent of socioeconomic status.⁴⁴

The Growing Up in New Zealand longitudinal study has found that children who demonstrated higher levels of self-control at age four and a half were more likely to have been read to or told stories by their mothers. They also received more praise and encouragement, and experienced more shared mother-child interactions not dominated by either person.⁴⁵

Importance of parental mental health

A critical factor in the fostering of a strong parent-child bond is the parent’s mental wellbeing. High levels of stress, anxiety or depression are likely to adversely affect a parent’s ability to bond optimally with their child. The overall prevalence of postnatal depression in New Zealand women is reported to range from 8 to 16%,⁴⁶⁻⁴⁸ although these figures do not account for the likely higher prevalence of

subclinical depression,⁴⁸ and also obscure the heightened risks for certain subgroups such as women who had experienced prenatal depression or are of Asian or Pacific ethnicity. Indeed, another New Zealand study focused on Pacific families found depressive symptoms in 31% of post-partum Tongan women.⁴⁹ An estimated 4% of fathers also develop depression following birth of their child.⁵⁰

The impact of poor maternal mental health on compromised bonding with the child can feed into a vicious intergenerational cycle. A longitudinal study showed that women exposed to childhood emotional neglect had more than four times the risk of experiencing prenatal depression.⁵¹ Prenatal depression is in turn associated with altered fetal brain development and biochemistry, including compromised development of executive functions in the child.⁵² These children may therefore become more susceptible to psychological distress later in life.⁵³

Fathers have a critical role too

Although the majority of research has focused on mother-child relationships, the increasing numbers of working mothers and changing social norms regarding gender and caregiving have prompted growing focus on the importance of fathers.⁵⁴ There is clearly a critical role for fathers to play in their child's development starting from the earliest days of life: fathers, like mothers, experience increased release of oxytocin following skin-to-skin contact with their infant.⁵⁵ Secure father-child attachment during infancy is associated with higher socioemotional development, language skills and self-esteem in early to middle childhood, even controlling for the mother-child relationship.⁵⁶ A systematic review has demonstrated a positive association between father involvement (level of engagement, accessibility and responsibility) and children's cognitive skills in early to middle childhood.⁵⁷ Notably, several studies reported that this finding held across ethnicities and socioeconomic status.

Paternal involvement generally requires wider environmental factors to accommodate it, such as workplace and government policies enabling paternal leave. Fathers who take longer periods off work after the birth of a child are more likely to partake in caregiving and developmental activities from infancy through to early childhood, and by middle childhood, their children report greater closeness and communication with their father.^{58, 59}

Implications for parenting and policy

The importance of strong parent-child bonding and its effects on brain development has many implications for parenting guidance and policy development. However, integral to all aspects is the need to recognise that efforts to promote a child's brain development, particularly through establishing strong bonds with a parent, cannot be regarded as an individual endeavour but rather as a collective behaviour involving the family/whānau unit. Parents need to be empowered with knowledge of the importance of bonding on brain development. Family/whānau circumstances and the wider social environment also need to be conducive for bonding to occur (Figure 2). Multiple barriers may be in play, such as disturbed family dynamics (e.g. family violence), lack of whānau/social support and low socioeconomic status, leaving a busy parent little time or opportunity to engage in sustained bonding activities.

Here we highlight three areas for further discussion.

1. Paid parental leave

The current paid parental leave policy in New Zealand has multiple limitations that mean intended benefits are not fully realised. One limitation is the length of paid parental leave. While recent legislative changes to increase the length to 26 weeks are a step in the right direction, this covers a small fraction of the first 1,000 days of the child's life. Although above the OECD average of 18.4 weeks, many countries provide considerably longer leave payments, notably Greece (43 weeks), UK

(39 weeks) and Slovak Republic (34 weeks).⁶⁰ A second limitation is the low payment rate.⁶¹ Weekly payments are currently capped at about 57% of the median weekly income,ⁱⁱⁱ placing New Zealand near the bottom among OECD countries. Fourteen other OECD countries offer a 100% payment rate.

New Zealand does not have dedicated paid paternity leave, which tends to act as a major deterrent to fathers planning to provide primary care and establish strong bonds with their child,⁶¹ even though there is compelling evidence that New Zealand fathers prefer to spend more time with their child than they are able to, both after birth and during childhood; indeed, spending time with mother and baby is a strong cultural norm for Pacific fathers.⁶⁴⁻⁶⁶ Another consequence of the limitations is that parents of lower socioeconomic status are less likely to be able to afford to take unpaid parental leave, and therefore have less time and mental energy available to regularly engage in bonding activities with their child. In 2019, nearly half of all newborns were born into socioeconomic deprivation, and in 2021 an estimated 187,300 children were living in poverty.^{67, 68}

New Zealand currently ranks fifth-lowest on public expenditure on parental leave among OECD countries.⁶⁰ Improved paid parental leave – in both payment amount and duration of payment – may not only help provide opportunities to nurture strong bonds, but also reduce the financial stressors that exacerbate poor parental mental health.⁵³ This form of structural change will have numerous downstream benefits for parents, children and wider society that continue to future generations.

2. Screen time

Another factor that is increasingly implicated as interfering with parent-child interactions is screen time/device use, both by parents and by children. New Zealand tamariki are generally exposed to a substantial amount of screen time, with 2019/2020 data showing that more than half of two- to four-year-old children watch screens for two or more hours per day.⁶⁹ Time spent on screens tends to substitute for time best spent interacting with parents, and exposing young children to screen time is not recommended without attentive parental involvement.⁷⁰ Further, any screen time for infants under two years is not recommended due to potential adverse effects on cognitive and socioemotional development. The importance of monitoring screen time is supported by real-world data in the New Zealand context: having limits to screen time from the age of two was associated with improved self-control in preschool children from the Growing Up in New Zealand study.⁴⁵ Screen time and device use by parents themselves needs to be monitored, as this may detract from time and attention given to children. Preliminary research indicates that mothers of newborns tend to underestimate their own device use, suggesting the need to inform and support new parents in choices about device use.⁷¹

3. Executive functions

There is likely to be great value in emphasising the link between parent-child bonding and executive functions. These functions predict behavioural, emotional, academic and social competencies throughout life. The importance of a child's well-developed executive functions in leading to success across multiple domains of life, and the consequent benefits to society, cannot be overstated⁴ and further reinforces the value of ensuring all children are able to enjoy warm, secure relationships with their parents. Parents, too, will likely appreciate being provided with such knowledge and respond accordingly. Again, however, this depends heavily on supportive broader environmental factors that facilitate the establishment of such relationships.

Extensive economic analyses strongly support the concept that investing in children from the earliest stages is critical to obtaining the best returns in terms of health, education and productivity.⁷²

iii At the time of publication, the maximum weekly paid parental leave is \$621.76 while the median weekly salary is \$1,093.

Importantly, there are also intergenerational repercussions: children who lack strong bonds with their parents may, in turn, be less likely to form a secure bond with their own children; conversely, children who enjoy a strong bond with their parents may be more likely to later form strong bonds with their children.⁷³ Research from the Dunedin multidisciplinary study has shown that mothers who had experienced warm, sensitive parenting parented their three-year-old children in a similar way, with more positive behaviours seen in the child.⁷⁴ Interventions to promote parent-child bonding opportunities would therefore provide intergenerational benefits.

A mix of targeted and universal intervention measures can be adopted. With regards to targeted measures, overseas studies suggest that a range of interventions can be effective in at-risk families. For example, when parents at risk for child neglect or abuse underwent a programme to increase parental nurturance and sensitivity, their children demonstrated a range of improved outcomes in executive functions, emotional regulation and stress responses.^{75, 76} Effective interventions, reflected by improved post-treatment emotional bonding, have also been reported for other at-risk groups such as mothers with postpartum depression or with preterm babies.⁷⁷ On the other hand, more universal measures – whether involving educational guidelines for parents about executive functions and screen time, strategies to address maternal mental wellbeing, or increased financial assistance via paid parental leave – are also needed for impact at a population-wide level, and to be most effective these must be aimed not only at parents/whānau but also the wider societal environment.

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BEYOND GENES: HOW FATHERS PLAY A BIOLOGICAL ROLE IN THE HEALTH OF FUTURE GENERATIONS

Chloe Wilkinson, Dr Felicia Low and Sir Peter Gluckman

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BEYOND GENES: HOW FATHERS PLAY A BIOLOGICAL ROLE IN THE HEALTH OF FUTURE GENERATIONS

Key points

- It is well established that the environmental conditions a person is exposed to before and in the first few years after birth shape their future wellbeing, but most research and public health advice focuses on the health and lifestyle choices of women rather than considering both biological parents.
- There is growing evidence that men's health around the time they father a child exerts a biological influence on their child's health. This influence may persist across multiple generations.
- Health and wellbeing advice for men preparing to conceive should be normalised, and information about the father's role in their children's health should be conveyed to the general public and integrated into school learning programmes.
- Since the effectiveness of individual education around responsibility for one's own health is constrained by wider socioeconomic and systemic forces, population-wide approaches aimed at addressing the broader social determinants of health should be bolstered in the interests of all of society.
- Society should refocus towards promoting a shared biological and social parental responsibility for the health of future generations.

The developmental origins of health and disease

The concept of the *developmental origins of health and disease (DOHaD)* is based on observations that the environmental conditions a person is exposed to before and in the first few years after birth affect health after birth and later in life. A large body of research has unearthed connections between exposure to a range of influences such as stress and poor nutrition *in utero* and in early childhood with a host of chronic diseases in adulthood including psychiatric disorders, obesity, heart disease and type 2 diabetes.

Most DOHaD research has focused on women rather than men. This reflects a widely-held assumption that the environment a mother creates for her baby during pregnancy – through behaviours such as smoking and pre-existing factors like obesity or being of older age – strongly influences her baby's health.¹ This assumption means women bear the brunt of social disapproval if they are perceived to make choices that will harm future generations. Furthermore, the sex imbalance in the available research means that potential opportunities to improve population health by targeting information towards men may be missed.¹

Advances in the science of epigenetics over the last two decades have changed the way inheritance is understood, and revealed that children inherit more than just DNA from their parents. It is now clear that genes in the DNA sequence have epigenetic markers that switch those genes on or off, without affecting the underlying DNA sequence.² The ways in which genes are turned on or off or expressed within a cell affect its function and those of other cells. Environmental factors such as stress, diet, or chemical exposure have been shown to affect sperm epigenetic markers and have effects after fertilisation thus leading to alterations in offspring gene expression (Figure 1).³ This information has opened the door for investigations into the biological ways men might contribute to their children's health.

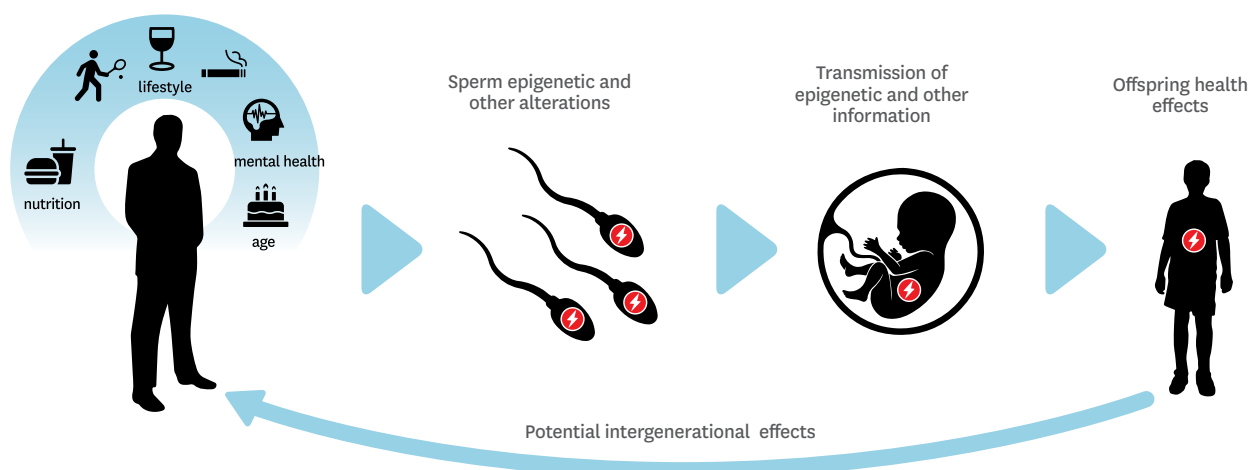


Figure 1. Potential mechanism by which paternal environmental exposures affect disease risk in children, with possible intergenerational consequences.

Understanding these potential new forms of inheritance of disease risk is important because, just as epigenetic markers are changed by environmental factors such as poor diet or stress, they can also respond positively to health and lifestyle changes such as improved diet or mental health support. Those positive changes could potentially interrupt multigenerational cycles of ill health, because animal studies have shown that epigenetic changes can persist across multiple generations, with changes in sperm and corresponding effects on offspring health observed after paternal and *grand*-paternal exposure to various environmental influences.³⁻⁵

Much of the existing knowledge in this field comes from animal studies, where controlled breeding in experimental environments and rapid turnaround of generations allow robust conclusions to be drawn. Evidence for epigenetic inheritance in humans is still emerging; human studies tend to be observational due to ethical and practical barriers to conducting intervention studies. Nevertheless, the combined evidence from animal and human studies points to a range of men's nutritional, health and lifestyle factors as potentially important contributors to the paternal origins of health and disease.

This evidence brief focuses on the biological aspects of the father's role in contributing to his children's health. However, this should be considered in concert with social aspects of parenting and whānau relationships; for example, the supporting partner's behaviour from before conception and into his or her child's life, including emotional support offered to the mother and the strength of their bond with the child.⁶ Children are increasingly being born and raised in a diverse range of family structures, and non-biological parents or caregivers of all genders have a vital role to play in children's health and wellbeing.

Physical health and nutrition

The leading paternal physical health and lifestyle factors thought to affect children's health include bodyweight and other aspects of nutrition. High paternal weight around the time of conception correlates with clinical predictors of obesity, heart disease and diabetes in children.^{7, 8} It is not clear whether these effects are due to epigenetic inheritance, genetic effects or fathers' influence on their families' diets. Paternal type 2 diabetes and poor nutrition have also been linked with negative effects on children's birth weight, risk of diabetes and other signs of metabolic health such as cholesterol levels.^{7, 8} Studies of historic events have shown these effects can reach across multiple generations; for example, in a Swedish community that experienced periods of food shortage and abundance between

the late 1800s and early 1900s, boys who had an abundance of food before puberty had sons who were more prone to diabetes and grandsons with a higher risk of dying from cancer, whereas those who had limited food had grandsons who lived longer.⁹⁻¹¹

Fathers may influence their children's weight in multiple ways, including shared diet and physical activity habits. However, shared habits do not fully explain observed links between paternal weight and children's birth weight, and there is growing evidence for direct (i.e., via sperm) transmission of health risk from father to child.

There are multiple examples from animal studies where offspring of fathers fed high-fat diets show signs of obesity, heart disease and type 2 diabetes that can be traced back to epigenetic changes in the fathers' sperm.^{7, 12, 13} If the unhealthy diet is continued over multiple generations, excess weight and related sperm epigenetic changes accumulate.¹⁴ Diet, weight and physical activity patterns are typically interlinked, and so too are the effects on sperm epigenetics and on offspring health outcomes. For instance, paternal exercise induces positive epigenetic changes in mouse offspring which alleviate the negative effects of poor diet and obesity. These positive changes in the offspring include enhanced brain function, lower risk of the equivalent of diabetes, better cardiovascular health and reduced body fat.¹⁵ Animal studies have shown that even the fluid portion of semen can affect early embryo development depending on paternal diet. In mice, this fluid from males fed low-protein diets has been associated with higher body weight, glucose intolerance and gene expression patterns characteristic of liver disease in offspring.¹⁶

In humans, a modest body of research has reported influences of a man's weight and diet on sperm epigenetic regulators of genes implicated in weight and metabolic health. These include differences in overweight versus normal weight men,¹⁷ relationships between paternal obesity and epigenetic markers found in babies and young children,^{18, 19} and correlations between frequent consumption of fatty foods such as pizza and fries and increased likelihood of sperm epigenetic changes.¹² Importantly, differences have been found in epigenetic profiles of sperm taken from men before and after surgery for weight loss,²⁰ and before and after a six-week diet enrichment with a supplement high in vitamin D and healthy fatty acids.²¹ These studies provide evidence that epigenetic modifications respond to improvements in nutrition, which suggests that improving a man's diet and lifestyle may prevent or reduce transmission of health risk to his children.

Mental health

It has long been thought that parents with mental health disorders can pass a tendency of poor mental health to their children. While many studies focus on maternal mental health, those looking at fathers report effects that are independent of the mother's mental state. Aspects of paternal mental health that have been examined include depression, anxiety, bipolar disorder and post-traumatic stress disorder. They appear to have effects on children ranging from an increase in very young children's negative behaviours and emotions to symptoms of psychiatric disorders in adults.²² For example, in a follow-up of almost 60,000 Finnish children born in 1987, those whose fathers had previously been hospitalised for a psychiatric illness were twice as likely to be diagnosed with a mental disorder by age 21 (Figure 2).²³ Studies of war and genocide have also identified effects of paternal trauma on their offspring; for instance, adult children of men who served in the Vietnam war are more likely to experience anxiety, depression, self-harm and suicidal thoughts compared with children whose fathers were in the army but were not deployed to war.^{24, 25}

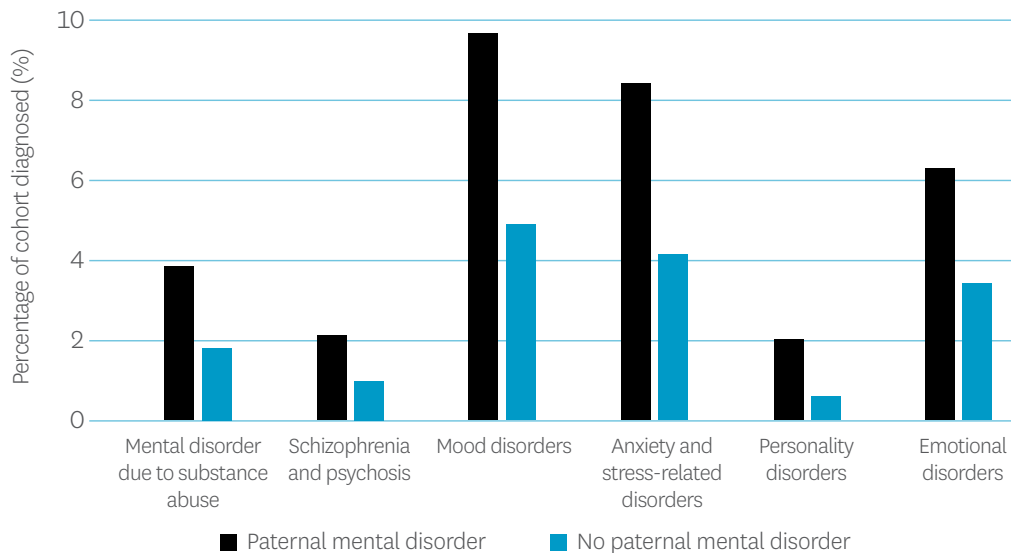


Figure 2: Comparison of the percentage of a Finnish birth cohort diagnosed with a mental disorder whose fathers also had a mental disorder, compared with those whose fathers had no mental disorder. Adapted from Paananen et al.²³

The mechanisms behind the transmission of mental health risk likely involve a combination of genetic inheritance, epigenetics and behavioural factors related to how the father interacts with his family.^{22, 25} Animal studies have shown that offspring of fathers subjected to stress or trauma are more susceptible to symptoms of depression and anxiety, and that this susceptibility is transmitted through sperm.²⁶⁻²⁹ Such signs of depression and related behaviours in offspring can persist across at least four generations.³⁰ The timing and type of exposure may be relevant, with some studies suggesting that stress has more impact on offspring if it is chronic rather than acute or experienced early in the father's life.²⁹ Importantly, it has also been demonstrated that epigenetic dysregulation in mouse sperm occurring as a result of early-life stress can be reversed through positive changes to the mouse's later physical and social environment, thereby interrupting the transfer of stress signals to the next generation.³¹

A small number of human studies have also demonstrated epigenetic changes as a result of stress or trauma. Men who experienced adverse childhood experiences have been found to have altered sperm epigenetic markers.³² In a recent study, associations were found between men's histories of early life trauma and the pattern of epigenetic markers in their children's blood.³³

Age

Advanced paternal age at conception (defined as anywhere between 35 to 45, depending on the study) has been associated with a range of effects on children's health including an increased chance of premature birth, low birth weight, chromosomal disorders and psychiatric/mental disorders. There is also some evidence pointing to a higher frequency of birth defects such as cleft palate and more complicated pregnancies and childbirths.^{34, 35} These associations are independent of the mother's age, suggesting they are mediated by sperm.

An increased likelihood of psychiatric disorders, mainly autism spectrum disorder and schizophrenia, is well documented in children of older fathers. A synthesis of multiple studies found that a 10-year increase in paternal age was associated with a 21% higher chance of autism in children.³⁶ Regarding schizophrenia, a 2021 review reported that an increased risk starts to become significant for children born when their fathers were in their mid-to-late 30s and becomes stronger with increasing age, with up to a fivefold increase in risk when fathers were aged 50 or above.³⁷ There is also some evidence of

persistence across generations, with a grandfather's age linked to both autism and schizophrenia in his grandchildren.^{38, 39}

The risks observed with higher paternal age are thought to result from biological processes associated with aging. These include reduced sperm quality and epigenetic changes in sperm.^{34, 35} Another important contributor appears to be the large number of *de novo* (newly arising) mutations occurring in older men. *De novo* mutations happen as sperm or egg cells are formed and lead to genetic changes in children that are not present in the parent. While the number of *de novo* mutations found in egg cells increases only slowly over a woman's reproductive lifetime, sperm cells have been found to contain many more mutations than egg cells and, crucially, the number of mutations increases progressively as men age (Figure 3).^{40, 41}

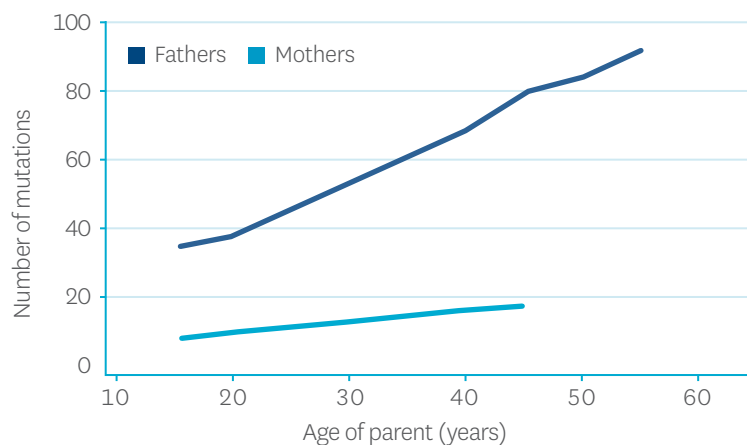


Figure 3: The relationship between the age of mothers and fathers at the time of their child's conception and number of *de novo* mutations identified from either parent. Adapted from Jónsson et al.⁴⁰

De novo mutations have long been known to cause various diseases and genetic disorders. A group of developmental disorders caused by *de novo* mutations, such as achondroplasia, Noonan syndrome and Costello syndrome, have been shown to be so closely linked to increased paternal age that they are known as paternal age effect disorders.⁴² Research indicates that both *de novo* mutations and altered paternal sperm epigenetics may be responsible for some occurrences of psychiatric disorders including autism spectrum disorder and schizophrenia in offspring.⁴¹⁻⁴⁵

Alcohol, tobacco and illicit drug use

The effects on children's health of paternal alcohol exposure prior to conception have been studied for over 100 years, and a range of negative outcomes in humans and other animals have been reported.^{46, 47} In humans, it confers a moderately higher chance of congenital heart defects, with a systematic review calculating that children whose fathers had a history of alcohol exposure in the three months prior to conception were 1.44 times more likely to be born with a heart defect.⁴⁸ There is also evidence pointing to an increased chance of birth defects including cleft lip or palate, miscarriage and low birth weight.^{47, 49-51} In animal studies, paternal alcohol exposure produces symptoms in offspring that are also seen in attention-deficit hyperactivity disorder (ADHD) and fetal alcohol spectrum disorder. These include impaired learning, increased anxiety and impulsiveness, and low birth weight.^{47, 52, 53}

Evidence from both human and animal studies suggests that paternal alcohol exposure prior to conception can adversely affect offspring's attitudes and sensitivity towards alcohol, and produce behaviours in offspring that are commonly seen in animals under chronic stress.^{47, 54} Reduced sensitivity

to alcohol is a risk factor for developing alcohol-use disorder and has been identified in children of alcoholic fathers.⁵⁵ These children, particularly sons, have a higher likelihood of developing alcohol-use disorder themselves, as well as a range of other brain and behavioural problems.⁵⁵

A range of potential alcohol-related effects on sperm epigenetics have been identified.^{47, 52} In one mouse study, ongoing alcohol exposure changed several sperm epigenetic patterns, including in regions of the genome thought to play a role in father-child epigenetic transmission.⁵⁶ Other studies have identified differences in sperm epigenetic markers potentially relating to stress and ADHD.^{46, 53}

Paternal recreational drug use around the time of conception is under-researched but is also implicated in offspring health and developmental outcomes. A review identified a small collection of research, mostly focused on cocaine or cannabis.⁵⁷ Paternal cocaine exposure had mixed effects on birth weight in animal studies, but doubled the risk of offspring heart defects in human studies. Paternal cannabis exposure has been linked with various congenital abnormalities and mild cognitive impairment in animal offspring, and with increased risks of heart defects, a specific form of sarcoma, and sudden infant death in humans.⁵⁷ A small number of animal studies are available and suggest potential for intergenerational effects of paternal cannabis exposure on offspring growth and ability to pay attention.^{58, 59} Two human studies identified sperm epigenetic patterns in male cannabis users that were similar to those seen in cannabis-exposed rodents and involved genetic pathways relating to early life development and autism spectrum disorder.^{58, 60}

Cigarette smoking by fathers before conception and during pregnancy has been linked with moderately increased risks of congenital heart disease, limb and digestive tract abnormalities, cancer, asthma and neural tube defects in their children.⁶¹⁻⁶⁵ For example, a systematic review concluded that children whose fathers smoked were 1.68 times more likely to have a neural tube defect and that the risk increased in line with the number of cigarettes smoked per day.⁶¹ A long-running British longitudinal study recently reported that boys whose fathers started smoking before puberty, and girls whose grandfathers or great-grandfathers smoked before puberty, had increased body fat during childhood and into early adulthood.⁶⁶ Tobacco smoke damages the DNA of developing sperm cells, causing chromosomal abnormalities and *de novo* mutations which may be passed to children.⁶⁵ Exposure to cigarette smoke has been found to affect animal sperm epigenetic regulation.⁶⁷⁻⁶⁹ There is also growing evidence of sperm epigenetic changes in men who smoke, and isolated examples of measurable epigenetic changes in blood samples from young and adult children of male smokers.^{64, 70-73}

Why this matters in New Zealand

Like most high-income countries, New Zealand has concerning rates of obesity and non-communicable disease. According to the 2020/2021 New Zealand health survey, three-quarters of men aged 15 and over have diets lacking in fruit and vegetables, and seven out of ten are overweight or obese. Fifteen percent have been diagnosed with a mood and/or anxiety disorder. Over 80% drink alcohol and 27% meet the New Zealand health survey definition of hazardous drinkers. Eighteen percent of men report using cannabis in the prior 12 months. A large amount of public policy work has been done to reduce tobacco use; however, 11% of men currently smoke.⁷⁴ Around 10% of men, and almost one quarter of those aged 18–24, use electronic cigarettes (vapes) at least once a month,⁷⁴ and the potential impacts of this on child health are not yet known. Furthermore, the average age of New Zealand fathers has risen since records began in 1980 (Figure 4).

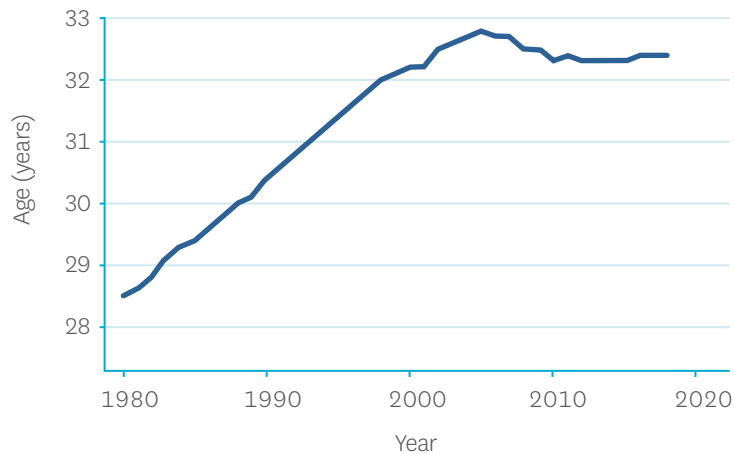


Figure 4: Median age of New Zealand fathers at the time of the birth of their child, from 1980 to 2018. Adapted from Statistics New Zealand.⁷⁵

A significant proportion of New Zealand biological fathers thus have factors putting them at risk of adversely affecting the health status of their children, and ingrained assumptions around women as the sole contributing parent to a child’s early growth and development are no longer valid. Additionally, Māori and Pacific men tend to be overrepresented in statistics relating to obesity, psychological distress, smoking and hazardous alcohol use. The accumulating evidence for paternal effects and the impact on intergenerational health therefore offer a compelling basis for policymakers, and indeed the medical profession and general public, to act on this information.

Implications for society, the health system and the education system

The available evidence suggests an important paternal biological influence on children’s health. The public health implications therefore warrant consideration of three recommendations:

1. Public health educational campaigns

Policymakers should consider health educational campaigns to share information about the role fathers play in the health of their children even before conception. While men are capable of fathering children at a wide range of ages, they may not routinely access primary health care, and in New Zealand about 50% of pregnancies are unplanned.⁷⁶ Men are currently missing out on information about potential intergenerational ramifications of their health status and lifestyle behaviours. In addition, much of the current information about the preconception period available on websites that men might access, such as the Ministry of Health’s ‘Advice for dads’ page or Health Navigator’s ‘Planning for pregnancy’ page, contains either brief advice about “remaining well for your baby” or focuses on factors affecting fertility.^{77, 78} This can lead men to unwittingly believe that their health and lifestyle exposures have no longer-term impact beyond the ability to achieve conception.

2. Routine advice for intending fathers

Primary health providers should implement routine advice for men about preparing to conceive a child that goes beyond guidance for improving fertility. Many of the recommendations that might form part of this counselling, for example to maintain a healthy weight or abstain from smoking, are already included in general population health advice. However, reframing these recommendations will have specific impact and will ensure men are fully informed, as is their right as consumers of a healthcare service. This will provide an opportunity for men to proactively plan for health and lifestyle improvements in advance of starting a family. Such improvements are likely to be effective even over a period of months prior to conception, so intending fathers should be reassured that if

maintaining such behaviours over a sustained period feels unachievable, short-term changes are still beneficial.

3. School learning programmes

The concept of paternal origins of health and disease should be integrated into school learning programmes, especially as habits and behaviours developed during the adolescent years track through to adulthood and influence periconceptional health and environmental exposures.⁷⁹ The Liggins Institute at the University of Auckland has partnered with schools to implement the Healthy Start to Life Education for Adolescents Project, a learning programme designed to facilitate the development of scientific and health literacy.^{80, 81} This programme introduces students to simple DOHaD concepts, but there remains scope for a greater focus on boys, men and their role in future generations' health.

These recommendations need to be considered within the wider context of two further points. Firstly, much of public health policy tends to be based on individuals taking responsibility for their own health behaviours. However, a person's ability to make healthy choices depends not only on their level of knowledge, but also their capability and opportunity.⁸² If money, time or other resources are scarce, a person's choices can be effectively made for them by the greater availability and affordability of less healthy options. This is particularly relevant for members of our most deprived communities, who are typically more likely to have one or more of the health and lifestyle factors that place their children at greater health risk. To achieve transformative change, population-wide approaches aimed at addressing the broader social determinants of health are needed to complement individual-level interventions. This will benefit the health of whole of society – men, women and children.

Secondly, the prevailing social discourse reflected in news articles, opinion pieces and public health advice has tended to focus on women and their childbearing behaviours. This could be seen to place the burden of responsibility for future generations disproportionately onto one sex, and pregnant women are subjected to a level of public scrutiny which has real consequences in terms of limiting their autonomy, such as their choice of food or drink.⁸³ Women tend to experience social disapproval regarding having babies later in life, and in some companies are being offered egg freezing as a work perk instead of more parent-friendly workplace policies.^{84, 85} Meanwhile, the average age of New Zealand fathers has also increased without the same level of public pressure around the male biological clock, and men tend not to receive public judgement about the effect their choices may have on their future children. At a societal level, wider awareness of the concept of the developmental origins of health and disease, and the role both men and women play in their children's health, is needed to help normalise shared responsibility for offspring health. Better integration of these concepts into practice within our medical, education and policy communities will advance public health.

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PERINATAL MENTAL DISTRESS: AN UNDER-RECOGNISED CONCERN

Chloe Wilkinson, Sir Peter Gluckman and Dr Felicia Low

September 2022



PERINATAL MENTAL DISTRESS: AN UNDER-RECOGNISED CONCERN

Key points

- Perinatal mental distress is an under-recognised condition that can have serious consequences for a woman and her baby. These include disabling effects on mood and daily functioning, and potential intergenerational cycles of compromised wellbeing.
- A woman's risk of developing perinatal mental distress is likely determined by biological vulnerabilities interacting with her pregnancy experience and her wider social and environmental context.
- Symptoms of perinatal distress are often broader than depression, and they frequently occur during or prior to pregnancy as well as after birth. Distress that arises after pregnancy should not be dismissed as temporary, hormone-driven 'baby blues'.
- Early universal screening, along with the development of a culturally-appropriate Aotearoa New Zealand-specific screening tool, is paramount for the wellbeing of both mother and child.
- Women would benefit from being able to choose from a range of therapeutic approaches, and affected families should receive tailored support to optimise their child's early development.
- Raised awareness of perinatal distress is essential to reduce stigma and encourage women to seek help.

Perinatal mental distress: A critically important public health issue

Maternal mental health remains a critically important yet under-recognised issue. It needs much greater priority within public policy frameworks in Aotearoa New Zealand. Mental distress during the perinatal period (encompassing conception through pregnancy to one year after birth) is thought to affect at least 15% of New Zealand women,ⁱ although this figure obscures the heightened risk among women of Māori, Asian, and Pacific ethnicity, for whom rates can reach one in three.¹⁻⁵ The figure also excludes the probable high prevalence of women whose symptoms fall just below the threshold of clinical detection but whose functioning and wellbeing can be as significantly affected as those meeting the criteria for formal diagnosis.⁶ For example, the prevalence of women with high subclinical levels of mental distress after birth was estimated at about 14% in a small Auckland-based survey.⁷ Larger, more recent studies overseas have reported high subclinical levels of distress in up to 30% of pregnant women.⁶ In total, therefore, mental distress may affect nearly half of all pregnant and postnatal women.

'Distress' is used here as an umbrella term to capture the range of symptoms women experience. Distress most often manifests as depression, but women also frequently exhibit anxiety and may suffer from obsessive-compulsive traits, bipolar disorder or, more rarely, psychosis.

Maternal mental distress can have serious consequences for both the woman and her baby. Adverse pregnancy outcomes, as well as the unpleasant and potentially disabling effects on mood and daily functioning, are common to major depressive disorders and are well documented in women experiencing

i We use the terminology woman/women to ensure consistency with the research referenced in this brief, however we acknowledge that not all pregnant people identify as women, and non-cisgender people have unique experiences of pregnancy. We also acknowledge that partners, adoptive parents, family, and whānau can also be affected by mood changes. This paper focuses on the pregnant and postnatal woman because of the especially high prevalence of mental distress in this group, the additional biological and social vulnerabilities associated with pregnancy and childbirth, and the potential intergenerational impacts of exposure to stress *in utero*.

perinatal distress. For some women, the extent of their suffering can be too much to bear. Suicide is the largest single cause of death for New Zealand women during and in the six weeks following pregnancy. New Zealand's maternal suicide rate is about six times higher than that of the United Kingdom, and wāhine Māori are over three times more likely to die by suicide than New Zealand European women.^{8, 9} As part of their symptoms, mothers may experience intrusive thoughts about harming their baby.

*I was standing in the kitchen and I remember having the most peaceful and clear thought:
I'll kill myself. If I'm dead, I'll be asleep. – Emily Writes, writer and mother.¹⁰*

In the longer term, children whose mothers were hindered in their bonding and parenting capabilities due to mental distress, even at mild to moderate levels, may go on to have mood disorders including anxiety, and girls have a much higher chance of experiencing depression during pregnancy when they reach that life stage.¹¹ Depression during pregnancy is associated with altered fetal brain development and biochemistry, including compromised development of executive functionsⁱⁱ in the child.^{13, 14} Impaired executive functions place a person at greater risk of negative lifelong consequences such as school failure, job instability, and poorer physical and mental health.¹² Supporting women with their mental health is therefore a vital step in interrupting intergenerational cycles of negative impact.^{12, 15}

*I wanted my baby to feel as helpless as I did, and take responsibility for
the frustration that I was feeling – which is a ludicrous thing for a baby to do.
– Hayley, a New Zealand mother.¹⁶*

A complex interplay of biology and society

A woman's risk of developing perinatal distress is likely determined by the interaction of biological factors with her wider social and environmental context. It is clear that the psychosocial risk factors for developing perinatal distress are also common to mental distress in the general population, such as low income, lack of social support, or a difficult family environment.¹⁷ But the risk and any biological propensity can be exacerbated by pregnancy-related factors. In New Zealand women, such factors include unplanned or complicated pregnancy, difficult birth experience, and infant temperament.^{1, 3, 18}

*[I]t feels like I've been eroding away. Losing who I am, the very essence of myself.
– Linda Jane Keegan, writer and mother.¹⁹*

Emerging research into the biological contributors to perinatal distress suggests possible hormonal and genetic influences, although the specific mechanisms are not yet clear.²⁰⁻²⁵ Certain genes have been found to play a role in both perinatal distress and non-perinatal mental disorders, while other genes may be unique to perinatal distress.^{21, 23, 26}

A hormone system that could potentially be involved is one that is activated in response to stress called the hypothalamic-pituitary-adrenal axis.²¹ It can be altered by a steroid called allopregnanolone that is derived from the hormone progesterone, which the placenta makes during pregnancy.²⁷ Recent research has linked low levels of allopregnanolone with increased likelihood of perinatal distress.

ii Executive functions are a set of cognitive processes that help with paying attention, planning ahead, working towards goals, and restricting impulsive behaviours. They are essential for success in school and working life, and for maintaining good relationships with others.¹²

In 2019, a synthetic form of allopregnanolone called brexanolone was approved in the United States as the first-ever drug designed specifically to treat perinatal distress.^{20, 28}

Although there is more to understand, what is clear is that perinatal distress is more than simply a social or a hormonal issue. Symptoms of distress that many women experience after their baby is born must not be dismissed as simply being the ‘baby blues’ that are assumed and expected to be minor and temporary. While biological influences may include hormone-driven baby blues for some women who only develop transient symptoms after giving birth, perinatal distress is a discrete, complex, and important phenomenon about which understandings have rapidly evolved in recent years.

Mum said: 'it's okay, it's just the baby blues'. I remember distinctly thinking: 'I don't think baby blues include trying to kill your child'. – Erica, a New Zealand mother.¹⁶

Perinatal mental distress often starts before or during pregnancy, even if it is unrecognised until after the birth. Some women experience depression or anxiety for the first time after they give birth, but for many who experience perinatal distress, their general mood state of less-than-optimal mental wellbeing largely remains constant throughout pregnancy and into the postnatal period.²⁹ The strongest predictor of postnatal distress is depression during pregnancy, and the most important risk factor for distress during pregnancy is a prior history of depression or anxiety.^{29, 30} Postnatal distress is therefore frequently a continuation of a set of symptoms that emerged during or even before pregnancy. However, the demands of caring for a newborn, such as the rapid increase in sleep deprivation, can affect or compound a woman’s distress.³¹ The experience of motherhood and any other related factors, such as a traumatic birth or a baby requiring intensive care or changed domestic circumstances, can exacerbate pre-existing distress to the point where a previously unnoticed or well-managed issue becomes more pressingly apparent to the woman and those around her.

Prevention approaches

Since perinatal distress symptoms appearing after birth are often indicative of an earlier problem, early intervention is paramount. Managing distress during pregnancy helps prevent a woman’s condition from worsening once she gives birth,³¹ and lessens the amount of stress her baby is exposed to *in utero*, thus reducing intergenerational consequences. Universal screening should be implemented for all pregnant women at the first lead maternity carer visit, and repeated in mid-pregnancy and again postnatally. Midwives and other lead maternity carers are ideally placed to carry out screening; however, it is imperative that any screening programme is supported by appropriately-resourced maternal mental health services.³² At present, existing publicly-funded services are insufficient to meet women’s needs, particularly for Māori, Pacific, and Asian women.³³ Services should be available for women experiencing any degree of distress, not only those most severely affected,^{6, 32} and women with a prior history of mental illness should automatically be offered a referral for specialist help.

The Edinburgh Postnatal Depression Scaleⁱⁱⁱ is a widely-used screening tool for perinatal distress in the community. This tool has been validated for Tongan and Samoan women living in New Zealand,³⁴ but it does not appear to have been tested for relevance in Māori women. Furthermore, it may not pick up on differences in symptom presentation in high-risk groups due to differences in how mental distress manifests in non-Western cultures. For instance, perinatal distress may present primarily as physical

iii This tool was initially developed to screen specifically for postnatal depression, as reflected in its name; however, it is now also used for screening during pregnancy.

ailments rather than emotional or mood problems in Māori women.³⁵ Similarly, Asian women may experience unexplainable pain such as stomach pain or headaches as their body's way of expressing that something is wrong.³⁶ Consideration should be given to the development of a screening tool customised to New Zealand's diverse ethnic makeup, encompassing a wider range of cultural world views and concepts of wellbeing. Such a tool should use the term 'perinatal distress' rather than 'postnatal depression' to reflect the fact that symptoms are not limited to depression and may present at any time during pregnancy.

Raised awareness of the high prevalence of perinatal distress is needed to reduce stigma and encourage women to seek help. Awareness should be promoted in partners, wider family and whānau, and healthcare providers, as well as women themselves.

One day I placed my screaming baby on the floor, went to the shed ... and called my husband. If I didn't have that fleeting moment and call him I don't know if I or my baby would be here today. – Jess, a New Zealand mother.¹⁶

Families need support to thrive. Firstly, support can help prevent perinatal distress in the first place. Secondly, proactive support of children whose mothers were affected will reduce the likelihood of those children developing mental illness. At a societal level, this requires continued investment in social policies aimed at improving the social determinants of health, as well as prioritising family-focused policies such as paid parental leave.^{11, 17}

Management approaches

Management should follow a two-pronged approach. Firstly, women at risk of developing perinatal distress would benefit from preventive care to reduce the chance of them becoming symptomatically unwell and women with existing symptoms need treatment and environmental management to help restore wellbeing. This should include being able to choose psychosocial and psychological interventions, either instead of or in addition to medication. Psychotherapy, cognitive behavioural therapy, counselling, and peer telephone support are all effective at both preventing and treating perinatal distress.^{37, 38} Women should also have the choice to access culturally-appropriate options.^{36, 39}

*I'm born from Papatūānuku,^{iv} so of course I return to her for healing.
– Joanne Rama, midwife and mother.³⁹*

For a minority of women, management will include antidepressant medication, which may be effective at reducing the severity of symptoms.⁴¹ There are limitations to antidepressants, including a lack of evidence of efficacy for preventing perinatal distress,⁴² concerns around taking medication during pregnancy and while breastfeeding, and a distrust of European medical philosophies by some women.^{35, 36} Treatment with brexanolone, the recently approved drug for perinatal distress, is promising but costly and requires an inpatient stay. Research is ongoing to develop oral formulations,^{20, 28} which when available could be considered.

iv In the Māori world view, Papatūānuku is the land. She is a mother earth figure who gives birth to all things, including people.⁴⁰

Secondly, women affected by perinatal distress may find it more difficult to bond with their child.¹¹ This imposes an extra burden on these children, who are already at increased risk of psychological disorders and impaired executive functions due to potential genetic risk factors and the altered fetal brain development that is associated with maternal depression during pregnancy. To assess mother-child bonding, a tool such as the Postpartum Bonding Questionnaire could be used. Women and their family and whānau should be offered early assistance where needed, such as tailored parenting classes with suggestions for home-based activities that promote bonding and interaction. Effective interventions include skin-to-skin contact for infants and responsively engaging in ‘serve and return’ (interactive to-and-fro) activities with older babies that can help brain development.¹¹ Women whose symptoms are more severe may require more intensive support to optimise their relationship with their newborn. This may include interactive therapies provided through specialised mother-infant mental health services and/or a period of care in a mother and baby inpatient or day unit.⁴³

I'm going to counselling now to deal with issues that I never even knew were there.

It's helped me realise . . . that a lot that has happened is not all my fault.

– Roimata, a New Zealand mother.³⁵

Fetal life and early childhood is a time of rapid brain development, and at this stage the brain is at its most malleable or plastic. Supportive social policies are therefore crucial for young families during this window of opportunity. Children should be assessed for executive functioning during the preschool years and offered individualised interventions if required. This will help provide a strong foundation for lifelong wellbeing for that child and for future generations.

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