Motu Working Paper 24-02

The effect of income on New Zealand children's behaviour: The influence of maternal stress and children's screen use

Motu economic & public policy research

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September 2024

Document information

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Acknowledgements

We are very thankful for the ideas and comments from our policy partners – you have made this project what it is. At the Child Wellbeing and Poverty Reduction Group thank you to Hannah Kerr, and earlier in the project Laura Ross and Penny Gault. At Te Puni Kōkiri, Dr Kristie Carter (your methodological help was also very appreciated). And from Save the Children New Zealand, Jacqui Southey. Finally, we are grateful for the feedback and ideas from our external reviewers Dr Lynn Riggs, Dr Francisco Perales and Dr Isabelle Sin.

This report has been produced for the Ministry of Social Development with funding from the Children and Families' Research Fund.
www.msd.govt.nz

Disclaimer

The views and interpretations in this report are those of the researchers and not the Ministry of Social Development.

This report uses data from the Growing Up in New Zealand (GUiNZ) study collected by the University of Auckland. The data have been accessed and used according to the GUiNZ Data Access Protocol.

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Executive summary

The early years of a child's life are developmentally critical and the most effective time to target policy interventions.

A typical policy response to the many developmental gaps that exist between children growing up in advantaged and disadvantaged environments is to raise the household income of struggling families. The positive association between low household income and child behaviour problems has been shown internationally, however, little is known about *how* income affects children's behavioural development, especially in the New Zealand context.

Research aims

We look at the role income plays in New Zealand children's behavioural development. We explore the differences in children's behaviour outcomes that exist between high- and low-income families and what could be causing them. We are particularly interested in the role of maternal stress as an unexplored pathway in the New Zealand context and whether the higher rates of screen use for lower income families could explain differences in behavioural outcomes. We also identify child ages where these processes may be sensitive for child development in order to establish where policy may have an outsized impact in supporting families.

The study has three primary research questions:

- What is the persistent effect of household income on child behaviour?
- What influences do mother's stress and children's screen use play in the above relationship?
- Do these relationships differ by child gender?

Data and sample

To answer these questions, we use mother-reported data from 6,852 children in the Growing Up in New Zealand (GUiNZ) study. GUiNZ is a contemporary longitudinal child development study following children born in 2009-2010 from the Auckland, Counties-Manukau and Waikato regions from birth to young adulthood.

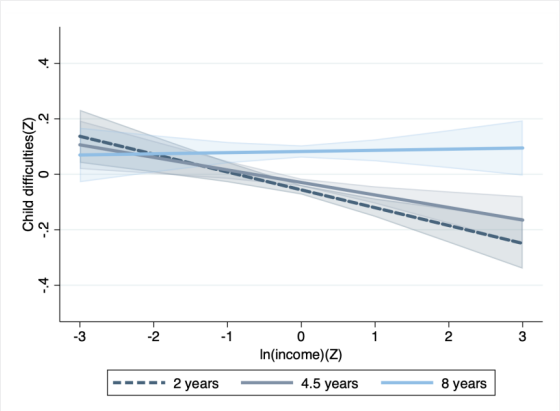
Our analysis compares low-income and high-income households from pregnancy until children are 8 years of age. We then exploit the longitudinal nature of the data using a 'fixed effects' framework to follow the same households over time and compare periods when income is higher with when income is lower, allowing comparisons in the parent-child relationship as the child grows.

Key findings

Lower incomes are associated with more reports of behaviour problems in children

New Zealand children in higher-income households have fewer reported behavioural problems than children in lower-income households, even once socio-demographic differences, and parenting differences are accounted for. Importantly, these associations remain statistically significant when examined in a fixed-effects framework that controls for (fixed) unobservable characteristics of individuals. In contrast, children across the income groups have similarly reported strengths (prosocial behaviour).

Child difficulties by equivalised income (fixed effects results)



Source: Growing Up in New Zealand, DCW2,DCW4, DCW5

The strength of the association between low income and greater behaviour problems—and explanations for how income matters—changes across the early-to-middle childhood life course

The associations between income and behaviour problems are statistically significant and greater during the preschool waves when compared with middle childhood (i.e., when children were 8 years old), highlighting the importance of both income and the investment of parents in the early years. During these preschool years, parenting factors such as parenting style, reading to children and screen use explain much of the difference in levels of behaviour problems across the income groups.

Maternal stress and children's screen use play a role in explaining the association between lower incomes and children's behaviour problems

An examination of maternal stress and screen time found that both factors explain part of the association between income and reports of children's behaviour problems.

Higher levels of both maternal stress and screen time are associated with lower household income and also with reports of higher levels of problem behaviours in children, with suggestive evidence of a mediational pathway. These pathways however were strongest—or only existed—during the early childhood years before children entered formal schooling.

These development trajectories differ by child gender

Girls have consistently lower difficulties scores and higher strengths scores than boys. The difference between the sexes increases across the waves. However, patterns of behaviour by income, stress or screen use do not vary by gender.

Policy implications

These findings indicate key points during early and middle childhood where additional policy supports may have additional benefit for both mothers and children.

The first 1,000 days are important

The findings in this research are consistent with the wealth of evidence that points to early childhood and 'the first 1,000 days' as a critical period for setting in motion longer-term trajectories of development and wellbeing. While the positive association between lower incomes and poorer child outcomes is persistent across child ages, the association is stronger during the earliest years. So, too, are the associations between income and mothers' stress and on children's screen time, in turn explaining in part how income manifests in greater child behaviour problems. These earliest patterns of developmental disparities have the potential to be a force shaping broader-level population inequities, and the intergenerational transmission of inequity.

Increasing incomes are important for supporting children's development—but other types of resources also are salient

Increasing incomes—particularly of those families living in poverty—is likely to result in declines in children's behaviour problems. Although the combined results of these analyses find a relatively modest direct effect size for income, they do point to the multifaceted way in which child development occurs and point to a range of potential policy levers that may also promote child development above-and-beyond, and in place of, income supports.

While this study focused on maternal stress and children's screen use as potential mechanisms for how income matters for child development, other variables such as maternal health and housing are also important predictors of child outcomes, and also attenuated the direct effect of income. These findings point to the importance of other policy investments, such as in the health care system and in providing quality, affordable, and stable housing for low-income families, for child development.

Importance of intergenerational approaches to supporting children

The finding that having lower incomes increases maternal stress and, in turn, is associated with more behaviour problems in children, supports the need for whānau- and parent-centred approaches. As well as ensuring incomes are at a level where families can meet their everyday essential needs (such as through paid parental leave, adequate income benefit rates and through in-kind supports and subsidies), other factors that support the whole family and improve wellbeing of all family members are likely to have a spill over effect on children.

Indeed, mothers' reports of her health and their families' housing tenure and residential instability appeared to be pathways that drive much of the differences in maternal stress across income groups. These findings indicate the importance of policy supports that target parents and promote

their wellbeing in ways that allow them to parent and support their children with fewer stressors.

Large amounts of screen time during early childhood are associated with poorer child outcomes, but the utility of parents moderating children's screens when they are older, or in small doses is unclear

We find higher screen time is associated with more reported behaviour problems in preschool children and that these effects are not 'explained away' by socioeconomic differences across different levels of screen use. Thus, these findings present qualified support for the current recommendations that screen time be limited during the preschool years. Nevertheless, this area is complex. We found children's behavioural differences are mainly driven by those watching more than 4 hours per day. This suggests that screen use at lower levels and around the recommended threshold is unlikely to be driving disparities in child development outcomes, and that the most immediate need is addressing why it is that some very young children, primarily in low-income families, are spending four or more hours of their day in front of screens.

Income as a source and compounding effect on ethnic inequities in Aotearoa New Zealand

Finally, and while not the explicit focus of the main analyses, the findings point to the differences in income, stress, and child outcomes among Māori and Pacific mothers compared with New Zealand European mothers. Consequently, prioritising investment in Māori and Pacific communities, generally, and for those mothers, specifically, is important for ameliorating population-level inequities.

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1 Introduction

New Zealand children grow up in a wide variety of environments, all of which shape their development differently. Children growing up free from poverty have a greater likelihood of positive developmental outcomes than those who do not (Noonan et al., 2018; Pickett et al., 2022). While the causal evidence that poverty impacts child development is growing clearer, the specific pathways by which income affects behaviour are not clearly proven (although well-hypothesised), especially using New Zealand data. A wide variety of literature has shown that children from financially advantaged families have fewer behaviour problems. However, understanding *why* this occurs is difficult because income is conceptualised and measured in many ways, underlying mechanisms will work differently in different contexts, across different developmental stages and by other child and family characteristics.

This study helps to rectify this gap by using longitudinal survey evidence to examine the link between income and child development outcomes, with added analysis of the roles maternal stress and children's screen use play in the relationship between income and child behaviour. These pathways were chosen as the New Zealand literature has generally focused on the practical impact of poverty on children (e.g. the health effects of living in damp housing) and has rarely addressed how the stress of parenting in poverty affects children's development. In addition, whether the differences in screen use between higher and lower income families explains some of the differences in child behaviour outcomes between the groups has seldom been explored in international studies. Understanding these pathways is important as children with early behaviour problems are more likely to exhibit problems later in life (e.g. Mesman et al., 2001; Obsuth et al., 2020; Reef et al., 2010), although there is heterogeneity in this process with some children either displaying problematic symptoms as a response to a temporary stressor, or children may achieve behavioural developmental milestones later than average.

Consequently, the overall aims of this project are to:

1. **understand the role income plays in New Zealand children's behavioural development and to establish whether income and child development patterns seen in the international literature replicate in a contemporary cohort of children born in Aotearoa New Zealand;**
2. **understand the relative contribution of factors, such as increased stress, more screen use, and other variables that explain the association between income and child behaviour; and**
3. **identify potential child ages where these processes may be particularly sensitive or critical for child development and, in turn, where policy may have outsized impact in supporting families and ameliorating population-level early childhood development inequities.**

1.1 Literature review

Income and child behaviour

The positive relationship between income and favourable child outcomes has become known as the **income gradient.** There are two broad approaches to conceptualising why this gradient arises; first is the **parental investment theory**, which takes an economic lens and highlights that parents in wealthier families can invest more in resources that benefit their children such as quality housing, nutritious food and quality childcare (Becker, 1981; Duncan et al., 2014). Second, and more common in the psychology literature, is the **family stress model** which highlights how poverty affects parent's mental wellbeing and that this subsequently affects children through changes in parenting (Conger & Donnellan, 2007; Masarik & Conger, 2017).[1] It is important to note that these two theories are not considered mutually exclusive and both channels are often examined concurrently (e.g. Browne et al., 2018; Yeung et al., 2002).

When it comes to understanding the role of income in the parental investment theory, often it is difficult to distinguish whether the differences by income are caused by income itself, or by the myriad of other factors that distinguish families with higher and lower incomes such as education, social class, neighbourhoods, and parenting styles. While these factors are all associated with child outcomes, untangling their relative contributions is difficult and results are highly inconsistent across studies (Peverill et al., 2021). A small number of international studies have attempted to control for these other factors when examining the role of income by using either longitudinal data to measure the same children over time, or by randomisation techniques. Most are using US data and have found increases in income associated with fewer behaviour problems (e.g. Hamad and Rehkopf (2016), Dearing et al. (2006) and Gennetian and Miller (2002), Akee et al. (2010) and Costello et al. (2003) with samples of US children, and Zachrisson and Dearing (2015) with Norwegian preschool children). Although Khanam and Nghiem (2016) in Australia and Dooley and Stewart (2007) in Canada found no evidence of an effect of income on child behaviour.

However, there is little New Zealand evidence directly examining the effect of income on children's behaviour problems. Huang et al. (2022) found an association between income and several aspects of behaviour problems as part of their wider study on maternal health and children's socio-emotional development using GUiNZ data.[2] In addition, a technical report investigating behaviour problems using the New Zealand Health Survey data in 2012/13, 2014/15 and 2015/16 found that children in the most socially deprived areas were three times more likely to have a 'concerning' difficulties score than children from the least deprived areas (while controlling for age, ethnicity and sex) (New Zealand Ministry of Health, 2018b).[3] These results suggest that a similar

[1] A similar distinction is sometimes made between the "resources" and "family process" channels (Milligan & Stabile, 2011).

[2] They found an association between income and both emotion and peer relationship problems at 2 years, income and emotion, peer relationship and conduct problems at 5 years and income and emotional problems at 8 years.

[3] Concerning scores are considered in approximately the top 10% of scores.

relationship between low incomes and higher behaviour problems observed in international studies may be found in New Zealand. However, the scale of the differences is uncertain, there is no longitudinal evidence to isolate the effect of income from other correlated factors, and the pathways by which income affects behaviour are currently unknown.

Maternal stress

When it comes to understanding the family stress model, it is important to note that during their earliest years, children's brains go through a period of heightened neuroplasticity as they learn through "serve and return" interactions with the world around them (Shonkoff et al., 2016). These interactions, particularly with a child's caregivers, form the foundation of their neurological development and can be interrupted if the child's caregiver is unable to provide high quality interactions through reasons such as being highly stressed.

The broad consensus from international evidence is that a lower income is associated with higher levels of parenting stress and maternal wellbeing more broadly is associated with behavioural problems in children.[4] Several studies have found that maternal distress mediates the relationship between income and child behaviour. In general, much of the income effect is removed with the addition of maternal distress into models (Khanam & Nghiem, 2016; Kiernan & Huerta, 2008; Kiernan & Mensah, 2009; Noonan et al., 2018).

In terms of understanding the family stress model as a whole, the strongest evidence comes from Wickham et al. (2017) who use data from the United Kingdom's Millennium Cohort Study to show a shift into poverty was found to increase the chance of behaviour problems with an odds ratio of 1.41 and a shift into poverty was found to increase the odds of maternal distress by 1.44. In addition, the effect of the shift into poverty on a child's mental health was partially explained by increases in maternal psychological distress.
There is a small amount of quantitative evidence from New Zealand showing the role of stress in children's behaviour development. Most notable is D'Souza et al. (2019), who, using GUiNZ data, found antenatal perceived stress associated with abnormal difficult behaviour at 2 years of age. Additionally, they found mothers with severe postnatal anxiety had children with almost double the odds of emotional problems at 2 years. Income was controlled for, but its role was not directly examined.

Children's screen use

A key part of the family stress model is that parenting is disrupted by the stress of poverty and this can affect children's healthy development. One way this disrupted parenting could occur is through a greater use of screens, a parenting option that requires less mental energy.

Screen use is now a ubiquitous part of modern childhood and is therefore becoming considered a fundamental part of the context of child development (Barr, 2019). The 2018/19 Ministry

[4] Higher maternal levels of the stress hormone cortisol during pregnancy are also associated with subsequent behaviour problems in children (e.g.Buss et al., 2012).

of Health annual New Zealand Health Survey found that 88.6% of under 15 year-olds are exceeding the screen time recommendations for their age.[5] This rises to 93.7% for under five-year-old children (New Zealand Ministry of Health, 2018a).
The literature on screen use and children's behaviour has grown rapidly in recent years.

There has been some convergence of findings on the harms of social media for adolescents' mental health, especially for girls (e.g.Twenge & Farley, 2021). But the evidence of the effect of screen time on younger children's behaviour is considered inconclusive (Eirich et al., 2022). Studies are more likely to show a small negative relationship between screen use and behaviour problems, but there are varying results and studies are prone to small and/or homogenous samples, differing measures of screen use, little differentiation on how screens affect children differently at each developmental stage, and a poor understanding of causality. There is also evidence of publication bias where studies showing the negative effects of screen use are more likely to be published (Ophir et al. (2021); Eirich et al. (2022)).

Lower-income households tend to use screens more frequently than higher-income households. Research undertaken prior to this study with GUiNZ data found that 2-year-old children in low-income households were exposed to 1.5 times the amount of screen time than higher income households (Monk, 2022). However, screen use is not generally understood as a pathway for explaining differing child behaviour for low- and high-income children. There is some evidence to suggest this pathway exists; for example, McArthur et al. (2022) find that screen use mediates the relationship between a mother's cumulative risk factors both for internalising problems and for the achievement of developmental milestones in their sample of Canadian preschool children. However, income was not examined directly, and screen use did not mediate the relationship with externalising problems.

In the New Zealand context, there have been three recent studies using GUiNZ data to examine screen use and aspects of child behaviour. Stewart et al. (2019) found that children who did not adhere to screen use guidelines at 2 years were more likely to exhibit hyperactivity problems at 4.5 years (as part of a wider study). Corkin et al. (2021) examined the relationship between screen use and inattention/hyperactivity, alongside hot and cool executive functioning (EF) finding an association between weekday television exposure at 2 years and the hot EF test at 4.5 years, but no relationship between screen use and inattention/hyperactivity or their cool EF task.[6] More recently, Gath et al. (2023) examined the impact of screen exposure during the preschool years on various child development measures and found it associated with peer relationship problems. Together these studies point to the role of screen use in determining aspects of behaviour, but do not examine behaviour as a whole.

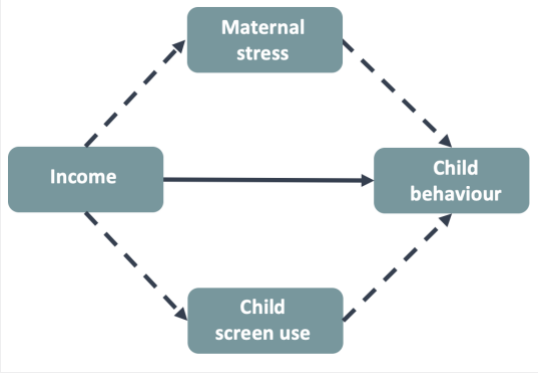
[5] Recommendations are: 0-24 months no screen use; 2-5 year-olds less than 1 hour per day; 5-15 year-olds less than two hours per day.

[6] However, the use of partner data may have meant the children with the highest problem scores were not included in their study. Families in the GUiNZ study without partner data were more likely to have higher child difficulties scores.

1.2 Conceptual relationships and report structure

Figure 1 illustrates a conceptual model of the relationships examined in this research. The central relationship of interest is that between household income and child behaviour, but the indirect influence of both maternal stress and children's screen use in this relationship is also examined.

Figure 1 - Conceptual model



Due to constraints in the data (discussed in detail in Section 2.2) the analysis is separated into three sections. The first section of the analysis sets the scene for a later, more detailed analysis of the relationship between household income and child behaviour by examining changes in child behaviour and income over time, alongside exploring differences in child behaviour by income group.

The second section uses the available data from the early years of the GUiNZ study (pregnancy – 2 years old) to focus on the influence of maternal stress in the relationship between income and behaviour. Finally, the relationship between income and behaviour is examined using more complex statistical analysis in the third section, which uses the later waves of the study (from 2-8 years of age). This section includes a further analysis of the role of screen use in the relationship between income and behaviour. The analyses focus on the time spent using screens and, as such, cannot capture the direct effect of the varied types of screen use. We analyse the effect of time spend engaged with technology (and by default, time not spent on other activities).

While Figure 1 provides a simplified model, it should be noted that there may be further, more complex, relationships (such as higher maternal stress leading to greater screen use and two-way relationships) that are beyond the scope of this study.

1.3 Engagement with policy collaborators

The overall research project has been developed in collaboration with policy partners at the Child Wellbeing and Poverty Unit at the Department of the Prime Minister and Cabinet, Te Puni Kōkiri and Save the Children New Zealand. The policy partners were consulted throughout the project development, analysis, and review stages. Their feedback has been incorporated throughout the process, however any errors or omissions that remain are the authors' responsibility.

2. Methodology

2.1 Data and sample

The data for this report are from the Growing Up in New Zealand (GUiNZ) study. GUiNZ is a contemporary longitudinal child development study following 6,852 New Zealand children from birth to young adulthood. Parents were recruited from all expected births in the Auckland, Counties-Manukau and Waikato District Health Board regions of New Zealand between 25 April 2009 and 25 March 2010. The GUiNZ cohort is broadly generalisable to the New Zealand population in terms of ethnicity and markers of family socioeconomic status (Morton et al., 2015).

This report uses data from the first five waves of this study covering pregnancy, nine months, two years, 4.5 years, and eight years of age. While partners were interviewed in the first three waves of the study, the sample for this report is restricted to mother-reported data.[7] It was decided that the benefit of including partners was likely to be outweighed by the introduction of bias by using partner data in the sample.[8] In addition, some studies show that the associations between income and child outcomes is similar across the different assessors of children's outcomes (Khanam et al., 2017).

The final analytical sample includes 6,155 children (those children in both the 9 month and two year waves), however for the descriptive and ordinary least squares (OLS) regression analyses in Section 4.3 the sample is further restricted to those who were a part of the study for the 4.5 years and 8 year waves).[9] This was done to ensure results could be compared between waves and differences in results across waves were not just due to the effects of study attrition. For the fixed effects panel models, to ensure the sample size is as large as possible, unbalanced models are used (which includes every child whether or not they participate in every wave).

2.2 Analytical approach

Overall approach

The analytical approach was guided by the research questions and the constraints of the data. The analysis is broken down into three main stages. The first examines differences in children's behaviour by household income group between 2 and 8 years of age and how child behaviour and household income changes over time. The second

[7] Growing Up in New Zealand is a child focused study. This means the 'mother' is not necessarily the birth mother and may change during the study. 45 children have a different mother by the 8-year wave than they did during the pregnancy wave.

[8] For example, the mean child difficulties score for children whose mother's partners are in the study is 10.57 versus 12.84 for those without. Restricting the sample to those with partners in the study would omit too many of the children of interest (those with behaviour problems).

[9] 39 children in the final analysis had changed mothers by 8 years. Because the primary research question is to understand the connection between current family contexts (such as exposure to caregiver stress and screen time) in a representative NZ cohort, we chose to include these small number of children. Moreover, the decision to include them did not substantively alter the findings, although children with changing caregivers were more likely to have higher difficulties scores, as well living in lower-income households and have more screen time. Thus, the inclusion of these children likely means our estimates are more conservative.

explores household income, mothers' stress and children's behaviour in the first 1,000 days (pregnancy to 2 years old). The third examines household income, children's screen use and children's behaviour in young childhood (2 years – 8 years old).

The analysis has been split this way chiefly due to limitations in data collection. The stress measure is only captured from pregnancy through to 2 years and the child behaviour and screen use measures are only captured at the 2-year, 4.5-year, and 8-year waves, meaning separate sets of models examining the early years and the later years were deemed the simplest approach.[10]

Each section looks at both the differences *between* income groups (in child behaviour, stress or screen use) alongside the average differences *within* the same children over time. These two approaches each shine a different light on the research questions. Both approaches are important as any differences in an outcome (such as child behaviour) across income groups may be due to differences in the households that cluster in the income groups (such as parenting styles, neighbourhood effects, and life experiences of parents). Some of these can be controlled for in statistical models that compare groups, but many cannot. Examining the changes within households allows a better understanding of causality than when examining just the differences between groups as factors that do not change over time (such as a mother's upbringing) can be controlled for.

The techniques used to examine differences between income groups in this research, firstly involve kernel density functions to graph the different distributions between income groups, before multivariate OLS regression is used to examine relationships of interest while controlling for other factors which may influence results. OLS is run with robust standard errors. VIF scores were used to test for multicollinearity issues. Separate OLS models have been run at each wave rather than using pooled OLS in order to use the Gelbach decomposition (see below) which captures the different pathways by which income is associated with behaviour at the different developmental stages.

Second, in each of the OLS models, once control variables are included the effect size for income significantly decreases.[11] To understand what variables are causing this decrease (and therefore to indicate the pathways by which income affects behaviour) a series of Gelbach regressions are run. Simply adding covariates into a base regression model to understand the effects of the additional covariates on the base model can cause different results by including covariates in different orders. Gelbach (2016) has created a simple and effective way to account for this problem by using the omitted variable bias formula to construct a conditional decomposition to consider various

[10] A more detailed analysis of the relationship between income and stress in the first 1,000 days was also requested by the policy partners to align with an ongoing project which dovetailed with this research.

[11] During the project planning phase the policy partners raised their interest in the pathways by which income affected maternal stress and child behaviour. One focus was to see if effect sizes varied by gender or ethnicity, the interaction of each variable with income, stress and screen use was tested for each of the OLS and FE models, none were found to be significantly statistically relevant.

covariates' (or groups of covariates') role in shifting base regressor's coefficients.

Finally, to move closer to understanding causality, changes within households over time are examined using fixed effects (FE) models. Fixed effects models were chosen over random effects models after Hausman tests indicated random effects were not appropriate (p-value <0.001 in each case). Covariates were included based on theoretical consideration and on whether they were consistently measured across the waves of interest—a necessary condition for inclusion in FE models. All continuous variables are standardised (i.e., a mean of zero and standard deviation of one) in the fixed effects models to ensure comparability over time.[12] This was particularly important to distinguish age related effects from the (minor) variable measurement differences across the waves.

All analyses were conducted in Stata Version 15.

Missing data

The potential for bias from missing data was highlighted at the beginning of the project, both from data which was missing due to respondents missing questions (item non-response) and from families dropping out of the study (wave non-response). Of particular concern was the missing data from the household income measures which was missing 511 values due to item non-response in the 2-year wave (8.1% of respondents), 983 items at the 4.5-year wave (16% of respondents) and 1,177 items at the 8-year wave (23.9% of respondents). Table 1 illustrates the drop in sample size if complete case analysis is used. Information on missing values for all variables is provided in Appendix 1 and, for reference, a comparison of ordinary least squares (OLS) results using complete case analysis and multiple imputation to estimate child difficulties is provided in Appendix 13.

Table 1 - Missing data

Sample (children)	Full sample at wave	Complete cases for OLS difficulties model	Cases lost from item non-response
Full pregnancy sample	6,852		
2-year wave	6,321	4,344	1,977
4.5-year wave	6,151	4,240	1,911
8-year wave	4,920	2,661	2,259

Multiple imputation (MI) was used to account for missing data from those who did not fully answer questions. MI was used for missing data from both dependent and independent variables. Imputation models only used variables from earlier waves to predict later outcomes and not vice-versa. Imputation was done using chained equations with 100 imputed datasets with the Stata *mi estimate* suite of commands used to estimate models across the imputed datasets. Each equation had its own imputation model run.

Bias due to wave non-response (study attrition) was also considered a potential issue. An examination of the results comparing the balanced and unbalanced fixed effects show that they were

[12] Standardisation was done using the mean and standard deviation cross-sectionally at each wave.

relatively similar (see Appendix 12).[13] While wave non-response may affect results, this similarity provides some reassurance that the effect is not substantial.

Variables

The central outcome examined in this report is child behaviour, measured using the Strengths and Difficulties Questionnaire (SDQ) (Goodman, 1997), reported by mothers when children were two years, 4.5 years and 8 years old. The SDQ is a parent-rated 25-item scale that measures five aspects of child behaviour; emotional problems, peer relationship problems, hyperactivity/inattention, conduct problems and prosocial behaviour. The first four subscales are summed to generate a total difficulties score (see Appendix 2 for a full list of the survey questions by subscale).[14] Prosocial behaviour provides the strengths score. Additionally, the difficulties score can be split into an 'internalising problems' score consisting of emotional problems and peer relationship problems and an 'externalising problems' score consisting of hyperactivity/inattention and conduct problems (see Figure 2).

The SDQ involves mothers responding to 25 statements as to whether she considers them "Not true"(0), "Somewhat true"(1), or "Certainly true"(2) of her child. Example questions include: "Often has temper tantrums or hot tempers", "Helpful if someone is hurt, upset or feeling ill", "Often argumentative with adults". In data collection, the "early-years" version of the SDQ was used (for ages 2-4), and it was asked of both mothers and partners with both fully answering the SDQ questionnaire.

At 4.5 years and 8 years the regular SDQ was used. Due to the small differences in the questions between the early years and the regular SDQ, the SDQ variables were standardised for the fixed effects models. Table 2 provides the overview statistics for the strengths and difficulties scores.

Figure 2 - Construction of SDQ scores

<table>
<tr><td>Emotional problems</td><td rowspan="2">Internalising problems</td><td rowspan="4">Overall difficulties</td></tr>
<tr><td>Peer relationship problems</td></tr>
<tr><td>Hyperactivity/inattention</td><td rowspan="2">Externalising problems</td></tr>
<tr><td>Conduct problems</td></tr>
<tr><td>Prosocial behaviour</td><td>Overall strengths</td><td>Overall strengths</td></tr>
</table>

Source: Growing up in New Zealand (2018)

[13] There are minor differences in the effect sizes and sometimes in statistical significance, but overall, the pattern of results remain substantively similar when examining child difficulties, but some differences when examining maternal stress. The central difference is that there is a significant relationship between income and stress at 9 months for the balanced model, but not for the unbalanced model.

[14] Cronbach's alpha is 0.701 for the 2-year variable, 0.786 for the 4.5-year variable and 0.827 for the 8-year variable.

During the 4.5-year wave of the SDQ, one question was missed out of the survey "Often fights with other children or bullies them" which contributed to the conduct scores, externalising scores and overall difficulties. The recommended approach by the SDQ developers for a missing item is to impute it with the mean from the other items in the subscale, however this particular question was identified as having a lower mean score than the other questions in the conduct domain at the 2-year and 4.5-year waves so taking this approach would give biased scores. To account for this, a model was developed which estimated the missing question's score based on the scores from the other questions in the conduct domain at 2 years.

Household income is recorded in GUiNZ using 7 income bands as an answer to the question "What was your household's total income, before tax or anything else was taken out of it?".[15] For this research, the income variable is used in its categorical form for the basic descriptive work and for the OLS regressions measuring associations at a single point in time. This was done for simplicity of interpretation, and it meant any differences at upper and lower ends of the income distribution could be easily examined when using the Gelbach decompositions. Differences in household composition were included as separate control variables in the OLS models.

Table 2 - Household income bands

1	< $20,000	5	$70,001-$100,000
2	$20,001-$30,000	6	$100,001-$150,000
3	$30,0001-$50,000	7	$150,000+
4	$50,001-$70,000		

For the fixed effects models, it was important to ensure that the measure of income was equivalent across each wave. Consequently, the variable was changed to a continuous measure by selecting the mid-point of the income band.[16] Income was then adjusted for inflation and was equivalised for household composition using the square root scale (income divided by the square root of household size). Income was log transformed and then standardised for ease of interpretation. This measure will be referred to as 'equivalised income' through the rest of the report.

Table 3 - Summary statistics for strengths and difficulties scores

	2 years		4.5 years		8 years	
	Mean (SD)	Min, Max	Mean (SD)	Min, Max	Mean (SD)	Min, Max
Difficulties	10.89 (4.87)	0, 30	8.88 (4.79)	0, 31	7.50 (5.22)	0, 31
Internalising	3.73 (2.55)	0, 16	3.28 (2.65)	0, 16	3.12 (2.89)	0, 17
Externalising	7.19 (3.35)	0, 20	5.61 (3.21)	0, 17	4.38 (3.29)	0, 18
Strengths	7.14 (1.82)	0, 10	7.76 (1.78)	0, 10	8.15 (1.82)	0, 10

[15] Except for the 2-year wave where there are 12 income bands. These were collapsed into the same 7 bands as the other waves.

[16] $175,000 was chosen for the $150,000+ band.

The maternal stress variable is developed from six questions on sources of worry asked of mothers in the pregnancy, 9-month and two-year waves. This scale was developed for GUiNZ with reference to Abidin et al. (2006). Each question asks the respondent, "To what extent are the following sources of stress for you?" Respondents are asked to respond on a four-point scale; Not at all stressful (0); Somewhat stressful (1); Moderately stressful (2) and Highly stressful (3). Those who responded "n/a" were coded as 0. Results for the six questions were then added together.[17] The questions are:

- Worry about a disabled or ill family member (adult or child).
- Worry about current housing difficulties.
- Worry about balancing work and family life.
- Worry about money problems.
- Worry about family members not getting on.
- Worry about another child's behaviour.

The screen use variable captures the amount of exposure a child has directly to screen time. While screen use may affect children's behaviour through the pathways of content watched and, through crowding out more developmentally enriching activities (the '**displacement hypothesis**'), there was not enough detailed data on screen content, so time has instead been examined.

The screen use measures for each wave were developed slightly differently in line with technology changes and survey development. During the 2-year wave only, data on screen use during the last weekday was collected, so to ensure that results were comparable across the waves, weekday screen use was adopted as the measure used for each of the three waves. The full screen use questions are detailed in Appendix 3.

Background screen use was also considered for inclusion but was ultimately rejected in favour of a more clearly measured option. Using both together was not possible as there was concern over overlap in the measurement of both measures. Including a control variable for the date/time data was also considered to account for the differences in screen use during school holidays and different days of the week. Unfortunately, data collection frequently ran over several days or weeks, so the day measure was too imprecise. Controlling for the month the questionnaire was started was also tested but had no discernible effect on results.

For the OLS models, screen use is captured using a categorical variable as there were concerns over measurement error due to clustering around half hour and full hour measurements. There was also some evidence of an exponential relationship between screen use and difficulties using the OLS models, and this was tested, but not found to fit the data for the fixed effects models. For the fixed effects models, standardisation across the waves was important to account for differences in how the question was asked across the waves, so the screen use variable in the fixed effects models is continuous.

A number of covariates were included in the OLS and FE models. The model development strategy was to use a variety of variables due to concern

[17] Cronbach's alpha is 0.707 for the pregnancy variable, 0.617 for the 9-month variable and 0.659 for the 2-year variable.

about omitted variable bias. Variables selected covered the developmental pathways suggested in prior research to be associated with a child's behaviour development including maternal factors, household factors and parenting factors.

In the OLS models estimating maternal stress, covariates include whether a mother's baby is her first or a subsequent child, a mother's personality, ethnicity, education, general health, age, employment status, household structure, the NZ Deprivation index score for her neighbourhood, the number of recent house moves, and her household's housing tenure. The OLS models estimating child behaviour include these covariates and in addition the child-related variables of sex at birth (to control for factors such as differences in socialisation of behaviour for boys and girls), general health, screen use and the number of times a child wakes at night. Due to variable availability household structure is captured in the OLS models estimating child behaviour using the number of children in the household alongside a mother's partner status (both of which will effect a mother's ability to spend time engaging with children).

The covariates selected for the fixed effects models include those from the OLS models that are measured consistently over the waves. The equations estimating maternal stress include a mother's employment status, partner status, general health, NZ Deprivation Index score, housing tenure and residential mobility. The equations estimating child behaviour also include child health and the number of times a child wakes at night. Time invariant factors are controlled for by the structure of the fixed effects models.
A comprehensive description of the variables can be found in Appendix 3.

3. Results

This report aims to understand the mechanisms through which living in lower-income households contributes to the positive association between poverty and behaviour problems among New Zealand children. To achieve this, it is vital to understand both how household income and children's behaviour are associated across different households, and also how changes in income for individual households affects the behaviour of the children in those households.

In line with the research aims, this section details the results of our analysis and is split into three subsections (noting that timeframes are in part determined by data availability for the relevant variables):

- Household income and children's behaviour – associations and changes over time.
- Household income, mothers' stress and children's behaviour in the first 1,000 days (pregnancy – 2 years old).
- Household income, children's screen use and children's behaviour in young childhood (2 years – 8 years old).

3.1 Household income and children's behaviour – associations and changes over time

This subsection is split into three smaller sections; the first and second examine how the income and behaviour measures, respectively, change over time. The third subsection illustrates the differences in children's behaviour by contemporaneous household income for the GUiNZ children between 2 and 8 years of age.

Child behaviour changes over time

On average, child difficulties scores decrease over time (i.e., their behaviour improved). The mean score for the sample of 2-year-olds is 10.76 and this decreases to an average score of 7.31 by the 8-year wave (Table 4). This decrease is driven predominantly by girls' scores falling faster than boys with the difference increasing over time.

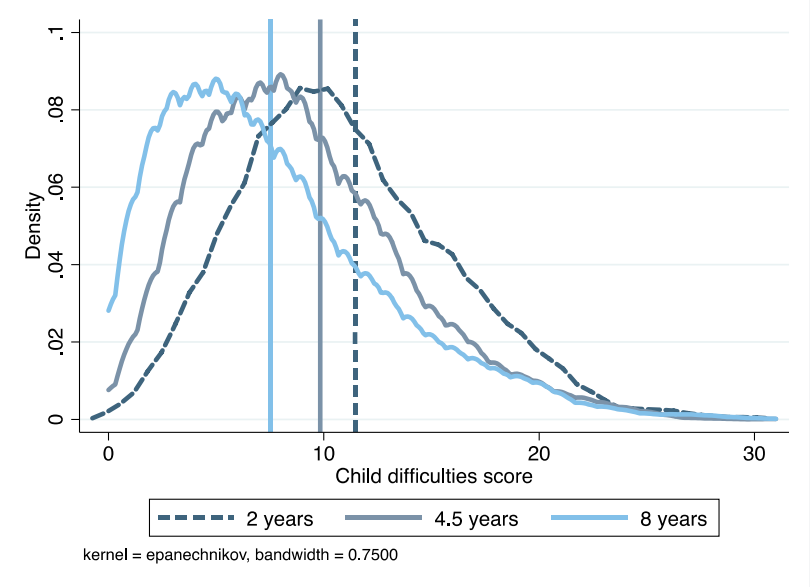
Table 4 - Mean difficulties scores by sex for each wave

	2 years	4.5 years	8 years
Overall	10.89	8.88	7.50
Boys	11.13	9.23	8.19
Girls	10.65	8.51	6.77
Difference	0.48***	0.72***	1.42***

*** p<0.01, ** p<0.05, * p<0.1

Source: Growing Up in New Zealand, DCW2, DCW5, DCW8

Figure 3 - Distribution of child difficulties scores by wave



Source: Growing Up in New Zealand, DCW2, DCW5, DCW8

Figure 3 shows the distribution of difficulties scores across each wave with the vertical line illustrating the mean for each wave.

Child difficulties scores are the sum of internalising and externalising problem scores and can therefore be broken down into these subscales for analysis. Specifically, internalising scores cover emotional and peer relationship problems, whereas externalising scores cover hyperactivity and conduct problems (see Appendix 1 for the complete list of SDQ questions). While internalising and externalising behaviour problems do often overlap, both have different developmental trajectories so it is worth exploring them separately as well as together in the form of an overall difficulties score.

The mean internalising scores consistently drop over each wave, although this drop is small (Table 5). Interestingly, there is little difference in internalising scores by sex, with the minimal difference in scores apparent at 2 years becoming insignificant by 4.5 and 8 years.

Table 5 - Mean internalising scores by wave and sex

	2 years	**4.5 years**	**8 years**
Overall	3.73	3.28	3.12
Boys	3.79	3.26	3.13
Girls	3.66	3.30	3.11
Difference	0.12*	-0.04	0.03

*** p<0.01, ** p<0.05, * p<0.1

Source: Growing Up in New Zealand, DCW2, DCW5, DCW8

Mean externalising scores drop more substantially over the waves than internalising scores do. This decrease is driven more by decreasing scores for girls than boys (Table 6). These results indicate that decreasing externalising scores for girls is the most substantial contributor to the decrease in overall difficulties scores over time.

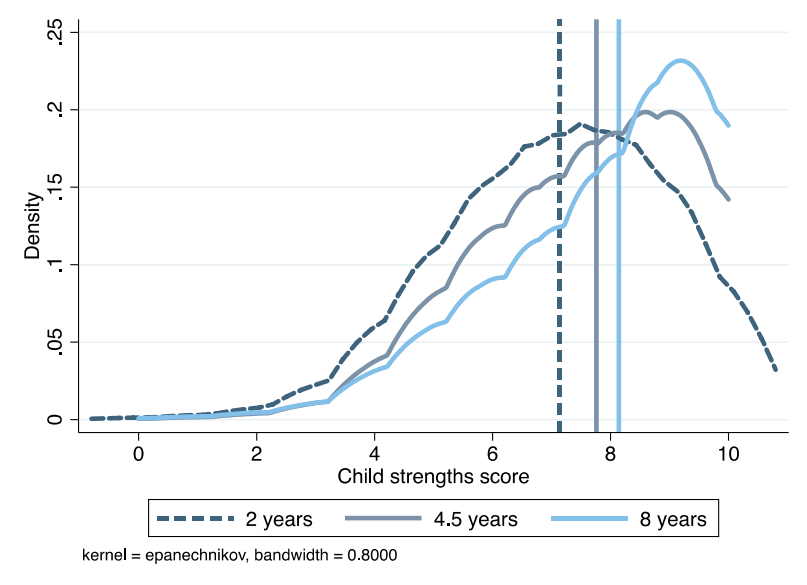
Table 6 - Mean externalising scores by wave and sex

	2 years	4.5 years	8 years
Overall	**7.19**	**5.61**	**4.38**
Boys	7.36	5.99	5.06
Girls	7.01	5.21	3.67
Difference	0.34***	0.78***	1.39***

*** p<0.01, ** p<0.05, * p<0.1

Source: Growing Up in New Zealand, DCW2, DCW5, DCW8

Figure 4 - Distribution of child strengths scores by wave



Source: Growing Up in New Zealand, DCW2, DCW5, DCW8

Child strengths scores measure a child's prosocial behaviour, which, while negatively associated with behaviour problems, measures a different developmental process (exhibiting voluntary behaviours intended to help others). Strengths scores steadily increase over each wave, with the most considerable increase from the 2- to 4.5- year waves (Table 7). Girls have consistently higher strengths scores than boys, and the gap increases over time. Figure 4 shows that as the children get older there is a higher concentration of strengths scores near the top of the distribution.

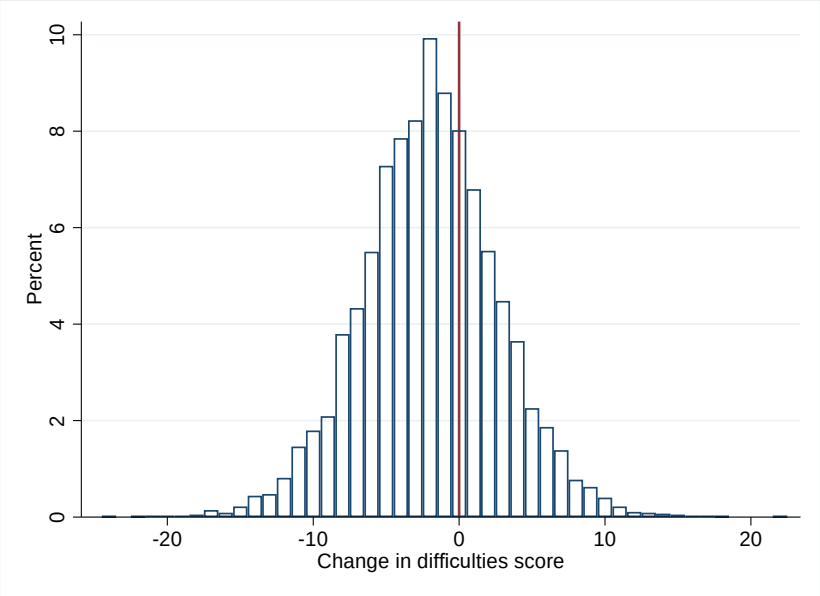
Table 7 - Mean strengths scores by wave and sex

	2 years	4.5 years	8 years
Overall	7.14	7.76	8.15
Boys	6.91	7.46	7.81
Girls	7.39	8.08	8.51
Difference	-0.48***	-0.62***	-0.71***

*** p<0.01, ** p<0.05, * p<0.1

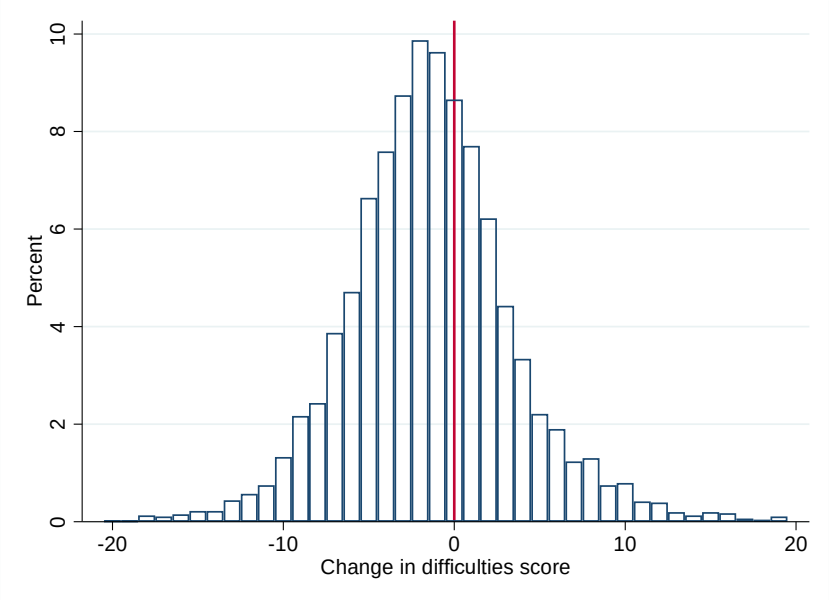
Source: Growing Up in New Zealand, DCW2, DCW5, DCW8

Figure 5 - Change in difficulties scores from 2 to 4.5 years



Source: Growing Up in New Zealand, DCW2, DCW4

Figure 6 - Change in difficulties scores from 4.5 to 8 years



Source: Growing Up in New Zealand, DCW5, DCW8

The results so far show changes in the mean behaviour scores across the different waves; however, this approach does not consider how difficulties scores change for children individually. To show changes for individual children, Figures 5 and 6 graph the changes in difficulties scores from one wave to the next. The figures show that children tend to have a lower difficulties score from one wave to the next (63.5% had decreasing scores from the 2 year to 4.5 year waves and 59.7% decrease from the 4.5 year to 8 year waves). However, there are still many children whose scores increased (28.5% had increasing scores from the 2 to 4.5 year waves and 31.6% increase from the 4.5 to 8 year waves).

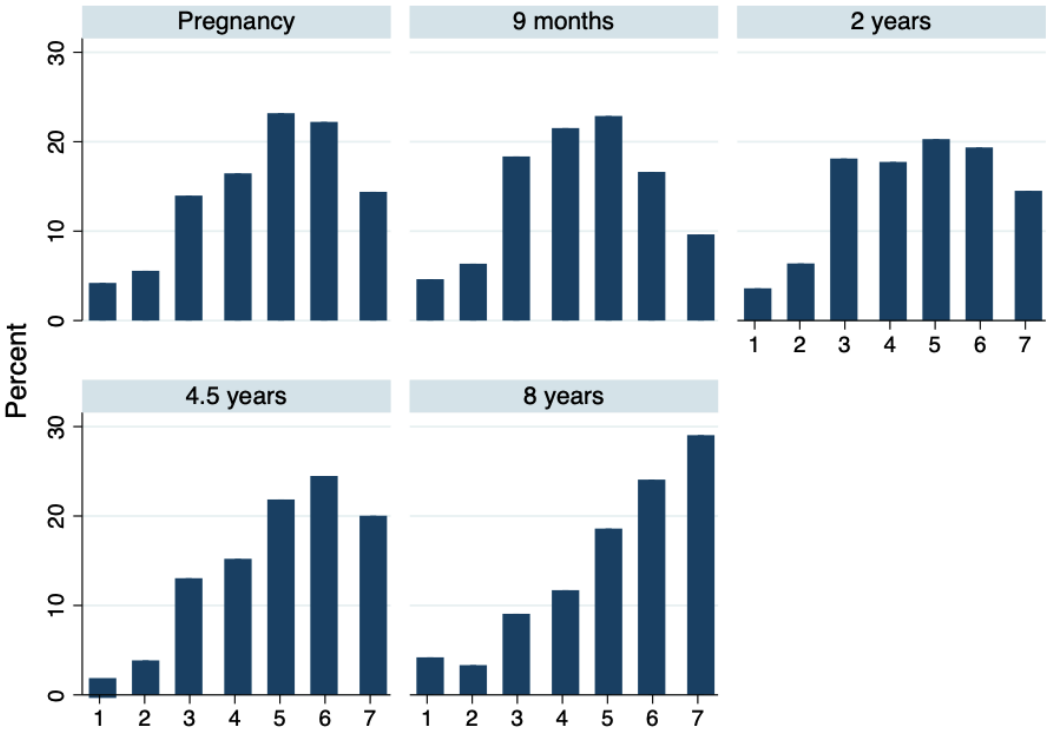
Household income changes over time

From pregnancy to when the study children are eight years old, there is an increasing concentration of households in higher income groups, likely reflecting parents returning to work as children get older and parents gaining more experience in the labour market (Figure 7).

When we examine the income measure which has been equivalised for household size and adjusted for inflation a similar pattern is apparent (Figure 8). However, there are more families with higher incomes during the pregnancy wave when using this measure as the equivalisation process results in a higher income when there is one less family member before the baby is born.

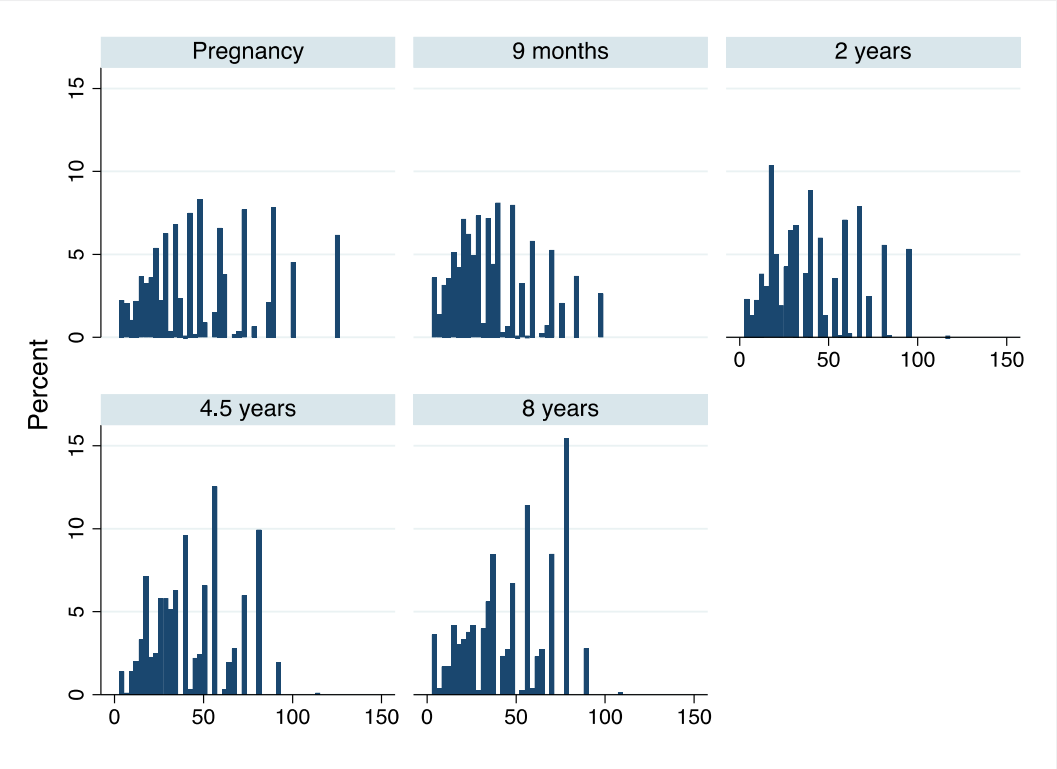
Household income groups			
1	< $20,000	5	$70,001-$100,000
2	$20,001-$30,000	6	$100,001-$150,000
3	$30,0001-$50,000	7	$150,000+
4	$50,001-$70,000		

Figure 7 - Household income group by wave



Source: Growing Up in New Zealand, DCW0, DCW1, DCW2, DCW4, DCW5, DCW8

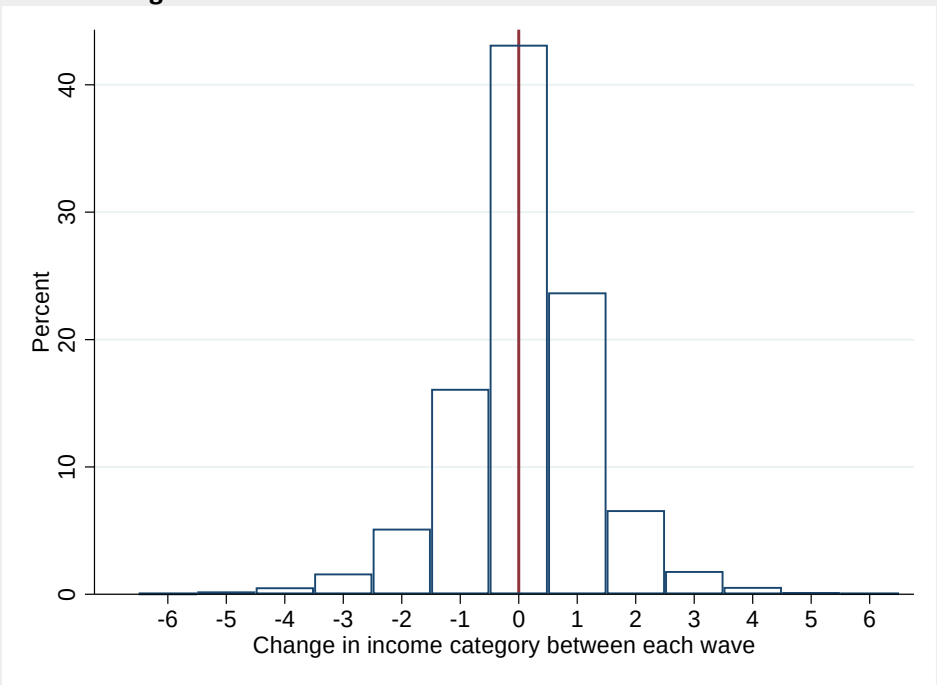
Figure 8 - Equivalised household income by wave



Source: Growing Up in New Zealand, DCW0, DCW1, DCW2, DCW4, DCW5, DCW8

Figure 9 charts each mother's household income group transition between waves. It shows that mothers remain in the same group between waves nearly half the time. The rest of the transitions are more likely to be an increase in income groups between the waves than a decrease.

Figure 9 - Household income transitions between waves



Source: Growing Up in New Zealand, DCW0, DCW1, DCW2, DCW4, DCW5, DCW8

How children's behaviour scores vary by income group (2 – 8 years of age)

At each age group, mean child difficulties scores consistently decrease with higher household income (Figures 10-12 and Table 8).[18] A similar relationship is apparent across each of the waves.

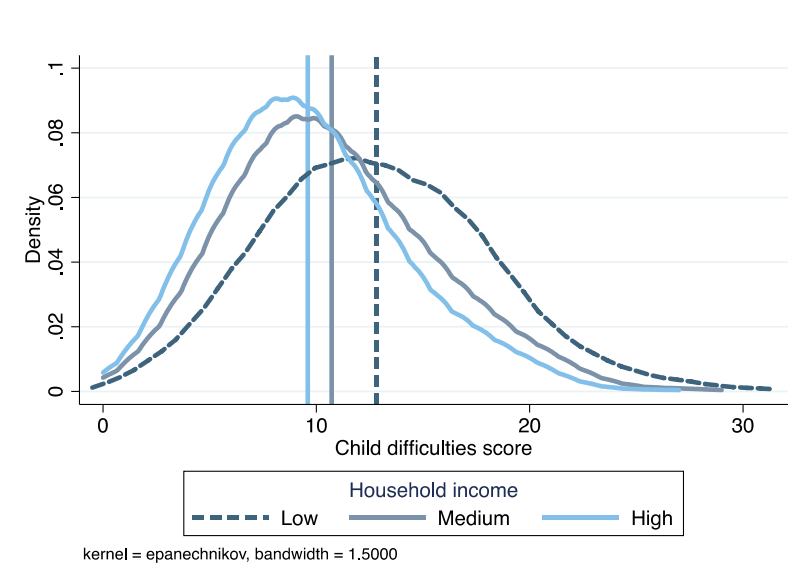
One-way ANOVA testing shows a significant difference in difficulties scores by income group across each wave at the 1% level. These results show that child difficulties scores have a clear income gradient.

Table 8 - Child difficulties scores by household income group

	2 years			4.5 years			8 years		
	Mean	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**
<20k	13.98	5.56	103	11.24	5.60	37	10.86	6.24	136
20k-30k	13.47	5.46	200	10.87	5.56	124	8.56	5.72	117
30k-50k	12.42	4.92	633	10.98	4.93	455	8.66	5.25	335
50k-70k	11.11	4.70	721	9.76	4.73	612	8.18	5.20	438
70k-100k	10.41	4.64	898	8.60	4.41	937	7.68	5.01	705
100k-150k	9.87	4.39	903	8.03	4.18	1,093	6.95	4.78	935
150k +	9.24	4.19	669	7.40	4.28	905	6.10	5.05	1,165
Overall	10.76	4.81	4,127	8.71	4.74	4,163	7.31	5.12	3,831
ANOVA Prob > F	P<0.001			P<0.001			P<0.001		

Source: Growing Up in New Zealand, DCW2, DCW5, DCW8

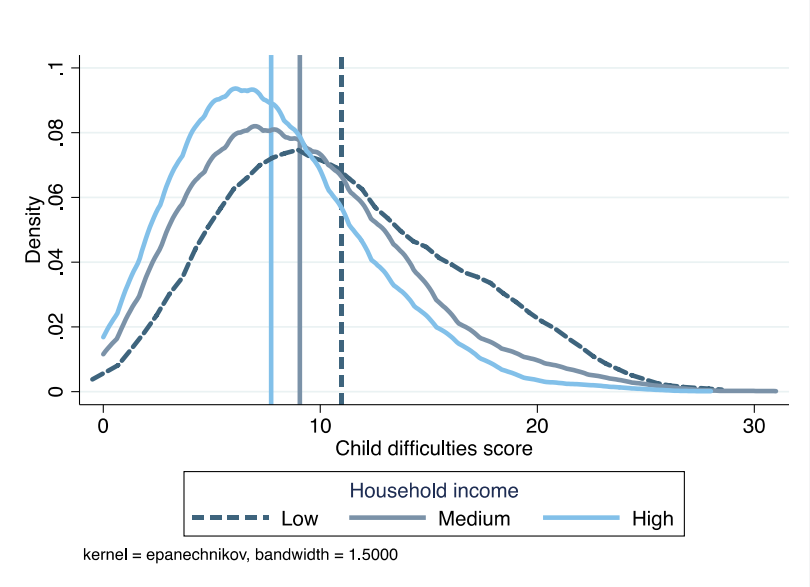
Figure 10 - Distribution of difficulties scores by household income group – 2 years



Source: Growing Up in New Zealand, DCW2

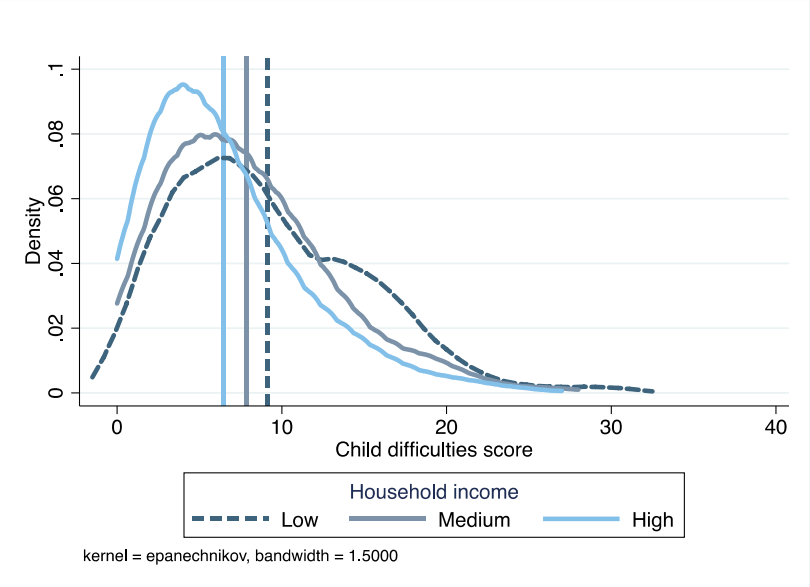
[18] In figures 10-12 low income is classified as less than $50,000, medium income is classified as $50,001-$100,000 and high income is $100,001+.

Figure 11 - Distribution of difficulties scores by household income group – 4.5 years



Source: Growing Up in New Zealand, DCW5

Figure 12 - Distribution of difficulties scores by household income group – 8 years



Source: Growing Up in New Zealand, DCW8

Generally, there are far fewer differences in child strengths scores across household income groups. The exception is for the lowest income group, where strengths scores at the 8-year wave are about half a point lower than for the other income groups (Table 9). One-way ANOVA testing shows no significant difference in mean strengths scores by income group across each wave at the 10% level for the 2-year and 4.5-year waves. However, there is a significant difference at eight years, driven mainly by the <20k income group's lower mean strengths scores.

Table 9 - Child strengths score by household income group

	2 years			4.5 years			8 years		
	Mean	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**
<20k	6.86	1.78	111	7.68	1.79	37	7.40	1.92	137
20k-30k	7.03	1.82	215	7.59	1.78	128	8.07	2.04	117
30k-50k	7.09	1.74	659	7.75	1.79	462	8.03	1.76	335
50k-70k	7.23	1.81	755	7.74	1.81	625	8.29	1.82	438
70k-100k	7.14	1.86	921	7.84	1.75	949	8.07	1.79	706
100k-150k	7.17	1.80	930	7.81	1.74	1,103	8.31	1.72	935
150k +	7.17	1.85	702	7.70	1.85	914	8.26	1.86	1,166
Overall	**7.15**	1.82	4,293	**7.76**	1.78	4,218	**8.19**	1.78	3,834
ANOVA Prob > F	P=0.408			P<0.150			P<0.001		

Source: Growing Up in New Zealand, DCW2, DCW4, DCW5

3.2 The role of maternal stress in the first 1,000 days

This section examines the role of maternal stress in the relationship between household income and children's behaviour in the child's first 1,000 days (pregnancy to 2 years of age). Maternal stress measures how worried a mother is across six domains including finance, housing, work/life balance, ill/disabled family members, family conflict and other children's behaviour.[19] This section comprises two main subsections. The first examines the direct association between household income and maternal stress using descriptive statistics and a multivariate ordinary least squares (OLS) regression. Note also that income groups have not been adjusted for inflation in this section, so inflation artificially increases the proportion of households in higher income groups over time.[20] A fixed effects regression is then used to examine how changes in income affects a mother's levels of stress. The second subsection then examines how mothers' stress is associated with children's behaviour problems at two years of age (the only wave at which age income, stress and behaviour are measured concurrently) using multivariate OLS regression.

Income and maternal stress in the first 1,000 days

This subsection assesses the relationship between household income and maternal stress during children's first 1,000 days.

Distribution of stress scores over each wave and by household income group

Mean stress scores for mothers are highest during pregnancy and when mothers have a 2-year-old and are lowest when the study child is nine months of age (Table 10).

Table 10 - Mean stress scores by wave

	Mean	SD	Min	Max
Pregnancy	5.43	3.69	0	18
9 months	4.40	3.21	0	18
2 years	5.36	3.52	0	18

Source: Growing Up in New Zealand, DCW0, DCW1, DCW2

Table 11 shows the distribution of mean stress scores by household income group over each wave. Mothers with higher household incomes have, on average, lower stress scores. The differences by income group are slightly less during the 9-month wave, where stress scores are lower across the board. There is a significant difference in the mean stress levels between each income group for all three waves at the 1% level when tested with one-way ANOVA testing.

[19] The full questions used to develop the stress measure are included in Appendix 2.

[20] In this section (and in the following sections which use cross-sectional OLS regression), household income is not inflation adjusted, meaning that income groups are not directly comparable between waves.

Table 11 - Mean stress scores by household income group across waves

	Pregnancy		9 months (%)		2 years (%)	
Income group	N	Stress (mean)	N	Stress (mean)	N	Stress (mean)
<20k	171	7.11	235	5.30	189	6.03
20k-30k	234	6.43	310	4.77	342	5.66
30k-50k	612	5.87	920	4.75	990	5.87
50k-70k	753	5.82	1,123	4.72	976	5.67
70k-100k	1,094	5.64	1,196	4.43	1,124	5.55
100k-150k	1,074	4.96	876	4.06	1,079	4.90
150k +	708	4.25	517	3.55	807	4.18
Total	**4,646**	**5.44**	**5,177**	**4.40**	**5,982**	**5.36**
ANOVA Prob > F		<0.001		<0.001		<0.001

Source: Growing Up in New Zealand, DCW0, DCW1, DCW2

OLS regression results

While mothers living in high-income households have consistently lower stress scores than mothers in low-income households, there could be many reasons for this finding (e.g. the stress of living in rental accommodation versus owning one's own home). The following section controls for other factors which may influence these results. Multivariate ordinary least square (OLS) regression analysis is used to estimate results. Note that these results do not explain any causal relationships but merely show associations between variables, controlling for the other variables in the regression equation.

Table 12 presents the results of six OLS regressions in which the relationship between household income and stress is examined at the pregnancy, nine-month and two-year waves (i.e. for each wave for which the stress measure is available). At each wave, the direct relationship between income and stress is examined (Equation (1)), and then the relationship between income and stress is examined while controlling for other variables (Equation (2)). The control variables are listed below Table 12 and Appendix 4 presents the full results for the control variables (with standard errors) for all variables including the control variables.

Restricted model: Maternal stress = f(household income) (1)

Full model: Maternal stress = f(household income, control variables) (2)

Table 12 shows that lower household income is associated with higher maternal stress across all three waves, although the relationship is slightly less pronounced at nine months of age. The relationship is statistically significant both with and without the inclusion of control variables, although the addition of the control variables reduces the effect size and level of statistical significance. When the control variables are excluded, those in the lowest income group have a 0.5 SD higher stress scores at 9 months compared to the highest income groups and approximately 0.75 SD higher stress scores during the pregnancy and 2-year waves. When control variables are included these estimates drop to 0.3 SD higher scores at 9 months and 0.4 SD higher scores during the pregnancy and 2 year waves.

What other factors influence the relationship between household income and stress?

The findings in the previous section have provided evidence of the association between household income and stress, net of observable factors that may be correlated with both income and stress. However, these factors may also be—in part—an explanation for *why* income affects stress levels. In turn, understanding these underlying mechanisms is important for informing policy that aims to alleviate parental stress in ways beyond income.

Table 12 - OLS results for equations (1) & (2) at pregnancy, 9-month and 2-year waves

MATERNAL STRESS	(1) Pregnancy restricted	(2) Pregnancy full	(3) 9 months restricted	(4) 9 months full	(5) 2 years restricted	(6) 2 years full
Key variables						
Household income						
<20k	2.787***	1.489***	1.646***	0.910***	2.681***	1.552***
	(0.342)	(0.369)	(0.265)	(0.275)	(0.340)	(0.331)
20k-30k	2.137***	0.784**	2.120***	1.302***	2.345***	1.312***
	(0.287)	(0.323)	(0.235)	(0.242)	(0.236)	(0.249)
30k-50k	1.572***	0.402*	1.360***	0.814***	1.779***	1.041***
	(0.195)	(0.233)	(0.165)	(0.177)	(0.157)	(0.174)
50k-70k	1.549***	0.656***	1.200***	0.756***	1.471***	0.947***
	(0.178)	(0.198)	(0.159)	(0.163)	(0.153)	(0.156)
70k-100k	1.355***	0.689***	1.019***	0.697***	1.153***	0.682***
	(0.165)	(0.174)	(0.155)	(0.150)	(0.142)	(0.138)
100k-150k	0.707***	0.421***	0.465***	0.300**	0.778***	0.485***
	(0.163)	(0.161)	(0.167)	(0.157)	(0.769)	(0.135)
150k+	(base)	(base)	(base)	(base)	(base)	(base)
Constant	4.285***	-0.187	3.348**	0.154	4.126***	0.428
	(0.121)	(0.761)	(0.126)	(0.648)	(0.103)	(0.705)
Observations	**5,994**	**5,994**	**5,994**	**5,994**	**5,994**	**5,994**
R-squared	0.034	0.137	0.027	0.168	0.039	0.205

Note: Control variables and potential mediators include whether a mother's baby is her first or a subsequent child, a mother's personality, ethnicity, education, general health, age, employment status, household structure, the NZ Deprivation index score for her neighbourhood, the number of recent house moves, and her household's housing tenure status.

*** p<0.01, ** p<0.05, * p<0.1

Source: Growing Up in New Zealand, DCW0, DCW1, DCW2

To provide some insight into these potential mediating pathways, we conduct a series of Gelbach decompositions to examine the effect that adding each of the control variables to Equation (1) has on estimates for the effect of household income. While these are not formal mediational path analyses, the findings provide suggestive evidence of the ways in which having less income can contribute to higher rates of stress.

Firstly, a restricted model is specified.

Restricted model:

Maternal stress = f(household income, covariates) (3)

Where the likely covariates are a mother's: self-prioritised ethnicity, Big 5 personality variables, age and employment. Then a full model is specified with the addition of the other control variables which are considered likely to mediate the relationship between income and stress.

Full model:

Maternal stress = f(household income, covariates, mediators) (4)

Appendix 5 provides the detailed results of the Gelbach decompositions.

The results from the Gelbach decompositions, presented visually in Figures 13-15, show that a mother's general health is the variable that is the most important potential mediator between household income and stress across the three waves (i.e., the inclusion of mother's health in the models changed the coefficients for income the most). Mothers living in lower-income households have poorer health (potentially due to factors such as inconsistent access to healthcare and quality food), and poorer health is associated with higher levels of stress. (Reverse causality could also be present, i.e., stress itself may lead to worse health and worse health could in turn lead to a lower income through less work undertaken.)

The inclusion of housing tenure decreases the effect size for income significantly. This result likely occurs as living in rental accommodation is both associated with having a lower income and is more stressful. A lower income may also necessitate living in arrangements such as sharing with other family members, or with other adults which is stressful.

The number of times a family moves house is directly associated with stress during pregnancy and 2 years, however there is evidence that it mediates the relationship between household income and stress during the 9-month wave. This evidence suggests that mothers who move with a new baby may be more likely to be doing so due to financial constraints.

Of the other variables included, neither a mother's age, level of education, or neighbourhood deprivation had any significant association with stress (aside from a very small mediating effect for the NZ deprivation score during pregnancy).

Figure 13 - Pathways relating household income and stress – pregnancy

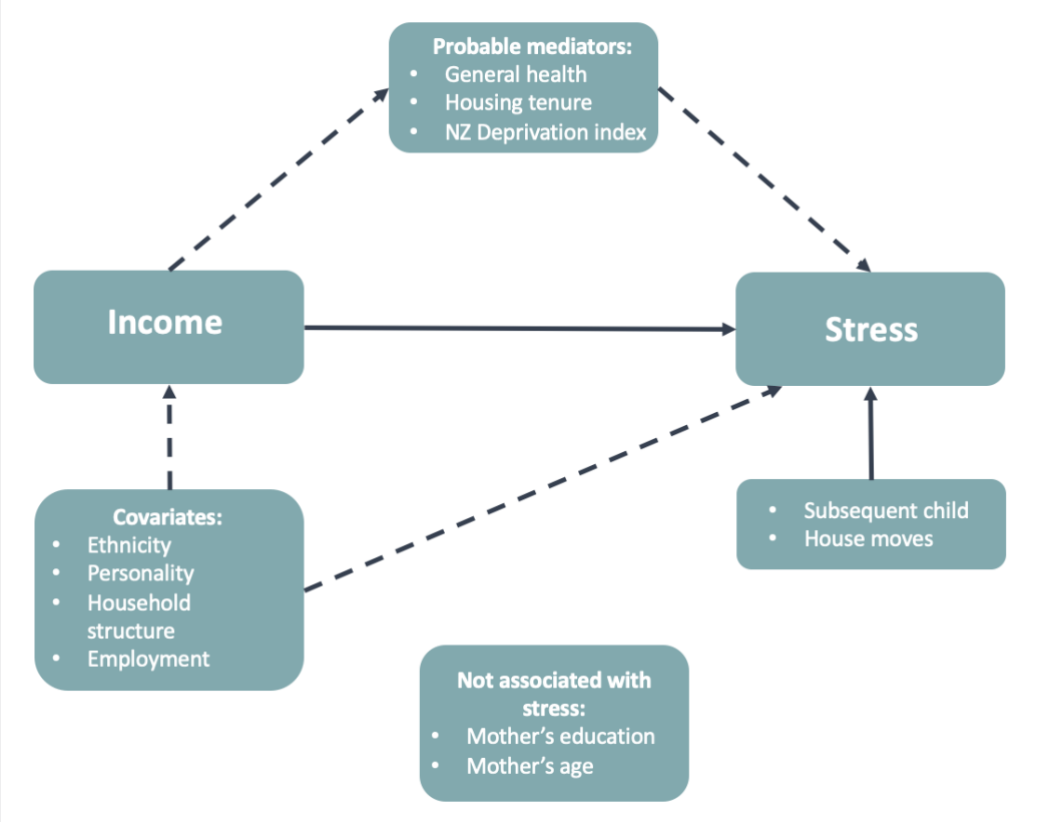


Figure 14 - Pathways relating household income and stress – 9 months

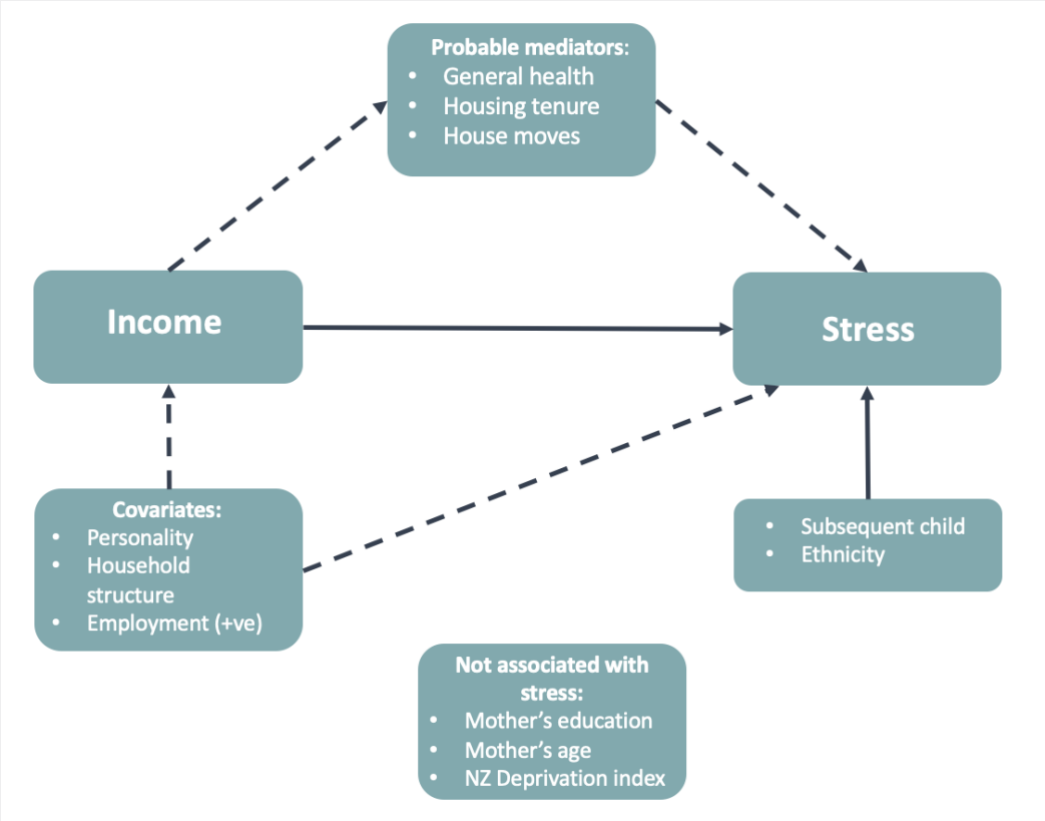
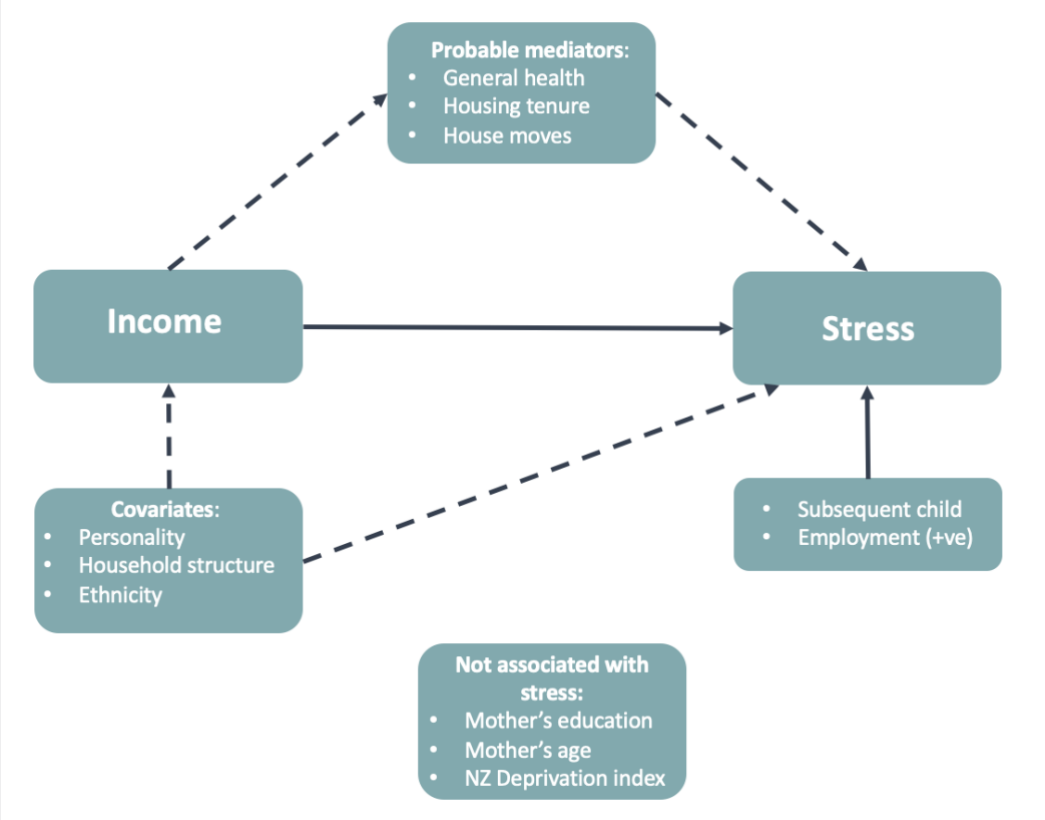


Figure 15 - Pathways relating household income and stress – 2 years



Maternal stress fixed effects results

The previous results using OLS regression measured associations between the variables of interest, while controlling for other variables in the model. However, a substantial limitation to this approach is that many unobserved factors (such as the influence of a mother's upbringing on her stress and her parenting practices) are likely to affect both the independent and dependent variables – this is known as omitted variable bias. The GUiNZ study measures the same participants over time and this means we can leverage the longitudinal nature of the data to control for unobservable or unmeasured factors that do not change over time (such as a mother's upbringing).

Fixed effects models allow for the examination of the association between equivalised income and stress at one time point for an individual compared to the association between income and stress at another time for that same individual, taking advantage of the variation in income and stress within an individual. This allows us to examine how an individual's change in equivalised income over time affects their level of stress. A limitation of fixed effects models is that only variables that are measured at each time point—and which are time-varying—can be included in the model. Full details on model selection are provided in Section 2.2.

The household income measure for the fixed effects model has been adjusted for inflation and is equivalised to account for family size before being log transformed. Standardised variables are indicated with a (Z) suffix. The first two fixed effects equations estimated are expressed in equations (5) and (6) below.

Restricted model: $y_{it} = \alpha_1 \ln (eq.income)_{it} + \lambda_i + \lambda_t + \varepsilon_{it}$ (5)

Full model: $y_{it} = \alpha_1 \ln (eq.income)_{it} + \alpha_2 X_{it} + \lambda_i + \lambda_t + \varepsilon_{it}$ (6)

Where X is a vector of covariates which include a mother's employment status, NZ Deprivation Index score, partner status, housing tenure status, and maternal general health and λ_i and λ_t refer to vectors of individual and time fixed effects, respectively.[21] A third equation is also estimated which supplements (6) with the interaction between equivalised income and child age.

The income gradient for stress remains apparent when the data are examined longitudinally with the fixed effects model – an increase in *ln(eq. income)* is associated with a decrease in stress, significant at the 5% level (Table 13). Figure 16 presents these results visually using a margins plot to show the average predicted probability of a mother's stress score given her equivalised income.

The effect size is, however, modest. Looking at column (3), a one standard deviation increase in equivalised income during pregnancy (e.g. from $40,000 to $83,500 for a single mother of two) is associated with a decrease in stress of approximately 0.10 of a standard deviation (or a 0.34-point decrease in the stress score). A smaller effect (approximately 0.07 of a standard deviation) is observed for the impact of equivalised income when the child is two years' old, while the effect of income on mother's stress when the child is 9 months old is approximately 0.04 of a standard deviation. However, it is likely that these results underreport effect sizes as the use of broad income groups in the GUiNZ data means that incomes are not accurately measured so leading to attenuation bias in the estimate.

A shift to employment was significantly associated with a 0.06 SD higher stress scores for mothers. In addition, a one SD increase in a mother's general health score was associated with a 0.07 SD decrease in stress scores. New Zealand Deprivation Index score, partner status, housing tenure and residential mobility were not significantly associated with stress.

[21] The equation description is in line with the standard presentation in the economics literature, other disciplines may use different (but equivalent) terminology.

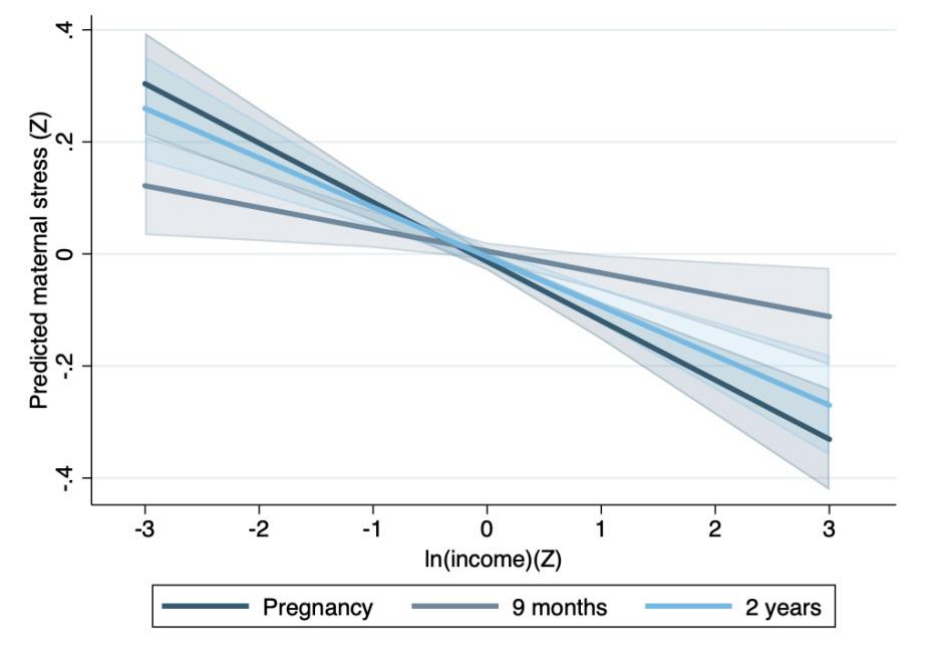
Table 13 – Fixed effects results estimating equations (5) and (6)

MATERNAL STRESS (Z)	(1)	(2)	(3)
	Restricted	Full	Full + wave x income interaction
Eq. income (Z)	-0.067***	-0.069***	-0.039**
	(0.014)	(0.015)	(0.016)
Wave			
Pregnancy	-0.006	-0.015	-0.019
	(0.014)	(0.015)	(0.015)
9 months	(base)	(base)	(base)
2 years	0.0006	-0.009	-0.013
	(0.008)	(0.014)	(0.013)
Eq. income*wave			
Pregnancy			-0.056***
			(0.017)
9 months			(base)
2 years			-0.034***
			(0.015)
Employed			
No		(base)	(base)
Yes		0.051***	0.062***
		(0.020)	(0.020)
NZDep			
(1-2)		(base)	(base)
(3-4)		-0.068*	-0.071*
		(0.040)	(0.040)
(5-6)		-0.029	-0.030
		(0.040)	(0.040)
(7-8)		0.015	0.011
		(0.041)	(0.041)
(9-10)		-0.042	-0.044
		(0.045)	(0.045)
Partner status			
No		(base)	(base)
Yes		-0.004	-0.009
		(0.046)	(0.046)
Homeownership			
Owns		(base)	(base)
Private rent		0.049	0.050
		(0.032)	(0.032)
Public rent		-0.055	-0.057
		(0.081)	(0.081)
Other		0.012	0.005
		(0.231)	(0.231)
Maternal general health (Z)		-0.074***	-0.071***
		(0.012)	(0.012)
Residential mobility (Z)		0.003	0.005
		(0.008)	(0.008)
Constant	-0.002	-0.007	-0.003
	(0.008)	(0.054)	(0.055)
No. observations	19,605	19,458	19,458
No. groups	6,853	6,853	6,853
R^2 within[22]	0.004	0.009	0.011

*** p<0.01, ** p<0.05, * p<0.1

[22] The within R^2 is not equivalent to the adjusted R^2, this measure is typically lower.

Figure 16 – Fixed effects estimates for the relationship between equivalised income and maternal stress by wave (Equation (6))



Source: Growing Up in New Zealand, DCW0, DCW1, DCW2

Mothers' stress and children's behaviour at two years of age

This subsection explores the association between mothers' stress and children's behaviour at two years of age (the only wave where stress and children's behaviour are measured concurrently). Table 14 and Figure 17 show the distribution of child difficulties scores at two years by their mothers' stress score.[23] It shows that mothers who report higher stress levels have children with higher difficulties scores on average. There is a significant difference in the mean levels of child difficulties between each stress group at the 1% level when tested with one-way ANOVA. It should be noted that it is likely that the relationship between maternal stress and child behaviour runs both directions.

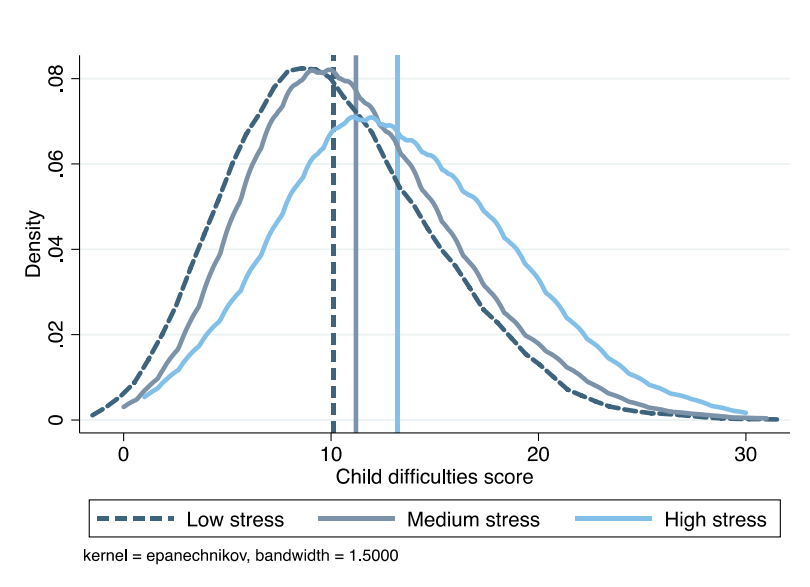
Table 14 – Mean child difficulties score by mother's stress at 2 years

	Mean	SD	N
Low stress	10.13	4.71	2,035
Medium stress	11.19	4.85	1,985
High stress	13.25	5.44	1,627
Overall	11.40	5.14	5,647
ANOVA Prob > F	P<0.001		

Source: Growing Up in New Zealand, DCW2

[23] The stress scores were categorised into three groups by splitting the scores approximately into thirds (low = 0-4) , medium= 5-8 and high = 9-24).

Figure 17 – Distribution of child difficulties by mother's stress – 2 years



Source: Growing Up in New Zealand, DCW2

Stress and children's behaviour at two years – OLS regression results

Table 15 presents the results of two OLS regressions where the relationship between stress and child difficulties scores is examined at the two-year wave. First, the direct relationship between stress and child difficulties is examined (Equation (7)), and then the relationship is examined while controlling for other variables including household income (Equation (8)). The control variables and potential mediators are described below Table 15. Full results for equation (6) are included in Appendix 6.

When using OLS regression, maternal stress is significantly, positively associated with children's behaviour problems at two years of age (Table 15 and Figure 18). When the control variables are excluded, mothers with the highest stress have children with 1.2 SD higher difficulties scores than children of mothers with the lowest stress. When the control variables are included in Equation (8) the results are still statistically significant at the 1% level, however the difference between the highest and lowest stress mothers drops to a 0.4 SD difference.

Restricted model: Child difficulties = f(maternal stress) (7)

Full model: Child difficulties = f(maternal stress, household income, control variables) (8)

Table 15 – OLS results for equations (7) and (8)

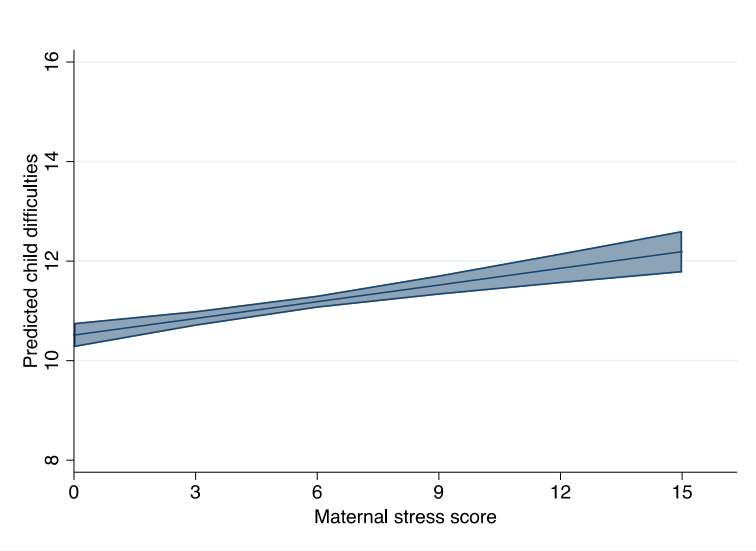
CHILD DIFFICULTIES	(7)	(8)
Maternal stress (2 years)	0.324***	0.107***
	(0.019)	(0.018)
Other controls	NO	YES
Constant	9.212***	21.683***
	(0.118)	(1.224)
Observations	6,145	6,145
R-squared	0.055	0.371

Note: The control variables and potential mediators include household income, a child's sex, mother's ethnicity, education and age, alongside a child's health, screen use and times waking at night, the number of recent house moves, housing tenure status, a mother's personality, NZ Deprivation index score, employment status, partner status, postnatal depression, self-efficacy, personal support, and general health.

*** p<0.01, ** p<0.05, * p<0.1

Source: Growing Up in New Zealand, DCW2, DCW4, DCW5

Figure 18 – Child difficulties by maternal stress (equation (8))



Source: Growing Up in New Zealand, DCW2

3.3 Household income and children's behaviour from 2 - 8 years

This section examines the relationship between household income and children's behaviour from two to eight years with an additional focus on understanding the role children's screen use plays in determining behaviour. It is split into three subsections.

The first subsection examines the relationship between household income and child behaviour problems; multivariate ordinary least squares (OLS) regression is used to understand the association between income and child difficulties scores at each wave individually. Then fixed effects models are used to examine the relationship between income changes and changes in child behaviour problems over time, with child difficulties scores and the internalising and externalising subscales examined. Finally, a Gelbach decomposition explores variables that may mediate the cross-sectional income and child difficulties relationship.

The second subsection looks at the relationship between household income and children's strengths scores using OLS before the final subsection addresses the role of children's screen use in the relationship between income and behaviour.

Household income and child difficulties (2-8 years)

Ordinary Least Squares (OLS) results

Table 16 presents the results of six OLS regressions where the relationship between household income and child difficulties is examined at the 2-year, 4.5-year and 8-year waves.[24] Each wave is examined separately to capture the developmental differences that occur between each age group. At each wave, the direct relationship between income and child difficulties is examined (Equation (9)). Then the relationship between income is examined while controlling for other variables (Equation (10)).

The control variables are the same as those described in Table 15. Results are presented for the control variables of stress, a child's sex, and screen use. Full results are in Appendix 7. There were no significant interactive effects with gender.

Restricted model: Child difficulties = f(household income) (9)

Full model: Child difficulties = f(household income, control variables) (10)

[24] Results are presented using multiple imputation to account for missing data due to item non-response.

Table 16 shows that household income is directly associated with child behaviour problems across all three waves at the 1% level. Children in the lowest income group have 4 to 5-point higher estimated difficulties scores than those in the highest income group (approximately 1 SD higher). However, once the control variables are included, this association is no longer statistically significant for the two- and four-and-a-half-year waves (aside from the <20k group having a one-point higher score than the 150k+ group at two years) and is significant only at the eight-year wave.

Once control variables are included in the eight-year wave, the middle five income groups have scores significantly greater than zero, but not significantly different from each other. However, the highest income group has a slightly lower score, and the <20k income group has a score approximately three points (0.6 SD) higher than the 150k+ income group.

Maternal stress (measured at the two-year wave) remains significantly associated with child difficulties across the waves, however its effect size decreases as the child grows older (although this may be due to measurement differences as stress is likely to change over time).

Screen use is discussed at the end of this section.

Table 16 – OLS results for equations (9) and (10) at 2 years, 4.5 years and 8 years

DIFFICULTIES	2 years		4.5 years		8 years	
	(1)	(2)	(3)	(4)	(5)	(6)
Household income						
<20k	5.081***	1.142**	4.170***	0.344	5.068***	2.918***
	(0.547)	(0.507)	(0.917)	(0.802)	(0.497)	(0.517)
20k-30k	4.480***	0.568	3.758***	0.141	2.829***	0.784
	(0.409)	(0.390)	(0.493)	(0.485)	(0.532)	(0.533)
30k-50k	3.398***	0.471*	3.832***	0.680**	2.768***	0.668**
	(0.252)	(0.258)	(0.271)	(0.277)	(0.318)	(0.338)
50k-70k	2.127***	0.172	2.518***	0.106	2.219***	0.900***
	(0.238)	(0.227)	(0.248)	(0.240)	(0.282)	(0.293)
70k-100k	1.289***	-0.127	1.281***	0.051	1.668***	0.625***
	(0.226)	(0.209)	(0.202)	(0.192)	(0.241)	(0.240)
100k-150k	0.719***	-0.022	0.650***	-0.061	0.874***	0.418**
	0.719***	-0.022	0.650***	-0.061	0.874***	0.418**
150k+	(base)	(base)	(base)	(base)	(base)	(base)
Maternal stress (2 years)		0.098***		0.077***		0.057**
		(0.021)		(0.021)		(0.023)
Child sex						
Boy		(base)		(base)		(base)
Girl		-0.318***		-0.605***		-1.295***
		(0.120)		(0.120)		(0.138)
Screen use						
No screens		(base)		(base)		0.650
						(0.550)
0.1-1 hours		-0.064		0.605		(base)
		(0.159)		(0.404)		
1.1-2 hours		-0.026		0.675		0.409*
		(0.190)		(0.404)		(0.248)
2.1-3 hours		0.658**		1.190***		0.186
		(0.394)		(0.424)		(0.265)
3.1-4 hours		0.349		1.041**		0.571*
		(0.394)		(0.495)		(0.313)
4.1 hours +		1.733***		1.878***		0.842***
		(0.410)		(0.494)		(0.258)
Other controls	NO	YES	NO	YES	NO	YES
Constant	9.191***	21.683***	7.471***	20.468***	6.185***	22.651***
	(0.165)	(1.395)	(0.136)	(1.379)	(0.138)	(1.578)
Observations	4,691	4,691	4,691	4,691	4,691	4,691
R-squared	0.080	0.347	0.072	0.290	0.056	0.237

*** p<0.01, ** p<0.05, * p<0.1

Source: Growing Up in New Zealand, DCW2, DCW4, DCW5

What other factors influence the relationship between household income and child difficulties?

The findings in this section so far provide evidence of the association between household income and child difficulties. However, there are likely to be factors which explain, at least in part, *why* income affects children's behaviour. Consequently, understanding these underlying mechanisms is important for informing policy that aims to address child behaviour in ways beyond just income.

To provide some insight into these potential mediating pathways, we conduct a series of Gelbach decompositions to examine the effect that adding each of the control variables to Equation (9) has on estimates for household income. While these are not formal mediational path analyses, the findings provide suggestive evidence of the ways in which having less income can contribute to child behaviour problems.
As before, a restricted model is specified.

Restricted model:

Child difficulties = f(household income, covariates) (11)

where the covariates are a mother's self-prioritised ethnicity, Big 5 personality variables, age and employment. A full model is then specified with the addition of other control variables which are considered likely to mediate the relationship.

Full model:

Child difficulties = f(household income, covariates, mediators) (12)

Figures 19-21 show the relationships between the variables at each wave (listed in order of importance). Appendix 8 provides the detailed results of the Gelbach decompositions.

At two years and 4.5 years the pathways between income and behaviour are very similar. The inclusion of parenting variables (hostile parenting, reading frequency, screen use, positive parenting, protective parenting) in the restricted equation substantially decreases the effect size of income on difficulties (Appendix 8). This finding suggests that parents in lower-income groups may be parenting differently than those in higher income groups, which may be affecting children's behaviour problems during the preschool years. Mothers' stress levels are the second most important potential mediating factor explaining the association between income and child difficulties. Finally, child health also plays a role, suggesting that the health issues associated with poverty are occurring alongside behaviour problems.

At eight years of age, parenting variables were less important and a child's general health becomes the most crucial potential mediating factor, with how frequently a child has moved houses the second most important and the frequency a child wakes in the night the third. Screen use also plays an important role, reflecting the fact that children in low-income families tend to watch screens for longer.

Including as control variables the number of recent house moves, housing tenure status, NZ Deprivation Index, partner status, postnatal depression, personal support (from partners, family, friends and support services), and a mother's general health had no significant bearing on difficulties estimates across any of the waves. Overall, several variables mediate the relationship between household income and child behaviour in each wave, with the mediating variables differing

between the preschool years and eight years. This finding suggests that several complex factors through childhood intersect with income to determine children's behaviour.

Figure 19 – Pathways relating household income and difficulties – 2 years

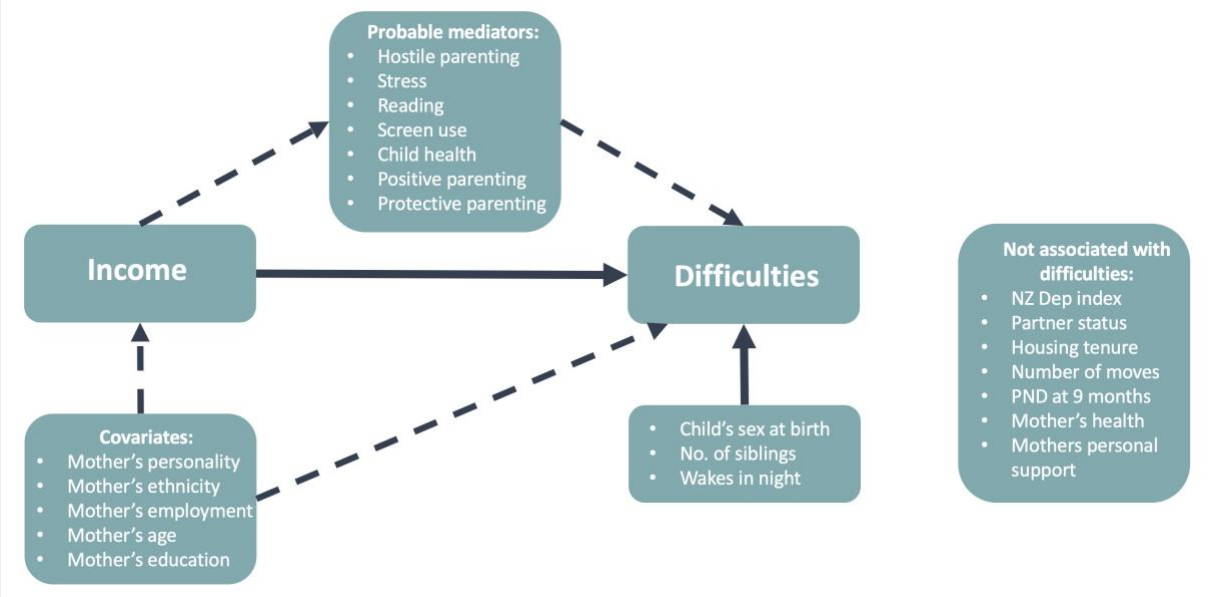


Figure 20 – Pathways relating household income and difficulties – 4.5 years

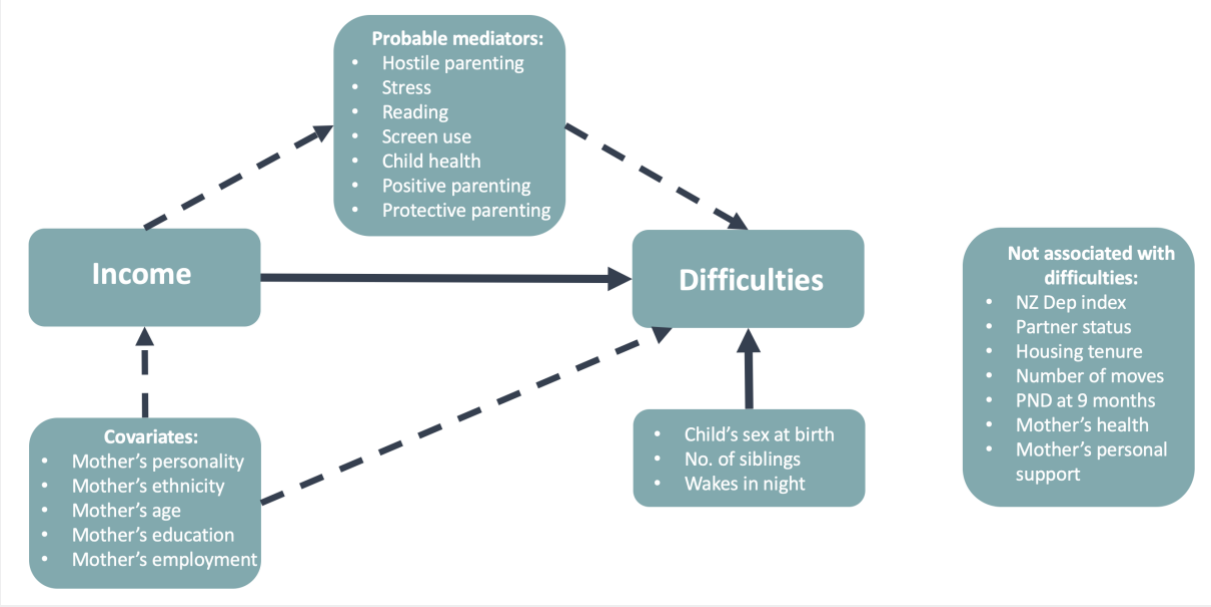
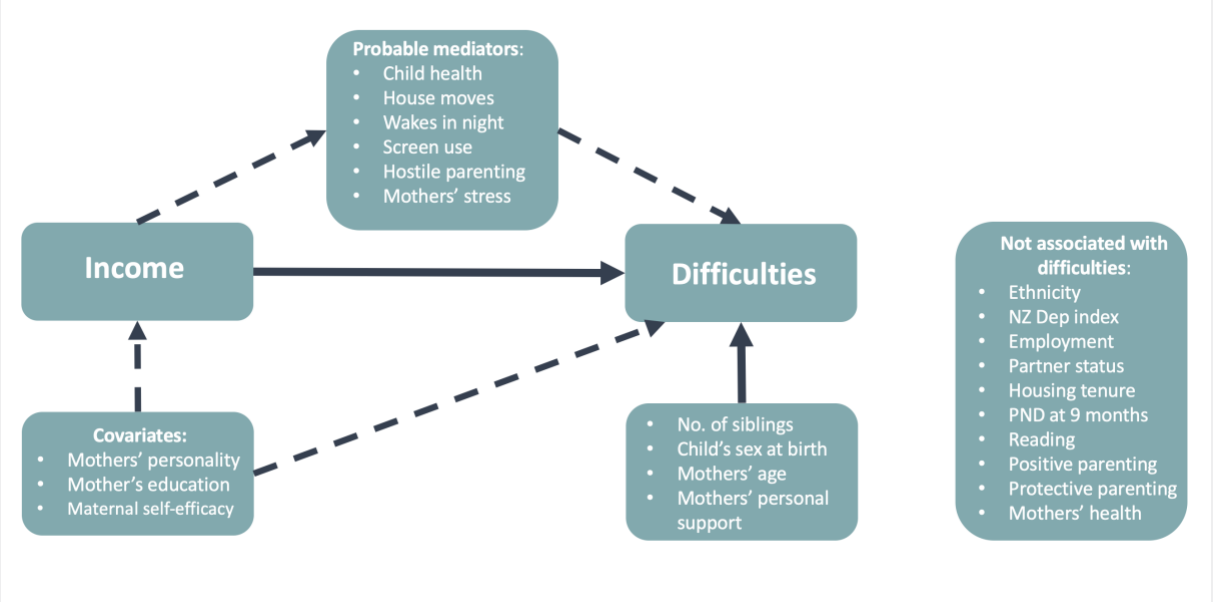


Figure 21 – Pathways relating household income and difficulties – 8 years



Child difficulties fixed effects results

The previous results using OLS regression measured the association between household income and child behaviour, while controlling for other variables in the model. However, unobserved factors (such as the child's genes) are still likely to contribute to the differences found between the income groups.

A fixed effects model measures how a household's change in equivalised income over time affects a child's behaviour, so we are measuring differences within an individual child, rather than differences between individuals as when using OLS. Full details on model selection are provided in Section 2.

As in the prior fixed effects models, the income measure for the fixed effects model has been adjusted for inflation and is equivalised to account for family size before being log transformed. All continuous variables are standardised (with suffix Z) to ensure comparability over time. First, the direct relationship between equivalised income and child difficulties is examined (Equation (13)), and then control variables are introduced into the model (Equation (14)) before the potential mediating variables are included (Equation (15)). Where X is a vector of control variables which include a mother's employment status and partner status, and M is a vector of potential mediating variables detailed below Table 17. Three wave interaction terms for equivalised income, screen use and the child's sex are then included in the full model one at a time (for ease of interpretation) to understand the differences in each variable's relationship with difficulties over the different waves. Full results are presented in Appendix 9.

Restricted model: $$difficulties_{it} = \alpha_1 \ln(eq.income_{it}) + \lambda_i + \lambda_t + \varepsilon_{it} \quad (13)$$

Restricted + controls: $$difficulties_{it} = \alpha_1 \ln(eq.income_{it}) + \alpha_2 X_{it} + \lambda_i + \lambda_t + \varepsilon_{it} \quad (14)$$

Full model: $$difficulties_{it} = \alpha_1 \ln(eq.income_{it}) + \alpha_2 X_{it} + \alpha_3 M_{it} + \lambda_i + \lambda_t + \varepsilon_{it} \quad (15)$$

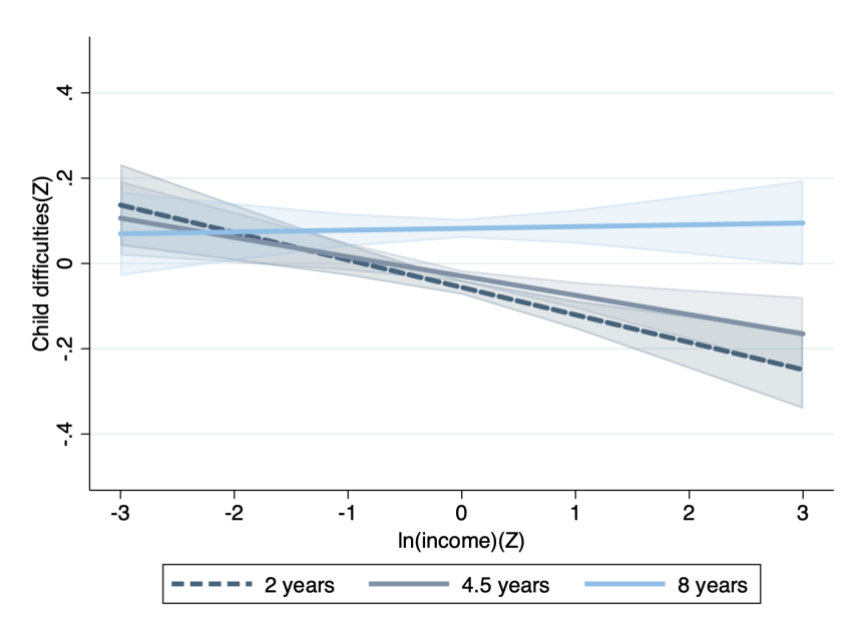
The coefficient of *ln(eq. income)* is not generally significantly different from zero, but is also mostly negative in sign, suggesting a negative relationship between income and difficulties scores between 2 and 8 years of age (Table 17). However, once the wave and income interaction variables are included, the relationship is significant during the preschool years at the 1% level but is not significant at 8 years (see column (4)) suggesting that the coefficients for income in columns (1) – (3) are likely to be insignificant as they do not take these differences by age into account.

Figure 22 presents the results from column (4) visually to show the average predicted probability of a child's difficulties score given their family's equivalised income The addition of both control variables and potential mediators to the restricted model does not materially change the effect size for equivalised income suggesting the effect of income on child behaviour is likely to be fairly direct.

The effect size is modest. When looking at column (4) in Table 17, a 1 standard deviation increase in equivalised income at 2 years is associated with a 0.06 standard deviation decrease in difficulties scores (or for a single mother with two children an increase of approximately $40,000 to $80,000 is associated with a 0.27-point decrease in difficulties scores, on a 40-point scale). Again, it is likely these results are underreporting effect sizes due to attenuation bias caused by measurement inaccuracies for income.

The inclusion of interaction terms between the wave and a child's sex allows us to understand different patterns of difficulties scores across the waves between boys and girls.[25] These results show that boys have bigger differences between the waves than do girls.

Figure 22 – Fixed effects results from column (4), child difficulties by equivalised income



[25] The interaction terms were included separately for ease of interpretation.

Table 17 – Fixed effects results for equations (13)-(15) estimating child difficulties

DIFFICULTIES (Z)	(1)	(2)	(3)	(4)	(5)	(6)
	Restricted	Restricted + controls	Full (includes mediators)	Full with income* wave interaction	Full with screens*wave interaction	Full with sex*wave interaction
Eq. income (Z)	-0.023	-0.026*	-0.021	0.021	-0.022	-0.021
	(0.014)	(0.014)	(0.015)	(0.019)	(0.015)	(0.015)
Wave						
2-year	-0.110***	-0.127***	-0.146***	-0.143***	-0.143***	
	(0.017)	(0.018)	(0.019)	(0.019)	(0.019)	
4.5-year	-0.098***	-0.108***	-0.113***	-0.112***	-0.113***	
	(0.014)	(0.015)	(0.016)	(0.016)	(0.016)	
8-year	(base)	(base)	(base)	(base)	(base)	
Eq. income*wave						
2-year				-0.076***		
				(0.019)		
4.5-year				-0.054***		
				(0.017)		
8-year				(base)		
Total screens (Z)			0.038***	0.036***	-0.026	0.038***
			(0.010)	(0.010)	(0.016)	(0.010)
Screen*wave						
2-year					0.118***	
					(0.021)	
4.5-year					0.082***	
					(0.019)	
8-year					(base)	
Wave*sex						
2*boys						-0.227***
						(0.026)
4.5*boys						-0.169***
						(0.022)
8*boys						(base)
2*girls						-0.059**
						(0.024)
4.5*girls						-0.054***
						(0.021)
8*girls						(base)
Other controls	NO	YES	YES	YES	YES	YES
Constant	0.074***	0.035***	0.010	0.004	0.010	0.010
	(0.011)	(0.039)	(0.046)	(0.046)	(0.046)	(0.046)
No. observations	17,028	17,021	16,795	16,795	16,795	16,795
No. groups	6,386	6,386	6,319	6,319	6,319	6,319
R^2 within	0.008	0.009	0.022	0.024	0.026	0.025

*** p<0.01, ** p<0.05, * p<0.1

Source: Growing Up in New Zealand, DCW2, DCW4, DCW5

Note: control variables include a mother's employment status and partner status and potential mediating variables including NZ Deprivation Index score, housing tenure status, maternal general health, child health and the number of times a child wakes at night.

Internalising and externalising problems fixed effects results

This section applies the same fixed effects model as the previous section but with internalising and externalising problems as the outcome measures. We, therefore, have a series of four fixed effects equations where the control variables are the same as Table 17. Full results are presented in Appendix 10.

An increase in *ln(eq. income)* is not associated with a significant decrease in either internalising or externalising scores, on average across 2-8 years of age, similarly to the results obtained for overall difficulties. However, once the wave and income interaction variables are included (to account for differences in the relationship between income and behaviour across the waves) an increase in equivalised income is associated with a decrease in both internalising and externalising at 2 years and 4.5 years (Table 18). At 8 years the relationship between equivalised income and both internalising and externalising is not statistically significant.

Restricted model: $internalising_{it} = \alpha_1 \ln(eq.income_{it}) + \lambda_i + \lambda_t + \varepsilon_{it}$ (16)

Full model: $internalising_{it} = \alpha_1 \ln(eq.income_{it}) + \alpha_2 X_{it} + \lambda_i + \lambda_t + \varepsilon_{it}$ (17)

Restricted model: $externalising_{it} = \alpha_1 \ln(eq.income_{it}) + \lambda_i + \lambda_t + \varepsilon_{it}$ (18)

Full model: $externalising_{it} = \alpha_1 \ln(eq.income_{it}) + \alpha_2 X_{it} + \lambda_i + \lambda_t + \varepsilon_{it}$ (19)

Table 18 – Fixed effect results for equations (16)-(19) estimating internalising and externalising problems

	INTERNALISING			EXTERNALISING		
	(1)	(2)	(3)	(4)	(5)	(6)
	Income	Full + income interaction	Full + screen interactions	Income	Full + income interaction	Full + screen interactions
Ln(eq. income) (Z)	-0.015	0.024	-0.014	-0.019	0.013	-0.019
	(0.014)	(0.020)	(0.015)	(0.014)	(0.018)	(0.016)
Wave						
2-year	-0.116***	-0.152***	-0.153***	-0.075***	-0.098***	-0.099***
	(0.017)	(0.020)	(0.020)	(0.017)	(0.020)	(0.020)
4.5-year	-0.101***	-0.121**	-0.121***	-0.067***	-0.075***	-0.076***
	(0.015)	(0.017)	(0.017)	(0.014)	(0.016)	(0.016)
8-year	(base)	(base)	(base)	(base)	(base)	(base)
Wave*ln(eq. income)						
2-year		-0.059***			-0.067***	
		(0.020)			(0.019)	
4.5-year		-0.058***			-0.030*	
		(0.018)			(0.017)	
8-year		(base)			(base)	
Total screens (Z)		0.029***	-0.012		0.029***	-0.028*
		(0.010)	(0.017)		(0.010)	(0.016)
Wave*screen (Z)						
2*screen			0.082***			0.112***
			(0.022)			(0.021)
3*screen			0.051**			0.069***
			(0.020)			(0.019)
4*screen			(base)			(base)
Other controls	NO	YES	YES	NO	YES	YES
Constant	0.074***	0.036	0.039	0.050***	-0.005	0.003
	(0.011)	(0.050)	(0.048)	(0.010)	(0.047)	(0.047)
No. observations	17,032	16,795	16,795	17,031	16,769	16,769
No. of groups	6,386	6,319	6,319	6,386	6,319	6,319
R^2 within	0.006	0.019	0.019	0.004	0.014	0.016

*** p<0.01, ** p<0.05, * p<0.1

Source: Growing Up in New Zealand, DCW2, DCW4, DCW5

Household income and child strengths (2-8 years)

This section shifts to examine the relationship between household income and child strengths scores (otherwise known as children's prosocial behaviour).

Table 19 presents the results of six OLS regressions where the relationship between household income and child strengths is examined at the 2-year, 4.5-year and 8-year waves. At each wave, the direct relationship between income and strengths is examined (Equation (16)), and then the relationship between income and stress is examined while controlling for other variables (Equation (17)). Where control variables and potential mediators are the same as those from Table 17. Results are presented for the control variables of a child's sex, maternal stress and screen use. Full results are presented in Appendix 11.

Restricted model:

Child strengths = f(household income) (20)

Full model:

Child strengths = f(household income, control variables) (21)

Looking at household income, the <20k income groups have significantly lower strengths scores in the two-year and eight-year waves than the 150k+ group. At two years, this lowest income group has a 0.4-point (0.2 SD) lower strength score than the highest income group, and at eight years, they have approximately half a point (0.25 SD) lower strengths score. Strength scores are broadly constant across the other income groups.

Notable in Table 19 (and Appendix 11) is that strengths scores vary far less by any demographic factors than difficulties scores do. The only variables by which strengths scores vary substantially are sex and maternal stress (at 2- and 8-year waves). Girls have a 0.4-point higher strengths score (0.2 SD) than boys at two years, which increases to a 0.65-point (0.4 SD) higher strengths score by eight years of age. Interestingly, mothers with higher levels of stress have children with slightly higher strength scores - with the difference between the lowest and highest stress mothers being associated with a nearly one-point difference in strengths scores. This result could be because mothers who are more worried about their children invest more carefully in ensuring their children behave positively or that children with stressed mothers are more attuned to others' behaviour.

Table 19 - Results for equations (20) and (21) estimating strengths scores

STRENGTHS	2 years		4.5 years		8 years	
	(1)	(2)	(3)	(4)	(5)	(6)
Household income						
<20k	-0.380**	-0.442**	-0.121	0.078	-0.925***	-0.544***
	(0.182)	(0.200)	(0.313)	(0.310)	(0.169)	(0.189)
20k-30k	-0.134	-0.083	0.010	0.093	-0.283	0.075
	(0.141)	(0.154)	(0.154)	(0.173)	(0.184)	(0.194)
30k-50k	-0.110	-0.077	-0.171*	-0.031	-0.281**	0.025
	(0.097)	(0.110)	(0.102)	(0.114)	(0.113)	(0.131)
50k-70k	0.028	0.077	-0.074	0.110	-0.005	0.189*
	(0.096)	(0.101)	(0.091)	(0.098)	(0.099)	(0.108)
70k-100k	-0.027	0.026	-0.086	-0.028	-0.229***	-0.076
	(0.092)	(0.093)	(0.082)	(0.082)	(0.097)	(0.092)
100k-150k	-0.004	0.011	0.058	0.060	0.041	0.078
	(0.092)	(0.088)	(0.079)	(0.076)	(0.078)	(0.078)
150k+	(base)	(base)	(base)	(base)	(base)	(base)
Child sex						
Boy		(base)		(base)		(base)
Girl		0.430***		0.580***		0.647***
		(0.052)		(0.050)		(0.051)
Maternal stress		0.019**		0.009		0.029***
(2 years)		(0.009)		(0.008)		(0.009)
Screen use						
No screens		(base)		(base)		0.234
						(0.194)
0.1-1 hours		-0.069		-0.094		(base)
		(0.070)		(0.169)		
1.1-2 hours		-0.100		-0.117		-0.006
		(0.083)		(0.168)		(0.102)
2.1-3 hours		-0.160		-0.177		0.100
		(0.109)		(0.173)		(0.105)
3.1-4 hours		-0.192		-0.200		-0.049
		(0.157)		(0.190)		(0.117)
4.1 hours +		-0.424**		-0.362**		-0.011
		(0.171)		(0.200)		(0.100)
Other controls	NO	YES	NO	YES	NO	YES
Constant	7.174***	0.655	7.796***	1.308**	8.252***	1.765***
	(0.070)	(0.575)	(0.058)	(0.592)	(0.051)	(0.577)
Observations	4,691	4,691	4,691	4,691	4,691	4,691
R-squared	0.002	0.114	0.002	0.127	0.013	0.127

*** p<0.01, ** p<0.05, * p<0.1

Source: Growing Up in New Zealand, DCW2, DCW4, DCW5

Screen use and children's behaviour (2-8 years)

This section focuses on screen use and its relationship with income and children's behaviour, pulling together the results from the previous tables and figures examining screen use.

Children who have higher screen use have higher difficulties scores, on average, across each of the waves (Table 20) with the differences between the screen use groups bigger during the preschool waves than at 8 years.

Table 21 shows that screen use also has an income gradient, with children in the lower income groups exposed to higher levels of screen use than the children in the highest income groups. Again, the biggest differences are during the preschool years, however some of this relationship may be explained by the fact the screen use variable captures weekday screen use at home and children of higher income parents are more likely to be in care during weekdays,

Table 20 - Child difficulties by screen use

	2 years			4.5 years			8 years		
	Mean	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**
None	10.11	4.68	904	7.29	4.26	109	6.89	5.47	92
0.1-1 hours	10.37	4.64	1,913	7.95	4.48	1,349	6.10	4.51	497
1.1-2 hours	11.01	4.64	848	8.43	4.49	1,682	6.78	4.99	866
2.1-3 hours	12.55	5.06	355	9.56	4.94	893	6.75	4.79	703
3.1-4 hours	13.15	5.35	165	10.66	4.83	352	7.74	5.02	484
4 hours +	15.45	5.03	141	12.24	5.22	283	7.90	5.33	986
Overall	**10.88**	4.86	4,326	**8.88**	4.79	4,668	**7.12**	5.04	3,628
ANOVA Prob > F	P<0.001			P<0.001			P<0.001		

Table 21 - Child screen use by income group

	2 years			4.5 years			8 years		
	Mean	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**
<20k	1.76	1.59	115	2.46	1.84	38	4.23	2.99	84
20k-30k	1.71	1.88	215	2.36	1.60	128	4.20	3.15	75
30k-50k	1.54	1.60	674	2.21	1.41	462	4.16	3.18	246
50k-70k	1.40	1.42	769	2.25	1.57	626	4.37	3.53	340
70k-100k	1.16	1.21	937	1.91	1.45	955	3.75	3.15	589
100k-150k	0.95	1.10	948	1.75	1.25	1,108	3.81	3.41	801
150k +	0.93	0.95	708	1.54	1.22	915	3.29	3.07	1,081
Overall	**1.22**	1.34	4,366	**1.89**	1.40	4,232	**3.73**	3.25	3,216
ANOVA Prob > F	P<0.001			P<0.001			P<0.001		

OLS regression results

Children who watch more than 4 hours screens per weekday have significantly higher difficulties scores than other children across each age group when other factors are controlled for using OLS regression (Table 16). Difficulties scores for the 4 hours+ group are 1.73 points (0.36 SD) higher than the no screens group at 2 years, 1.88 points (0.40 SD) higher at 4.5 years and 0.8 points (0.15 SD) higher at 8 years. During the preschool years, screen use at more than 2 hours per weekday is also associated with higher difficulties scores, although the pattern is less clear at 2 years of age than 4.5 years due to fewer children in the higher screen use categories.

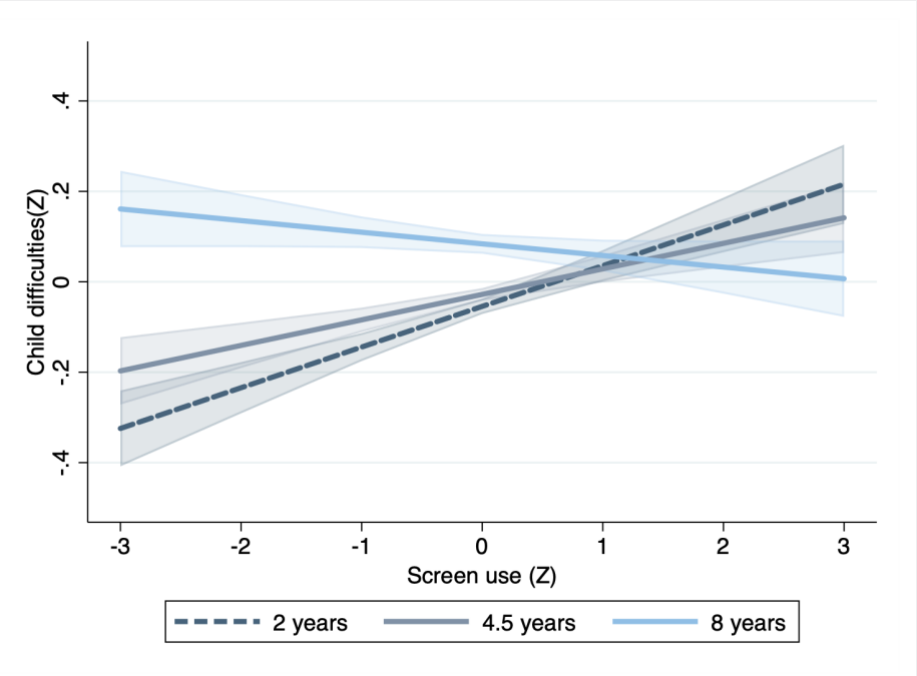
Regarding strengths scores, children who watch more than 4 hours of screens per weekday have an approximately 0.4-point (0.22 SD) lower strengths score than those who watch no screens at 2 and 4.5 years of age (Table 19). There is no association between screen use and children's strengths scores at 8 years of age.

Fixed effects results

For the fixed effects models measuring changes in individual children over time, an increase in screen use alone does not appear to be associated with higher overall difficulties scores (Table 17, column (3)). However, once differences in screen use over the waves are accounted for, a significant relationship between screen use and difficulties is apparent in the preschool waves, but not at eight years of age (see Table 17, column (5)). Figure 23 presents these results visually to show the average predicted probability of a child's difficulties score given their screen use. At 2 years of age a one standard deviation increase in screen use is associated with a 0.092 standard deviation increase in difficulties scores.

Looking at the fixed effects models for internalising and externalising separately, an increase in screen use is associated with both higher externalising and internalising scores in the 2-year and 4.5-year waves, with the effect size being larger for externalising than internalising.

Figure 23 - Fixed effects estimates for child difficulties by screen use



Source: GUiNZ DCW2, DCW4, DCW5

Turning to the potential of screen use to mediate the relationship between household income and child behaviour, Appendix 8 shows that adding screen use to the equation estimating the effect of income on behaviour significantly decreases the income estimates at both 2 years and 4.5 years of age. About 6-8% of the decrease in income estimates due to the addition of control variables came from the addition of screen use. The addition of screen use does not significantly change income estimates at eight years of age, reflecting the finding that screen use is not as strongly associated with behaviour at this later age.

In summary, higher screen use appears to negatively affect child behaviour in the preschool years, but by 8 years of age there is only limited evidence to suggest that it is a problem at the highest levels of screen use (4+ hours).

4. Discussion and policy implications

This study sought to understand better how living in lower-income households contributes to the well-established association between low household income and poor developmental outcomes among children. We did so by examining the influence of maternal stress and children's screen use in understanding the association between low incomes and higher levels of reported child behaviour problems, with a lens on how these associations differ at different child ages across the early life course.

The purpose of doing so was three-fold. First, to establish whether income and child development patterns in the international literature replicate in a contemporary cohort of children born in Aotearoa New Zealand. Second, to understand the relative contribution of various factors, such as increased stress, more screen use, and other variables that are both endogenous to, and explain the association between, income and child development. And third, to pinpoint potential child ages where these processes may be particularly sensitive or critical for child development and, in turn, where policy may have an outsized impact in supporting families and ameliorating population-level early childhood development inequities.

To address these aims, we used longitudinal data from *Growing Up in New Zealand* which, crucially, provides repeated measures of child development, income poverty, maternal stress, and screen use at multiple points during early-to-middle childhood. Testing a conceptual model through several multivariable regression analyses and assessing the robustness of these findings through fixed-effects models that better support causal inference, several key findings emerged.

4.1 Discussion – key findings

Lower incomes were associated with more reports of behaviour problems in children.

First, and in line with the existing extant international research on poverty and child development, New Zealand children in higher-income households were reported to have fewer behaviour problems than those children in lower-income households. This association persisted even when sociodemographic (e.g., maternal education, age, ethnicity, family structure) and parenting differences were accounted for in the models.

Importantly, these associations remained statistically significant during the preschool years when examined in a more rigorous fixed-effects framework. This framework compares the association between income and behaviour of a child at one study wave to the association between their income and behaviour at another (i.e., a within-child analyses). Put simply, these models found that levels of behaviour problems were higher when household incomes were lower when comparing children to themselves at waves when their household incomes were higher. This finding was similar and consistent across three measures of socioemotional development: 1) internalising behaviours; 2) externalising behaviours; and 3) a composite measure of general difficulties

combining reports of internalising and externalising behaviours.

When examining a measure of children's strengths (e.g., prosocial behaviour), however, there were no significant differences by income group (except for those in the <$20k group at 2 years and 8 years). Prosocial behaviour points to socioemotional development skills, such as being considerate of other people's feelings, sharing things such as toys and treats readily with others, being kind to younger children, and offering to help at home. This finding suggests that, while a lack of economic resources that put stresses on families may manifest in behaviour problems, such as children being withdrawn, aggressive, or finding it harder to self-regulate, low resources have not precluded families from providing environments that foster children's interpersonal skills.

The strength of the association between low income and greater behaviour problems—and explanations for how income matters—changed across the early-to-middle childhood life course

Second, and importantly, these associations were statistically significant and greater during the preschool waves compared to middle childhood (i.e., when children were 8 years old). This finding points to the potential importance for child development of income during the earliest years. But this finding could also reflect that early childhood is a period where children are generally spending more time in the family home and less time in formal schooling (such as by the time they are 8 years old)—contexts that can potentially provide a 'buffer' between poverty and child wellbeing.

Indeed, examining the influence parenting practices play in explaining the association between income and children's problem behaviours supports this potential hypothesis. Gelbach decomposition analyses provided evidence that, during the preschool years, parenting factors, such as parenting style, reading to children, and screen use practices, explain much of the difference in levels of reported behaviour problems across the different income groups. That is, having less income can cause stressors that might lead to less engaged or sensitive parenting, decrease time to facilitate meaningful parent-child reading moments, and be less able to secure quality care or facilitate other play activities in lieu of screen time. These factors, in turn, can lead to more behaviour problems.

In contrast, these same parenting factors appeared to explain very little of the association between income and behaviour problems by the time children were 8 years old. While both children's general health and how frequently they had moved house explained some of the association between income and child outcomes, including other covariates in the models did much less to explain the association at the 8-year wave compared to earlier ages. This suggests that the impacts of income at these later waves was more likely to be explained by other contextual factors—unmeasured and often unmeasurable time-varying variables—not accounted for in our models. This could include factors such as, but not limited to, access to better -resourced schools, access to higher quality health care, educational and behaviour support, and other enriching environments that promote children's wellbeing.

Maternal stress and children's screen use played a role in explaining the association between lower incomes and children's behaviour problems

Third, an examination of maternal stress and screen time (i.e., a test of the family stress model in understanding the pathways through which income impacts child development) found that both factors explained part of the association between income and reports of children's behaviour problems. Specifically, mothers in low-income households report both higher levels of stress and that their children spent more hours watching screens than higher-income mothers. In turn, these higher levels of stress and rates of screen time for children explained part of the association between income and children's behaviour problems.

As noted, mothers with higher household incomes persistently reported lower stress levels, with a clear income gradient with the highest stress levels among mothers in the lowest-income households. This income gradient remained statistically significant with the inclusion of other covariates in the model that might also be correlated with income and stress, such as ethnicity and educational attainment. This finding was also robust when examining the associations in a more rigorous fixed-effects framework showing that, on average, mothers reported higher stress levels during periods when their household incomes were lower compared to themselves at other periods when they had higher incomes.

Importantly, maternal stress, generally, and the strength of the association between lower household incomes and higher levels of stress, specifically, appeared to be age-graded—differing at different child ages. Stress was highest across the sample during pregnancy, before dropping at nine months and increasing again by the time children were two years old.

Similarly, screen use when children were preschool age (2 years and 54 months old) was associated with higher behaviour problems. The association between screen use and difficulties, however, was only statistically different among those children with the highest screen use (compared with no or little screen use): those spending over four hours per day using screens. There was no association between screen use and differences in problem behaviours when children were 8 years old. This finding potentially points to a combination of factors occurring by 8 years, such as children spending more hours in learning environments outside of the home (i.e., increased time in formal schooling and extracurricular activities), screen use becoming more common and accepted across the cohort, and changes in screen use that are transitioning away from more passive viewing (e.g., watching television) toward more active and engaged viewing (e.g., video games on interactive devices such as tablets or using screens for educational purposes).

Taken together, higher levels of maternal stress and screen time were associated with household income and reports of higher levels of problem behaviours in children, with full models and decomposition analysis providing suggestive evidence of a mediational pathway. These pathways however, were strongest—or only existed—during the early childhood years before children entered formal schooling.

These development trajectories differed by child gender

Fourth and finally, girls were consistently reported to have lower overall difficulties scores and higher strengths scores compared to boys. This gap in reported difficulties widened as children aged, with the gap almost three times wider by the time children were 8 years old compared to reports of behaviour when they were 2 years old.

These disparities in overall difficulties were primarily driven by larger gaps in externalising behaviours (e.g., aggression) where the gap grew 400% from when children were 2 years old to when they were 8 years old. There were no statistical differences in reports of internalising behaviours by the time children were 8 years old. Mothers reported higher strengths scores (i.e., prosocial behaviours) for girls than for boys, with these disparities widening more modestly (compared with disparities in externalising behaviours) from when children were 2 years to when they were 8 years old.

4.2 Policy implications and study limitations

These findings point to both broader structural challenges in supporting families and key points during early and middle childhood where additional policy supports may have outsized benefits for both mothers and children.

The first 1,000 days are important

While the association between lower incomes and poorer child outcomes was persistent across child ages, the association was stronger during the earliest years. So, too, were the associations between income and mothers' stress and children's screen time, in turn helping to explain how income manifests in greater child behaviour problems.

The impact of income on child behaviour and mothers' stress in the early childhood years may reflect new and increasing stressors during early childhood as families transition to life with a new baby. The family environment is a more crucial developmental context during the earliest years when children spend more time with their family and in the home than in later years, such as when they enter formal schooling.

These findings are consistent with a wealth of research evidence that points to early childhood and 'the first 1,000 days' as a critical period for setting in motion longer-term trajectories of development and wellbeing that persist into adulthood. These earliest patterns of developmental disparities have the potential to be an important force shaping broader-level population inequities and are implicated in the intergenerational transmission of inequity. Moreover, an extant literature points to the early childhood years as being a period that is particularly sensitive to policy interventions and supports, a period in which policy interventions can have an outsized impact on children's outcomes and so can create fiscal savings in the long term (Heckman, 2006).

Increasing incomes are important for supporting children's development—but other types of resources are also important

The New Zealand evidence presented here indicates that increasing incomes—particularly of those families living in poverty—is likely to result in declines in children's behaviour problems. This conclusion is supported by numerous studies, including ones with rigorous causal frameworks for assessing policy impact (Boccia et al., 2023).

An outstanding question, however, relates to estimating the overall effect of income on child development, incorporating both the direct effect and its effects in combination with other factors that support child development. In this study, once a variety of sociodemographic and contextual factors were controlled for, the size of the remaining statistically significant effect of income on child socio-emotional development is small. This is not to say, however, that income is not an important causal determinant of child wellbeing, but rather that the mechanisms through which income affects child development may be multifaceted. These multifaceted factors point to a range of potential policy levers that promote child development above-and-beyond, and in place of, income supports.

While this study firmly trained a lens on maternal stress and children's screen use as potential mechanisms for how income matters for child development, other variables in our models also provided preliminary evidence of mediating the association between income and child outcomes. For example, maternal health and housing were also important predictors of child outcomes and reduced the direct effect of income. These findings point to the importance of other policy investments for child development, such as in the health care system and in providing quality, affordable, and stable housing for low-income families.

Future studies should interrogate these findings further to better understand the role of differential development contexts and the complex interplay of these factors for promoting child development in the Aotearoa New Zealand context. In addition, future studies could explore why the significant minority of children from low income families who had few behaviour problems were able to beat the odds.

Importance of intergenerational approaches to supporting children

This study also highlighted the salient potential of policies that are whānau-centred and promote intergenerational wellbeing in ways that confer benefits for children. Indeed, the finding from this study that having lower incomes increased maternal stress and, in turn, was associated with more behaviour problems in children, supports the need for whānau- and parent-centred approaches that can alleviate stress. As noted, the arrival of a new baby brings joy, but also a set of financial and social stressors as parents adapt to their new normal. As well as making sure incomes are stabilised at a level that makes sure families can meet their essential everyday needs, such as through paid parental leave and adequate income benefit rates, and alleviating financial burden through in-kind supports and subsidies (e.g., accommodation supplement, early childcare subsidies), other factors that support the whole

family and improve wellbeing of all family members are likely to have a spillover effect on children.

Indeed, in the Gelbach decomposition models, mothers' reports of their health and their families' housing tenure and residential instability appeared to be pathways that drive much of the differences in maternal stress across income groups. These findings emphasize the importance of policy supports that target parents and promote their wellbeing in ways that allow them to parent and support their children with fewer stressors.

Large amounts of screen time during early childhood are associated with poorer child outcomes, but the utility of parents moderating children's screens when they are older, or in small doses is unclear

We found that screen time at high levels was associated with more reports of behaviour problems. We note again that these effects were concentrated among preschool children and were not 'explained away' by socioeconomic differences across different levels of screen use. Thus, these findings present qualified support for the current recommendations that screen time be limited during the preschool years. Our findings, however, provide less evidence of immediate harm to middle-childhood age children in terms of the quantity of screen use, and suggests that further research should explore whether recommendations should incorporate more nuance into recommendations around content and the ways older children use and interact with screens and the internet.

In giving qualified support for screentime recommendations among preschool-age children, we note that disparities in child outcomes were driven by those children who had the highest levels of screentime—four or more hours per day. The implication of this result is that screen use at or below the recommended threshold (two hours per day) is unlikely to be driving disparities in child development outcomes, and that the most immediate need is addressing why it is that some very young children, primarily in low-income families, are spending four or more hours of their day in front of screens—between 33-40% of their awake time. Further research should explore the factors that are driving differences in heavy screen use among families, especially those with low incomes. Indeed, as prior research has found in the New Zealand context (Monk, 2022), screen use is often employed in response to parental stress and, indeed, could have net positive effects on child wellbeing if it is providing a buffer from other potential stressors children are exposed to in the home. This example of screen use potentially being beneficial in a high stress household highlights the complexity of the issue and why public health messaging around screen use may not resonate with families or have the intended wellbeing effects on children.

One limitation in this study is that we could not assess screentime when children were 9 months old. Indeed, by age two, most children are watching or interacting with screens for at least some of their day. If we were able to assess screen use at 9 months—where international studies have found screentime is less common—there is the potential that we might have found a stronger link between screen use and child development outcomes.

Income as a source and compounding effect on ethnic inequities in Aotearoa New Zealand

Finally, and while not the explicit focus of the main analyses, the findings pointed to the inequities in income, stress, and child outcomes among Māori and Pacific mothers compared with New Zealand European mothers. Indeed, the broader legacy and lingering effects of colonialism and racism that have resulted in population-level equities across numerous social, economic, and health outcomes are found in this study, even after controlling for income and other relevant sociodemographic differences.

It is important to note, however, that measures such as the Strength and Difficulties Questionnaire (SDQ), from which this study's measures of children's socioemotional development are derived, have not been validated empirically for tamariki Māori and Pacific children living in New Zealand, and questions have been raised about its suitability for these children (Kersten et al., 2016; Kersten et al., 2018). In terms of assessing children's development, other tools may be better suited for assessing the socioemotional development of tamariki Māori and Pacific children.

Overall, though, the effect of income may be compounded with other broader structural inequities, so prioritising investment in Māori and Pacific communities, and especially for mothers in these communities, is important for ameliorating population-level inequities—a policy-focus that aligns with the Crown's responsibilities under Te Tiriti o Waitangi.

Limitations

There are some further limitations to the work in this report. First are measurement challenges. Household income has been measured using income bands, which, by nature are imprecise. As mentioned previously, many of the changes in income will be too smalll to force a change in income band and so will not get picked up in the data. Consequently, the estimates of income effects are likely to be underreporting effect sizes. A concentration on weekday home-based, screen use also limits the screen use measure. Similar longitudinal studies have shown that screen use by children is substantially higher on weekend days than on weekdays (e.g. (Australian Insititue of Family Studies, 2012; Growing up in Ireland, 2017). Not including data from partners (due to substantial missing data) also risks missing an important part of the child development picture. In addition, the prescence of a partner in the home was not consistently captured so this has not been explored in detail.

Second, the use of OLS regression and fixed effects models are not able to capture the cumulative effects of exposure to factors such as screen use. Fixed effects models assess the relationship between changes in screen use and changes in difficulties scores, but further investigation of the cumulative impact of these factors is needed. In addition, fixed effects models are limited to measuring within household changes in the variable of interest and may fail to capture complexities around those changes, such as if a drop in income comes from a stressful life event that may have further spill over effects for the family.

Finally, this report could not statistically isolate the direction of the relationship between the variables. While some relationships are inituatively one way (a higher income is likely to lead to fewer child behaviour problems rather than the other way around), other relationships are likely to go in both directions. Further research that concentrates on the causal pathways that influence child development outcomes is a natural extension of the work reported here.

Appendices

Appendix 1 – Summary statistics

Summary statistics for key variables

	%/Mean	SD	Min	Max	Item missing (%)
Difficulties					
2 years	10.89	4.87	0	31	7.27
4.5 years	8.88	4.79	0	31	2.12
8 years	7.50	5.22	0	31	3.71
Internalising					
2 years	3.73	2.55	0	16	3.92
4.5 years	3.28	2.65	0	16	1.63
8 years	3.12	2.89	0	17	5.06
Externalising					
2 years	7.19	3.35	0	20	4.44
4.5 years	5.61	3.21	0	20	0.57
8 years	4.38	3.29	0	19	5.16
Strengths					
2 years	7.14	1.82	0	10	3.52
4.5 years	7.76	1.78	0	10	0.70
8 years	8.15	1.82	0	10	3.63
Maternal stress	5.37	3.53	0	18	0.18
Screen use hours (weekday)					
2 years	1.37	1.48	0	16	2.31
4.5 years	2.07	1.60	0	15.5	0.49
8 years	3.76	3.25	0	12	17.37

Summary statistics for covariates

	%/Mean	SD	Min	Max	Item missing (%)
Child health					
2 years	4.33	0.83	1	5	0.04
4.5 years	4.34	0.79	1	5	0.08
8 years	4.27	0.82	1	5	0.83
Child parity					
First-born	41.86				0.13
Subsequent	58.14				
Child sex at birth					
Male	51.5				0.10
Female	48.4				
Child wakes in night					
2 years					
Sleeps through	50.71				0.14
Wakes once	32.45				
Wakes 2+ times	16.84				
45 months					
Sleeps through	62.04				0.2
Wakes once	30.86				
Wakes 2+ times	7.10				
8 years					
Sleeps through	74.98				4.15
Wakes once	21.33				
Wakes 2+ times	3.69				
Clinically sig. PND symptoms					
Yes	8.08				0.26
No	91.92				
Housing tenure - Pregnancy					
Owns home	52.9				9.47
Private rental	38.9				
Public rental	6.58				
Other	1.62				
Housing tenure – 9 months					
Owns home	53.82				7.31
Private rental	38.63				
Public rental	7.13				
Other	0.42				
Housing tenure – 2 years					
Owns home	53.91				5.27
Private rental	39.02				
Public rental	6.89				
Other	0.18				
Housing tenure – 4.5 years					
Owns home	55.56				2.79
Private rental	36.87				
Public rental	6.50				

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Other	1.07				
Housing tenure – 8 years					
Owns home	56.10				4.29
Private rental	27.83				
Public rental	5.69				
Other	10.38				
Hostile parenting					
Low hostile parenting	21.6				0.67
Med hostile parenting	38.5				
High hostile parenting	39.9				
Household structure - Pregnancy					
Parent alone	3.46				0.13
Two parents	65.57				
Parent(s) with extended family	25.65				
Parent(s) living with non-kin	5.32				
Household structure – 2 years					
Parent alone	5.13				5.03
Two parents	67.64				
Parent(s) with extended family	21.00				
Parent(s) living with non-kin	6.22				
Labour force status - Pregnancy					
Employed (or in 4 weeks)	56.54				4.67
Unemployed	8.41				
Studying	7.18				
Not in workforce	27.88				
Labour force status -2 years					
Employed (or in 4 weeks)	51.20				0.09
Unemployed	4.10				
Studying	4.65				
Not in workforce	40.04				
Maternal self-efficacy	59.95	4.57	32	66	0.79
Mother's age	30.04	5.86	18	41	0.02
Mother’s agreeableness	3.97	0.50	1.89	5	0.53
Mother’s conscientiousness	3.99	0.57	1.22	5	0.47
Mother’s education					
No qual./NCEA 1-4	30.98				0.3
Diploma/trade cert/NCEA	30.67				
Bachelor’s degree	22.62				
Higher degree	15.73				
Mother's ethnicity					
European	53.06				0.3
Māori	13.97				
Pacific	14.66				
Asian	14.77				
Other	3.53				
Mother’s extroversion	3.60	0.69	1.13	5	0.66

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Maternal general health					
Pregnancy	2.64	0.95	0	4	0.01
9 months	2.75	0.95	0	4	0.03
2 years	2.75	0.95	0	4	0.03
4.5 years	2.92	0.96	0	4	0.13
8 years	2.73	1.00	0	4	4.91
Mother's neuroticism	2.66	0.69	1	4.88	0.47
Mother's openness	3.72	0.56	1.5	5	0.66
Mother paid job – 2 years					
Yes	52.90				0.06
No	47.10				
Mother paid job – 4.5 years					
Yes	65.41				0.20
No	34.59				
Mother paid job – 8 years					
Yes	80.57				5.17
No	19.43				
Mother reads with child – 2 years					
Never/seldom	13.85				0.05
Several times a week	19.47				
Daily	29.14				
Several times a day	37.54				
Mother reads with child – 4.5 years					
Never/seldom	15.46				0.17
Several times a week	25.33				
Daily	42.18				
Several times a day	17.04				
Mother reads with child – 8 years					
Never/seldom	44.77				5.30
Several times a week	30.92				
Daily	21.75				
Several times a day	2.57				
NZ Deprivation index score					
Pregnancy	6.04	2.92	1	10	0.05
9 months	5.93	2.93	1	10	0.04
2 years	5.83	2.95	1	10	2.08
4.5 years	5.63	3.02	1	10	5.06
8 years	5.18	2.94	1	10	3.55
No. siblings at home – 16 months					
None	37.18				3.93
1 sibling	34.64				
2 siblings	15.90				
3+ siblings	12.28				
No. siblings at home – 4.5 years					
None	14.63				0.17
1 sibling	45.86				
2 siblings	25.62				
3+ siblings	13.89				

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Partner status – 2 years					
Has partner	9.88				0.01
Does not have partner	90.12				
Partner status – 4.5 years					
Has partner	10.31				0.07
Does not have partner	89.69				
Partner status – 8 years					
Has partner	11.69				6.23
Does not have partner	88.31				
Personal support	32.77	7.22	12	60	4.30
Positive parenting					
Low positive parenting	19.6				0.42
High positive parenting	80.4				
Protective parenting					
Low protective parenting	29.6				1.62
Med protective parenting	32.1				
High protective parenting	38.3				
Recent moves					
Pregnancy	2.33	1.65	0	6	0.35
9 months	0.31	0.60	0	4	1.36
2 years	0.40	0.68	0	5	0.32
4.5 years	0.85	1.06	0	4	0.16
8 years	1.16	1.57	0	11	9.24

Appendix 2 – Strengths and difficulties questionnaire questions

Early years SDQ (2 years)	Regular SDQ (4.5 and 8 years)
Internalising problems	Internalising problems
Emotional problems	*Emotional problems*
Often complains of headaches, stomach-aches, or sickness.	Often complains of headaches, stomach-aches, or sickness.
Many worries, often seems worried.	Many worries, often seems worried.
Often unhappy, down-hearted or tearful.	Often unhappy, down-hearted or tearful.
Nervous or clingy in new situations, easily loses confidence.	Nervous or clingy in new situations, easily loses confidence.
Many fears, easily scared	Many fears, easily scared
Peer relationship problems	*Peer relationship problems*
Rather solitary, tends to play alone.	Rather solitary, prefers to play alone.
Has at least one good friend.	Has at least one good friend.
Generally liked by other children.	Generally liked by other children.
Picked on or bullied by other children.	Picked on or bullied by other children.
Gets on better with adults than with other children.	Gets on better with adults than with other children.
Externalising problems	Externalising problems
Conduct problems	*Conduct problems*
Often has temper tantrums or hot tempers	Often loses temper
Generally obedient, usually does what adults request	Generally well behaved, usually does what adults request
Often fights with other children or bullies them	Often fights with other children or bullies them
Often argumentative with adults	Often lies or cheats
Can be spiteful to others	Steals from home, (pre)school or elsewhere
Hyperactivity/inattention	*Hyperactivity/inattention*
Restless, overactive, cannot stay still for long	Restless, overactive, cannot stay still for long
Constantly fidgeting or squirming	Constantly fidgeting or squirming
Easily distracted, concentration wanders	Easily distracted, concentration wanders
Can stop and think things out before acting	Can stop and think things out before acting
Sees tasks through to the end, good attention span	Has good attention span, sees chores or work through to the end
Prosocial behaviour/strengths	*Prosocial behaviour/strengths*
Considerate of other people's feelings	Considerate of other people's feelings
Shares readily with other children, for example toys, treats, pencils.	Shares readily with other children, for example toys, treats, pencils.
Helpful if someone is hurt, upset or feeling ill	Helpful if someone is hurt, upset or feeling ill
Kind to younger children	Kind to younger children
Often volunteers to help others (parents, teachers, other children)	Often volunteers to help others (parents, teachers, other children)

Appendix 3 – Variable description

Variable	Description	Wave sourced from
Key variables		
Child difficulties	From the Strengths and Difficulties Questionnaire. Mother-reported scale developed from 20 questions on child behaviour. Created by summing responses to four five-item subscales (emotional problems, peer relationship problems, hyperactivity/inattention and conduct problems). Scores can range from 0-40.	2-year, 4.5-year, 8-year
Child strengths	From the Strengths and Difficulties Questionnaire. Mother-reported scale developed from 5 questions on child behaviour. Created by summing responses to a five-item subscale. Scores can range from 0-10.	2-year, 4.5-year, 8-year
Household income	"What was your household's total income, before tax or anything else was taken out of it?". Associative analysis: income bands <$20k, $20,001-$30,000, $30,0001-$50,000, $50,001-$70,000, $70,001-$100,000, $100,001-$150,000, $150,000+. FE analysis: mid-point of income band, adjusted for inflation and equivalised for household composition using the square root scale (income divided by the square root of household size).	Pregnancy, 9-month, 2-year, 4.5-year, 8-year
Mother's overall stress	The sum of responses to 6 questions on sources of stress: "Thinking about the time since your [child was/children were] nine months old, to what extent are the following sources of stress for you and your family." Ill or disabled family member, housing difficulties, balancing work and family life, money problems, family members not getting on, another child's behaviour. Overall stress scale is from 0-18.	Pregnancy, 9-month, 2-year
Screen use	**2 years** - Mother reported number of hours *last weekday* spent watching television, dvds, or using a laptop, children's computer system or electronic gaming system. **4.5 years** – Mother reported number of hours on a *usual weekday* child spends "at home watching television programming including free-to-air, online, and pay TV or DVDs either on TV or other media?" Plus "…using electronic media e.g. computer or laptop, including children's computer systems such as Leapfrog, ipads, tablets, smart phones and any electronic gaming devices". **8 years** - Mother reported number of hours on a *normal weekday*, "spending time watching television programming including free to-air, online, and pay TV or DVDs either on TV or other screen-based devices?" Plus "…spending time doing activities or tasks, e.g. homework, playing games, or sending messages, on any screen-based device including computers, laptops, tablets, smart phones or gaming devices?"	2-year, 4.5-year and 8-year
Other covariates		
Child health	Mother reported variable on a scale of 1-5. In response to "In general, how would you say baby/child's current health is?"	9-month, 2 years, 8 years

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Child parity	Whether study child is firstborn or a subsequent child.	Pregnancy
Child sex at birth	Male or female	9-month
Clinically significant PND symptoms	Derived from 10 item Edinburgh post-natal depression scale (Cox et al., 1987). Original scores from 0-30. Clinically significant cut off point of 13 or more.	9-month
Housing tenure	Housing tenure classified by private ownership, private rental, public rental or "other". Family trust ownership was classified as private ownership.	Pregnancy, 9 months, 2-year, 4.5-year, 8-year
Hostile parenting	Sum of response to four questions “During the past 4 weeks how often did you…” get angry at him/her, criticize his/her ideas, shout at him/her, argue when disagree with him/her. Categorised into low/medium/high.	2-year
Household structure	Household structure classified by “Parent alone”, “Two parents”, “Parent(s) with extended family”, “Parent(s) living with non-kin (and extended family if applicable)”.	Pregnancy, 2 years
Labour force status	Four categories 1. Employed, or will be in 4 weeks 2. Unemployed 3. Studying 4. Not in the workforce.	Pregnancy 2-year
Maternal self-efficacy	Extract from the Pridham scale. (Pridham & Chang, 1989). Nine items from the original Pridham scales plus two extra questions about overall parenting confidence and mother-child closeness. Scores range from 6-66.	9-month
Mother’s age	Mother’s age in years at antenatal interview.	Pregnancy
Mother’s agreeableness	Mother reported and derived from the Big Five Inventory – Adolescent version (chosen due to simpler text than adult version)(John & Srivastava, 1999). Scale from 0-5.	2-year
Mother’s conscientiousness	Mother reported and derived from the Big Five Inventory – Adolescent version (chosen due to simpler text than adult version)(John & Srivastava, 1999). Scale from 0-5.	2-year
Mother’s education	Four categories. 1. No secondary school qualification/NCEA 1-4 2. Diploma/trade certificate/NCEA5-6 3. Bachelor’s degree 4. Higher degree.	Pregnancy
Mother’s ethnicity	Mother self-identified and self-prioritised ethnicity. Categorised as New Zealand European, Māori, Pacific, Asian and other.	Pregnancy
Mother’s extroversion	Mother reported and derived from the Big Five Inventory – Adolescent version (chosen due to simpler text than adult version)(John & Srivastava, 1999). Scale from 0-5.	2-year
Mother's general health	Answer to the question "Thinking about your current health, in general how would you say your health was?" Response options are poor, fair, good, very good and excellent. Scale of 1-5.	Pregnancy, 9-month
Mother has paid job	Answer to “Do you have a paid job at the current time?” Binary yes/no.	9 months, 2 years, 4.5 years, 8 years

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Mother reads with child	Response to question "How often do you read books with your child?" Never/seldom/several times a week/daily/several times a day.	2-year, 4.5 years, 8 years
Mother's neuroticism	Mother reported and derived from the Big Five Inventory – Adolescent version (chosen due to simpler text than adult version)(John & Srivastava, 1999). Scale from 0-5.	2-year
Mother's openness	Mother reported and derived from the Big Five Inventory – Adolescent version (chosen due to simpler text than adult version)(John & Srivastava, 1999). Scale from 0-5.	2-year
NZ Deprivation Index score	Categorised New Zealand Deprivation Index score from 2006 (Pregnancy – 2 years) or from 2013 (4.5 – 8 years). Transformed from a 10-pointscale to 5 categories.	Pregnancy, 9 months, 2-year, 4.5-year, 8-year
Number of siblings	The number of siblings a child has living with them at home.	16-month, 4.5 years
Partner status	Answer to "Do you have a current partner?"	2-year, 4.5-year, 8-year
Personal support	Parenting Social Support Scale (Dunst et al. (1984)). A measure derived from 10 questions asking about support from a mother's partner, wider family and support services (e.g. doctors). Individual questions are scored from 1 (not available) to 6 (extremely helpful). Overall scores range from 12-60.	9-month
Positive parenting	Time Spent With Child Scale (Davies et al., 2002). Sum of 12 questions of whether parent engages positively with child.	2-year
Protective parenting	Sum of 4 questions on protective parenting: "How often do you try to protect child from life's difficulties?" "How often do you put child's needs and wants before your own?" "How often does leaving child with other people upset you no matter how well you know them?" "How often do you let child take a risk if there is no major threat to [his/her] safety?" Categorised into low/medium/high.	2-year
Recent moves/residential mobility	Number of times mother has moved house since the previous wave or in the last 5 years (for antenatal wave).	Pregnancy, 9 months, 2-year, 4.5-year, 8-year
Wakes in night	The number of times the child wakes in the night, on average	2-year, 4.5-year, 8-year

Appendix 4 – Full OLS results for Equation (2) estimating maternal stress

MATERNAL STRESS	(1) Pregnancy restricted	(2) Pregnancy full	(3) 9 months restricted	(4) 9 months full	(5) 2 years restricted	(6) 2 years full
Household income						
<20k	2.787***	1.489***	1.646***	0.910***	2.681***	1.552***
	(0.342)	(0.369)	(0.265)	(0.275)	(0.340)	(0.331)
20k-30k	2.137***	0.784**	2.120***	1.302***	2.345***	1.312***
	(0.287)	(0.323)	(0.235)	(0.242)	(0.236)	(0.249)
30k-50k	1.572***	0.402*	1.360***	0.814***	1.779***	1.041***
	(0.195)	(0.233)	(0.165)	(0.177)	(0.157)	(0.174)
50k-70k	1.549***	0.656***	1.200***	0.756***	1.471***	0.947***
	(0.178)	(0.198)	(0.159)	(0.163)	(0.153)	(0.156)
70k-100k	1.355***	0.689***	1.019***	0.697***	1.153***	0.682***
	(0.165)	(0.174)	(0.155)	(0.150)	(0.142)	(0.138)
100k-150k	0.707***	0.421***	0.465***	0.300**	0.778***	0.485***
	(0.163)	(0.161)	(0.167)	(0.157)	(0.769)	(0.135)
150k+	(base)	(base)	(base)	(base)	(base)	(base)
Child parity						
Firstborn		(base)		(base)		(base)
Subsequent		0.684***		0.975***		0.636***
		(0.106)		(0.080)		(0.087)
Extroversion		-0.065		0.036		0.041
		(0.076)		(0.062)		(0.067)
Agreeableness		-0.037		-0.171*		-0.263***
		(0.107)		(0.089)		(0.096)
Conscientiousness		-0.013		-0.145*		-0.166**
		(0.093)		(0.079)		(0.083)
Neuroticism		1.094***		1.046***		1.426***
		(0.076)		(0.068)		(0.070)
Openness		0.372***		0.400***		0.414***
		(0.092)		(0.075)		(0.080)
Mother's ethnicity						
European		(base)		(base)		(base)
Māori		0.541***		0.244*		0.839***
		(0.166)		(0.137)		(0.145)
Pacific		1.332***		0.242		0.258
		(0.201)		(0.161)		(0.242)
Asian		-0.468***		-1.073***		-1.180***
		(0.162)		(0.118)		(0.127)
Other		0.333		-0.476**		0.035
		(0.287)		(0.220)		(0.235)
Mother’s education						
No qual./NCEA1-4		(base)		(base)		(base)
Diploma/trade		0.113		0.087		0.003
		(0.132)		(0.108)		(0.115)
Bachelors		0.110		0.227**		-0.015
		(0.145)		(0.116)		(0.122)
Higher educ.		-0.143		0.043		-0.278*
		(0.157)		(0.128)		(0.137)
Mother's general health	-	-0.276***		-0.473***		-0.393***
		(0.056)		(0.045)		(0.047)
Mother's age (years)		0.008		-0.007		0.019**
		(0.011)		(0.008)		(0.009)
Mother employed						
Yes				(base)		
No				-0.545***		
				(0.080)		

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	(1)	(2)	(3)	(4)	(5)	(6)
	Pregnancy	Pregnancy + controls	9 months	9 months + controls	2 years	2 years + controls
Labour force status						
Employed (or starting in 4 weeks)		(base)				(base)
Unemployed		-0.473**				0.048
		(0.213)				(0.242)
Studying		-0.012				-0.246
		(0.178)				(0.213)
Not in workforce		-0.531***				-0.842***
		(0.122)				(0.090)
Household structure						
Sole parent		0.259		0.449**		0.571***
		(0.260)		(0.216)		(0.232)
Two parent		(base)		(base)		(base)
With family		0.545***		0.213*		0.384***
		(0.138)		(0.115)		(0.122)
With other adults		0.264		0.183		0.263
		(0.216)		(0.169)		(0.187)
NZ Deprivation Index score						
(1-2)		(base)		(base)		(base)
(3-4)		-0.025		0.060		0.131
		(0.144)		(0.116)		(0.123)
(5-6)		0.080		0.144		0.139
		(0.154)		(0.123)		(0.128)
(7-8)		0.308**		0.121		0.373***
		(0.157)		(0.125)		(0.133)
(9-10)		0.387**		-0.071		0.124
		(0.167)		(0.133)		(0.144)
No. moves in last 5 years/since prev. wave		0.049**		0.245***		0.144**
		(0.023)		(0.073)		(0.066)
Homeownership						
Owns home		(base)		(base)		(base)
Private rental		0.431***		0.139		0.220**
		(0.112)		(0.095)		(0.102)
Public rental		0.468*		0.255		0.197
		(0.258)		(0.219)		(0.249)
Other		-0.739		0.056		-1.440
		(0.692)		0.593)		(0.977)
Constant	4.285***	-0.187	3.348**	0.154	4.126***	0.428
	(0.121)	(0.761)	(0.126)	(0.648)	(0.103)	(0.705)
Observations	**5,994**	**5,994**	**5,994**	**5,994**	**5,994**	**5,994**
R-squared	0.034	0.137	0.027	0.168	0.039	0.205

*** p<0.01, ** p<0.05, * p<0.1

Source: Growing Up in New Zealand, DCW0, DCW1, DCW2

Appendix 5 – Full Gelbach decomposition results showing how the addition of covariates affects the relationship between income and stress

Pregnancy

Stress	<20k	20k-30k	30k-50k	50k-70k	70k-100k	100k-150k	150k+
Base	2.754***	2.083***	1.547***	1.623***	1.367***	0.674***	(base)
Full	1.465***	0.772***	0.432**	0.737***	0.696***	0.394***	(base)
Total change	**1.289*** **	**1.311*** **	**1.115*** **	**0.885*** **	**0.671*** **	**0.279*** **	**(base)**
Change from:							
Covariates	0.378**	0.447***	0.388***	0.343***	0.287***	0.117**	(base)
Housing tenure	0.248***	0.240***	0.206***	0.161***	0.099***	0.051***	(base)
General health	0.233***	0.205***	0.204***	0.148***	0.120***	0.049***	(base)
Household structure	0.171**	0.128**	0.097***	0.064***	0.041***	0.008***	(base)
NZ Dep index	0.169***	0.188***	0.141***	0.099***	0.068**	0.026**	(base)
							N = 5,994

9 months

Stress	<20k	20k-30k	30k-50k	50k-70k	70k-100k	100k-150k	150k+
Base	1.624***	2.109***	1.300***	1.207***	0.975***	0.405**	(base)
Full	0.977***	1.315***	0.778***	0.762***	0.661***	0.234	(base)
Total change	**0.647*** **	**0.793*** **	**0.552*** **	**0.444*** **	**0.314*** **	**0.171*** **	**(base)**
Change from:							
Covariates	0.155	0,236**	0.131	0.171**	0.130**	0.062	(base)
General health	0.207***	0.304***	0.231***	0.186***	0.140***	0.113***	(base)
Household structure	0.139***	0.111***	0.049***	0.015*	0.004	-0.008	(base)
No. house moves	0.079***	0.075***	0.052***	0.028***	0.006	-0.002	(base)
Housing tenure	0.096	0.101*	0.083*	0.056*	0.033*	0.006	(base)
NZ Dep index	-0.029	-0.033	0.131	-0.012	0.001	0.001	(base)
							N = 5,994

2 years

Stress	<20k	20k-30k	30k-50k	50k-70k	70k-100k	100k-150k	150k+
Base	2.607***	2.315***	1.777***	1.378***	1.121***	0.717***	(base)
Full	1.543***	1.222***	1.026***	0.830***	0.641***	0.432***	(base)
Total change	**1.063*** **	**1.092*** **	**0.751*** **	**0.548*** **	**0.480*** **	**0.285*** **	**(base)**
Change from:							
Covariates	0.409***	0.520***	0.262***	0.195**	0.254***	0.161***	(base)
General health	0.249***	0.164***	0.175***	0.149***	0.094***	0.050***	(base)
Household structure	0.196***	0.186***	0.120***	0.052***	0.023**	0.009	(base)
No. house moves	0.049**	0.036**	0.027**	0.015*	0.009	0.001	(base)
Housing tenure	0.101	0.114*	0.101**	0.062**	0.046**	0.018**	(base)
NZ Dep index	0.058	0.072	0.076	0.073*	0.054*	0.036*	(base)
							N = 5,994

*** p<0.01, ** p<0.05, * p<0.1

Source: Growing Up in New Zealand, DCW0, DCW1, DCW2

Appendix 6 – Full OLS results for equations (7) and (8)

CHILD DIFFICULTIES	(1) Restricted	SE	(2) Full	SE
Maternal stress (2 years)	0.324***	(0.019)	0.107***	(0.018)
Household income				
<20k			1.115***	(0.417)
20k-30k			0.613*	(0.320)
30k-50k			0.481**	(0.231)
50k-70k			0.122	(0.211)
70k-100k			-0.113	(0.196)
100k-150k			-0.035	(0.018)
150k+			(base)	(base)
Child sex at birth				
Boy			(base)	(base)
Girl			-0.477***	(0.108)
Child health			-0.483***	(0.067)
Mother's ethnicity				
European			(base)	(base)
Māori			1.241***	(0.196)
Pacific			1.972***	(0.231)
Asian			0.267	(0.189)
Other			0.084	(0.333)
Mother's highest education				
No qual./NCEA 1-4			(base)	(base)
Diploma/Trade cert			-0.031	(0.150)
Bachelor's degree			-0.546***	(0.168)
Higher degree			-0.688***	(0.184)
Screen use				
No screens			(base)	(base)
0-1 hours			0.160	(0.149)
1-2 hours			0.120	(0.173)
2-3 hours			0.672***	(0.229)
3-4 hours			0.814**	(0.320)
4 hours +			1.932***	(0.344)
Mother age (years)			-0.066***	(0.012)
NZDep				
Low			(base)	(base)
Med			-0.001	(0.135)
High			0.310*	(0.166)
Labour force status				
Employed (or starting in 4 weeks)			(base)	(base)
Unemployed			0.997***	(0.317)
Not in workforce			0.476***	(0.122)
Studying			0.288	(0.293)
Partner status				
Has partner			(base)	(base)
Does not have partner			-0.118	(0.223)
Number of siblings				
No siblings			(base)	(base)
One sibling			-0.164	(0.130)
Two siblings			-0.554***	(0.172)
Three+ siblings			0.016	(0.235)
Housing tenure				
Owns home			(base)	(base)
Private rental			-0.143	(0.133)
Public rental			0.299	(0.299)
Other			1.904	(1.527)
No. moves since last wave			0.041	(0.085)

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	(1) Restricted	SE	(2) Full	SE
Extroversion			0.107***	(0.018)
Agreeableness			-0.381***	(0.099)
Conscientiousness			-0.602***	(0.111)
Neuroticism			0.689***	(0.099)
Openness			-0.480***	(0.113)
Clinically sig. PND symptoms at 9 months				
Yes			0.043	(0.225)
No			(base)	(base)
Self-efficacy (9 months)			-0.040***	(0.014)
Personal support (9-monthwave)			-0.010	(0.009)
Mother's general health			0.056	(0.065)
Mother reads with child				
Seldom or never			(base)	(base)
Once a week			-0.689**	(0.343)
Several times a week			-0.926***	(0.307)
Once a day			-1.281***	(0.304)
Several times a day			-1.505***	(0.310)
Positive parenting (2 years)				
Low positive parenting			(base)	(base)
High positive parenting			-0.615***	(0.154)
Hostile parenting (2 years)				
Low			(base)	(base)
Medium			0.801***	(0.142)
High			2.600***	(0.158)
Protective parenting (2 years)				
Low protective parenting			(base)	(base)
Med protective parenting			0.200	(0.137)
High protective parenting			0.450	(0.146)
Constant	9.212***	(0.118)	21.683***	(1.224)
Observations	6,145		6,145	
R-squared	0.055		0.371	

*** p<0.01, ** p<0.05, * p<0.1

Source: Growing Up in New Zealand, DCW0, DCW1, DCW2

Appendix 7 – Full OLS results for equations (9) and (10) at 2 years, 4.5 years and 8 years

DIFFICULTIES	2 years		4.5 years		8 years	
	(1)	(2)	(3)	(4)	(5)	(6)
	Restricted	Full	Restricted	Full	Restricted	Full
Household income						
<20k	5.081***	1.142**	4.170***	0.344	5.068***	2.918***
	(0.547)	(0.507)	(0.917)	(0.802)	(0.497)	(0.517)
20k-30k	4.480***	0.568	3.758***	0.141	2.829***	0.784
	(0.409)	(0.390)	(0.493)	(0.485)	(0.532)	(0.533)
30k-50k	3.398***	0.471*	3.832***	0.680**	2.768***	0.668**
	(0.252)	(0.258)	(0.271)	(0.277)	(0.318)	(0.338)
50k-70k	2.127***	0.172	2.518***	0.106	2.219***	0.900***
	(0.238)	(0.227)	(0.248)	(0.240)	(0.282)	(0.293)
70k-100k	1.289***	-0.127	1.281***	0.051	1.668***	0.625***
	(0.226)	(0.209)	(0.202)	(0.192)	(0.241)	(0.240)
100k-150k	0.719***	-0.022	0.650***	-0.061	0.874***	0.418**
	(0.224)	(0.202)	(0.190)	(0.173)	(0.218)	(0.207)
150k+	(base)	(base)	(base)	(base)	(base)	(base)
Child sex at birth						
Boy		(base)		(base)		(base)
Girl		-0.318***		-0.605***		-1.295***
		(0.120)		(0.120)		(0.138)
Child health		-0.521***		-0.579***		-1.126***
		(0.075)		(0.084)		(0.100)
Mother's ethnicity						
European		(base)		(base)		(base)
Māori		0.971***		0.646***		-0.051
		(0.225)		(0.230)		(0.265)
Pacific		2.365***		2.446***		-0.061
		(0.298)		(0.296)		(0.310)
Asian		0.346		0.242		-1.148***
		(0.223)		(0.214)		(0.232)
Other		0.274		-0.119		-0.616
		(0.384)		(0.335)		(0.387)
Maternal stress		0.098***		0.077***		0.057**
(2 years)		(0.021)		(0.021)		(0.023)
Mother's highest education						
No qual./NCEA 1-4		(base)		(base)		(base)
Diploma/Trade cert		0.009		-0.018		-0.070
		(0.175)		(0.174)		(0.195)
Bachelor's degree		-0.496***		-0.780***		-0.498***
		(0.187)		(0.183)		(0.209)
Higher degree		-0.774***		-0.591***		-0.484**
		(0.204)		(0.208)		(0.230)
Screen use						
No screens		(base)		(base)		0.650
						(0.550)
0-1 hours		-0.064		0.605		(base)
		(0.159)		(0.404)		
1-2 hours		-0.026		0.675		0.409*
		(0.190)		(0.404)		(0.248)
2-3 hours		0.658**		1.190***		0.186
		(0.394)		(0.424)		(0.265)
3-4 hours		0.349		1.041**		0.571*
		(0.394)		(0.495)		(0.313)
4 hours +		1.733***		1.878***		0.842***
		(0.410)		(0.494)		(0.258)

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	2 years		4.5 years		8 years	
	(1)	(2)	(3)	(4)	(5)	(6)
Mother age (years)		-0.069***		-0.073***		-0.042***
		(0.072)		(0.013)		(0.015)
NZDep						
(1-2)		(base)		(base)		(base)
(3-4)		0.150		-0.021		-0.081
		(0.182)		(0.173)		(0.202)
(5-6)		-0.198		-0.297*		-0.300
		(0.190)		(0.185)		(0.210)
(7-8)		0.095		-0.138		-0.392
		(0.201)		(0.202)		(0.241)
(9-10)		0.226		-0.132		-0.306
		(0.225)		(0.236)		(0.267)
Labour force status						
Employed (or starting in 4 weeks)		(base)				
Unemployed		1.045***				
		(0.406)				
Not in workforce		0.455***				
		(0.134)				
Studying		0.251				
		(0.351)				
Mother paid job						
Yes				(base)		(base)
No				-0.125		0.205
				(0.144)		(0.196)
Partner status						
Has partner		(base)		(base)		(base)
Does not have partner		0.097		-0.520*		0.061
		(0.267)		(0.264)		(0.278)
Number of siblings						
No siblings		(base)		(base)		(base)
One sibling		-0.153		-0.139		-0.705***
		(0.143)		(0.264)		(0.218)
Two siblings		-0.704***		-0.612***		-1.379***
		(0.191)		(0.206)		(0.235)
Three+ siblings		0.083		-0.461*		-1.526***
		(0.275)		(0.264)		(0.296)
Housing tenure						
Owns home		(base)		(base)		(base)
Private rental		-0.214		0.233		0.039
		(0.149)		(0.149)		(0.188)
Public rental		-0.027		0.643		0.779*
		(0.400)		(0.414)		(0.451)
Other		-0.394		-0.369		-0.107
		(1.855)		(0.538)		(0.232)
No. moves since last wave		0.074		0.185		0.148***
		(0.096)		(0.069)		(0.050)
Extroversion		-0.205**		-0.215**		-0.245**
		(0.100)		(0.098)		(0.111)
Agreeableness		-0.502***		0.591***		-0.543***
		(0.148)		(0.144)		(0.163)
Conscientiousness		-0.600***		-0.869***		-0.993***
		(0.122)		(0.121)		(0.147)
Neuroticism		0.560***		0.591***		0.527***
		(0.109)		(0.109)		(0.120)
Openness		-0.386***		0.023		0.162
		(0.123)		(0.120)		(0.136)

(cont. over page)

	2 years		4.5 years		8 years	
	(1)	(2)	(3)	(4)	(5)	(6)
Clinically sig. PND (9 months)						
Yes		-0.053		0.395		0.325
		(0.263)		(0.285)		(0.234)
No		(base)		(base)		(base)
Self-efficacy (9 months)		-0.053***		-0.046***		-0.047***
		(0.016)		(0.015)		(0.018)
Personal support (9 months)		-0.015		-0.014		-0.045***
		(0.010)		(0.009)		(0.011)
Mother's general health		0.049		0.084		-0.082
		(0.072)		(0.071)		(0.083)
Mother reads with child						
Seldom or never		(base)		(base)		(base)
Once a week		-0.557		-0.624		0.478**
		(0.435)		(0.408)		(0.218)
Several times per week		-1.089***		-1.067***		0.196
		(0.394)		(0.365)		(0.215)
Once a day		-1.362***		-1.153***		0.270
		(0.387)		(0.363)		(0.228)
Several times a day		-1.598***		-1.282***		0.670
		(0.392)		(0.389)		(0.494)
Positive parenting (2 years)						
Low		(base)		(base)		(base)
High		-0.615***		-0.316**		-0.171
		(0.171)		(0.173)		(0.197)
Hostile parenting (2 years)						
Low		(base)		(base)		(base)
Medium		0.756***		0.185		-0.105
		(0.156)		(0.153)		(0.173)
High		2.475***		1.059***		0.743***
		(0.173)		(0.177)		(0.201)
Protective parenting (2 years)						
Low		(base)		(base)		(base)
Med		0.179		-0.100		0.329**
		(0.147)		(0.146)		(0.167)
High		0.460***		0.433***		-0.094
		(0.161)		(0.163)		(0.186)
Constant	9.191***	21.683***	7.462***	20.468***	6.185***	22.651***
	(0.165)	(1.395)	(0.136)	(1.379)	(0.138)	(1.578)
Observations	4,691	4,691	4,691	4,691	4,691	4,691
R-squared	0.080	0.347	0.072	0.290	0.056	0.237

*** p<0.01, ** p<0.05, * p<0.1

Source: Growing Up in New Zealand, DCW2, DCW4, DCW5

Appendix 8 – Full Gelbach decomposition results showing how the addition of covariates affects the relationship between income and child difficulties

How adding control variables to Equation (9) affects income estimates – 2 years

	<20k	20k-30k	30k-50k	50k-70k	70k-100k	100k-150k	150k+
Base	5.234***	4.463***	3.342***	2.273***	1.315***	0.761***	(base)
Full	1.319***	0.531	0.508**	0.308	-0.115	0.028	(base)
Total change	**3.915*** **	**3.932*** **	**2.913*** **	**1.965*** **	**1.430*** **	**0.733*** **	**(base)**
Change from:							
Covariates	2.268***	2.411***	1.852***	1.168***	0.866***	0.427***	(base)
Hostile parenting	0.604***	0.508***	0.376***	0.235***	0.164***	0.110**	(base)
Reading	0.253***	0.293***	0.192***	0.140***	0.122***	0.046**	
Stress	0.220***	0.240***	0.162***	0.132***	0.101***	0.067***	(base)
Screen use	0.175***	0.171***	0.169***	0.115***	0.054***	0.013	(base)
Child health	0.133***	0.047	0.059**	0.047**	0.051**	0.024	(base)
Positive parenting	0.102***	0.099***	0.062***	0.051***	0.030**	0.017	(base)
Protective parenting	0.095**	0.113***	0.067***	0.057***	0.032**	0.0134	(base)
Wakes in night	0.049**	0.032*	0.024*	0.033**	0.016	0.004	(base)
Self-efficacy	-0.055*	-0.006	-0.021	-0.018	0.001	-0.001	(base)
Personal support	0.069**	0.050*	0.027*	0.017	0.009	0.002	(base)
							N = 4,691

*** p<0.01, ** p<0.05, * p<0.1

How adding control variables to Equation (9) affects income estimates – 4.5 years

	<20k	20k-30k	30k-50k	50k-70k	70k-100k	100k-150k	150k+
Base	3.861***	3.900***	3.819***	2.453***	1.304***	0.600***	(base)
Full	0.080	0.302	0.649**	0.078	0.072	-0.115	(base)
Total change	**3.781*** **	**3.594*** **	**3.170*** **	**2.374*** **	**1.232*** **	**0.715*** **	**(base)**
Change from:							
Covariates	1.959***	1.954***	1.744***	1.246***	0.717***	0.374***	(base)
Child health	0.330***	0.091**	0.153***	0.184***	0.092***	0.062**	(base)
Screen use	0.302***	0.217***	0.171***	0.175***	0.089***	0.067***	
Partner status	0.205**	0.238**	0.135**	0.054**	0.017*	0.008	(base)
Housing tenure	0.178*	0.195*	0.128	0.075**	0.035	0.019	(base)
Stress	0.138**	0.157***	0.134***	0.130***	0.089***	0.059***	(base)
Protective parenting	0.129**	0.116***	0.089***	0.061***	0.047***	0.046***	(base)
Hostile parenting	0.156**	0.172***	0.172***	0.129***	0.059***	0.049**	(base)
Reading	0.098**	0.145***	0.135***	0.108***	0.045**	0.029	(base)
House moves	0.079**	0.073**	0.104***	0.048**	0.015	-0.003	(base)
Self-efficacy	-0.056	-0.053**	-0.037**	0.003	-0.009	-0.001	(base)
							N = 4,691

*** p<0.01, ** p<0.05, * p<0.1

How adding control variables to Equation (9) affects income estimates – 8 years

	<20k	20k-30k	30k-50k	50k-70k	70k-100k	100k-150k	150k+
Base	5.151***	2.764***	2.614***	2.011***	1.713***	0.864***	(base)
Full	2.890***	0.618	0.382	0.111***	0.657***	0.445**	(base)
Total change	**2.262*** **	**2.146*** **	**2.232*** **	**1.300*** **	**1.056*** **	**0.418*** **	**(base)**
Change from:							
Covariates	0.923***	0.782***	0.879***	0.654***	0.600***	0.246***	(base)
Child health	0.397***	0.506***	0.478***	0.284***	0.237***	0.146***	(base)
Housing tenure	0.259**	0.188*	0.163*	0.045	0.036	0.003	(base)
House moves	0.218***	0.142***	0.135***	0.075***	0.064***	0.014	(base)
Wakes in night	0.206***	0.178***	0.232***	0.091***	0.079***	0.040	(base)
Screens	0.120***	0.098**	0.142***	0.081**	0.031	0.016	(base)
Hostile parenting	0.116***	0.082**	0.130***	0.086***	0.044**	0.014	(base)
Personal support	0.109***	0.182***	0.097***	0.016	0.013	-0.021	(base)
Self efficacy	-0.091***	-0.016	-0.056**	-0.026*	-0.009	-0.045***	(base)
Stress	0.062**	0.086**	0.103**	0.061*	0.062**	0.027**	(base)
							N = 4,691

*** p<0.01, ** p<0.05, * p<0.1

Source: Growing Up in New Zealand, DCW2, DCW4, DCW5

Appendix 9 – Full fixed effects results for equations (13)-(15) estimating child difficulties

DIFFICULTIES (Z)	(1)	(2)	(3)	(4)	(5)	(6)
	Restricted	Restricted + controls	Full (includes mediators)	Full with income* wave interaction	Full with screens*wave interaction	Full with sex*wave interaction
Income (Z)	-0.023	-0.026*	-0.021	0.021	-0.022	-0.021
	(0.014)	(0.014)	(0.015)	(0.019)	(0.015)	(0.015)
Wave						
2-year	-0.110***	-0.127***	-0.146***	-0.143***	-0.143***	
	(0.017)	(0.018)	(0.019)	(0.019)	(0.019)	
4.5-year	-0.098***	-0.108***	-0.113***	-0.112***	-0.113***	
	(0.014)	(0.015)	(0.016)	(0.016)	(0.016)	
8-year	(base)	(base)	(base)	(base)	(base)	
Income*wave						
2-year				-0.076***		
				(0.019)		
4.5-year				-0.054***		
				(0.017)		
8-year				(base)		
Total screens (Z)			0.038***	0.036***	-0.026	0.038***
			(0.010)	(0.010)	(0.016)	(0.010)
Screen*wave						
2-year					0.118***	
					(0.021)	
4.5-year					0.082***	
					(0.019)	
8-year					(base)	
Wave*sex						
2*boys						-0.227***
						(0.026)
4.5*boys						-0.169***
						(0.022)
8*boys						(base)
2*girls						-0.059**
						(0.024)
4.5*girls						-0.054***
						(0.021)
8*girls						(base)
Employed						
No		(base)	(base)	(base)	(base)	(base)
Yes		-0.059***	-0.060***	-0.050**	-0.060***	-0.059***
		(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Partner status						
No		(base)	(base)	(base)	(base)	(base)
Yes		0.096**	0.093**	0.083**	0.092**	0.092**
		(0.039)	(0.040)	(0.040)	(0.040)	(0.040)
NZDep						
(1-2)			(base)	(base)	(base)	(base)
(3-4)			-0.003	0.003	-0.002	0.004
			(0.027)	(0.027)	(0.027)	(0.027)
(5-6)			0.009	0.018	0.012	0.008
			(0.030)	(0.030)	(0.030)	(0.030)
(7-8)			0.030	0.039	0.029	0.029
			(0.033)	(0.033)	(0.033)	(0.033)
(9-10)			0.004	0.011	-0.001	0.003
			(0.039)	(0.039)	(0.039)	(0.039)

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	(1)	(2)	(3)	(4)	(5)	(6)
	Restricted	Restricted + controls	Full (includes mediators)	Full with income* wave interaction	Full with screens*wave interaction	Full with sex*wave interaction
Moves (Z)			0.010	0.014	0.013	0.010
			(0.009)	(0.009)	(0.009)	(0.009)
Maternal general health (Z)			-0.019*	-0.021**	-0.019*	-0.018*
			(0.010)	(0.010)	(0.010)	(0.010)
Child health (Z)			-0.073***	-0.075***	-0.076***	-0.072***
			(0.009)	(0.009)	(0.009)	(0.009)
Homeownership						
Owns			(base)	(base)	(base)	(base)
Private rent			-0.002	-0.002	-0.001	-0.001
			(0.024)	(0.024)	(0.024)	(0.024)
Public rent			-0.091	-0.079	-0.076	-0.090
			(0.070)	(0.070)	(0.070)	(0.066)
Other			0.025	0.020	0.017	0.027
			(0.042)	(0.042)	(0.042)	(0.042)
Wake in night						
Never			(base)	(base)	(base)	(base)
Once			0.064***	0.066***	0.065***	0.064***
			(0.018)	(0.018)	(0.018)	(0.018)
Twice +			0.137***	0.135***	0.131***	0.138***
			(0.132)	(0.132)	(0.132)	(0.132)
Constant	0.074***	0.036	0.010	0.004	0.010	0.010
	(0.011)	(0.039)	(0.046)	(0.046)	(0.046)	(0.046)
No. observations	17,028	17,021	17,021	16,795	16,795	16,795
No. groups	6,386	6,386	6,386	6,319	6,319	6,319
R^2 within	0.008	0.009	0.011	0.024	0.026	0.025

*** p<0.01, ** p<0.05, * p<0.1

Source: Growing Up in New Zealand, DCW2, DCW4, DCW5

Appendix 10 – Full fixed effect results for equations (16)-(19) estimating internalising and externalising problems

	INTERNALISING			EXTERNALISING		
	(1)	(2)	(3)	(4)	(5)	(6)
	Income	Full + income interaction	Full + screen interaction	Income	Full + income interaction	Full + screen interaction
Income	-0.015	0.024	-0.014	-0.020	0.013	-0.019
	(0.014)	(0.020)	(0.015)	(0.014)	(0.018)	(0.016)
Wave						
2-year	-0.116***	-0.152***	-0.153***	-0.075***	-0.098***	-0.099***
	(0.017)	(0.020)	(0.020)	(0.017)	(0.020)	(0.020)
4.5-year	-0.101***	-0.121**	-0.121***	-0.067***	-0.075***	-0.076***
	(0.015)	(0.017)	(0.017)	(0.014)	(0.016)	(0.016)
8-year	(base)	(base)	(base)	(base)	(base)	(base)
Income*wave						
2-year		-0.059***			-0.067***	
		(0.020)			(0.019)	
4.5-year		-0.058***			-0.030*	
		(0.018)			(0.017)	
8-year		(base)			(base)	
Total screens		0.029***	-0.012		0.029***	-0.028*
		(0.010)	(0.017)		(0.010)	(0.016)
Screen*wave						
2-year			0.082***			0.112***
			(0.022)			(0.021)
4.5-year			0.051**			0.069***
			(0.020)			(0.019)
8-year			(base)			(base)
Employed						
No		(base)	(base)		(base)	(base)
Yes		-0.059***	-0.068***		-0.036**	-0.043**
		(0.022)	(0.022)		(0.022)	(0.022)
NZDep						
(1-2)		(base)	(base)		(base)	(base)
(3-4)		-0.001	-0.003		-0.007	0.002
		(0.029)	(0.029)		(0.028)	(0.028)
(5-6)		0.018	0.015		0.004	-0.002
		(0.032)	(0.032)		(0.031)	(0.031)
(7-8)		0.049	0.042		0.017	0.007
		(0.035)	(0.035)		(0.034)	(0.034)
(9-10)		0.035	0.029		-0.017	-0.030
		(0.040)	(0.040)		(0.040)	0.040)
Partner status						
No		(base)	(base)		(base)	(base)
Yes		0.071*	0.079**		0.062	0.068*
		(0.040)	(0.040)		(0.040)	(0.040)
Moves		0.011	0.010		0.008	0.007
		(0.010)	(0.010)		(0.010)	(0.010)
Maternal health		-0.021**	-0.019*		-0.013	-0.012
		(0.011)	(0.011)		(0.010)	(0.010)
Child health		-0.072***	-0.073***		-0.054***	-0.056***
		(0.010)	(0.010)		(0.009)	(0.009)

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	INTERNALISING			EXTERNALISING		
	(1)	(2)	(3)	(4)	(5)	(6)
Homeownership						
Owns		(base)	(base)		(base)	(base)
Private rent		-0.023	-0.022		0.010	0.010
		(0.026)	(0.026)		(0.024)	(0.024)
Public rent		-0.077	-0.076		-0.069	-0.066
		(0.072)	(0.072)		(0.067)	(0.067)
Other		-0.038	-0.039		0.052	0.049
		(0.043)	(0.043)		(0.042)	(0.042)
Wake in night						
Never		(base)	(base)		(base)	(base)
Once		0.041***	0.040**		0.063***	0.062***
		(0.010)	(0.010)		(0.019)	(0.019)
Twice+		0.109**	0.104**		0.115***	0.112***
		(0.033)	(0.033)		(0.032)	(0.032)
Constant	0.074***	0.036	0.039	0.050***	-0.005	0.003
	(0.011)	(0.050)	(0.048)	(0.010)	(0.047)	(0.047)
No. observations	17,032	16,795	16,795	17,031	16,796	16,796
No. of groups	6,386	6,319	6,319	6,386	6,319	6,319
R^2 within	0.006	0.019	0.019	0.004	0.014	0.016

*** p<0.01, ** p<0.05, * p<0.1

Source: Growing Up in New Zealand, DCW2, DCW4, DCW5

Appendix 11 – Full OLS results for Equation (18) estimating child strengths at 2, 4.5 and 8 years

STRENGTHS	2 years		4.5 years		8 years	
	(1)	(2)	(3)	(4)	(5)	(6)
	Restricted	Full	Restricted	Full	Restricted	Full
Household income						
<20k	-0.360**	-0.442**	-0.121	0.078	-0.925***	-0.544***
	(0.182)	(0.200)	(0.313)	(0.310)	(0.169)	(0.189)
20k-30k	-0.135	-0.083	0.010	0.093	-0.283	0.075
	(0.141)	(0.154)	(0.154)	(0.173)	(0.184)	(0.194)
30k-50k	-0.106	-0.077	-0.171*	-0.031	-0.281**	0.025
	(0.097)	(0.110)	(0.102)	(0.114)	(0.113)	(0.131)
50k-70k	0.027	0.077	-0.074	0.110	-0.005	0.189*
	(0.096)	(0.101)	(0.091)	(0.098)	(0.099)	(0.108)
70k-100k	-0.029	0.026	-0.086	-0.028	-0.229***	-0.076
	(0.092)	(0.093)	(0.082)	(0.082)	(0.097)	(0.092)
100k-150k	-0.003	0.011	0.058	0.060	0.041	0.078
	(0.092)	(0.088)	(0.079)	(0.076)	(0.078)	(0.078)
150k+	(base)	(base)	(base)	(base)	(base)	(base)
Child sex at birth						
Boy		(base)		(base)		(base)
Girl		0.430***		0.580***		0.647***
		(0.052)		(0.050)		(0.051)
Maternal stress (2 years)		0.019**		0.009		0.029***
		(0.009)		(0.008)		(0.009)
Mother's ethnicity						
European		(base)		(base)		(base)
Māori		0.185*		0.078		0.125
		(0.095)		(0.091)		(0.096)
Pacific		0.136		0.128		0.039
		(0.112)		(0.106)		(0.114)
Asian		0.250***		0.222***		0.035
		(0.090)		(0.086)		(0.089)
Other		0.277*		0.162		0.091
		(0.277)		(0.134)		(0.154)
Mother's highest education						
No qual./NCEA 1-4		(base)		(base)		(base)
Diploma/Trade cert		0.015		-0.034		0.061
		(0.070)		(0.067)		(0.070)
Bachelor's degree		-0.068		-0.199***		-0.057
		(0.079)		(0.076)		(0.080)
Higher degree		0.087		-0.133		-0.056
		(0.088)		(0.087)		(0.154)
Screen use						
No screens		(base)		(base)		0.234
						(0.194)
0-1 hours		-0.069		-0.094		(base)
		(0.070)		(0.169)		
1-2 hours		-0.100		-0.117		-0.006
		(0.083)		(0.168)		(0.102)
2-3 hours		-0.160		-0.177		0.100
		(0.109)		(0.173)		(0.105)
3-4 hours		-0.192		-0.200		-0.049
		(0.157)		(0.190)		(0.117)
4 hours +		-0.424**		-0.362**		-0.011
		(0.171)		(0.200)		(0.100)

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	2 years		4.5 years		8 years	
	(1)	(2)	(3)	(4)	(5)	(6)
	Restricted	Full	Restricted	Full	Restricted	Full
Child health		0.086***		0.104***		0.244***
		(0.033)		(0.034)		(0.036)
Mother age (years)		-0.014**		-0.024***		-0.006
		(0.006)		(0.005)		(0.005)
NZDep						
(1-2)		(base)		(base)		(base)
(3-4)		-0.040		-0.033		-0.019
		(0.078)		(0.077)		(0.077)
(5-6)		-0.027		0.035		0.017
		(0.082)		(0.079)		(0.078)
(7-8)		0.021		-0.065		-0.018
		(0.090)		(0.085)		(0.088)
(9-10)		-0.009		-0.194**		-0.106
		(0.100)		(0.093)		(0.098)
Labour force status						
Employed (or starting in 4 weeks)		(base)				
Unemployed		0.133				
		(0.153)				
Studying		0.190				
		(0.132)				
Not in workforce		-0.083				
		(0.057)				
Mother paid job						
Yes				(base)		(base)
No				0.221***		0.048
				(0.060)		(0.071)
Partner status						
Has partner		(base)		(base)		(base)
Does not have partner		-0.173*		-0.001		0.029
		(0.103)		(0.096)		(0.096)
Number of siblings						
No siblings		(base)		(base)		(base)
One sibling		-0.089		-0.216***		-0.006
		(0.061)		(0.074)		(0.078)
Two siblings		-0.126		-0.342***		-0.054
		(0.082)		(0.083)		(0.086)
Three+ siblings		-0.276**		-0.310***		-0.031
		(0.121)		(0.107)		(0.109)
Housing tenure						
Owns home		(base)		(base)		(base)
Private rental		0.042		-0.059		-0.071
		(0.063)		(0.061)		(0.070)
Public rental		0.262*		0.356**		-0.207
		(0.154)		(0.146)		(0.160)
Other		0.066		-0.090		-0.160
		(0.532)		(0.265)		(0.090)
No. moves since last wave		0.031		0.007		-0.039**
		(0.042)		(0.028)		(0.019)
Extroversion		0.089**		0.127***		0.182***
		(0.043)		(0.041)		(0.043)
Agreeableness		0.244***		0.151**		0.198***
		(0.064)		(0.060)		(0.059)
Conscientiousness		0.256***		0373***		0.254***
		(0.055)		(0.051)		(0.052)

(cont. over page)

	2 years		4.5 years		8 years	
	(1)	(2)	(3)	(4)	(5)	(6)
Neuroticism		-0.032		0.018		-0.035
		(0.046)		(0.045)		(0.045)
Openness		0.279***		0.127**		0.159***
		(0.052)		(0.050)		(0.051)
Clinically sig. PND symptoms at 9 months						
Yes		(base)		(base)		(base)
No		0.151		0.175		0.125
		(0.111)		(0.108)		(0.115)
Self-efficacy (9 months)		0.040***		0.052***		0.026***
		(0.006)		(0.007)		(0.007)
Personal support (9-monthwave)		0.005		0.001		0.012***
		(0.004)		(0.004)		(0.004)
Mother's general health		-0.034		0.009		-0.031
		(0.031)		(0.030)		(0.031)
Mother reads with child						
Seldom or never		(base)		(base)		(base)
Once a week		0.566***		0.364**		0.071
		(0.184)		(0.159)		(0.083)
Several times a week		0.381**		0.297**		0.129
		(0.171)		(0.145)		(0.081)
Once a day		0.624***		0.431***		0.145*
		(0.167)		(0.143)		(0.086)
Several times a day		0.547***		0.365**		0.098
		(0.170)		(0.154)		(0.195)
Positive parenting (2 years)						
Low positive parenting		(base)		(base)		(base)
High positive parenting		0.384***		0.168**		0.138*
		(0.075)		(0.071)		(0.074)
Hostile parenting (2 years)						
Low		(base)		(base)		(base)
Medium		0.024		-0.113*		0.025
		(0.069)		(0.066)		(0.067)
High		-0.097		-0.187***		-0.122
		(0.075)		(0.072)		(0.075)
Protective parenting (2 years)						
Low protective parenting		(base)		(base)		(base)
Med protective parenting		-0.066		0.012		-0.031
		(0.064)		(0.062)		(0.067)
High protective parenting		0.074		0.093		0.043
		(0.069)		(0.068)		(0.069)
Wake in night						
Sleeps through		(base)		(base)		(base)
One wake		0.007		0.024		-0.151**
		(0.069)		(0.055)		(0.069)
Two+ wakes		-0.214		0.033		-0.124
		(0.135)		(0.098)		(0.162)
Constant	7.174***	0.606	7.796***	1.305**	8.251***	1.845***
	(0.070)	(0.575)	(0.058)	(0.592)	(0.051)	(0.577)
Observations	4,691	4,691	4,691	4,691	4,691	4,691
R-squared	0.002	0.114	0.002	0.127	0.013	0.127

*** p<0.01, ** p<0.05, * p<0.1

Source: Growing Up in New Zealand, DCW2, DCW4, DCW5

Appendix 12 – Unrestricted versus restricted fixed effects results

Estimating maternal stress (Pregnancy – 2 years)

MATERNAL STRESS (Z)	(1)	(2)	(3)	(4)
	Restricted unbalanced	Restricted balanced	Full unbalanced	Full balanced
Income (Z)	-0.067***	-0.076***	-0.039**	-0.071***
Wave				
Pregnancy	-0.006	-0.038**	-0.019	-0.048***
9 months	(base)	(base)	(base)	(base)
2 years	0.0006	-0.008	-0.013	-0.019
Income*wave				
Pregnancy			-0.056***	-0.008
9 months			(base)	(base)
2 years			-0.0340***	-0.021
Employed				
No			(base)	(base)
Yes			0.062***	0.067***
NZDep				
(1-2)			(base)	(base)
(3-4)			-0.071*	-0.080*
(5-6)			-0.030	-0.026
(7-8)			0.011	0.008
(9-10)			-0.044	-0.049
Partner status				
No			(base)	(base)
Yes			-0.009	-0.029
Homeownership				
Owns			(base)	(base)
Private rent			0.050	0.084**
Public rent			-0.057	-0.116
Other			0.005	-0.121
Maternal health (Z)			-0.071***	-0.057***
Residential mobility (Z)			0.005	-0.003
Constant	-0.002	-0.005	-0.003	0.004
No. observations	19,605	14,228	19,458	14,152
No. groups	6,853	4,772	6,853	4,772
R^2 within	0.004	0.006	0.011	0.011

*** p<0.01, ** p<0.05, * p<0.1

Source: Growing Up in New Zealand, DCW0, DCW1, DCW2

Unbalanced vs balanced results estimating child difficulties (2-8 years)

DIFFICULTIES (Z)	(1)	(2)	(3)	(4)
	Restricted unbalanced	Restricted balanced	Full unbalanced	Full balanced
Income (Z)	-0.023	-0.027*	0.021	-0.026*
Wave				
2-year	-0.110***	-0.105***	-0.145***	-0.144***
4.5-year	-0.098***	-0.104***	-0.113***	-0.118***
8-year	(base)	(base)	(base)	(base)
Total screens (Z)			0.038***	0.034***
Employed				
No			(base)	(base)
Yes			-0.061**	-0.060***
NZDep				
(1-2)			(base)	(base)
(3-4)			0.003	0.004
(5-6)			0.008	0.014
(7-8)			0.029	0.032
(9-10)			0.003	0.014
Partner status				
No			(base)	(base)
Yes			0.093**	0.094**
Moves (Z)			0.010	0.004
Maternal health (Z)			-0.019**	-0.023**
Child health (Z)			-0.073***	-0.072***
Homeownership				
Owns			(base)	(base)
Private rent			-0.002	-0.005
Public rent			-0.091	-0.116
Other			0.023	0.023
Wake in night				
Never			(base)	(base)
Once			0.064***	0.060***
Twice +			0.137***	0.140***
Constant	0.074***	0.005	0.010	-0.059
No. observations	17,028	14,244	16,795	14,137
No. groups	6,386	4,772	6,319	4,751
R^2 within	0.008	0.009	0.024	0.023

*** p<0.01, ** p<0.05, * p<0.1

Source: Growing Up in New Zealand, DCW2, DCW5, DCW8

Appendix 13 – Comparing OLS estimates for child difficulties using complete case analysis and multiple imputation

DIFFICULTIES	2 years		4.5 years		8 years	
	(1)	(2)	(3)	(4)	(5)	(6)
	Complete case analysis	MI	Complete case analysis	MI	Complete case analysis	MI
Household income						
<20k	1.286***	1.142**	-0.359	0.344	2.470***	2.918***
	(0.481)	(0.507)	(0.632)	(0.802)	(0.702)	(0.517)
20k-30k	0.429	0.568	0.166	0.141	0.637	0.784
	(0.363)	(0.390)	(0.474)	(0.485)	(0.699)	(0.533)
30k-50k	0.393	0.471*	0.300	0.680**	0.803*	0.668**
	(0.258)	(0.258)	(0.286)	(0.277)	(0.431)	(0.338)
50k-70k	0.090	0.172	-0.088	0.106	1.030***	0.900***
	(0.231)	(0.227)	(0.242)	(0.240)	(0.339)	(0.293)
70k-100k	-0.060	-0.127	-0.047	0.051	0.956***	0.625***
	(0.208)	(0.209)	(0.195)	(0.192)	(0.277)	(0.240)
100k-150k	-0.017	-0.022	-0.254	-0.061	0.548**	0.418**
	(0.200)	(0.202)	(0.174)	(0.173)	(0.223)	(0.207)
150k+	(base)	(base)	(base)	(base)	(base)	(base)
Maternal stress	0.112***	0.098***	0.075***	0.077***	0.034	0.057**
(2 years)	(0.021)	(0.021)	(0.022)	(0.021)	(0.030)	(0.023)
Screen use						
No screens	(base)	(base)	(base)	(base)	0.515	0.650
					(0.634)	(0.550)
0-1 hours	0.141	-0.064	0.643	0.605	(base)	(base)
	(0.163)	(0.159)	(0.425)	(0.404)		
1-2 hours	0.193	-0.026	0.768*	0.675	0.434*	0.409*
	(0.195)	(0.190)	(0.424)	(0.404)	(0.262)	(0.248)
2-3 hours	0.716***	0.658**	1.342***	1.190***	0.316	0.186
	(0.252)	(0.394)	(0.444)	(0.424)	(0.274)	(0.265)
3-4 hours	0.862**	0.349	0.979**	1.041**	0.609*	0.571*
	(0.373)	(0.394)	(0.479)	(0.495)	(0.320)	(0.313)
4 hours +	2.154***	1.733***	1.993***	1.878***	0.787***	0.842***
	(0.437)	(0.410)	(0.527)	(0.494)	(0.283)	(0.258)
Controls included	YES	YES	YES	YES	YES	YES
Constant	22.972***	21.683***	19.923***	20.468***	22.476***	22.651***
	(1.394)	(1.395)	(1.614)	(1.379)	(2.011)	(1.578)
Observations	4,344	4,691	4,240	4,691	2,661	4,691
R-squared	0.369	0.347	0.309	0.290	0.235	0.237

*** p<0.01, ** p<0.05, * p<0.1

Source: Growing Up in New Zealand, DCW2, DCW5, DCW8

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